INTERDISCIPLINARY CONFERENCE of young earth system scientists

Interdisciplinary Conference of Young Earth System Scientists 2013

Understanding and Interpreting Uncertainty

22 - 25 September 2013, Hamburg, Germany

ICYESS2013 - Session Overview

	Sunday, 22 September 2013
19:00	Registration and ice breaker

	Monday, 23 September 2013	
08:00–09:00	Registration and poster setup	
09:00–10:00	Opening	
10:00-11:20	Oral presentations	Session I: Limited understanding of physical, chemical, and biological processes and interactions
11:20-13:00	Poster presentations	
13:00-14:00	Lunch break	
14:00-15:30	Keynote lecture by Eli Tziperman (Havard University, US)	
15:30-15:45	Coffee break	
15:45–17:15	Keynote lecture by Richard Tol (University of Sussex, UK)	
17:15-18:40	Oral presentations	Session II: Uncertainties in the context of Earth system governance
18:40-19:45	Poster presentations	
19:45	Conference dinner	

	Tuesday, 24 September 2013	
09:00-10:15	Oral presentations	Session III: Finite resources in modelling, observations and analysis (Part A)
10:15-11:45	Poster presentations	
11:45–12:25	Networking presentations	
12:25–14:00	Lunch break	
14:00–15:55	Oral presentations	Session IV: Innovative presentation formats
15:55-17:00	Poster presentations	
17:00–18:30	Panel discussion: Uncertainty at the science-policy interface: Why does it all go wrong?	
18:30	Reception	

	Wednesday, 25 September 2013	
08:30-09:45	Oral Presentations	Session III: Finite resources in modelling, observations and analysis (Part B)
09:45-11:30	Poster Presentations	
11:30–13:00	Keynote lecture by Joyeeta Gupta (University of Amsterdam, NL)	
13:00–14:00	Lunch break	
14:00–14:55	Oral Presentations	Session V: Uncertainties in environmental impacts, their perception and communication
14:55-16:00	Poster Presentations	
16:00–17:00	Closing	

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Welcome to Hamburg

We welcome you to the ”Interdisciplinary Conference of Young Earth System Scientists 2013. Understanding and Interpreting Uncertainty“. We are happy that we received so many applications and we look forward to a lively and instructive conference with you here in Hamburg.

ICYESS 2013 is organised by young scientists from various institutes and disciplines from different countries, in close collaboration with the School of Integrated Climate System Sciences (SICSS) and the Young Earth System Scientists community (YESS). ICYESS 2013 continues and extends the Young Scientists Conference series initiated by the three German marine and climate science Clusters of Excellence in Bremen, Hamburg and Kiel. We are glad to be back again in Hamburg and we are especially happy that this time the conference is open to all young Earth system scientists, independent of their current institution.

This conference is unique: it is not your typical science conference with all the experts from a specific field attacking one or two questions. We are young, we are interdisciplinary, we allow for new presentation methods, and, at the same time, we have an important, common thematic focus:

ICYESS 2013 focuses on *uncertainties in Earth system sciences*. There is a multitude of causes for uncertainties in different research fields and they are sometimes multiplied in interdisciplinary research. Uncertainties and its consequences are dealt with in our daily scientific work; they are explicit focus, implicit motivation, boundary condition or constraint to our work. In this conference, we want you to embed your own research into the bigger question of how your specific discipline deals with uncertainty. The conference brings together scientists from various disciplines contributing to the understanding of processes and interactions in the Earth system. We would like to invite you all to promote the interdisciplinary exchange and mutual understanding between the diversity of research fields in Earth system science. We want to learn from one another here, start to use the same language and attempt to understand the difficulties of our partnering fields in Earth system science. We look forward to interactive and innovative presentations of your research, and fruitful discussion afterwards. Moreover, we hope that you will use the chance to expand your networks at an early career stage.

We would like to thank you all for your contributions, for you being here. We also acknowledge our partners that made this possible: the Körber Foundation, the Cluster of Excellence CliSAP via SICSS (Hamburg), the Center for a Sustainable University, the German Climate Consortium (DKK) and Copernicus for sponsoring the conference. Finally, we thank our

partners MARUM (Bremen), Future Ocean (Kiel), the Young Earth System Scientists community (YESS), the University of Hamburg and the Earth System Governance Project.

Let's use ICYESS2013 to learn new things, discover new science, meet new friends and colleagues – and to have a great time together.

Florian Rauser
Andreas Schmidt
Sebastian Sonntag
Diana Süsser

For the organising committee

Contact:

Email: icyess2013@yess-community.org
Phone (Diana): 0049 1525 3704780

Conference coordination

Florian Rauser	Max-Planck-Institute for Meteorology, Hamburg, Germany
Andreas Schmidt	Media Constructions of Climate Change, University of Hamburg, Germany
Sebastian Sonntag	Advancement of Coupled Climate Ocean Ecosystem Models, University of Hamburg, Germany
Diana Süsser	Institute of Coastal Research, Helmholtz-Zentrum Geesthacht, Germany

Scientific and organizing Committee

Rafael Abel	Ocean Circulation and Climate Dynamics, GEOMAR, Kiel, Germany
Armine Avagyan	Regional Hydrology in Terrestrial Systems, University of Hamburg, Germany
Tjado Barsuhn	Institute for Media and Communication, University of Hamburg, Germany
Nils Brüggemann	Theoretical Oceanography, Institute of Oceanography, University of Hamburg, Germany
Isa Olalekan Elegbede	Environmental and Resource Management, Brandenburg University of Technology, Cottbus, Germany
Davide Faranda	National Centre for Scientific Research, Atomic Energy Commission, Gif-Sur-Yvette, France
Manuel Gottschick	Research Center of Biotechnology, Society and Environment, University of Hamburg, Germany
Laure Hoeppli	School of Integrated Climate System Sciences, KlimaCampus, University of Hamburg, Germany
Laurie Hofmann	Marine Botany, University of Bremen, Germany
Ulrike Holzwarth	GLOMAR / MARUM, University of Bremen, Germany
Gholamali Hoshyaripuor	Institute of Geophysics, University of Hamburg, Germany

Kristian Lass	Ocean Surface Chemistry & Reaction Kinetics, University Kiel, Germany
Alice Lefebvre	GLOMAR / MARUM, University of Bremen, Germany
Martin Scharffenberg	Remote Sensing and Assimilation, Institute of Oceanography, University of Hamburg, Germany
Ines Schaudel	KlimaCampus / Department of Economics and Social Sciences, University of Hamburg, Germany
Jörn Schmidt	Sustainable Fisheries, Department of Economics, University Kiel, Germany
Rebecca Stecker	Chameleon Research Group, Department of Economics, University of Oldenburg, Germany
Felipe Vallejo	Stratigraphy Research Institute, University of Caldas, Colombia, and University of Salamanca, Spain
Aiko Voigt	Max-Planck-Institute for Meteorology, Hamburg, Germany
Guidi Zhou	Marine meteorology, Geomar, Kiel, Germany

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KIEL MARINE SCIENCES

People, Places, and the Planet
Earth System Governance

YESS community

Conference Venue

The ICYESS2013 Conference is held in the Geomatikum, an 18-storey building of the University of Hamburg. The lecture hall (H2), where the talks will be given, is located on the ground floor of the Geomatikum building.

Address

University of Hamburg
Geomatikum building, ground floor, lecture hall H2
Bundesstrasse 55
20146 Hamburg
Germany

Lunch

For lunch we ask you to find your own place individually or in small groups. We indicate a few options below, but the area around the Geomatikum is full of potential restaurants

Asia Lounge (Grindelallee 146)
Chinese and Thai food, Sushi, lunch from 5.50 €

Balutschistan (Grindelallee 91)
Pakistani food, lunch from 4.60 €, menus from 7.90 €

Café Backwahn (Grindelallee 148)
Pasta, salads, and further changing offers, lunch from 5.80 €

Dai Nam (Beim Schlump 1)
Vietnamese food, lunch from 5.50 €

Geo 53 (Beim Schlump 53)
International kitchen, e.g. Pizza

Gopalam (Grindelallee 159)
Vegetarian Indian food, lunch menu from 6.50 €

Hadley's (Beim Schlump 84A)
Sandwiches, salads, soups and pasta, approx. 6-8 €

Kumpir König (Grindelhof 8)
Stuffed potatoes, approx. 4 €

Rucola e Parma (Beim Schlump 27)
Italian food, lunch from 5 €

Schweinske (Grindelallee 117)
Meat-heavy food, from 6 €

Students' mensa (Bundesstr. 55)
Changing offers, main dishes 3-4 €

Rules of Conduct

- Smoking is prohibited in the entire university except in the areas designated for smokers.
- Please switch off any mobile phones in the lecture rooms.

Official Language

The official language of the ICYESS2013 Conference is English. Simultaneous interpretation is not provided. It is therefore expected that authors are able to present their research more or less fluently in the English language.

Insurances

The organizers cannot accept liability for personal accident, loss or damage to private property, which may be incurred as a result of the participation in the ICYESS2013 Conference. Participants are, therefore, advised to arrange appropriate insurance cover. This should extend not only to travel but also to cancellation costs.

Abstract Management

Copernicus Meetings
Bahnhofsallee 1e
37081 Göttingen
Germany
Tel.: +49-551-900339-0
Fax: +49-551-900339-70
meetings@copernicus.org
www.copernicus.org
http://meetings.copernicus.org/icyess2013

Special session

Keynote lectures

To guide our discussions and extend the contributions of all participants, we invited three high profile speakers for keynote lectures:

- **Eli Tziperman** (Harvard University, US):

  Warm, Hot… Freezing! - From past climate variability to future climate change

- **Richard Tol** (University of Sussex, UK):

  Targets for global climate policy: An overview

- **Joyeeta Gupta** (University of Amsterdam, NL):

  Climate Change, Scientific Uncertainty, Skepticism and Politics: A Thirty Year History

Networking presentations

In the networking session different scientific networks will present their work and share experiences about career paths. These include:

- Young Earth System Scientists community (YESS)
- Earth Science Women's Network (ESWN)

Panel discussion

Uncertainty at the science-policy interface: why does it all go wrong?

Climate change and other global environmental problems pose great challenges both for science and politics – but in different ways. While researchers struggle with complexity and build knowledge incrementally, politicians are confronted with the task to set up potentially far-reaching interventions into societal activities. To inform and justify these interruptions, scientific policy advice is often seen as crucial.

Some Earth system scientists are comfortable with engaging in policy advice even if that means to leave their respective scientific core competencies. For others, this means a threat to scientific integrity and neutrality. The science-policy interface is populated by many actors, with a variety of interests that potentially interfere with an idealized science speaks the truth to parties of power process.

Uncertainty plays a decisive role in these difficult science-policy interactions. Different languages, rationalities and strategies often lead to confusion and a perceived mismatch of expectations between science and politics. Against this background, we want to discuss with scientists, policy experts and decision-makers about their perceptions.

Host:

- Philipp Griewank, Max-Planck-Institute for Meteorology, Hamburg, Germany

Discussants:

- **Alexander Otto** (Environmental Change Institute, University of Oxford, UK)
- **Inge Paulini** (German Advisory Council on Global Change)
- **Michael Pregernig** (Institute of Environmental Social Sciences and Geography, Albert-Ludwigs-University Freiburg, Germany)
- **Hauke Schmidt** (Max-Planck-Institute for Meteorology, Hamburg, Germany)

Sunday, 22 September 2013

19:00
Registration and Ice breaker

Monday, 23 September 2013

08:00-09:00:
Registration and poster setup

09:00-10:00:
Opening

10:00–13:00:
Session I: Limited understanding of physical, chemical, and biological processes and interactions

Chairperson: Sebastian Sonntag
Lecture Room: Lecture Hall H2 Geomatikum
Poster Area: Poster Area Geomatikum

Introduction by Sebastian Sonntag

10:10–10:25: ICYESS2013-129
Poster: P1
Uncertainties in estimating Greenland's long-term melt
Krapp M.

10:28–10:31: ICYESS2013-42
Poster: P3
Geo-Bio interactions in shallow water hydrothermal vents and their impact on trace metals
Kleint C., Koschinsky A.

10:31–10:34: ICYESS2013-53
Poster: P4
The history of anthropogenic induced Zinc input to the German Bight, North Sea
Asendorf S., Schnetger B., Hebbeln D.

10:34–10:37: ICYESS2013-70
Poster: P5
Pelagic Biodiversity and Ecophysiology of Mesozooplankton in the Atlantic Ocean: Latitudinal and Bathymetric Trends
Bode M.

10:37–10:40: ICYESS2013-79
Poster: P6
Uncertainty in Marine Ecology - Understanding Ocean Acidification
Alvord C.

10:40–10:43: ICYESS2013-94
Poster: P7
Transport of nitrogen oxides ionized by energetic particle precipitation
Meraner K., Schmidt H.

10:43–10:46: ICYESS2013-96
Poster: P8
What effect do volcanic emissions have on sea level within the North Atlantic Ocean?
Hemming M.P.

10:46–10:49: ICYESS2013-109
Poster: P9
∆-15N of Chlorophyll Pigment as an Indicator to interpret the N-Cycling in the Past Oxygen Minimum Zone in Central Benguela Upwelling System
Xin Yu

10:55–10:58: ICYESS2013-123
Poster: P12
Projecting the potential phenological responses of North Sea small copepods to climate warming with a modelling approach
Xing C.

10:58–11:01: ICYESS2013-125
Poster: P13
Investigation of the simultaneous effects of ocean acidification and warming on coral reef Foraminifera
Schmidt C., Kucera M., Uthicke S.

11:01–11:04: ICYESS2013-19
Poster: P14
Global ocean surface latent heat flux trends during 1958-2012
Yang H., Liu J., Shi X., Hu Y., Chen X.

11:04–11:07: ICYESS2013-24
Poster: P15
Down load or up load? Climate change, net primary productivity and bush fire fuel load
Clarke H., Evans J., Pitman A.

11:10–11:13: ICYESS2013-52
Poster: P17
Estimating Impacts of Lichens and Mosses on Global Biogeochemical Cycles
Porada P., Weber B., Elbert W., Pöschl U., Kleidon A.

11:13–11:16: ICYESS2013-87
Poster: P19
A consequence of Addition; sub lethal effects of the plastic additive Bisphenol A on a marine copepod
Carlsson T.

11:20–13:00: Poster Session

13:00 Lunch break

14:00–15:30
Keynote lecture by Eli Tziperman (Harvard University, US):
Warm, Hot… Freezing! - From past climate variability to future climate change

15:30 Coffee break

15:45–17:15
Keynote lecture by Richard Tol (University of Sussex, UK):
Targets for global climate policy: An overview

17:15–19:45:
Session II: Uncertainties in the context of Earth system governance

Chairpersons: Andreas Schmidt & Rebecca Stecker
Lecture Room: Lecture Hall H2 Geomatikum
Poster Area: Poster Area Geomatikum

Introduction 1: Policies and decision-making for Earth system governance by Rebecca Stecker

17:20–17:23: ICYESS2013-39
Poster: P20
Conservation and Sustainable Use of Ocean Areas Beyond National Jurisdiction: The Role of Principles and Procedures under International Law in a Context of Legal and Scientific Uncertainty
Houghton K.J.

17:23–17:26: ICYESS2013-65
Poster: P21
Ecological and socio-economic feasibility of a long-term scallop bottom culture in Sechura Bay, Northern Peru
Kluger L., Wolff M.

17:26–17:29: ICYESS2013-122
Poster: P22
Increasing the Value of Climate Finance in an Uncertain Environment
Chirambo D.

17:32–17:35: ICYESS2013-75
Poster: P24
Uncertainty in key abatement technologies: A sensitivity analysis for the CGE model DART
Weitzel M.

17:35–17:38: ICYESS2013-34
Poster: P25
On the Influence of Risk Aversion and Time Preference on Optimal Policy and Welfare
Neubersch D.

17:38–17:41: ICYESS2013-18
Poster: P26
Climate Policy Decisions under Uncertainty
Staub-Kaminski I.

17:41–17:44: ICYESS2013-30
Poster: P27
Uncertainty in Climate-Economic Modeling
Klippert C.K., Geisendorf S.G.

17:44–17:47: ICYESS2013-37
Poster: P28
Uncertainty is essential! How to manage a world that doesn't fit into Newtonian models
Freier K.P.

Introduction 2: Understanding the (conflictive) development of Earth system governance by Andreas Schmidt

17:52–18:07: ICYESS2013-78
Poster: P29
Policy-making under uncertainty: the case of carbon pricing in New Zealand
Richter J. L.

18:07–18:22: ICYESS2013-92
Poster: P30
Cost and choice - how economic incentives drive cities to adapt to climate change despite uncertainty
Huang J.T., Guenther E.

18:22–18:25: ICYESS2013-77
Poster: P31
The European Emissions Trading System (EU ETS): Learning to deal with uncertainty
Rodriguez Lopez J. M.

18:28–18:31: ICYESS2013-120
Poster: P33
Maritime spatial planning for the Baltic Sea Region - as a regulating instrument for sustainable future “without” uncertainties for the marine environment?
Riekens E.

18:31–18:34: ICYESS2013-68
Poster: P34
How do governance structures affect climate change adaptation policies?
Bullmer I.

18:37–18:40: ICYESS2013-108
Poster: P36
How to tackle climate change appropriately? Climate governance norms in the public debate
Schmidt A.

18:40–19:45: Poster Session

19:45 Conference Dinner

Tuesday, 24 September 2013

09:00–11:45:

Session III: Finite resources in modelling, observations and analysis

Chairpersons: Florian Rauser & Rafael Abel
Lecture Room: Lecture Hall H2 Geomatikum
Poster Area: Poster Area Geomatikum

Introduction by Florian Rauser

09:10–09:25: ICYESS2013-110
Poster: P37
Uncertainities in low-cloud feedbacks
Cheedela S.K.

09:25–09:28: ICYESS2013-71
Poster: P38
Towards More Realistic Future Ocean Projections
Abel R.

09:28–09:31: ICYESS2013-32
Poster: P39
Drift-corrected Trends in MIPAS Ozone Measurements
Eckert E., von Clarmann T., Stiller G., Lossow S., Kiefer M., Glatthor N., Degenstein D. A., Froidevaux L., Godin-Beekman S., Leblanc T., McDermid S., Pastel M., Steinbrecht W., Swart D. P. J., Walker K. A., Bernath P. F.

09:31–09:34: ICYESS2013-44
Poster: P40
A sampling strategy to escape the dilemma of undersampling in marine science
Thomsen S., Kanzow T., Krahmann G.

09:34–09:37: ICYESS2013-26
Poster: P41
High resolution atmospheric modelling on the Tibetan Plateau: How to understand a system with sparse observations?
Gerken T., Herzog M., Foken T., Graf H-F.

09:37–09:40: ICYESS2013-31
Poster: P42
Regional scale inversions to estimate Net Ecosystem Exchange in terms of network design.
Kountouris P.

09:40–09:43: ICYESS2013-33
Poster: P43
Modelling the Spatial Distribution of Herring in the North Sea
Dudeck T., Floeter J.

09:43–09:46: ICYESS2013-36
Poster: P44
Uncertainties in Global Soil Erosion Modelling
Naipal V., Reick Ch., Pongratz J.

09:46–09:49: ICYESS2013-47
Poster: P45
A new covariant form of the equations of geophysical fluid dynamics and their structure-preserving discretization
Bauer W.

09:49–09:52: ICYESS2013-51
Poster: P46
Assessing and Quantifying Uncertainties for Model Evaluation in the MiKlip Prediction System
Illing S., Kadow C., Cubasch U.

09:52–09:55: ICYESS2013-55
Poster: P47
Analyzing the significance of air temperature trends in the Arctic region
Wernecke A., Gabrielski A., Athmer R., Froß K., Parsakhoo Z.S., Leontiou C.

09:55–09:58: ICYESS2013-59
Poster: P48
Tropical Convection as a source of Uncertainty in Global Climate Models
Silvers L., Giorgetta M.

09:58–10:01: ICYESS2013-61
Poster: P49
Goal-orientated Error Estimators for Stochastic Finite Elements
Kraemer J.

10:04–10:07: ICYESS2013-128
Poster: P51
Ocean Surface Velocities from Space - looking behind the scenes
Scharffenberg M.

10:07–10:10: ICYESS2013-74
Poster: P52
Water mass variability observed at the Mid-Atlantic Ridge in the subpolar North Atlantic
Denker C.

10:10–10:13: ICYESS2013-81
Poster: P53
Trends in temperature extremes in Morocco
Khomsi K., Mahe G., Tramblay Y., Sinan M., Snoussi M.

10:15–11:45: Poster Session

11:45–12:05: ICYESS2013-138
Young Earth System Scientists community (YESS)
Rauser, F., Sonntag, S.

12:05–12:25: ICYESS2013-137
Earth Science Women's Network (ESWN)
Kirchgaessner, A.

12:25 Lunch break

14:00–16:30
Session IV: Innovative presentation formats

Chairperson(s): Alice Lefebvre & Ulrike Holzwarth
Lecture Room: Lecture Hall H2 Geomatikum
Poster Area: Poster Area Geomatikum

Introduction by Alice Lefebvre & Ulrike Holzwarth

14:05–14:20: ICYESS2013-56
Poster: P71
Sahel greening due to increasing CO2 in CMIP5 Earth System Models
Bathiany S., Claussen M., Brovkin V.

14:20–14:35: ICYESS2013-15
Poster: P72
Current Societal Interpretation of Scientific Knowledge And Its Limits in Third World Contries
Obeng A.Y.

14:35–14:50: ICYESS2013-45
Poster: P73
Examining uncertainty in design rainfalls in Australia
Johnson F.

14:50–15:05: ICYESS2013-115
Poster: P74
Ideal Inundation Simulation using Numerical model and SAGA GIS in Pearl River Delta
Li L.

15:05–15:20: ICYESS2013-130
Poster: P75
Going back a step - Parameter Uncertainty in Global Hydrology Modelling
Smith K.

15:20–15:35: ICYESS2013-89
Poster: P76
Separating direct acidification response signal from variability in plankton dynamics.
Moreno M., Schartau M., Wirtz K.W.

15:35–15:45: ICYESS2013-23
Poster: P77
Global North and South: Conflicting aspirations, deprived participation, what the future of Global Environment holds?
Muzenda A.

15:45–15:55: ICYESS2013-58
Poster: P78
The cloud lifetime: modeling and remote sensing framework
Stepanov I, Russchenberg H

15:55–16:30: Poster Session

17:00–18:30:
Panel discussion Uncertainty at the science-policy interface: why does it all go wrong?

18:30 Reception

Wednesday, 25 September 2013

08:30–11:30:

Session III: Finite resources in modelling, observations and analysis

Chairpersons: Florian Rauser & Rafael Abel
Lecture Room: Lecture Hall H2 Geomatikum
Poster Area: Poster Area Geomatikum

Introduction by Rafael Abel

08:40–08:55: ICYESS2013-73
Poster: P54
Implications of uncertainties on the feasibility of the climate change mitigation mechanism Reducing Emissions from Deforestation and forest Degradation (REDD+)
Plugge D., Baldauf T., Köhl M.

08:55–08:58: ICYESS2013-101
Poster: P18
Why is the Arctic warming more?
Pithan F., Mauritsen T.

08:58–09:01: ICYESS2013-82
Poster: P56
Statistical Methods and Metrics in the Standardized Evaluation System for Decadal Climate Prediction in MiKlip
Kadow C., Illing S., Cubasch U.

09:01–09:04: ICYESS2013-84
Poster: P57
Estimating sedimentary proxies along with associated uncertainties
Goswami B., Heitzig J., Rehfeld K., Marwan N., Ambili A., Prasad S., Kurths J.

09:04–09:07: ICYESS2013-88
Poster: P58
Estimating uncertainty of HOAPS precipitation rates from satellite data over the Atlantic Ocean
Burdanowitz J., Klepp C., Bakan S.

09:07–09:10: ICYESS2013-91
Poster: P59
Optimization of vegetation model parameters through sequential assimilation of surface albedo observations
Geppert G., Loew A.

09:13–09:16: ICYESS2013-112
Poster: P61
The role of anthropogenic heat in urban climate
Petrik R., Grawe D., Schlünzen H., Bungert U.

09:19–09:22: ICYESS2013-116
Poster: P63
The Arctic hydrologic cycle and its variability in a regional coupled climate model
Niederdrenk L., Sein D.V.

09:22–09:25: ICYESS2013-117
Poster: P64
Correlation estimation between two climate time series with improved uncertainty measures
Olafsdottir K. B., Mudelsee M., Schulz M.

09:25–09:28: ICYESS2013-118
Poster: P65
Reducing uncertainties in earth system sciences by optimizing model parameters and measurements
Reimer J.

09:28–09:31: ICYESS2013-119
Poster: P66
Need for simple models in climate prediction
Haerter J. O.

09:31–09:34: ICYESS2013-126
Poster: P67
Quantifying uncertainty in global climate models when predicting species distributions: a case study in South-Eastern Australia
McGregor K. J., Regan T. J.

09:34–09:37: ICYESS2013-72
Poster: P68
Uncertainties in empirical downscaling of land surface temperature
Bechtel B., Zaksek K., Wiesner S.

09:37–09:40: ICYESS2013-131
Poster: P69
Initialization strategies for decadal climate predictions
Polkova I., Köhl A., Stammer D.

09:40–09:43: ICYESS2013-63
Poster: P70
Incorporating uncertainty into the estimation of slip during pre-instrumental earthquakes
Lindsay A., Mccloskey J, Nalbant S, Murphy S, Simao N, Nic Bhloscaidh M

09:45–11:30: Poster Session

11:30–13:00
Keynote lecture by Joyeeta Gupta (University of Amsterdam, NL):
Climate Change, Scientific Uncertainty, Skepticism and Politics:
A Thirty Year History

13:00 Lunch break

Session V: Uncertainties in environmental impacts, their perception and communication

Chairpersons: Diana Süsser, Ines Schaudel & Tjado Barsuhn
Lecture Room: Lecture Hall H2 Geomatikum
Poster Area: Poster Area Geomatikum

14:00–16:00

Introduction 1: Environmental Impacts on the Anthroposphere by Diana Süsser

14:05–14:20: ICYESS2013-20
Poster: P79
Uncertainty recognition, understanding and assessment supporting the climate change adaptation in forest management
Petr M., Boerboom L, Veen A, Ray D

14:32–14:35: ICYESS2013-83
Poster: P84
Collective Efforts of People to Reduce the Impact of Climate Change in Sundarban, India: a Study
Bera Mr.

Introduction 2: Communication and perception of Earth system science and environmental risks by Ines Schaudel & Tjado Barsuhn

14:40–14:43: ICYESS2013-21
Poster: P85
Amelioration of climate change uncertainties with indigenous perceptions in the Niger Basin, West Africa
Oyerinde G.T., Hountondji F.C.C., Wisser D., Diekkrüger B., Afouda A., Lawin E.A., Odofin A.J., Adegbidi A.A.

14:43–14:46: ICYESS2013-106
Poster: P86
Uncertain Climate Change; Certain Natural Hazards: Perception and Communication of Climate Change Risks in the Coastal Regions of Bangladesh and India
Mahmud S.

14:46–14:49: ICYESS2013-46
Poster: P87
Uncertainty in weather forecasts and warnings. Perception, communication and application.
Kox T.

14:49–14:52: ICYESS2013-111
Poster: P88
Uncertainty, Climate Science, and the Divine: Interdisciplinary Understanding of Blue Holes in The Bahamas
Wise S.P.

14:55–16:00: Poster Session

16:00–17:00
Closing

Abstracts

Special Session: Keynote Lectures

Warm, Hot ... Freezing! - From past climate variability to future climate change

Eli Tziperman

Harvard University, US

The geologic record is a fascinating source for surprising information and useful lessons on the diverse states in which the Earth climate system may be. The Pliocene (2-5 Myr ago) was only slightly warmer than present-day climate, yet was characterized by a permanent El Nino in the equatorial Pacific and by a dramatic warming of mid-latitude ocean upwelling sites. The climate of the Cretaceous and Eocene (146-34 Million years ago) was exceptionally warm. Crocodiles and Palm trees, which cannot survive even a few nights of sub freezing temperatures, could be found in the waters of Greenland and in the middle of present day North America, where current winter temperatures can drop to -40C.

State-of-the-art climate models cannot reproduce nor explain these past warm climates even at high atmospheric CO2 concentrations. One wonders whether these models are missing some significant feedbacks that may also affect their global warming predictions. We'll discuss possible physical mechanisms for both of these past warm climates and the possible implied lessons.

Further back in time, the complete freezing of the Earth during the Snowball Earth events of the Neoproterozoic Era (1,000 to 542 Myr) pose several interesting and unanswered questions. We'll discuss the possibility that these events were initiated by bacteria in the deep ocean, as well as what the ocean circulation may have been under a kilometer of ice. Even in this case, there may be some surprising lessons for understanding present-day ocean, apart from the relevance to our understanding of the origin of life and its evolution.

Targets for global climate policy: An overview

Richard Tol

University of Sussex, UK

A survey of the economic impact of climate change and the marginal damage costs shows that carbon dioxide emissions are a negative externality. The estimated Pigou tax and its growth rate are too low to justify the climate policy targets set by political leaders.
A lower discount rate or greater concern for the global distribution of income would justify more stringent climate policy, but would imply an overhaul of other public policies. Catastrophic risk justifies more stringent climate policy, but only to a limited extent.

Richard S.J. Tol, Targets for global climate policy: An overview, Journal of Economic Dynamics and Control, Vol. 37, Issue 5, May 2013, Pages 911-928, http://dx.doi.org/10.1016/j.jedc.2013.01.001

Climate Change, Scientific Uncertainty, Skepticism and Politics: A Thirty Year History

Joyeeta Gupta

University of Amsterdam, NL

Climate change became a global issue in 1979 when the World Climate Conference discussed it. Ten years later, it had became a global political issue. With the establishment of the Intergovernmental Panel on Climate Change and the Intergovernmental Negotiating Committee on a Framework Convention on Climate Change, institutional frameworks were set up to both assess the science of climate change and to create a policy framework. These circumstances catapulted action and in 1992, just two years later a legally binding convention was adopted. And yet in the following 20 years, a combination of scientific uncertainty, scientific skepticism, the political inconvenience of climate change, and other factors have slowed down the pace of negotiation results. This lecture traces the key challenges over time focusing on scientific uncertainty, climate skepticism and politics.

Special Session: Networking presentations

ICYESS2013-138
Young Earth System Scientists community (YESS)

F. Rauser, S. Sonntag

The community of Young Earth System Scientists (YESS) is a network originating in the three graduate schools of the climate and marine science related excellence clusters of northern Germany (SICSS, GLOMAR, ISOS) and the International Max Planck Research School on Earth System Modelling at the Max Planck Institute for Meteorology in Hamburg. It has been founded in 2010 to facilitate exchange between young researchers from these schools and all related institutions in Germany, and - in time - worldwide.

To do this, YESS has implemented an independent communication infrastructure, a web community that allows for exchange and communication between YESS members. YESS is a platform that allows each member to achieve what s/he wants to do in her/his professional network within YESS. Multiple seminars, meetings, a retreat and now finally the ICYESS have been organized using YESS resources.

YESS is your easy contact option for German and international Earth System Science related institutions and agencies; we are, after all, the future of Earth system research. YESS extends your existing alumni networks of your respective school, institute or university and gives you a unique opportunity to shape the leading network community in a very active way. We are independent of every institution, we do not compete with any existing solution but aim to extend and bridge gaps in the current community.

We are the first of an interdisciplinary cohort of Earth system researchers, and we should try to improve exchange and communication with each another - for the science, and for our professional development. The YESS community is a place to do this, organized by you, for you. We hope that the ICYESS is a conference in this exact YESS spirit, to learn from a variety of Earth system science related disciplines, and to grow a robust and diverse personal network of friends and colleagues for our future careers, as diverse as they might be.

In this talk, we will use the time to discuss further plans for YESS, demands and ideas of the audience, and discuss a few strategical options that YESS will have in the near future.

ICYESS2013-137
Earth Science Women's Network (ESWN)

A. Kirchgaessner

amelie.kirchgaessner@bas.ac.uk

The Earth Science Women's Network (ESWN) was founded as a grassroots network by a group of six women in 2002. About ten years later it has become a global network with over 1200 members in more than 50 countries.

I will introduce ESWN during this presentation, and, based on this example discuss the benefits of networking, and introduce some ideas about how to network effectively.

Session I: Limited understanding of physical, chemical, and biological processes and interactions

Chair:
Sebastian Sonntag (sebastian.sonntag@zmaw.de)

Limited understanding of processes and interactions in the Earth system leads to uncertainties, which need to be identified and - if possible - also quantified. Many contributions in this session already make clear that often a combination of several disciplines is crucial to shed light on incompletely understood natural processes and interactions. Here, we would like to bring people working in different fields in the natural sciences even closer together in order to jointly contribute to a better understanding of uncertainties in Earth system science.

The contributions in this session address physical, chemical, and biological processes in different parts of the Earth system as well as interactions among these parts. The diversity of topics presented in this session is immense, with processes from ice sheet dynamics to wildfires, with locations from the stratosphere to the sea floor, with global studies as well as regional studies ranging from polar to tropical regions, across atmosphere, hydrosphere, cryosphere, and biosphere. Involved disciplines include climate and atmospheric science, oceanography, biogeochemistry, and biology. Also methodologically, contributions in this session are diverse, with examples from model, observational, and also laboratory experiment studies.

ICYESS2013-129
Poster: P1
Uncertainties in estimating Greenland's long-term melt

M. Krapp

Potsdam-Institut für Klimafolgenforschung, Potsdam, Germany (mario.krapp@pik-potsdam.de)

The Greenland melt season in 2012 exceeded by far any year in the satellite record since 1979 in terms of melt extent and duration. It may seem straightforward to link global warming to intense summers that facilitate a longer and more intense melt season but it is not. Many processes and feedbacks affect the surface mass balance of the Greenland Ice Sheet, the most important being accumulation of snow, surface melt, and refreezing. Regarding estimates, refreezing is the least understood (and least observed) process but the most important one regarding future estimates for which all processes will culminate in one big number that is relevant to society: global sea level rise which is one of the largest threats due to global climate change. In this exercise, I give some estimate on the individual processes adding to Greenland surface mass balance and discuss uncertainties in terms of process understanding, modeling, and observations.

Melting the entire Greenland Ice Sheet would culminate in a global sea level rise of 7m and melt rates are increasing since the beginning of the satellite era. But where the melt water finally ends up is poorly understood and, thus, a matter of uncertainty. This uncertainties is based on the poor understanding of Ice Sheet dynamics and relevant surface processes. To reduce uncertainties for future melt estimates we have to constrain model parameters to fit present-day and past interglacial conditions. Studying parameter sensitivities is a key to this kind of problem.

ICYESS2013-42
Poster: P3
Geo-Bio interactions in shallow water hydrothermal vents and their impact on trace metals

C. Kleint and A. Koschinsky

Jacobs University Bremen, School of Engineering and Science, Campus Ring 1, 28759 Bremen, Germany, c.kleint@jacobs-university.de

Life at shallow- and deep-sea hydrothermal vents is exposed to high concentrations of different metals in the venting fluids. Some are biologically

essential and serve as micronutrients (e.g. iron), while others act toxic at even low quantities (e.g. copper).
Hydrothermal vents at the sea floor release large volumes of these metal rich fluids into the ocean. Several studies confirmed that microorganisms, living at these habitats, produce small molecules, organic ligands that are able to form strong complexes with different metals to enhance its bioavailability or to reduce its toxicity. Due to the formation of metal-ligand complexes, keeping the metals soluble, the trace metal flux into the ocean is expected to be higher than assumed until recently. While deep-sea vents have been intensively studied with respect to metal complexation, corresponding knowledge about shallow-marine vents is rather rare.
In this study, we want to examine the total dissolved Cu and Fe concentrations, as well as corresponding Cu- and Fe-binding ligand concentrations at shallow water hydrothermal vent fields by a voltammetric ligand titration, using adsorptive cathodic stripping voltammetry. Hydrothermal fluid and pore water samples were taken off the coast of Milos, Greece (2012) and in the shallow waters off Dominica, Caribbean (2013). A third set of samples will be collected during a SONNE cruise in June/July 2013 at the Coriolis Troughs, Vanuatu.
As an outcome, a complex data set on the complexation of Fe and Cu at shallow-marine hydrothermal systems, which are not only influenced by chemoautotrophic organisms, as at deep-sea vents, but also by phototrophic microbes, is aimed. Parameters such as total concentrations of dissolved Fe and Cu, as well as the quantification of ligands and determination of stability constants will give a detailed overview on the geo-bio interactions happening at hydrothermal systems in shallower water depths and to what extent they influence the metal flux into the ocean.
Uncertainties within this research project might start with the sample treatment. To avoid changes, such as metal precipitation or ongoing complexation processes, all aqueous samples are directly filtered and frozen at -20°C. This is the common treatment for such investigations, however, one never knows if all processes within the solution really stop and if the geochemistry stays the same, until the samples are being measured.
Secondly, as every method, also the voltammetric measurements display uncertainties with respect to analytical errors during each run. Additionally, the addition of buffer solutions, standards and artificial ligands increases the risk of contamination.
Another uncertainty within my research is the representativeness of the samples investigated. The amount of samples taken at each shallow marine hydrothermal vent site is limited due to sampling constraints and maybe too low to project the geochemical and biological results of each individual realm to the whole system.
However, this project is the first study on organic metal complexation processes at shallow marine hydrothermal vents and will therefore serve as an essential basis for ongoing research at these habitats in the future.

ICYESS2013-53
Poster: P4
The history of anthropogenic induced Zinc input to the German Bight, North Sea

S. Asendorf (1), B. Schnetger (2), and D. Hebbeln (1)

(1) MARUM - Center for Marine Environmental Sciences, University of Bremen, Leobener Straße, D-28355 Bremen, Germany (sasendorf@marum.de), (2) Institute for Chemistry and Biology of the Marine Environment (ICBM), Carl von Ossietzky-University, Carl-von-Ossietzky-Straße 9-11 , D-26111 Oldenburg, Germany

In sediments of the Helgoland mud area, one of the few depocenters in the shallow North Sea, increased zinc concentrations, compared to the natural background, have been found. These indicate human-induced pollution of this near-coastal area with yet uncertain consequences for the ecosystem. Initially, the high Zn input has been related to the dumping of polluted harbor muds in the time after World War II. However, more recent data point to a much earlier onset of high Zn input beginning already at approximately 1750 A.D., possibly related to the very early onset of industrialization and its effects on silver and zinc mining in the Harz Mountains. The Harz Mountains as well as the Erzgebirge are well-known mining areas, exploited for several centuries, and both lie along the tributaries of the Elbe and Weser rivers, both draining into the German Bight. Even before, during medieval times, mining activities in the Harz Mountains have been identified as the most likely reason for elevated Zn contents in river clays of the Weser River. A further increase in Zn content in these sediments occurred at approximately 1900 A.D. and probably reflects increasing environmental pollution in the course of an accelerating industrialization. Exploiting a set of sediment cores collected from various sites on the Helgoland mud area, this study aims to assess the Zn distribution in these sediments, to verify the temporal development of Zn input and, finally, to quantify the anthropogenic Zn input into the German Bight. Using XRF-scanner and quantitative XRF analysis, the absolute concentrations of Zn and other heavy metals in the sediment cores were determined. The results reveal some scatter for the initial steep increase in Zn concentrations in the sediments occurring in core depths between 20 to 100 cm. Ongoing radiocarbon dating analyses will reveal if these onsets are contemporaneous. Combining these data will allow for the intended quantification of anthropogenic Zn input.

To reconstruct past environmental changes by using sedimentary archives, it is essential to know the exact age of specific sediment layers. Dating of the sediments is therefore a crucial parameter in any palaeo-reconstruction. The method of choice – radiocarbon dating – is based on the ratios of carbon isotopes in organic material within the sedimentary layer and is prone to

various uncertainties. These are for example based on changes of the atmospheric composition of carbon isotopes, reservoir effects, and input of younger or older organic material. To minimize these effects, several records from similar locations should be correlated and other dating methods may be applied to verify radiocarbon ages.

ICYESS2013-70
Poster: P5
Pelagic Biodiversity and Ecophysiology of Mesozooplankton in the Atlantic Ocean: Latitudinal and Bathymetric Trends

M. Bode

BreMarE, University of Bremen, Germany (mabode@uni-bremen.de)

Zooplanktonic organisms are animals that live freely in the water column but are, by definition, not capable of swimming against currents. My study is mainly focused on copepods which are by far the most abundant components of mesozooplankton communities throughout the world's ocean. As dominant primary consumers, they play a key role in the marine ecosystem as a linkage between primary producers and higher trophic levels. Due to their enormously high secondary production and behavioural adaptations such as vertical migrations, copepods are important to the global carbon cycle as they enhance the vertical flux of organic matter from the euphotic zone to the deeper layers.

Knowledge about the distributional patterns, dietary preferences and metabolism of copepods are essential to understand their role in the complex marine food web and element cycles. The results of my studies will provide a high resolution picture of the physiological performance and biodiversity of copepods as well as trophic relations within mesozooplankton communities throughout the different geographic regions in the eastern Atlantic Ocean. Samples were collected on the research vessel Polarstern from Portugal (~40°N) to Namibia (~21°S). Carbon demands, trophic levels and dietary preferences of surface and deep-dwelling copepods will be estimated to help understanding carbon fluxes and disentangling food web structures in different subsystems across the Atlantic Ocean. Distributional patterns of copepods will be set in relation to environmental factors, such as temperature, salinity, oxygen and nutrients to determine primary factors influencing their distribution. Cryptic species diversity will be analyzed genetically by testing for differences in certain DNA sequences to explore speciation and distribution processes across the eastern Atlantic Ocean. In addition, a permanent transect in the highly productive Benguela Current upwelling system at 20°S was sampled regularly between 2005 and 2011 to

identify temporal and seasonal trends in zooplankton abundance and species composition in relation to environmental factors.

The handling and communication of uncertainties in science have become increasingly crucial to avoid external misunderstandings and misinterpretations. Thus, scientists have the responsibility to make themselves clear when speaking of uncertainties within their results. Disentangling the complicate relationships within different marine ecosystems, uncertainties are omnipresent due to the input of countless parameters. The distribution of zooplankton and its dependence on environmental factors is a complex non-linear system and long-term predictions seem to be almost impossible. However, we try to narrow down influencing factors and possible responses of zooplankton communities to environmental changes to make shorter-term predictions. During this work we are constantly confronted with uncertainties, e.g. due to random effects or lack of knowledge of certain factors. Results are therefore handled with great care, while uncertainties are estimated, communicated and openly discussed to make them clear to the reader in the end. Uncertainty is and has always been an essential but also natural feature in science and is not the uncertain what drives us scientists? However, it may also be frustrating. It is important to be honest about uncertainties and discuss them openly to make science more comprehensible for the public and policy-makers.

ICYESS2013-79
Poster: P6
Uncertainty in Marine Ecology – Understanding Ocean Acidification

C. Alvord

University of Gothenburg, Kristineberg, Sweden (charlotte.alvord@gmail.com)

Ocean acidification is a global phenomenon created by the increase in anthropogenic carbon dioxide (CO_2) emissions that is threatening the health of our world's oceans. This process alters the water chemistry by lowering the pH, which lessens the organisms' ability to develop and grow, thus changing their capability to cope with outside stressors. An example of a stressor is the heavy metal copper (Cu). Copper is ubiquitous; it is found in copper pipes, on rooftops, and on boats. It is naturally occurring in sediment, yet in higher concentrations it is very toxic and potentially fatal. When copper is combined with acidic water (lower pH), the water chemistry changes, making the copper more toxic. These conditions vary based on human activity. As we anticipate more (CO_2) to be absorbed by the oceans, it will become more acidic, and with more copper released into the ocean, the water becomes more toxic. When the oceans are in poor health, it affects the whole ecosystem, including fisheries and aquaculture. Without healthy

oceans, we will have little fish and seafood to feed ourselves or the next generation.

Animals of major concern for acidity and toxic copper are calcifying organisms, i.e. corals, shrimp, lobsters, mussels, oysters, sea urchins and sea stars. In this study, the brittle star Amphiura filiformis (Echinodermata) was used as it regenerates quickly. A. filiformis was used to investigate if there is a multiplied or an added effect when acidic water (low pH) reacts to coppered water, thus affecting the water chemistry and perhaps altering the animals' ability to cope and grow. To investigate growth, two out of the five stars' arms were amputated creating new regenerating arms. Regeneration and differentiation growth rates, along with survival and self-amputation (a stress indicator) were analyzed to determine the effects of pH and copper. This research, as a part of a larger EU project, was conducted to understand how A. filiformis behaves in these conditions and predict how other calcifying organisms may as well. As we can only hypothesize how animals will react, it is essential for us to decrease the uncertainty of how copper may affect our acidic oceans in the future, by continuing to conduct relevant research.

With all scientific research there is a level of uncertainty. One is uncertain if the experiment will work, if the animals will fair well in the environment provided and if the experimental plan will provide significant results. With all of these uncertainties, it is crucial to modify ones ideas to the circumstances that arise. Therefore, one must continue to test out different scenarios, using the best tools available to correctly analyze the scientific data. Thereby, we can make more accurate predictions to affect policy makers and politicians to make the best decisions to regulate pollutants, creating a better environment for us all.

Although uncertainty will always be present, it fuels creativity, strength and tenacity.

ICYESS2013-94
Poster: P7
Transport of nitrogen oxides ionized by energetic particle precipitation

K. Meraner and H. Schmidt

Max Planck Institute for Meteorology, Hamburg, Germany (katharina.meraner@zmaw.de)

Energetic particles enter the atmosphere of the Earth in the polar region, where they cause the production of nitrogen oxides (NO_x). Magnetospheric energetic particles in general only reach the lower thermosphere, while solar

protons penetrate into the stratosphere. It is supposed that during the polar night the NO_x can be transported downwards to the stratosphere, where they contribute to ozone depletion. This would affect the strength of the polar vortex, which in turn may influence the climate in the troposphere. However, it is still not clear which kind of transport causes the descent of NO_x into the stratosphere. Here, we analyze the transport of nitrogen oxides through the mesopause with the Hamburg Model of the Neutral and Ionized Atmosphere (HAMMONIA). We perform simulations with a passive tracer where single transport processes are switched off in order to assess their importance.

The transport of nitrogen oxides from the upper atmospheric levels downwards to the middle atmosphere is still an open question. This uncertainty propagates to the estimation of the processes which are influenced by the descending NO_x and finally to a possible influence on the climate.

ICYESS2013-96
Poster: P8
What effect do volcanic emissions have on sea level within the North Atlantic Ocean?

M.P. Hemming

(mphemming@live.co.uk)

Understanding sea level and the land-ocean flux of water is important when attempting to predict changes in future sea level. It is well documented that volcanoes have the power to alter the oceanic and atmospheric system. Notable volcanic effects include rapid cooling of the ocean (Graf et al.,(2007)), changes in precipitation (Grinsted et al.,(2007) & Marshall et al.,(2009)) and variations in sea level (Gleckler et al.,(2006)).

Previously, scientists agreed that sea level decreases after an eruption due to the reflection of incoming sunlight by atmospheric ash, reducing atmospheric and oceanic temperature (Graf, 2007). In contrast, Grinsted et al.,(2007) claim that both evaporation and latent heat is reduced as a result of this decreased incoming sunlight. Therefore, sea level is affected by the delayed transport of water from the land to the ocean due to this imbalance in the hydrological cycle. This causes sea level to rise within a year of an eruption and to drop 2-3 years afterwards, in contradiction to prior consensus, highlighting that uncertainties still exist in this field of science.

I will be undertaking research during the summer period focusing on sea level within the North Atlantic Ocean in order to determine whether the

hypothesis brought forward by Grinsted et al.,(2007) is plausible. If so, this would raise some interesting questions about how unknown planetary processes could affect vital components of the Earth system. I wish to present my progress at the ICYESS conference and I would welcome audience feedback.

ICYESS2013-109
Poster: P9

Δ-15N OF CHLOROPHYLL PIGMENT AS AN INDICATOR TO INTERPRET THE N-CYCLING IN THE PAST OXYGEN MINIMUM ZONE IN CENTRAL BENGUELA UPWELLING SYSTEM

Yu Xin (1,2)

(1) Institute for Biogeochemistry and Marine Chemistry, University of Hamburg, Bundes Str. 55, D-20146, Hamburg, Germany (yu.xin@zmaw.de), (2) Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research, Max-Planck-Str. 1, D-21502 Geesthacht, Germany

The Benguela Upwelling System (BUS) is one of the four major eastern boundary upwelling systems of the world, situated off the west coast of Africa between 15ºS - 37ºS and spanning three countries of Angola, Namibia and South Africa. There is year-round coastal upwelling, supplying coastal area with sufficient nutrients for phytoplankton growth for fish grazing. Besides, the upwelling water transported to coastal area is suboxic, and intense primary production resulted in further oxygen consumption, then leads to annual hypoxia (DO < 2ml/L) conditions in coastal water column, which in turn endanger the fish industry.
Under the background of global warming, Bakun's theory proposed an enhanced upwelling happening in the major eastern boundary upwelling systems. Long-time series development pattern of eastern boundary upwelling system indicates the boundary forcing variation at northern and southern of BUS. The biogeochemical response is carried and transferred by N isotope of nitrate transported by the corresponding upwelling activity. This signal may undergo amplification by denitrification along with the formation of OMZs at central BUS shelf. Hereby, my study proposes a compound specific δ15N-based method to check the biogeochemical feedback signal to upwelling variation at central BUS both historically and contemporarily under a regional sea surface warming trend by analyzing the δ15N of chlorophyll pigment in surface and dated core sediment at northern boundary and central upwelling area.
My study will focus on the following research objectives:
1) To uncover the upwelling activity variation in northern Angola Benguela

Front (ABF) boundary and the corresponding fluctuation in central Namibian coast;
2) To unveil the N-nutrient (nitrate) inputs and utilization from ABF to central BUS, its long-time variation and predict it future development.
3) To build up the long-term variation N-loss activity in OMZ of Central BUS, and build up its connection with global warming;

My study is based on analytical method of determination of compound specific δ15N of pigment, which means the separation and purity of pigment is essential to the final results. Beside, how to control the exogenic nitrogen contamination to the pigment samples is another important issue. Finally, the temporal development hydrography in BUS is a key to help to explain and understand the long-time pattern of nitrogen cycling. However, the lack of long-time series of in-situ observation of wind intensity, upwelling activity, seawater temperature and salinity at different water depth result in the complexity of understanding the currents circulations in BUS, which leaves open questions to many researchers.

ICYESS2013-123
Poster: P12
Projecting the potential phenological responses of North Sea small copepods to climate warming with a modelling approach

C. Xing

Institute for Hydrobiology and Fisheries Science (IHF), University of Hamburg Grosse Elbstrasse 133, 22765 Hamburg, Germany (chuanxi.xing@zmaw.de)

Energy transfer from the first trophical level (phytoplankton) to second trophical level (zooplankton) relies on temporal match between the seasonal cycle (phenology) of phytoplankton and zooplankton. The phenology of zooplankton and phytoplankton are sensitive to climate change. Concerns are thus raised that future climate warming may disturb the the phenology of phytoplankton and zooplankton, and cause a mismatch between them. When the mismatch happens, zooplankton abundance will decrease and the energy transfer from the first trophical level to higher trophical level will be blocked.

Here, I study the impacts of climate warming on phytoplankton and zooplankton with a focuse on phenological changes with a modelling approach. I choose Acartia clausi, a key zooplankton species in the North Sea as a representative for zooplankton and develop a life cycle model for this species. The developed model is then coupled to different warming

scenarios. The model results show that when the sea temperature is increased by 1.2°C from current level, the seasonal cycle of Acartia clausi and phytoplankton match more closely and Acartia clausi becomes more abundant compared to now. When temperature is increased by more than 2°C from current level, the seasonal cycle of Acartia clausi mismatch with the seasonal cycle of phytoplankton, which induces a sharp decrease in Acartia clausi abundance.

The uncertainty of my study is that I only consider the direct effects of climate warming on the biological processes of zooplankton. Climate warming can influence zooplankton indirectly e.g. through changing the ocean current and enhance the stability of water column. It is possible that the indirect effects are more important than the direct effects.

ICYESS2013-125
Poster: P13
Investigation of the simultaneous effects of ocean acidification and warming on coral reef Foraminifera

C. Schmidt (1), M. Kucera (1), and S. Uthicke (2)

(1) MARUM, University of Bremen, Leobener Str., 28359 Bremen, Bremen, Germany (cschmidt@marum.de), (2) Australian Institute of Marine Science, PMB No 3, Townsville, QLD, Australia

Ocean acidification and warming are two of the major environmental threats today. This work focuses on two coral reef Foraminifera, important calcium carbonate producers in the oceans, from the central Great Barrier Reef. Interactive effects of the two stressors are often understudied. In order to reduce uncertainties this research explores the interaction between pCO_2 and warming. Specimens have been exposed to increasing levels of pCO_2 (equivalent to a pH of 7.9 and 8.1) and warming (28 and 31 ^{rc}C) for up to six weeks in flow-through aquaria. The results indicate that in both species the photo-physiology of the symbionts, pigment concentration in the host and respiration are all negatively affected by temperature. Of these parameters, acidification affected only the photo-physiology. In Heterostegina depressa, both temperature and acidification affected growth rate and mortality. In both species, significant additive effects between the two stressors are observed. What is more, although the stressors alone had no effect on growth in Marginopora vertebralis, they had a significant interactive effect on this variable. These results indicate that the inhibition of photosymbiosis, respiration and growth in symbiont-bearing coral reef Foraminiferais likely to be stronger under simultaneous scenarios of acidification and temperature rise than what would be expected from the effect of each of the stressors

individually.

Simulating the combined effects of pCO_2 and warming at levels that are predicted to occur by the end of the century put uncertainties on this study. Climate models and changes in ocean chemistry can only be predicted by models and always possess a certain level of uncertainty. Furthermore, specimen's adaptation potential to long-term (over several years) changes in temperatures and ocean pH are not possible or at least very difficult to study in manipulative experiments. In summary, uncertainties in models might alter the amount of time at which effects become visible or alter the scope of the presented results. If specimens are not able to adapt to rapid changes these organisms might experience extinction events as seen several times through earth history.

ICYESS2013-19
Poster: P14
Global ocean surface latent heat flux trends during 1958-2012

H. Yang (1,5), J. Liu (2), X. Shi (3), Y. Hu (4), and X. Chen (5)

(1) Institute of Oceanography, University of Hamburg, Hamburg, Germany (hu.yang@zmaw.de), (5) Physical Oceanography Laboratory, Ocean University of China, Qingdao, China (xchen@ouc.edu.cn), (2) Department of Atmospheric and Environmental Sciences, University at Albany, State University of New York, New York, USA (jiping.liu07@gmail.com), (3) The Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany Germany (xshi@awi.de), (4) Department of Atmospheric and Oceanic Sciences, School of Physics, Peking University, Beijing, China (yyhu@pku.edu.cn)

Latent heat flux (LHF) plays a critical role in the climate since it relates to the heat and water vapor supply from the ocean to the atmosphere. Investigating the trends of LHF is helpful to explain and evaluate the climate change. In this work, the National Centers for Environmental Prediction / National Center for Atmospheric Research (NCEP/NCAR) reanalysis product and the Objectively Analyzed air-sea Fluxes (OAFlux) are used to study the LHF trends during the period of 1958-2012. Besides, the reasons for the LHF trends are investigated by linearizing the bulk flux formula and examining the trends of LHF-related parameters (i.e. surface wind speed, surface saturation humidity and surface specific humidity). Three remarkable structures of the LHF trends caused by different reasons are identified: 1) The LHF is enhanced along the path of the primary subtropical and mid-latitude western boundary currents (WBCs, i.e. Kuroshio Current, Gulf Stream, Agulhas current, Eastern Australian Current and Brazil Current) and

their extensions on the magnitude of 5~9 W/m^2 per decade, which is induced by the enhanced warming of sea surface temperature over the WBCs. 2) The LHF is reduced over the tropical and subtropical eastern Pacific on the magnitude of 4~7W/m^2 per decade, which is primarily induced by the decelerating surface wind speed that might be associated with a strengthening Walker Circulation. 3) The LHF is reduced over the northern tropical Atlantic on the magnitude of 2~4 W/m^2 per decade, which is induced by the increasing surface specific humidity as a result of the convergence of near surface atmospheric water vapor.

ICYESS2013-24
Poster: P15
Down load or up load? Climate change, net primary productivity and bush fire fuel load

H. Clarke (1,2,3), J. Evans (1), and A. Pitman (3)

(1) Climate Change Research Centre, University of New South Wales, Sydney, Australia (h.clarke@student.unsw.edu.au), (2) Climate and Atmospheric Science Branch, NSW Office of Environment and Heritage, Parramatta, Australia, (3) ARC Centre of Excellencefor Climate System Science, University of New South Wales, Sydney, Australia

Research
Wildfires can seriously affect not just people and property, but biodiversity, ecosystem health and the earth's carbon budget. Will present day patterns of wildfire across the globe change as our climate changes, and if so, how? So far most research has focused on how a changing climate will alter weather conditions that favour the outbreak and spread of fire. But weather is not the only factor in the outbreak of fire: there must be sufficient vegetation (i.e. fuel), the fuel must be dry enough to burn and there must be an ignition source e.g. lightning or arson.

Here we develop alternative model parameterisations of the link between wildfire fuel load and net primary productivity (NPP) over Australia. NPP is a measure of the rate of movement of carbon from the atmosphere into green plants; it is the difference between the carbon dioxide taken in during photosynthesis minus how much is released during respiration. The link between fuel load and NPP is to be expected as several seasons of high NPP followed by dry conditions and vegetation die-back would tend to increase the accumulated biomass that on drying provides fuel load. We use Community Atmosphere Biosphere Land Exchange (CABLE), a land surface model which calculates carbon, water and heat exchanges between the land surface and the atmosphere. The model parameterisations are evaluated

against field-based and remotely sensed observations of fuel load.

The next step of the project is to use the parameterisation(s) in CABLE coupled with the regional climate model Weather Research and Forecasting (WRF) to project changes of fuel load into the future. Will changes in fuel load be large enough to change the statistics of fire risk, compared to natural variability or changes in fire weather?

Uncertainty
Uncertainty over actual fuel load values makes modelling fuel load difficult. Model evaluation requires careful combination of data from field work, remote sensing and physical models.
The interplay between rising carbon dioxide levels and vegetation growth is a key source of uncertainty in projections of wildfire risk under climate change. Will the fertilisation effects of increased atmospheric carbon dioxide on plant growth be reinforced by, or counteract changes due to new climate conditions? How different will responses be among grasses and trees, two very different kinds of wildfire fuel? Will the changes in fuel load be of a magnitude comparable to those caused by natural variability or different weather conditions? And how will the answers to these questions vary in time and space?

One way that modellers love to deal with uncertainty is by running ensembles of simulations. The creation of two or three or nine or 27 or indeed hundreds of parallel worlds, all with subtly different conditions, allows researchers to separate the most central factors in various phenomena from those that are less important; to find out just how sensitive a process is to a range of underlying factors. Indeed, decision makers now are less likely to ask what the future climate will look like, than to ask about a range of plausible climate futures, perhaps each with their own level of confidence or probability.

ICYESS2013-52
Poster: P17
Estimating Impacts of Lichens and Mosses on Global Biogeochemical Cycles

P. Porada (1), B. Weber (2), W. Elbert (2), U. Pöschl (2), and A. Kleidon (1)

(1) MPI Biogeochemistry Jena, Jena, Germany (pporad@bgc-jena.mpg.de), (2) Max Planck Institute for Chemistry, P.O. Box 3060, 55020 Mainz, Germany

Lichens and mosses may have a significant effect on global biogeochemical cycles. Several studies suggest that they are important contributors to terrestrial nitrogen fixation and that they enhance surface weathering rates. Their potential effect on global weathering rates might have influenced climate throughout Earth's history. Most of these studies, however, are either conceptual or rely on upscaling of regional estimates to obtain global numbers. Here, we use a different method which allows us to quantify the impacts of lichens and mosses on biogeochemical cycles at the global scale. We focus on three processes, namely nitrogen fixation, phosphorus uptake and chemical weathering. Our estimates have the form of potential rates, which means that we quantify the amount of nitrogen and phosphorus needed by lichens and mosses to approximate their actual uptake of these elements. Furthermore, we use potential phosphorus uptake on bare ground in combination with the phosphorus content of rocks to estimate chemical weathering by the organisms, assuming that they release weathering agents to obtain phosphorus. The requirements of lichens and mosses for nitrogen and phosphorus are derived by multiplying their net carbon uptake by their nutrient content, also accounting for resorption and leaching of nutrients. The carbon uptake is calculated by a process-based simulation model. For medium scenarios of nutrient content, resorption and leaching the predicted requirement for nitrogen ranges from 3.5 to 34 Tg/yr and for phosphorus it ranges from 0.46 to 4.6 Tg/yr. Estimates of chemical weathering are between 0.058 and 1.1 (km^3 rock)/yr. These values seem to have a realistic order of magnitude. There are, however, not enough observational data available to make a definitive assessment of the estimates. Nevertheless, the results support the notion that lichens and mosses have the potential to play an important role for biogeochemical cycles.

Different factors contribute to the uncertainty in our estimates: The value of net carbon uptake, the nutrient content of lichens and mosses and the values of resorption and leaching. Uncertainty in carbon uptake is due to high functional variability of lichens and mosses, leading to broad ranges of possible model parameter values. A part of this uncertainty can be reduced by generating many random "strategies" in the model which differ in these parameter values. These "strategies" represent the functional variability of

real lichens and moss species. By determining which “strategies” are able to survive in a given climate, the range of possible values can be narrowed. Another method for reduction of uncertainty is to find relationships between different parameters of the model. This reduces the number of independent parameters. The uncertainty in the values of nutrient content, resorption and leaching is analysed by setting upper and lower bounds for these factors. We then discuss possibilities to reduce this uncertainty by establishing relations between nutrient content, resorption and leaching and other properties of lichens and mosses.

ICYESS2013-87
Poster: P19

A consequence of Addition; sub lethal effects of the plastic additive Bisphenol A on a marine copepod

T. Carlsson

Department of biology and environmental sciences, University of Gothenburg, Gothenburg, Sweden (therese.my.carlsson@gmail.com)

Worldwide there are 4000 different additives used in plastic products. With plastic being the biggest contributor to marine litter, 50% of the plastic produced in Europe being placed in landfills , and a continuous leaching of chemicals that often are not treated in the waste water treatment plants from the products themselves, there is an increased need to understand the effects that these chemicals have on marine life. Bisphenol A is one of the highest production volume chemicals in the world and has shown to mimic oestrogen. Little is known of how it affects organisms in the ocean and a lot of the research has focused on vertebrates. Of all known animals 95% are invertebrates. They often have important ecosystem functions and are essential parts of the marine food web. Additionally they often have other hormones and could therefore react differently. Through looking at non-lethal effects on several different parameters on a species of marine zooplankton I have shown that short term exposure to very small amounts of Bisphenol A decrease their egg production and growth efficiency which can have a negative effect on the species fitness. The chemical also affected the alga used which shows the importance of having an integrated ecosystem perspective when assessing chemicals in the environment.

Working with the effects of hormonal compounds on the environment there are several uncertainties that should be addressed. Through looking at biological effects such as egg production I wanted to get a better understanding of how it affects zooplankton as they are important to predict the effects on ecosystem structure and function. I used a species and a

concentration that has previously been investigated, using other parameters, to further increase the understanding of the effects that this chemical has. Although it was not an objective of the investigation I saw an unexpected effect of the chemical on the algae used. This further amplifies the need of searching to understand the effect on the ecosystem as such and not only on isolated species. Moreover Bisphenol A has been observed to not always have a dose dependent effect and in my experiments I saw a stronger effect on the smaller concentration than on the slightly higher. For future research it is important to investigate this further as it creates a larger uncertainty around “safe limit values”.

Session II: Uncertainties in the context of Earth system governance

Chairs:
Andreas Schmidt (andreas.schmidt@zmaw.de)
Rebecca Stecker (rebecca.stecker@uni-oldenburg.de)

Earth system governance encompasses a wide range of societal responses to global environmental problems. The concept describes public as well as private activities at various societal scales that are intended to mitigate anthropogenic pressure on (different parts of) the Earth system or to adapt to the consequences of its transformation, e.g. changed climatic conditions. In the social sciences, it is used to analyse the reactions of societies to changes in their surrounding environment and to find solutions for sustainable governance of natural resources. Different kinds of uncertainties are one of the central issues Earth system governance research deals with.

This session brings together diverse perspectives and approaches towards Earth system governance. Besides climate change mitigation and adaptation on various societal scales, presentations focus on maritime sustainability (problems) and management of global environmental problems in general. Moreover, the session includes both scientific analyses of as well as for societal responses, and research using diverse methods – from economic modelling to qualitative observations. This multitude of perspectives and approaches, we think, is very fruitful to elucidate ways of dealing with uncertainty. Especially, we see the potential of cooperation and learning from each other in order to reduce scientific uncertainties and to increase the value and quality of our research.

ICYESS2013-39
Poster: P20
Conservation and Sustainable Use of Ocean Areas Beyond National Jurisdiction: The Role of Principles and Procedures under International Law in a Context of Legal and Scientific Uncertainty

KJ Houghton

Institute for Advanced Sustainability Studies, Potsdam, Germany (kate.houghton@web.de)

Our knowledge of the high seas is characterized by a significant degree of scientific uncertainty. At the same time, international legal instruments for the protection and sustainable use of these areas are currently insufficient, creating legal uncertainty how best to govern these common spaces. This paper discusses the nature of these uncertainties and examines the role of four legal principles in the governance of high seas areas (also known as “areas beyond national jurisdiction” or ABNJ) in more detail: the freedom of the high seas, cooperation, precaution and integration. These principles, through corresponding procedural mechanisms (access and benefit sharing, information exchange and environmental impact assessment), operationalize critical information-related activities at the global, regional and national levels, which contribute to the reduction of both scientific and legal uncertainties. Together, these principles and procedures provide an integrated framework already applicable to all ocean areas, including ABNJ, which can support the generation of substantive obligations under treaty and customary international law to improve the protection of biodiversity and foster more sustainable use of high seas areas – even in a context of uncertainty.

ICYESS2013-65
Poster: P21
Ecological and socio-economic feasibility of a long-term scallop bottom culture in Sechura Bay, Northern Peru

L. Kluger and M. Wolff

Center for Tropical Marine Ecology (ZMT), Bremen, Germany (lotta.kluger@zmt-bremen.de)

Aquaculture has become an important factor to support global fisheries in achieving sustainable levels for overexploited natural stocks. The Peruvian scallop Argopecten purpuratus represents one of the economically most important bivalve along the Pacificcoast of South America. Sechura Bay

(5.6° S, 80.9° W), located close to the northern border of Peru, has become a major spot for its cultivation. Here, culture activities exponentially increased during the last years and today represent an important socioeconomic factor, with approximately 2500 artisanal fishers involved and an export value of more than 70 million US$ per year. A large part of cultivation, however, is still conducted without legal authorization thus formal control, which makes management efforts for the bay's system a challenging priority. A recently initiated interdisciplinary study will therefore determine the bay's carrying capacity in ecological and socio-economic terms. Carrying capacity was defined as the maximum amount of cultivated organisms that a system can support without causing an unacceptable impact on the ecological or social level. Using different modelling approaches (e.g. ECOPATH), respective limits will be determined. Ecological experiments will provide information to establish a trophic model by investigating how the increase of scallops' biomass due to culture efforts has changed trophic fluxes. Data from ecological and socio-economic surveys will be integrated to explore the response of the system under different culture scenarios and environmental conditions, such as the occurrence of El Niño. Resulting carrying capacity thresholds are urgently needed to establish a decision-framework supporting both local fishers and managers in their difficult position of finding a sustainable long-term level of scallop culture in Sechura Bay, Peru. Understanding possible future statutes of this local bay and developing an according adaptive management plan will help to adapt other culture system worldwide to a changing earth environment.

Although the theory of carrying capacity appears straight forward, the modelling process is complicated by the lack of data, multi-use of the bay, overlapping stakeholder groups and complex political structures surrounding the bay's system. Careful observation and mapping of the social structure, consulting and integrating different stakeholder's interests are crucial for the identification of what represents unacceptable levels of disturbance. Effectiveness of resulting management suggestions will strongly depend on acceptance and active participation of the involved population. The challenge of ecological and socio-economic modelling is therefore not only to define certain limits to production, but also to establish a useful and applicable decision-framework for local stakeholders and managers. One key for a successful application of new management strategies will be a continuous communication flow between different participatory levels. Anticipating future scenarios of coastal systems became a key goal of ecosystem-based management, for which ecological modelling and the concept of carrying capacity represent important tools. Techniques to address the social level, however, still have to be further developed. The presented study therefore aims on contributing to on-going research on the estimation of carrying capacity for aquaculture by providing an holistic approach. Presented results can be taken as an example for the governance of other coastal system exposed to aquaculture.

ICYESS2013-122
Poster: P22
Increasing the Value of Climate Finance in an Uncertain Environment

D. Chirambo

Brandenburg University of Technology Cottbus, Erich-Weinert-Str. 1, LG 10/334 , 03046 Cottbus/Germany , Tel (Office): +49355693271, Fax (Office): +49355693057 (chiradum@tu-cottbus.de)

Human activities are widely believed to be contributing to climate change and the associated increased frequencies of extreme weather events such as floods and droughts (Boko et al, 2007: p 437). Whilst there still remains considerable uncertainty over the precise extent, time-scale, and consequences of climate change (Morton et al., 2011), most policy makers acknowledge that concrete actions have to be undertaken to mitigate and adapt to climate change. Since climate change mitigation and adaptation strategies require new investments in pertinent technologies, human capacity and institutions, climate finance has emerged as a means for providing financial support for mitigation and adaptation activities, including capacity-building and Research & Development, as well as broader efforts to enable the transition towards low-carbon, climate-resilient development (Buchner et al., 2011).

Barriers to implementation of climate finance projects (e.g. renewable energy development and fuels switching projects) in different countries include ineffective regulatory frameworks, inequitable distribution of wealth, technology adaption and transfer, transaction cost, and investor risks (Nautiyal and Varun, 2012). Additionally, global political and economic performance and priorities dictate the commitment of donors to global funds (climate finance) and consideration is also made to uncertainties related to (shifting) public policies; unreliability and costs of (new) technologies; indefinite future economic growth prospects and future emissions paths from different countries; subsequently creating erratic commitment levels of different countries (McKibbin and Wilcoxen, 2009; Masini and Menichetti, 2013; Hu and Monroy, 2012; Rong, 2010). The combined effect of this is funding levels falling short of the investments needed for climate finance activities to be undertaken effectively hence undermining the whole process.

Evaluation methods such as multi-criteria analysis (MCA) have potential to be utilised to encourage the engagement of various stakeholders and advance responsibility for immediate action towards climate change policies and financing regardless of prevailing uncertainties. A multi-criteria analysis enables efficient integration of diverse issues (e.g. economic, environmental and social) when there is a need for the identification of trade-offs where conflicting objectives are involved by providing an interactive mean with

verbal, numerical and visual representation of preferences/alternatives even where there are criteria, objectives, costs and/or benefits that cannot be quantified and monetised (Broughton et al., 2012; Grafakos et al., 2010). Arguably, this can also improve stakeholder's understanding of climate finance.

This research aims to contribute to the existing body of knowledge on the implementation of climate finance. The paper briefly introduces the concept of multi-criteria analysis and how it can assist with climate finance decision making. This is then followed by suggesting that the value (i.e. importance and contribution) of climate finance can be enhanced if climate finance is considered as a development and investment instrument rather than an instrument related to environmental protection as it is often the case.
By improving the understanding of climate finance and enhancing the value of climate finance, some uncertainties related to funding can be minimised as projects will be addressing wider societal goals and developmental issues such as the Millennium Development Goals hence addressing the concerns and priorities of diverse stakeholder.

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ICYESS2013-75
Poster: P24

Uncertainty in key abatement technologies: A sensitivity analysis for the CGE model DART

M. Weitzel

Kiel Institute for the World Economy, Kiel, Germany (matthias.weitzel@ifw-kiel.de)

Many cost estimates and scenarios for possible future energy systems rely on assumptions of technological development in key technologies, which today still play only a minor role or are at its infancy. Technologies such as carbon capture and storage (CCS) or renewable energy generation are however expected to become more competitive in the future and are therefore often assumed to play a major role for CO_2 abatement. Traditional scenario analysis to estimate economic costs of carbon abatement usually does sensitivity analysis with binary assumptions of technologies, i.e. technologies being either available at a deterministic cost estimate or completely unavailable. Here, we propose a more refined analysis with the general equilibrium energy-economy model DART. In a first step, the distribution of technological variables used as input parameters for the model (such as the cost markup compared to current technologies and learning rates) is obtained from a literature review. Based on this, we are able to attach probabilities to certain values of parameters that describe the key

technologies, thus also allowing us to also obtain a distribution of outcome variables of interest such as welfare losses due to carbon abatement. Implementation in the model is carried out by applying a Gauss quadrature method.

The results are expected to deliver estimations variations in economic impacts due to uncertainty in different key technologies. We are particularly interested in the interaction and potentially adding up effects of uncertainties in different technologies. The results would also help determining a ranking of different uncertainties in energy-economy as it is possibilities to compare the results of technological uncertainty with other sources uncertainty of exogenous economic parameters in the model.

ICYESS2013-34
Poster: P25

On the Influence of Risk Aversion and Time Preference on Optimal Policy and Welfare

D. Neubersch (1,2)

(1) Max-Planck-Institut für Meteorologie, IMPRS, Hamburg, Germany (delf.neubersch@zmaw.de), (2) Research Unit Sustainability and Global Change, KlimaCampus, University of Hamburg

When assessing optimal policies in the context of global warming there are plenty of uncertainties that influence the result. A framework in which optimal policies can be found while simultaneously including future learning about the uncertain parameters is the cost benefit analysis. However, cost benefit analysis has serious issues with the valuation of human life and equality between countries of different development, as well as with the dismal theorem. Furthermore, the damage function is extremely uncertain. My research applies a new framework, cost risk analysis (CRA), to an integrated assessment model (IAM) to find the economic values of learning about climate sensitivity. CRA uses an often discussed target of staying below 2°C warming with a probability of 66% (IPCC: "likely") to calibrate the intrinsic risk of decision makers that support the 2°C guard rail. In this way, I can calculate economic values of new information about the climate sensitivity. Furthermore, I investigate how the value depends on other uncertain parameters such as risk aversion and discount rate.
Interesting for the global IAM community is to know if normative parameters affect the optimal policy and if so, by how much. Even if the change in optimal emissions is large, the effect on welfare might be small. The shape of the optimum can suggest for what kind of analysis the normative parameters are of importance. I investigate the welfare changes and the

policy changes of combinations of two normative parameters, constant relative risk aversion (CRRA) and pure rate of time preference (PRTP). For decreasing CRRA the change in optimal policy and the induced change in welfare is substantial, around 10% certainty- and balance growth equivalent (CBGE). I also show that the value of perfect information about climate sensitivity is greatly dependent on the normative parameters, i.e. a factor 10 in typical ranges of CRRA and PRTP.

In the model I assume uncertainty in the climate sensitivity and conduct probabilistic integrated analysis with the model MIND-L. I sample a distribution at equal intervals of 5% quantiles. The second uncertainty that is handled is in normative parameters. This is done by a sensitivity study varying constant relative risk aversion (CRRA) from 0.75 to 5 in six steps and pure rate of time preference (PRTP) from 0.5% to 4% in four steps. I calculate the loss of welfare if a choice of normative parameters turns out to be incorrect.
The main conclusions are twofold: (a) normative parameters can have a very strong impact on welfare and (b) any study relying on such parameters should test the sensitivity towards them.

ICYESS2013-18
Poster: P26
Climate Policy Decisions under Uncertainty

I. Staub-Kaminski

Potsdam Institute for Climate Impact Research, Potsdam, Germany (staub@pik-potsdam.de)

Climate economics aims to bridge the gap between science and policy and provide policy makers with valuable insights into policy issues. For this purpose, integrated assessment models (IAM) of climate change inform policy makers about the optimum level of global atmosphere warming and of the associated optimal transition-path to a low-carbon economy. However, instead of announcing a climate stabilization target, the instruments available to policy makers to implement a given target, are various policy instruments such as taxes, subsidies, quotas, emission allowances or feed-in-tariffs.

The model of Policy and Regulatory Instruments in a Decentralized Economy (PRIDE) complements standard IAM by allowing for computation of optimal portfolios of policy instruments and determines which policy instruments implement a given target at lowest cost*. The effect of uncertainty on the optimal choice of policy instruments has, however, not been as much studied as the effect uncertainty has on the stringency of

climate policy. The main reason is that IAM typically employ a social planner optimization that maximizes inter-temporal social welfare resulting in an optimal response to an emissions constraint.

The PRIDE model allows for multiple actors such as households, production, fossil and renewable energy firms, fossil resource owners and a Government which imposes policy instruments. The aim of the policy instruments within this model is to reduce GHG emissions and promote adaption of technologies that are constrained by imperfect innovation markets due to knowledge spill-overs (when companies can learn from and copy other companies' innovations and therefore reduce innovator's profits). In an economy of perfect information the optimal policy mix is a carbon tax, aimed at reducing GHG emissions, in combination with a subsidy, to support greater investments into technologies where inventors cannot appropriate returns from innovation due to knowledge spill-overs.

Kalkuhl et al. (2012) conducted a sensitivity analysis within the PRIDE model and concluded that the performance of a subsidy was very sensitive to small deviations from the optimal subsidy level. A key input for the optimal balance of the policy instrument mix is the degree of knowledge spill-overs. By adding uncertainty endogenously in the PRIDE model, the aim of this study is to provide valuable insights for policy making under uncertainty by analyzing the effect uncertain knowledge spill-overs have on the choice of policy instruments. We plan to model parametric uncertainty by allowing the spill-over rate to take different values with assigned probabilities of occurrence. The Government does not have perfect information anymore, but instead anticipates uncertainty in the spill-over rate, knowing the possible values and the associated probabilities. Under uncertain spill-overs it is not clear whether the Government will choose a higher level of subsidy (compared to the case of perfect information) or apply another more robust policy instrument.

(*)See Kalkuhl, M., O. Edenhofer and K. Lessmann (2012): Learning or Lock-in: Optimal Technology Policies to Support Mitigation. Resource and Energy Economics, 34(1), 1–23 for model details on the PRIDE model

ICYESS2013-30
Poster: P27
Uncertainty in Climate-Economic Modeling

C.K. Klippert and S.G. Geisendorf

ESCP Europe Business School Berlin, Chair of Environment and Economics, Berlin, Germany (cklippert@escpeurope.eu)

Aim and relevance of my research
The mainstream macroeconomics still use optimization models based on neoclassical assumptions such as the "homo oeconomicus" for analyzing economic problems.
There are various shortcomings:

- Such models assume a rather static economy with some growth rates for technological progress, population or GDP, but these are mostly given exogenously
- Neoclassical optimization models cannot resist an empirical verification. It seems quite obvious that people in the real world do not behave as optimization models assume.
- Optimization models could at best give an impression of what is possible to achieve maximally, but what truly happens depends on the actual decision of relevant actors.
- Optimization models consist of representative economic agents but the economic system rather consists of various economic agents with different attitudes, beliefs, goals etc.

  To cope with all these problems alternative methods are required. Agent-based models (ABM) are able to account for all this. They allow the realistic representation of agents and their decision behavior under uncertainty based on statistical data. Furthermore, such models are able to account for the complexity and dynamic of the system's evolution and connection.

  My research interests refer to the application of agent-based modeling in environmental economics. ABMs are particularly appropriate to assess environmental economic problems since these problems are even more characterized by long-term consequences (e.g.climate change) or cross-systemic dynamics (e.g. resource use). Coupling economic and ecological systems therefore increases the complexity and consequently the uncertainty of the agent's decisions. Hence, it is all the more important to ascertain (1) why some decisions are made too late or not all, (2) how the agents can be manipulated in a sufficient way, and (3) to what extend learning can/does affect the agent's decisions and therefore the system's behavior.

Uncertainty in my current research on climate-economic models

Many of the most well-known climate-economic models (integrated assessment models) are inter-temporal cost-benefit-analyses, trying to assess the economic costs of damages from climate change or costs of its mitigation, and balancing them against benefitsfrom economic output and damage prevention by calculating an inter-temporal optimum.
In my current research project I suggest putting some effort into investigating the impact of personal beliefs on climate policy and the resulting climate change. For this purpose I work with a multi-agent climate-economy model based on climate-economy equations, but instead of deriving an optimal solution, contains adaptive agents, controlling some of the parameters of the economic model. Such models are important to demonstrate the long-term consequences of wrong or delayed action in relation to the real world's behavior due to high uncertainty about the system's behavior.
Another concern of my research refers to the problem that conventional models do not allow for a change of the economic structure. Investments in climate protection might not just be a cost but simply an investment in a future technology with promising growth rates and the potential to incite further growth in adjoining sectors. Therefore, I want to enable the model to show how an economy can undergo structural change from within. This will enrich the climate discussion and, hopefully, change the way of thinking.

ICYESS2013-37
Poster: P28
Uncertainty is essential! How to manage a world that doesn't fit into Newtonian models

K.P. Freier (1,2)

(1) Bavarian Environment Agency, Augsburg, Germany (korbinian.freier@lfu.bayern.de), (2) Research Unit Sustainability and Global Change, Hamburg University, Hamburg, Germany

Without debating the justification of Newtonian models in spheres where they clearly have proven their power, it can be conjectured for reasons of limited access to data [1], fundamental limits [2,3] and - more pragmatically - a scarcity of non-trivial predictions that the Newtonian paradigm is exhibiting clear limitations when it comes to highly complex and living systems such as the earth system. Still, the Newtonian paradigm is erroneously regarded as more powerful by principle than non-Newtonian approaches. This prejudice often prevents adequate management decisions [4,5,6] and makes it necessary to clarify a) the characteristics, b) the strengths c) the relevant types of problems and d) the limitations of Newtonian and non-Newtonian paradigms in order to achieve a better management of global change phenomena.

Based on a literature review [7], I want to clarify characteristics of a non-Newtonian modeling paradigm which can be described as "relational approach". Out of principle, this paradigm doesn't allow the reduction of knowledge to algebraic formulas and universal laws. Instead, knowledge in this approach depends essentially on empirical engagement and the accumulation of experience. The transfer of knowledge in this paradigm is achieved by history dependent data storages (narratives, heuristics and strategies). In contrast to the explanatory power of Newtonian models, the relational paradigm emphasizes qualitative and quantitative pattern recognition and classificatory power. This contrast most often leads to severe misunderstandings, if both paradigms are mixed within one setting.
The striking advantage of the relational paradigm is that uncertainties and unpredictable properties are accepted as essential for living systems. This advantage explains a much more pronounced risk-avoiding planning under a relational paradigm [8] and leads to a critique of Newtonian/"rational" decision making within ecological and socio-economic settings.
As a consequence of these insights, a) global climate change must be seen as a serious problem of knowledge-loss and b) within ecological and socio-economic systems the experimental character of policies has to be taken much more into account. To achieve the latter, the limits of Newtonian models should be emphasized in science as well as in public.

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ICYESS2013-78
Poster: P29
Policy-making under uncertainty: the case of carbon pricing in New Zealand

J. L. Richter

International Institute for Industrial Environmental Economics, Lund University, Lund, Sweden (jessika.luth.richter@iiiee.lu.se)

Pricing carbon has been advocated as an essential component in the transition to low carbon economies and in addressing the challenge of climate change. To this end, emission trading schemes have emerged as a popular climate policy for reducing carbon dependency and greenhouse gas emissions. While there has been much analysis of hypothetical and proposed schemes, much less empirical analysis exists for schemes in operation, particularly for those outside Europe. Such research is important to understanding how these schemes are designed and operate in different contexts as well as factors affecting their ability to achieve objectives. To address this gap, the research presented here evaluated the New Zealand Emission Trading Scheme (NZ ETS), with particular focus on the institutional aspects of the policy during its first policy cycle (i.e. formation, design, implementation, review and amendments). The research explored how different stakeholder groups and administration both influenced and were affected by the policy process and ETS design. The research approach involved a mixed methodology with a review of academic literature, government reports, public submissions, market and survey data as well as 36 interviews with key stakeholders including decision makers, administrating officials, participants, academics, civil society groups, and carbon traders. The research provided evidence that achieving institutional feasibility in this case involved trade-offs with other important aspects of climate policy; for example, carbon emission reductions, legitimacy, and predictability.

The research questions posed by the Earth Governance context of the YESS conference are particularly relevant in examining the design and policy-making process behind emission trading schemes (i.e. How do uncertainties affect decision-making in Earth system governance? How to deal with them in politics?). Uncertainty has pervaded every stage of the policy process behind the NZ ETS. Technical uncertainties about the risks and costs of climate change, as well as the accuracy of data, were often discussed. There were instrumental uncertainties about how the policy instrument would operate in reality; for example, there were questions about the actual effects on businesses and possible unintended effects. There were and continue to be significant political uncertainties; for example, there were strong industry lobbies opposing the original design and there was a

change of government just after the ETS legislation was passed. These uncertainties continue to challenge policy-makers, who must balance flexibility and credibility in addressing the different types of uncertainty in climate policy. An explicit part of this research has involved examining how these uncertainties have been dealt with by decision-makers and stakeholders and how persisting uncertainties affect the future outlook of the NZ ETS. While the research has focused on the NZ ETS, most of the uncertainties and challenges faced in New Zealand are likely to be shared by decision-makers designing and implementing any carbon pricing climate policy. With an increasing number of such policies proposed or implemented at the regional and supra/national level, a better understanding and appreciation of these uncertainties, as well as learning from the New Zealand experience, is especially relevant for those working in climate policy.

ICYESS2013-92
Poster: P30
Cost and choice - how economic incentives drive cities to adapt to climate change despite uncertainty

J.T. Huang and E. Guenther

TU Dresden, Chair of Environmental Management and Accounting, Faculty of Business and Economics, Dresden, Germany (jo-ting.huang@tu-dresden.de, 0351 463 37764)

Climate change adaptation is often perceived costly and counter-effective to local economies. However, meanwhile we observe that cities including Hamburg and Rotterdam have invested in both hard and soft adaptation measures and they remain competitive. In literature, climate adaptation measures are often described as costly investment which might hinder local governments for early initiatives. However, in empirical evidence, we see many cities are very keen on climate change adaptation actions at the local level and the cities report that they see economic opportunities in local climate adaptation. The data sample taken for analysis is questionnaires responded to CDP cities 2012. Among 65 participating cities, 84% confirmed that they have economic opportunities in climate change efforts. The research is carried out to answer the main arching research questions: How does it pay for cities to adapt to climate change? How does climate change present any economic opportunities in cities? Why are some cities more willing to take initiative and invest in climate adaptation under uncertainty than others? Even with uncertainty, why do some cities tend to see more opportunities in climate change than others? How are cities driven to react to climate change under uncertainty? The theoretical background is built based

on Ostrom's theory exploring multiple governance on climate change and Buchanan's theory of cost and choice. The methodology carried out includes content analysis, qualitative analysis and statistics. The research outcomes aim to contribute to literature by presenting positive cases which receive benefits of local climate change adaptation and to investigate incentive structures which motivate cities to take actions in climate change despite uncertainty.

ICYESS2013-77
Poster: P31

The European Emissions Trading System (EU ETS): Learning to deal with uncertainty

J. M. Rodriguez Lopez

KNU / CGG, Hamburg University, Hamburg, Germany (miguel.rodriguez@zmaw.de)

Launched in 2005, the EU ETS is the world's largest experiment to control CO_2 emissions. It is an emissions trading scheme based on the hope that pricing emissions could be used as an incentive for companies to reduce emissions. Countries that produce 21% of emissions are under this kind of emissions trading systems, and prominent polluting countries (e.g., Brazil, China) are implementing new national emissions markets, bringing the total number of potential controlled emissions to the 49% (WorldBank, 2013). The expansion of emissions trading systems increases the potential control on emissions that a new international regulation of carbon market could reach.
Nevertheless, political struggle and price instability dominate the current reality of the emissions trading systems worldwide. Thus, I question how and why companies make decisions in the EU ETS under these uncertain conditions. I use a behavioral model of uncertainty (bounded rationality) and test this model by applying it to quantitative data from a survey conducted in two consecutive phases (Phase 1 occurred from 2005–2007 and Phase 2 occurred from 2008–2012) with German companies in the EU ETS. I have been interested in changing variables over time to determine how companies make decisions regarding emission allowances. The most important change was that companies tend to outsource decision-making regarding emissions allowances at the end of Phase 2 rather than during Phase 1.
This research explains why companies decide to either keep the emission allowances or outsource it. The model's prediction shows that companies are getting rid of allowances because of high transaction costs. Transaction costs can be viewed as friction (Williamson, 1981) between the wheels of a car and the ground beneath them. The number of working wheels determines the successful forward motion of the car. Broken wheels mean

there is no forward motion; in the EU ETS, companies face uncertain "wheels" of decision for emission allowances as they are confronted with indecisions regarding price development and future political regulation. As a result, this research shows that political uncertainty is more relevant than short- and long-term price uncertainties.
We use data from 857 questionnaires (249 in 2005, 234 in 2006, 193 in 2007, and 181 in 2012) in which German companies responded to this survey at least twice in the consecutive phases. The questionnaire contains 29 retrospective questions about trading activities, strategic investment, technological responses to the EU ETS, and responsible departments for emission trading.

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ICYESS2013-120
Poster: P33
Maritime spatial planning for the Baltic Sea Region - as a regulating instrument for sustainable future “without” uncertainties for the marine environment?

E. Riekens

MARUM, Bremen, Germany (eriekens@marum.de)

Within the framework of the integrated maritime policy (IMP) for the European Union (EU) several political initiatives have been approved to coordinate human and economic activities in European marine waters, such as offshore wind energy. However there is still a need to coordinate the competition for space and to control the pressure by the use of the marine resources, especially in terms of the sustainable management in this area. With a common European framework for maritime spatial planning (MSP) the activities should be mapped and should be transparent for all actors; and in particular, should include all interests (e.g. ecologic, economic and social). The offshore wind energy sector is one field of the framework and it is linked to other sectors as environmental protection, shipping or fishing industry.
The central paradox is that: on the one side, the offshore wind technology is promoted as a new sector of the "green economy" and reduces CO_2 emission. On the other side, the offshore wind farm installations will dramatically affect the marine environment and negative effects are unavoidable. New art of conflicts emerges. Environmental effects are

uncertain for now, especially in the long-term perspective. The fact is that the marine system will continue to me increasingly affected by human activities.
My doctoral research examines and compares the regulatory frameworks for offshore wind projects in Germany and Poland, focusing specifically on the effects on the marine environment. The main research question is: What strategies have the member states formulated; and to what extent are environmental impacts integrated in the national plans? Relating to this, I am searching for any conflicts-of-interests during the political decision making processes, as well as examples of cooperation among institutions, economic sector and environment associations. Oriented on the European IMP approach, I will analyze the national efforts to include different sectors. The aim of this analysis is to explore how the ecosystem-based management approach really works in practice. With my research results I want to contribute to the governance discussion which is relevant for the future development of the marine ecosystems.
In the current research phase I am looking for types and constellations of conflicts allocated in several areas (e.g. or i.e. social, ecological and economic sectors), which are visible by the policy decision making processes regarding the offshore wind energy planning. The result of this analysis should be an overview of existing conflicts and the future progress especially with relation to national offshore projects. In this respect, the scientific knowledge about existing conflict lines between different actors in this field will provide insight into various uncertainties within political decisions. The conflict overview will highlight the level of integration visible within the existing governance system.
Reducing uncertainty within the topic of renewable wind energy requires dealing with the topic as a complex, heterogeneous, and dynamic often with abrupt changes field. Thus a multiple perspective should be incorporate in maritime spatial plans. Otherwise, changing circumstances cannot be taken into consideration, new results of research cannot be monitored, and new failures of governance can take place.

ICYESS2013-68
Poster: P34
How do governance structures affect climate change adaptation policies?

I. Bullmer

University College Dublin, Earth Institute, School of Law, Dublin, Ireland (irene.bullmer@ucdconnect.ie)

Climate change is one of the greatest challenges that society is facing today (Tromans 2007: 357) and there are two complementary paths that society can go to address it: mitigation and adaptation. However, Stern notes that mitigation will have only a minor effect in reducing the cost of climate change over the next fifty years whereas adaptation is the only measure to do so now (Stern 2007: 319). Thus, there is a genuine interest in studying climate change adaptation and policies which implement adaptation. There are different aspects which may influence these policies. At the very least there are scientific uncertainties. At the same time the implementation of adaptation policies may also depend on governance structures for adaptation policies. Given this background, the research will investigate the question how governance structures in certain EU Member States may influence the type of climate change adaptation policy that is occurring. The basic idea is to first consider the national framework for adaptation in each Member State. Then the research will explore the adaptive responses of one region in each of the Member States. Finally, it will consider the governance structures of one local community in that region. The interest behind the question is to see (a) whether governance structures at a local level are similar in different Member States for the same regulated areas and (b) whether responses to climate change are similar in different Member States. One important omission of this research is that it does not estimate to which extent scientific uncertainties instead of governance structures influence the differences in Member States' adaptation responses. However, its main contribution is that it will investigate how the institutional context may affect the structure of adaptation policies and the handling of scientific uncertainties which are the same for each Member State.

Given that this research considers how governance structures affect climate change adaptation policies it will also address the question of what factors influence the establishment and design of governance structures for climate change adaptation policies. It will notably do so by asking whether governance structures at a local level are similar in different EU Member States for the same regulated areas. Posing this question, the research will study the question whether it is institutional factors that influence the establishment and design of governance structures. Here, institutions can be understood as in general sociology as 'organized, established, procedure[s]'

(Jepperson 1991:143). Additionally, the question of whether responses to climate change are similar in different Member States puts emphasis on the institutional context in which adaptation policies evolve. Thus, answering this question will also contribute to the question what factors affect the establishment and design of governance structures as an answer will one more time underscore to which extent the institutional context matters or not. The question of whether institutional factors affect the establishment and design of governance structures for climate change adaptation policies is relevant in order to support a better understanding of how national adaptation strategies can be implemented effectively.

ICYESS2013-108
Poster: P36

How to tackle climate change appropriately? Climate governance norms in the public debate

A. Schmidt

University of Hamburg, Research Group 'Media Constructions of Climate Change', CliSAP, Hamburg, Germany (andreas.schmidt@zmaw.de)

Many observers agree with UN secretary general Ban Ki-moon who described action on climate change as "the biggest challenge to humanity in the twenty-first century". As a global and long-term problem which is caused by side-products of many human activities (mainly greenhouse gases) climate change is arguably not an easy issue for established political institutions and routine politics. While a number of new governance structures has been established since the issue emerged on the political agenda in the late 1980s, there remain significant uncertainties about the appropriate norms and goals of climate governance. These normative uncertainties concern, for example, the relation between national sovereignty and competencies of supranational institutions or the principles for sharing the burden of climate mitigation and adaptation measures, both intra- and intergenerationally.
These issues get quite a lot of attention in academic literature. One strand of research tries to justify certain norms by means of philosophical argumentation and by weighing between different moral demands according to the respective ethical theory (e.g. utilitarianism or ethics of responsibility). Another strand looks at the genesis and diffusion of norms, but often the analyses remain on a rather superficial level, i.e. do not consider the (roots of) argumentation patterns and abstain from studying wider societal debates apart from official politics.
With my research I want to build on, and go beyond, these approaches. I analyse public debates about climate governance because I am interested in

the dynamics of overall societal opinion formation on this issue. For this, I have sampled articles dealing with climate governance from the national quality press of Germany, India and the US. By means of qualitative content analysis I identify normative justifications and criticisms employed by different societal actors. This allows for the identification of differences and similarities beyond the dichotomy of support/rejection – I can show in a comparative perspective what norms get support on which (moral) grounds. At the same time, this approach takes the positions and convictions of a broader group of societal actors serious as their communicative negotiations over the appropriate norms for tackling climate change are important for the legitimacy of political efforts.
My findings suggest significant normative conflicts which are, at least partly, rooted in diverging perspectives on the nature of climate change and in different moral value hierarchies. Among others, positions concerning the principles for burden sharingvary greatly: According to many US and some German actors, ecological effectiveness and a fair competition require emission reductions by all countries ("carbon and job leakage"). Others, in contrast, highlight industrialized countries' primary responsibility and reject constraints on catch-up development ("historic debt", "equal access").

Session III: Finite resources in modelling, observations and analysis

Chairs:
Florian Rauser (florian.rauser@zmaw.de)
Rafael Abel (rabel@geomar.de)

In both blocks of this session we will show a wide variety of natural science based studies, which discuss the problem of uncertainties in the Earth system sciences with specific examples from modelling, observations or analysis. One common problem of the underlying scientific problems are finite resources, as in limited computing power or scarce observations.

The participants of this session will aim to go beyond the immediate problem they face in their daily work and try to illustrate the general problems that are caused by these finite resources and how their approach to deal with this can be used by other scientists in our diverse field.

One part of this session will be to address multiple aspects of the Earth system, among others for example clouds, aerosols, atmospheric chemistry, ocean dynamics, sea ice, and soil dynamics. At the same time, we will focus on methods that are used to improve Earth system models, from initialisation techniques over numerical methods to decadal prediction approaches. Another subgroup of studies shows examples for scarcity of observations from Morocco to the Tibetan plateau – and methods how to deal with this.

The diversity of this session demands a lot from the presenters - and the audience. Everybody should try to identify the small common pieces of methodology and language. The following poster session will encourage each participant to transfer ideas and methods from the presenters to their own problems, even if the underlying applied problem might be very different.

ICYESS2013-110
Poster: P37
Uncertainities in low-cloud feedbacks

S.K. Cheedela

Max Planck Institute for Meteorology, Atmosphere in Earth System, Hamburg, Germany (suvarchal.kumar@zmaw.de)

Cloud feedbacks remain the main cause for inter-model differences in model-based estimates of climate sensitivity.
The complexity of cloud feedbacks mandates use of simplified configuration such as atmosphere-only, aquaplanets, and single column models. Using simulations from various model intercomparison studies, such as Coupled Model Intercomparison Project (round 5), we quantify in detail the extent to which these simplified configurations can be used to study cloud feedbacks. In particular, we demonstrate the utility of single column models using an idealistic framework and explore key physical mechanisms of low cloud feedbacks. This study helps us to better understand the inter-model differences in low cloud feedbacks and further exploit the relative simplicity of configurations in synergy.

ICYESS2013-71
Poster: P38
Towards More Realistic Future Ocean Projections

R. Abel

Germany (rabel@geomar.de)

Ocean modelling has come to a stage where mesoscale processes are explicitly resolved even in global Ocean General Circulation Models. It has been shown that a large amount of kinetic energy is contained at length scales of 10 to 500 km. This length scale is associated with oceanic eddies that contribute to the fidelity of large scale current field. In particular the North Atlantic Ocean has been extensively studied and the pathways, strengths and spatial distributions of the currents are far more realistic when the horizontal resolution is increased. However, a lot of computational effort is necessary to perform such experiments. Until now climate models cannot be run with eddy resolving resolution. Consequently the fidelity of the oceanic component in climate models is less realistic than for state of the art Ocean General Circulation Models. In summary: coarse resolution leads to unrealistic ocean current field which in turn influences the realism of the whole climate model and makes future climate projections with such models

less reliable.

A way out of this dilemma would be to reduce the complexity of the atmospheric model and transfer computing power towards the ocean component. Several promising approaches with simplified atmospheric models need to be tested regarding the ability to investigate the earth system for possible future climate scenarios.

So why is it useful to put more weight on the oceanic component than on the atmospheric component? Of course the atmosphere adopts faster to an external forcing like an CO_2 increase, but however the ocean due to its high heat capacity and high overturning time scales will not equilibrate fast under external forcing. It has been shown that ocean is a main sink for anthropogenic CO_2 but this behaviour might change when the ocean circulation changes. So it seems to be important to investigate the ocean circulation under future climate scenarios.

One of the largest sources of uncertainty is the choice of the simplified atmospheric component. So it is crucial to investigate the impacts of different simplifications of the atmospheric component on exchange rates of energy between the ocean and atmospheric (turbulent surface fluxes). Besides this many other assumptions are made to run climate models and each contributes to uncertainty of the final results.

ICYESS2013-32
Poster: P39
Drift-corrected Trends in MIPAS Ozone Measurements

E. Eckert (1), T. von Clarmann (1), G. Stiller (1), S. Lossow (1), M. Kiefer (1), N. Glatthor (1), D. A. Degenstein (2), L. Froidevaux (3), S. Godin-Beekman (4), T. Leblanc (5), S. McDermid (5), M. Pastel (4), W. Steinbrecht (6), D. P. J. Swart (7), K. A. Walker (8), and P. F. Bernath (9)

(1) Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research, karlsruhe, Germany (ellen.eckert@kit.edu), (2) Institute of Space and Atmospheric Studies, University of Saskatchewan, Saskatoon, Canada, (3) CalTech/Jet Propulsion Laboratory, Pasadena, California, (4) Laboratoire Atmosphère, Milieux, Observations Spatiales (LATMOS), Institut Pierre Simon Laplace, Université Pierre et Marie Curie, Université Versailles St-Quentin-en-Yvelines, Centre National de la Recherche Scientifique, Paris, France, (5) California Institute of Technology, Jet Propulsion Laboratory, Wrightwood, CA. USA, (6) Meteorological Observatory, Deutscher Wetterdienst, Hohenpeissenberg, Germany, (7) National Institute of Public Health and Environmental Protection, P.O. Box 1, NL-3720 BA Bilthoven,

The Netherlands, (8) Department of Physics, University of Toronto, Ontario, Canada, (9) Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126, USA

MIPAS was a limb emission mid-infrared spectrometer on the European satellite Envisat. It was measuring temperature and atmospheric constituent profiles from June 2002 to April 2012. Ozone trends in the stratosphere (10-50 km) have been calculated from these data. Stratospheric ozone trends are a very important tool to determine the recovery of the ozone layer. Thus the reliability on these trends, e.g. the knowledge about the instrument's temporal stability, is desirable. Because the uncertainty of the trends lies in the possible temporal instability of the measurements, which we call an instrument drift, not only the ozone trends were calculated from monthly zonally averaged ozone profiles, but also possible instrument drifts were determined by comparison with other instruments. All trend and drift analyses were performed using a multilinear parametric trend model which consists of a linear term, several harmonics with period lengths from three to twenty four months and the quasi-biennial oscillation (QBO). Significant drifts were mainly negative for ozone relative to the satellite instruments Aura MLS and Odin OSIRIS and negative or near zero for most of the comparisons to Lidar measurements. Lidar stations used here include those at Hohenpeissenberg (47.8° N, 11.0° E), Lauder (45.0° S, 169.7° E), Mauna Loa (19.5° N, 155.6° W), Observatoire Haute Provence (43.9° N, 5.7° E) and Table Mountain (34.4° N, 117.7° W). Drifts against the satellite instrument ACE-FTS were found to be mostly insignificant. The assessed MIPAS ozone trends cover the time period of July 2002 to April 2012 and range from -0.5 ppmv/decade to +0.5 ppmv/decade depending on altitude and latitude.

From the drift analyses we derive that the real ozone trends might be slighly more positive/less negative than those calculated from the MIPAS data, by conceding the possibility of MIPAS having a very small (approx. within -0.3 ppmv/decade) negative drift for ozone. This leads to drift-corrected trends of -0.4 ppmv/decade to +0.55 ppmv/decade for the time period covered by MIPAS Envisat measurements with very few negative and large areas of positive trends. These results of the drift-corrected ozone trends are in good agreement with recent literature. Differences of the trends compared with recent literature could be explained by a possible shift of the subtropical mixing barriers.

ICYESS2013-44
Poster: P40
A sampling strategy to escape the dilemma of undersampling in marine science

S. Thomsen, T. Kanzow, and G. Krahmann

GEOMAR, Kiel, Germany (sthomsen@geomar.de)

In the ocean physical phenomena like currents and waves exhibit a wide range of sizes from millimetres to thousands of kilometres.
A lot is known about oceanic processes with sizes larger than ~50 km, because they are resolved both by traditional observations made by research vessels and numerical global ocean model simulations. Also, small scale turbulent processes acting on millimetre to meter scales have been studied since decades. However, much less is known about processes occurring at the intermediate scale ranging from about 100 m to 10 km. The aim of this study is to investigate these processes because a strong coupling between physics and biogeochemistry exists on this scale. To do this via measurements is very challenging as the processes are associated with large temporal changes. Thus resolving these processes synoptically is very difficult as high resolution measurements are needed.

Electronical oceanic measurements (e.g. temperature) are very fast and consequently it is possible to make many samples. Instead, biogeochemical sampling (e.g. of nutrients) often depends on in-situ water samples, which later have to be analyzed by time consuming laboratory measurements. This fact limits the temporal and spatial sampling rate. Often only some hundred samples are taken during a research expedition of four weeks and thus the temporal and spatial variability cannot be resolved properly. This can introduce large uncertainties in the interpretation of an aquired data set. In order to understand processes on very small spatial and temporal scales much more data would be needed. However, this is not realistic for some very specific measurements.

Results of a research expedition are presented where a swarm of seven gliders was operated in the same area as the research vessel. Gliders are autonomously navigating underwater vehicles equipped with electronic sensors for e.g. temperature, salinity, chlorophyll and oxygen. The data set obtained by the gliders was transmitted via satellite to the research ship and analyzed there. In this way the location and size of interesting phenomena could be detected and adaptively sampled. Biogeochemical sampling requires a research ship as real water samples are needed. So in other words we were not blind anymore and were able to define a adaptive biogeochemical sampling strategy. This made the biogeochemical sampling much more effective and also representative.

ICYESS2013-26
Poster: P41
High resolution atmospheric modelling on the Tibetan Plateau: How to understand a system with sparse observations?

T. Gerken (1,2), M. Herzog (2), T. Foken (1,3), and H-F. Graf (2)

(1) University of Bayreuth, Department of Micrometeorology, Germany (tobias.gerken@uni-bayreuth.de), (2) University of Cambridge, Centre for Atmospheric Science, Geography Department, UK, (3) Member of Bayreuth Center of Ecology and Environmental Research, Germany

My research focuses on the Nam Co Lake basin on the Tibetan Plateau, which is a large lake surrounded by mountain chains. I use a high-resolution atmospheric model (ATHAM) in order to investigate atmospheric processes and the interaction of the land and lake surfaces with complex topography in the development of convection: It is frequently observed that, over the course of a day, fair weather cumulus clouds develop into the thunderstorms. These developments create feedbacks through precipitation and the surface energy-balance. Convection is dependent on the state of the atmosphere (stability and moisture contents), surface fluxes and soil moisture, wind speed and direction as well as thermal circulations developing between lake, land surface and mountains.
There is a high spatial variability of the surface and atmospheric conditions in mountainous areas. Additionally, observations are sparse and lack representativeness as stations locations are biased to more easily accessible locations.
My work tries to integrate field observations from standard atmospheric measurements and radio-soundings that where gathered during two field campaigns at Nam Co Lake in 2009 and 2012 into the high-resolution model in order to gain a better understanding of the system's dynamics. Our focus is on idealized sensitivity studies that show the influence of the different factors such as atmospheric profiles or wind direction.
The Tibetan Plateau acts as an elevated heat source and modifies the monsoon system and has thus very likely a great influence on the water cycle and water resources in the region. Up to this point there is a very limited understanding of atmospheric processes and surface-atmosphere interactions on the plateau, yet these processes determine both the surface energy-balance and the generation of precipitation. Increasing our understanding of these processes is hence vital for our understanding of water resources and environmental processes in a changing climate.

Uncertainty is of central importance to all modelling work, as small changes in input parameters have potentially large effects on modelled outcomes. Input parameters such as atmospheric temperature and moisture profiles and the state of the surface are relatively difficult to measure in a coherent

manner. This is especially true for the Tibetan Plateau, where mountains and complex surfaces lead to large variability of surface conditions. There are few weather stations, which additionally do not adequately reflect true conditions: For instance, no permanent weather stations on the Tibetan Plateau are located above 4800 m, while the mean elevation of the plateau is more than 4500 m. An important source of atmospheric data both for modelling purposes and in order to assess the impact of climate change are reanalysis data sets and satellite measurements. These however have been mainly developed and tested for regions that are less remote and complex in topography, so that uncertainties and biases are large.
As a consequence, we try to integrate data from different sources and try to estimate sensitivities of the atmosphere-surface system by running idealized simulations spanning a wide range of conditions, which is obviously limited by computational resources.

ICYESS2013-31
Poster: P42
Regional scale inversions to estimate Net Ecosystem Exchange in terms of network design.

P. Kountouris

Max Planck Institute for Biogeochemistry, Biogeochemical Systems, Jena, Germany (pkount@bgc-jena.mpg.de)

Aim and relevance

Long term observations of atmospheric greenhouse gases from measuring stations, located at representative regions over the continent, improve our understanding of greenhouse gas sources and sinks. These measurements (mixing ratios) can be linked to the surface fluxes by atmospheric transport inversions. Within the upcoming years new stations are to be deployed and the development of a decision making tool with respect to the location and the density of the network is crucial. We are developing a method to assess potential greenhouse gas observing networks in terms of their power to recover specific target quantities. As target quantities we use CO_2 fluxes at specific spatial and temporal scales. We introduce a high resolution modeling framework with nominal spatial resolution of 10 km x 10 km. The framework consists of the Lagrangian transport model STILT, the diagnostic biosphere model VPRM and a Bayesian inversion scheme. We aim to retrieve the spatiotemporal distribution of Net Ecosystem Exchange by inverting for linearized Gross Ecosystem Exchange and Respiration scaling factors instead of for the fluxes themselves. Thus the state space includes parameters for controlling photosynthesis and respiration with spatial and

temporal flexibility. Initially we perform inversions at the Ochsenkopf tower located in Germany and later on, the inversion framework will be expanded to network design. With this regional inverse modeling tool we address the questions of how well a set of network stations constrains a given target quantity, and we investigate the existence of objective criteria to select an optimal location for a new station. Direct comparison of the optimized fluxes and the assessment of the uncertainty reduction for the targeted quantities will reveal the abovementioned questions.

Uncertainties

Uncertainties in observations and in model-data mismatch representation are introduced in these inversions. Observational uncertainties consists of measurement errors. Model-data mismatch includes atmospheric transport errors by imperfect modelling of the atmospheric circulation, errors in the a-priori flux fields that we use, representation errors describing the difficulty to assign site specific measurements to a gridcell average mixing ratio, and aggregation errors resulting from limited resolution of the state space. We represent these uncertainties in form of a covariance matrix. We use off-diagonal elements considering temporal and spatial correlations for the errors with an error model following exponential decay. An important key to correctly quantify the uncertainties is to consider appropriate error statistics for the covariances. Therefore we need to set proper spatial and temporal correlation lengths for the errors. We perform a multimodel – data comparison utilizing a number of flux-stations among Europe and performing a variogram analysis of the residual fluxes at different temporal aggregation scales to reveal spatial and temporal correlations for the a-priori uncertainty covariance matrix.

ICYESS2013-33
Poster: P43
Modelling the Spatial Distribution of Herring in the North Sea

T. Dudeck and J. Floeter

Institute for Hydrobiology and Fisheries Science, University of Hamburg, Germany (tim.dudeck@uni-hamburg.de)

As part of the VECTORS project, a North Sea ecosystem model is going to be built and the spatial distribution of herring has not yet been implemented. Hence, it would be desirable if the distribution could be linked to simple oceanographic models to combine it with other earth system models, which was investigated in this study. The aim was to model the spatial distribution of North Sea herring based on the physical habitat properties temperature,

salinity and depth, which are also part of all oceanographic models. Based upon catch data from the International Council for the Exploration of the Seas (ICES) statistical models were used to determine which physical variables could predict herring abundances the best. For every year the best models were then taken to spatially predict herring abundances for the years 1991 to 2005. As best-fit models have a remaining, unexplained variance the influence of this “uncertainty” had to be investigated. Here, the unexplained variance was interpolated in space, which accounts for the influence of datapoints on their geographic neighbour. With this statistical technique, called Regression Kriging, the predictions could be improved by removing some of the uncertainty.
It was found that sea surface temperature in combination with a stratification proxy gave best estimates for the spatial distribution of herring. These covariates are promising candidates to parameterise herring distribution in a North Sea ecosystem model. Model predictions revealed two large scale fundamental habitats for herring: the northwest North Sea near the British coasts and the southeast. The distribution of herring in the latter was directly predictable with the models, whereas the northwest distribution displayed greater influence of neighbouring datapoints and hence larger uncertainty. It is thus possible to define general habitats of herring with only physical variables, but for concise ecosystem models other covariates like prey abundance are needed.

Uncertainty is a central, statistical point in this study. In biology, a physical model predicting biological parameters can never be accurate, because an organism may react unpredictably due to i.e. genetic infleunces. Yet in this study, a statistical, physical model was used, on purpose, to define a suitable, physical habitat for herring. Some of the uncertainty was accounted for by using an interpolation technique, which further constrained the habitats by interpolating the unexplained variance. As an example, it is more likely to find one person 30 meters next to a group of 1000 people than to a group of ten people. This solely statistical uncertainty was removed and revealed that the abundances of herring in the southeastern North Sea could be well predicted using the model, but abundances in the northwest changed considerably after unexplained variance had been corrected. Hence, the uncertainty of the model results were a signal itself meaning that other factors such as prey or predator abundance may have a greater influence on the distribution of herring in that region. This hypothesis is in accordance with the fact that both regions have different age structures, which affects the ability to deal with environmental stress.

ICYESS2013-36
Poster: P44
Uncertainties in Global Soil Erosion Modelling

V. Naipal, Ch. Reick, and J. Pongratz

Max-Planck Institute for Meteorology, Land, Hamburg, Germany (victoria.naipal@zmaw.de)

It is widely recognized that accelerated soil erosion has been a major threat to sustainable agriculture across the globe for many decades. Human activities induce land-use changes that can trigger soil erosion on large scales and lead to irreversible changes in the landscape. By altering the landscape however, soil erosion also influences the global carbon cycle, which plays an important role for the current climate change. How the carbon cycle is affected through all stages of soil erosion (soil detachment, sediment transport and deposition) is not well known yet. It is therefore important to investigate soil erosion and its controlling factors including global climate dynamics.
The current study aims to provide accurate soil erosion estimates on global scale for different climate and land-use scenarios and analyze the effects on the carbon dynamics.
Three main research questions are:
1. How to model soil erosion processes, which naturally occur on local scales, in an accurate way on global scale?
2. How do land-use and climatic changes influence the soil erosion fluxes?
3. How much carbon is mineralized and sequestered due to soil erosion on global scale and what are the uncertainties?
To answer the above questions, the Revised Universal Soil Loss Equation (RUSLE) model will be improved and applied to simulate the soil erosion fluxes on global scale for different climate scenarios. The RUSLE model combines properties of topography, precipitation, soil and land-use to estimate soil erosion fluxes. To assess the importance of soil erosion for the past and future global carbon dynamics, the RUSLE model will be coupled to the JSBACH dynamic global vegetation model and the effect of land-use changes will be studied.

There exist several uncertainties in the modelling of global soil erosion fluxes. The main uncertainties are due to coarse global datasets on elevation, precipitation, soil characteristics and land-use, and due to limitations in the use of the RUSLE model on global scale. The RUSLE model is an empirical model to be used on high spatial and temporal resolutions. To be able to use this model accurately on a half degree global scale, both the model parameters as the spatial and temporal resolution of the input global datasets have to be scaled. Here I show how the scaling issues are tackled in this study in order to improve the accuracy of the soil

erosion fluxes and what the challenges are.
Furthermore, RUSLE has two main limitations:
1. Absence of a limit to the amount of soil erosion generated by the model
2. Absence of a parameterization for deposition and transport of eroded sediments
The first mentioned limitation can be addressed by including the gravel content, as it prevents too high soil erosion fluxes to be generated. The second issue will be addressed by including the transport capacity in the RUSLE model. However, scaling will impose additional complication.

ICYESS2013-47
Poster: P45
A new covariant form of the equations of geophysical fluid dynamics and their structure-preserving discretization

W. Bauer

University of Hamburg, KlimaCampus, Hamburg, Germany (werner.bauer@zmaw.de)

For reliable climate simulations performed with Earth system models, an accurate simulation of the flow features of atmosphere and ocean is crucial. Beside plenty of other processes, these flows governed by the laws of geophysical fluid dynamics (GFD) are usually determined with computational models. The quality of the latter depend on the physical models that describe the phenomena to be simulated, i.e. on the sets of analytical equations, and on how these analytical equations are approximated (or discretized) in order to make them suitable for computational calculations. Such discrete models should inherit certain conservation properties from the analytical equations, such as mass and energy conservation and the preservation of certain flow features. Often already the formulation of the analytical equations provides a guideline to find the corresponding approximated equations.

I introduce a new formulation of the analytical equations of GFD that allows to find structure-preserving approximated equations for computational calculations. The resulting discrete model is structure-preserving in the sense that the calculated approximated solutions are mass and energy conserving and that the discrete velocity fields consist of divergence-free and rotation-free parts, analogously to the analytical fields. The latter property is important to preserve certain flow features also in the discrete case and is often refer to as Helmholtz decomposition.

The new formulation consists in a separation of the momentum and continuity equations into a metric-free (topological) and a metric-dependent

part. In the metric-free part, only neighborhood relationships are taken into account, which allow, for instance, to indicate the boundary of an area or to find its neighboring regions. The information about the metric structure, such as length, area, angle, etc., are confined to the metric-dependent equations. This splitting of the equations has been enabled by introducing additional prognostic variables and presenting all variables with differential forms instead of vector fields. The latter fact makes these equations covariant, i.e. their form is invariant under coordinate transformations. This new structure reveals important geometrical features of the equations of GFD, for instance, velocity and vorticity are more adequately described by differential forms than vector fields. A better understanding of the equations, in turn, allows more accurate approximations.

On the basis of this split formulation, I develop a new systematic discretization methodology, using tool of discrete differential geometry, that leads to approximated model equations that automatically preserve important conservation properties. I illustrate this methodology on the example of the linear shallow-water equations, for which I derive a finite difference approximation that conserves mass and energy, while preserving the Helmholtz decomposition, on arbitrarily structured C-grids. Using my structure-preserving approach thus minimizes the uncertainties in the simulation of geophysical scenarios, because approximated models that do not preserve such conservation properties usually require additional stabilizations, which may badly impact on the model accuracy.

ICYESS2013-51
Poster: P46
Assessing and Quantifying Uncertainties for Model Evaluation in the MiKlip Prediction System

S. Illing, C. Kadow, and U. Cubasch

FU Berlin, Meteorology, Germany (sebastian.illing@met.fu-berlin.de)

On the time scale of a few years to a few decades ahead, regional and seasonal variations in weather and climate are strongly influenced by the internal variability of the climate system. Decision makers in different areas need to know to what extent the climate events they see are caused through this natural variability or are the result of anthropogenic climate change.
The project MiKlip (www.fona-miklip.de) for medium-term climate prediction funded by the Federal Ministry of Education and Research in Germany (BMBF) has the objective to create a model system that can provide reliable decadal forecasts on climate. The system to be developed is novel in several aspects, that comes with great challenges for the methodology deployment.

This concerns especially the determination of the initial conditions, the inclusion into the model of processes relevant to decadal predictions, the increase of the spatial resolution through regionalisation, the improvement or adjustment of statistical post-processing, and finally the synthesis and validation of the entire model system. The evaluation and validation of decadal prediction systems is both a technical and a scientific challenge in the recent climate research.
Therefore, part of the MiKlip project is the development of a standardized evaluation system to validate the model system. This is done in the sub-project 'Integrated data and evaluation system for decadal scale prediction' (INTEGRATION).
This presentation will focus on uncertainties in model results affected by the choice of different observation based evaluation data-sets, such as physical uncertainties that include measuring inaccuracy and methodological uncertainties (for example reanalysis data), and the prevailing verification status of the data-set. We will present first results to what extend such uncertainties affect the evaluation within the MiKlip system. The evaluation system itself comes up with a unique way to assess such uncertainties as it enables direct access to both the set of implemented observation based data-sets and the model database including the deduced data used for evaluation.
In order to point out the parts of the climate system which are affected by such uncertainties we performed systematic analyzes. The documentation of such uncertainties as part of the evaluation system considerably improved the standardized and data-set specific evaluations conducted within MiKlip.

ICYESS2013-55
Poster: P47
Analyzing the significance of air temperature trends in the Arctic region

A. Wernecke (1), A. Gabrielski (2), R. Athmer (3), K. Froß (3), Z.S. Parsakhoo (4), and C. Leontiou (4)

(1) Institut für Meereskunde , University of Hamburg, Germany (andreas.wernecke@zmaw.de), (2) Institut für Meereskunde , University of Hamburg, Germany, (3) Meteorological Institute, University of Hamburg, Germany, (4) School of Integrated Climate System Sciences, University of Hamburg, Germany

The motivation for this work are the results of Franzke (2012), who found nearly no significant warming in the air temperature of the eurasian arctic region. This might lead to an underestimation of the danger of global warming.

The results of Franzke (2012) shall be verified by expanding the data base by using a climate model (CMIP5) and a model which includes actual observations (NCEP/NCAR Reanalysis 1), in addition to the use of station data. After estimating the temperature trends in the time series, we want to decide if it is likely that they are caused by natural variability. Otherwise there is a long term trend in the time series which we call significant and is probably caused by humans.
First we compute many new time series, so-called surrogates, from each time series we want to test. These surrogates conserve the variability of the original time series but do not conserve possible long term trends. Afterwards we compare them with the original time series to estimate the significance of the trend.
This is very important in order to be able to make strong statements about the actual observed change of the air temperature and if it is natural or not.

To test the explanatory power of our results we use different data sets, lengths of the time series, methods of computing surrogates and estimating trends.

Our results show that the areas of significant warming strongly depend on the used data, the method of estimating the trend and the method of computing surrogates. Furthermore there is a strong spatial dependency of the trends and their significance. By using a long time series (~150 years) of CMIP5 data we derive smaller trends, but more of them are significant compared to the case in which we use only the last ~60 years.
We figure out, that the data used by Franzke (2012) is not representative for the arctic region.

In this work the uncertainty of the measurements at the stations have no impact on the results, because we use very long time series to calculate the trend. But the variability causes an uncertainty in the estimation of the long term trend. We try to separate the cases where this uncertainty is as big as the derived quantity itself to increase the explanatory power of the estimated trend.

Furthermore, we use data from models to gain information about the temperature in the region of the arctic ocean, since there are no long time series from stations available. We want to include this region because it is very important for the global climate. We can see big differences between the datasets, so we have to be very careful with our results because we do not know which one is trustworthy, if any.

After all, we have been able to show that our well established method to work with uncertainty caused by natural variability is strongly dependent on several assumptions. Therefore it cannot be taken as certain without further discussions.

C. Franzke. On the statistical significance of surface air temperature trends in the eurasian arctic region. Geophysical Research Letters, 39(23), 2012.

ICYESS2013-59
Poster: P48
Tropical Convection as a source of Uncertainty in Global Climate Models

L. Silvers and M. Giorgetta

The Max Planck Institute for Meteorology, Hamburg, Germany (levi.silvers@zmaw.de)

This research seeks to understand the influence of convection on the climate state. The indirect representation of convection through parameterizations introduces biases and errors to the model. This is well known but not well quantified. Of particular importance is the precipitation efficiency that different clouds have in various atmospheric conditions. Precipitation efficiency strongly influences the balance of energy in the system as well as the amount of precipitation that reaches the surface. Mixing of cloudy air with the surrounding air as well as the small scale processes that generate water droplets and ice within the cloud both affect precipitation efficiency. This complexity has made quantification of changes and impacts that are related to precipitation efficiency difficult.

We employ a systematic approach to understanding how convection is modeled over a broad range of scales and domain sizes. The equilibrium state between convection and radiation is examined in an attempt to isolate the critical processes of convection. By comparing experiments with the convection parameterized to experiments that use no convective parameterization we can determine some of the biases that are present in many models. We also compare experiments that use different methods of convective parameterization. Specifically, we look at changes to the entrainment rate and to the microphysics. We explore how the spatial organization of convection influences the climate sensitivity to changes in surface temperatures. The climate sensitivity is thought to be connected to the precipitation efficiency. Results from radiative convective equilibrium experiments across a wide range of spatial scales demonstrate some important elements of the variability of convection.

It is well known that clouds represent the primary source of uncertainty in Earth system modeling. The large uncertainty of cloud effects results from their statistical behavior at the smallest scales and the nonlinearity of cloud

dynamics. Therefore simply examining one experiment is not sufficient. Part of this uncertainty in the system is dealt with by looking at clouds which are in a state of statistical equilibrium and part of it is dealt with by looking at many similar scenarios. Because it is not obvious how best to model convection we have chosen to look at several different grid resolutions and several different methods of parameterizing convection. Our research also addresses the possible relevance of the simplifying assumptions we have made. The combined results of these experiments provide some estimate or representation of the inherent variability of tropical convection.

ICYESS2013-61
Poster: P49
Goal-orientated Error Estimators for Stochastic Finite Elements

J. Kraemer

Fakultät für Mathematik, Karlsruher Institut für Technologie, Karlsruhe, Germany (juliankr@gmx.net)

In my diploma thesis I develop adaptive numerical methods to quantify uncertainties for problems modelled by partial differential equations. The latter are used to describe many physical phenomena in nature, such as for example flows in the ocean or in the atmosphere. A huge problem, however, is the uncertainty introduced by model and parameter errors due to for example measurement errors or a lack of available data. In the past, this uncertain influences were ignored, but as the precision did increase, it became inevitable to model the errors too.

Typically, even in the purely deterministic case, the discretization of such problems leads to a very large number of equations, which is significantly increased even further if stochastic (uncertain) models are taken into account. This necessitates the development of effective approaches, which still allow for a high accuracy in the numerical computation.

In numerical simulations, the underlying domain is typically divided into cells and the solution of the system is only evaluated at certain points of the cells, since one cannot evaluate all infinitely many points in a continuous domain. These cells may have different sizes. One can show that the division into these cells leads to a converging solution if the cells widths decrease. However, this leads to a growing number of equations which have to be solved. Therefore one has to find a way to partition the domain optimally into cells, which is intended by adaptive refinement strategies.

Adaptive strategies follow a simple procedure. First one takes a grid which

consists of equally sized cells and computes a solution on it. After that the error is estimated on each cell individually and the cells with the highest estimated error are selected and refined, which means that each selected cell is divided into a number of smaller ones. This algorithm is performed several times until a stopping criteria is fulfilled. This assures, that the points where the solution is computed are distributed in an optimal manner.

In my case, I investigate the so called goal-oriented adaptivity approach where a certain user-defined physical feature of the solution is of interest. For example, in weather forecasting not the domain and all its properties like wind speed and temperature at all points is of interest, but only one certain feature, like the rainfall, is evaluated. This focusing can be exploited and allows for highly efficient discretizations. The theory for the deterministic case is already well known, but there is little work yet published on the combination of the goal-oriented adaptivity with stochastic uncertainties. In my work I address the question how such goal-orientated techniques can be used to steer the adaptation of the cells in the presence of uncertainties in the data for the spatial and stochastic domain. This could lead to a new approach which could accelerate the simulation of flows and therefore allow a higher accuracy while using the same hardware resources.

ICYESS2013-128
Poster: P51
Ocean Surface Velocities from Space - looking behind the scenes

M. Scharffenberg

KlimaCampus University of Hamburg Institute of Oceanography (IFM) Remote Sensing & Assimilation Bundesstr. 53, 20146, Hamburg, Germany (martin.scharffenberg@zmaw.de)

Concerning my work:

I use satellite altimeter data - Sea Surface Height (SSH) data - to infer large scale geostrophic surface velocity anomalies to verify ocean models and to conduct basic research to understand the upper ocean flow field in general. I deal with velocity anomalies instead of absolut velocities, as from satellite altimetry only the time varying part of the velocity field can be captured with respect to a temporal mean. One could provide the missing mean part using an accurate mean dynamic topography, and compute a mean velocity field from that. However, very accurate estimates are just about to be released with the new gravity satellite missions. The velocity data originates from the Jason-1 - TOPEX/POSEIDON (JTP) tandem mission and covers the 3-year time period from 09/2002 until 09/2005 where the altimeter satellites Jason-1

and TOPEX/POSEIDON (successor of J-1) were flying next to each other with a separation of about 1.4° in latitude and thus allowed to calculate not only one velocity component incross track direction, but the complete velocity field. The opportunity to study each velocity component on its own without the necessity to assume isotropy and without prior gridding of the Sea Surface Height fields (SSH), yields an important increase in knowledge to the general behavior of the ocean circulation. This is turning the two altimeter satellites TOPEX/POSEIDON and Jason-1 into a space born near real time current meter.

I am especially interested in the seasonal cycle of the surface flow field and of the eddy kinetic energy (EKE), which is the energy that can be attributed to the turbulent flows of the ocean. Further, I investigated the geostrophic velocity fields to deepen the knowledge of their frequency and wavenumber spectra and to understand the Probability Density Functions (PDF) of the geostrophic velocities and their spatial distributions.

Concerning uncertainties:

For the description and interpretation of a dataset errors play a crucial role. However, an error calculation is not straigth forward and most likely consists of different error contributions.
To specify the formal uncertainties of the resulting velocity estimates, I used a formal error propagation approach. The resulting errors of zonal geostrophic velocity anomalies for the zonal and meridional flow component clearly display a pronounced latitudinal dependence, leading to enhanced errors due to a decreasing Coriolis parameter in low latitudes and due to a decreasing track spacing approaching the poleward turning latitudes.

Another latitudinal dependence arises due to the calculation procedure of the geostrophic velocity estimates that can be seen as a systematic error of the JTP tandem mission velocities.
Furthermore, and in the same order of magnitude as the systematic error, errors of geostrophic velocity estimates are slightly enhanced in areas of large variability associated with western boundary currents where the standard deviation of the SSH measurements dominates the resulting velocity error.

Further and most interestingly, when talking about wavenumber spectra of geostrophic velocity estimates from JTP, an error is introduced when calculating the wavenumber spectra in along-track and across-track direction. This error is originating in the two-dimensional spectra of SSH and the sample characteristic of the satellite measurements. We recently discovered this error, that very carefully has to be taken care of when discussing the distribution of energetic scales in the ocean.

Using this as an example, alltogether, it is crucial to know the errors of a variable in order to finally be able to draw the right conclusion.

ICYESS2013-74
Poster: P52
Water mass variability observed at the Mid-Atlantic Ridge in the subpolar North Atlantic

C. Denker

Bundesamt für Seeschifffahrt und Hydrographie, Hamburg, Germany (claudiadenker@hotmail.de)

The intermediate and deep waters formed in the subpolar North Atlantic are an important contributor to the global meridional overturning circulation. Intermediate water masses, such as the Labrador Sea Water (LSW), which is formed in the Labrador Sea, follow different known pathways. Especially the LSW is thought to be detached from the western boundary towards the northeast Atlantic by the North Atlantic Current (NAC). The NAC carries these waters towards the northeast Atlantic. The Mid-Atlantic Ridge (MAR) acts as a barrier for these water masses that can only cross the ridge through fracture zones such as the Faraday Fracture Zone (FFZ), located at ~50° N and ~30° W. Recent years have shown major changes in the water mass properties in the subpolar North Atlantic. One key aspect for the present study is to investigate the properties and the spreading of water masses over the MAR into the eastern Atlantic.
To analyze the variability of water masses next to the MAR the German Federal Maritime and Hydrographic Agency placed a mooring array consisting of three deep sea moorings at the western entrance of the FFZ. These moorings were installed during three deployment periods from November 2009 to July 2012. They were equipped with sensors to measure current velocity, temperature, pressure, and salinity. To analyze the intra- to interannual variability the time series were smoothed by applying a 48h-lowpass filter that removed the influence of tidal signals. For better comparison of the time series derived from different deployment periods, the data were interpolated to a common instrument level by considering temperature and salinity gradients derived from CTD profiles taken during the deployment and recovery of the moorings. Furthermore, the temperature and salinity data of profiling Argo floats located within 80km radius of each mooring were used to support the mooring measurements and to extend the mooring time series back until 2002.
First results show that during the observation periods the NAC was located over the mooring positions for several times, which is visible in the velocity records as well as in the temperature and salinity measurements of the

uppermost instruments moored at 300 dbar. The mooring data indicate that the NAC was meandering over the moorings, crossing the MAR over the FFZ. This is confirmed by satellite based datasets of surface currents.
The moored time series show high variability in salinity throughout the whole water column. At the level of the deep LSW (1800dbar) the mooring time series show an increasing trend which is supported by the Argo measurements. An increasing decadal trend was already found in the Labrador Sea in the western subpolar North Atlantic, the formation region of the LSW. With the help of the mooring array this trend can be traced towards the MAR. Here, the time series of the different moorings are presented and the observed patterns of variability concerning intra- and interannual time scales are discussed.

ICYESS2013-81
Poster: P53
Trends in temperature extremes in Morocco

K. Khomsi, G. Mahe, Y. Tramblay, M. Sinan, and M. Snoussi

Morocco (k.khomsi@gmail.com)

A heat wave is a period of excessively hot weather; severe heat waves can cause catastrophic crop failures, thousands of deaths and widespread power outages due to increased use of air conditioning. The heat wave in Maghreb during the summer of 2012 had bad consequences on the agricultural sector in Morocco that was hit by losses of 12 million Euros for poultry farmers. The aim of this study was to analyze the trends in extreme temperature during the last decades in two different regions: the Bourgreg in the North and the Tensift in the South of Morocco. Such analyses can help improve our understanding of local natural and anthropogenic climate variability. We identified extreme temperature events, using percentile thresholding (the 95th (5th) percentile for hot (cold) events). We studied their frequency, occurrence and their correlations with the North Atlantic Oscillation (NAO) and the Mediterranean Oscillation (MO) indexes using the Kendall's coefficient. We used daily maximum and minimum temperature series recorded by four meteorological stations on the full period of availability and also on the period common to all the series (1983-2009). Temperature datasets of the meteorological stations of Rabat-Sale on the coastline of the Bouregreg basin, Kasba-Tadla from the inland, Safi on the coastline of the Tensift basin and Marrakech from the inland were used.

To deal with uncertainties in data, the study period for each time series was chosen after applying criteria for the elimination of datasets with several missing data. According to the Mann-Kendall test, most of the observed

trends during the common period of data (1983-2009) are not statically significant; this may be due to the shortness of this period compared to full lengths records available at each station. Main conclusions focus on the results obtained over the full period available in each station. Most of the estimated trends in seasonal mean maximum and minimum temperature have positive magnitudes; these were estimated using the Sen's slope approach. The trend magnitudes in both basins are of the same order, no discernible spatial trend appears in the two datasets, however the number of stations considered is small so it reduces the possibilities of regional interpretations. Changes in cold events are larger than those for warm events. The southern region (Tensift) is the most affected with the changes of the temperature regime. The Kendall's coefficient of correlation is significant between the extreme temperature events during the summer and the MO index while the circulation related to the NAO doesn't affect recorded extreme events.
The results of this study highlight uncertainties in the response of the small scale regions to the recent global warming, this response may depend on the region characteristics and that emphasize the need for more regional studies. It would be worth while making such a study on other areas from Morocco or North Africa, if more long daily data records were to be recovered.

ICYESS2013-73
Poster: P54
Implications of uncertainties on the feasibility of the climate change mitigation mechanism Reducing Emissions from Deforestation and forest Degradation (REDD+)

D. Plugge (1), T. Baldauf (2), and M. Köhl (1)

(1) Institute for World Forestry, University of Hamburg, Germany (daniel.plugge@uni-hamburg.de), (2) Thünen Institute for World Forestry, Federal Research Institute for Rural Areas, Forestry and Fisheries, Hamburg, Germany (thomas.baldauf@ti.bund.de)

The world's forests biomass stores 289 gigatonnes (Gt) carbon. However, the destruction of forests released 0.5 Gt of carbon per year between 1990 and 2010, representing 12% to 20% of global anthropogenic CO_2 emissions. This calls for urgent activities to maintain the remaining areas of natural forests. Curbing emissions from deforestation has been identified to be a highly cost-effective way of reducing emissions. As part of a global climate change mitigation strategy REDD+ (Reducing Emissions from Deforestation and forest Degradation) should support developing countries to reduce emissions from deforestation and forest degradation via financial incentives.

We focuses on the development of a transparent, robust and operational measuring, reporting and verification system (MRV) to monitor the development of forest areas and carbon stocks and the aligned uncertainties. The UNFCCC demanded to tackle methodological issues concerning uncertainties in estimates on reductions and the development of a reliable MRV system. Only on the basis of reliable estimates financial benefits can be generated in form of carbon credits. The MRV system therefore forms a milestone of REDD+. However, any MRV system is subject to uncertainties.

Uncertainties are linked to the assessment of deforestation and forest degradation areas (activity data, AD) and the carbon stock changes therein (emission factor, EF) and consist of two error types: sampling errors and non-sampling errors. Sampling errors arise from inferring from a subset to the whole population. Non-sampling errors encompass all other sources of survey errors.
The quantification of AD is mostly done via remote sensing (RS) techniques. Here, uncertainty is influenced by map accuracies and the magnitude of changes. Detecting degradation by RS is another critical issue. Especially in natural forests, characterized by heterogenic vertical structures and contiguous canopies, degradation can only be detected, when the canopy cover is dissolved.
EFs are quantified by in-situ assessments. Carbon stock is quantified via tree volume or biomass, which cannot be assessed directly. Therefore, they are estimated through functions based on measured tree parameters. Volume estimates are converted into carbon stock estimates by applying conversion factors. For EF-estimates various error sources apply, including measurement errors and function errors. Frame errors arise through assessing a limited set of field plots which may not represent all forest types and disturbance levels.

For a reliable MRV methodology the 95%-confidence interval ought to be applied to quantify the uncertainty. However, the confidence interval relates to sampling errors only. The total survey error quantifies all error sources and is realized via an error budget. To address the high uncertainties of REDD+ estimates it is proposed to apply the "reliable minimum estimate" (RME), which is the lower bound of the confidence interval. The RME can be expanded from a sampling error perspective to total survey errors.
So far, minor attention has been drawn to the implications of uncertainties associated to MRV. To raise awareness we conducted simulation studies, showing the dependency of a functional REDD+ regime on uncertainties. These studies, together with studies on tackling these uncertainties will be presented at the ICYESS conference.

ICYESS2013-101
Poster: P18
Why is the Arctic warming more?

F. Pithan and T. Mauritsen

Max Planck Institute for Meteorology, Atmosphere, Germany (felix.pithan@zmaw.de)

Global climate change is amplified in the Arctic, as is evident in palaeo records from millions of years ago to the last ice age, in recent observations and in climate model experiments. Given a specified forcing, such as a known increase in CO_2 concentrations, uncertainty in the Arctic response is caused both by the unknown global climate sensitivity and the ratio of Arctic to global warming or Arctic amplification. The key role in causing Arctic amplification of climate change is often attributed to the increased absorption of solar radiation caused by the decrease of highly reflective snow- and ice-covered surfaces (surface albedo feedback). However, decomposing Arctic warming in climate models into contributions from individual feedback mechanisms, we find that temperature feedbacks, i.e. the increase in longwave radiation emitted to space due to temperature changes, cause the bigger part of Arctic amplification. We apply different decompositions of feedbacks using radiative kernels based on surface and top-of-atmosphere fluxes. Despite minor differences in the weight of feedback mechanisms, all results support a leading role of temperature feedbacks. All local feedback mechanisms contribute to the inter-model spread in total Arctic warming, while atmospheric heat transport changes reduce inter-model spread.

ICYESS2013-82
Poster: P56
Statistical Methods and Metrics in the Standardized Evaluation System for Decadal Climate Prediction in MiKlip

C. Kadow, S. Illing, and U. Cubasch

Freie Universität Berlin, Institute of Meteorology, Berlin, Germany (christopher.kadow@met.fu-berlin.de)

Working in the field of climate science and its new area of research, the decadal climate prediction reminds of the origin of science and the variety of open questions to be answered. Despite that, the evaluation of decadal prediction systems is of course a scientific challenge; nowadays it is a technical challenge in the climate research as well. The major project MiKlip (www.fona-miklip.de) for medium-term climate prediction funded by the

Federal Ministry of Education and Research in Germany (BMBF) has the aim to develop a model system that can provide reliable decadal forecasts on climate and weather. Therefore, a standardized evaluation system will be part of the MiKlip system to validate it, designed by the project 'Integrated data and evaluation system for decadal scale prediction' (INTEGRATION). Statistical methods are important instruments to provide such a system with reliability. The research field of metrics in the decadal climate prediction is not standardized like e.g. in the weather prediction and not even defined yet. Bringing different aspects of different research areas together and adapt them to one common system, as well as research on finding and combining new scores and skill scores is a major part of our research.

Uncertainties in the field of climate science and especially the decadal prediction are a prominent topic to be discussed right now. Due to the fact, that the decadal predictions are in between of initial and boundary conditions dependencies, uncertainties from both sides are enclosed in the system, plus the model uncertainties itself. The field of interest is the internal variability of natural processes like ENSO, AMOC, AMV, PDO, etc. To be able to detect the range of uncertainties, the ensemble approach is an effective method in climate science. Statistical methods like the CRPSS can help to understand the predictability and its reliability to observations and reanalyzes due to the ensemble spread. Key questions are: What affects such a decadal climateprediction system and how can a fundamental evaluation system indicate uncertainties in such a system in order to enhance it? First open questions will be answered.

ICYESS2013-84
Poster: P57
Estimating sedimentary proxies along with associated uncertainties

B. Goswami (1,2), J. Heitzig (1), K. Rehfeld (1,3), N. Marwan (1), A. Ambili (2), S. Prasad (2), J. Kurths (1,3,5)

(1) Potsdam Institute of Climate Impact Research, RD IV: Transdisciplinary Concepts and Methods, Potsdam, Germany (goswami@pik-potsdam.de), (2) Department of Physics, University of Potsdam, Karl-Liebknecht Str 24-25, 14476 Potsdam, Germany, (3) Department of Physics, Humboldt University Berlin, Newtonstr. 15, 12489 Berlin, Germany, (5) Institute for Complex Systems and Mathematical Biology, University of Aberdeen, AB24 3UE Aberdeen, United Kingdom

Sedimentary proxies such as oxygen isotopes, pollen count, biomarkers, etc. allow us to investigate past climate variability and transitions. However, due to dating uncertainties that are inherent in the construction of proxy records,

interpretations regarding past climatic shifts and variability are necessarily vague and/or difficult. Moreover, age uncertainties also make the inter-comparison of records from different geographical locations non-trivial.

We present here a generic, analytical, Bayesian framework that estimates the proxy versus time relations along with the uncertainty involved in such an estimation. We use this to reconstruct groundwater inflow and surface erosion proxies from the Lonar lake in central India.

We find that the variance of the proxy along the depth of an archive are inherently linked to its uncertainty of estimation along time, and consequently its variance in the time domain as well. For the Lonar lake data, we show that the variance of the proxies along depth is the major factor contributing to the final uncertainty rather than the dating uncertainties. Moreover, our framework naturally incorporates the proxy versus time estimates on an error-free, precise time scale that allows for easier interpretation of climatic shifts as well as inter-record comparisons.

ICYESS2013-88
Poster: P58
Estimating uncertainty of HOAPS precipitation rates from satellite data over the Atlantic Ocean

J. Burdanowitz (1,2), C. Klepp (3), and S. Bakan (1)

(1) MPI-M Hamburg, Land in the Earth System, Hamburg, Germany (joerg.burdanowitz@zmaw.de), (2) IMPRS-ESM Hamburg, Germany, (3) KlimaCampus, University Hamburg, Germany

The global hydrological cycle as an essential part of the Earth's climate system is closely linked to the global energy cycle. In order to understand the climate system and thus predict its changes, Earth system models are applied. Aiming at a realistic representation of the relevant climate-related processes, accurate and continuous global observations are required to validate the models. Precipitation in particular is highly variable in space and time dimension which is why its observation is still challenging. Especially over the oceans and sparsely populated areas satellites are inevitable to monitor precipitation with high coverage. Still, the coarse spatial resolution and a rather low sampling rate by polar-orbiting satellites constrain these space-borne measurements. However, the Hamburg Ocean Atmosphere Parameters and fluxes from Satellite (HOAPS) data set showed good performance exhibiting a comparatively high sensitivity for light rain intensities. But HOAPS is still lacking uncertainty estimates that are also important to know when modeling the climate. Furthermore the retrieval of

precipitation from brightness temperatures contains an uncertainty. For that reason, a recently collected ship-based in-situ precipitation data set will be explored to estimate the uncertainty of HOAPS. Thanks to the optical disdrometer measuring drop size spectra, this data set provides also information about the precipitation type which can be used to unveil deficits in HOAPS that is not able to distinguish between such. These goals are embedded within the DFG funded project 1740 aiming at "A new Approach toward Improved Estimates of Atlantic Ocean freshwater Budgets and Transports as Part of the Global Hydrological Cycle" in collaboration with the CM-SAF of the German Weather Service.

As previously stated, precipitation estimates are still afflicted with large uncertainties due to high temporal and spatial variability as well as retrieval constraints. Therefore the quantification of uncertainty estimates is an important but challenging task because the reference data sets differ in resolution (point-to-area) and sampling rate (time lags). In addition, ground-based precipitation measurements possibly observe different amounts of precipitation as significant parts might evaporate again before reaching the ground. These cases need to be considered when estimating the uncertainty. This kind of information would also reveal areas that are specifically challenging for precipitation measurements from space.

ICYESS2013-91
Poster: P59
Optimization of vegetation model parameters through sequential assimilation of surface albedo observations

G. Geppert and A. Loew

Max Planck Institute for Meteorology, Hamburg, Germany (gernot.geppert@zmaw.de)

The dynamic global vegetation model JSBACH, which is the land component of the MPI Earth System Model, uses different plant functional types (PFT) to represent the heterogeneity of vegetation on the land surface. Each PFT is described by a set of parameters and the global distribution of PFTs allows for a spatially differentiated description of the land surface. The PFT parameters, however, are constant over time and thus neglect processes that lead to seasonal changes of the described properties.

In the case of land surface albedo, modelled as a combination of background albedo from below the vegetation and canopy albedo, this simplification decreases the seasonal variability of modelled albedo because

the constant canopy albedo parameters in JSBACH do not adequately represent the seasonal changes of the leaves' radiative properties. Compared to surface albedo observations of the Moderate Resolution Imaging Spectroradiometer (MODIS), the modelled variability is too low.

To judge the seasonal variability of the canopy albedo parameters and to derive an appropriate seasonally varying parameterization, we set up a sequential data assimilation framework that allows to estimate a time series of parameter values. Every time a new observation of land surface albedo becomes available, the data assimilation framework combines the model states and parameters together with knowledge about their uncertainty with the observed values and knowledge about the observation error to arrive at an improved estimate.

We incorporated a standalone version of JSBACH into the Data Assimilation Research Testbed (DART). Because of the vicinity of the canopy albedo parameters to the physical boundaries of albedo we combined the Ensemble Kalman Filter with a Gaussian anamorphosis technique in order to use non-Gaussian distributions for the representation of the model and observation errors. We performed perfect model experiments to show that the assimilation system is able to retrieve seasonally varying parameters. The synthetic observations for these experiments are generated in a control run of JSBACH with seasonally varying canopy albedo parameters. They were perturbed to mimic observation error and subsequently used in an assimilation run. The results of the assimilation were evaluated with respect to reproducing the parameters of the control run.

ICYESS2013-112
Poster: P61
The role of anthropogenic heat in urban climate

R. Petrik, D. Grawe, H. Schlünzen, and U. Bungert

University of Hamburg (ronny.petrik@zmaw.de)

Urban regions are known to influence on the regional climate in a different number of ways. A variety of research studies deal with the urban heat island, the generation of turbulence as well as the acceleration and deceleration of wind over the heterogeneous city building. Since more and more people will move to the cities in future, an investigation of the urban climate and its impact on the comfort of its citizens is highly important. One feature of urban regions is the emission of anthropogenic heat. Recent studies show that the anthropogenic heat is not only an important player for the urban climate but has also an impact on the large scale atmospheric

dynamics in the atmosphere. Thereby, a challenging task is the quantification of the anthropogenic heat.
In our contribution the focus is on the quantification of anthropogenic heat and its small-scale contribution to the climate in urban region. Therefore, it is shown how to derive anthropogenic heat fluxes for cities aiming at high temporal and spatial resolution. Often an inventory approach and a top-down methodology is used, i.e. one starts with an annual energy budget report and ends up with a high-resolution information about heat fluxes in the region of interest. Since different approaches and assumptions are applied e.g. to simulate the population density at different times of the day, a certain degree of uncertainty with respect to the anthropogenic heat fluxes is inherent to this methods, which will be highlighted in our contribution. Taking exemplary the metropolitan region of Hamburg, the quantification and the impact of anthropogenic heat is presented.

ICYESS2013-116
Poster: P63
The Arctic hydrologic cycle and its variability in a regional coupled climate model

L. Niederdrenk and D.V. Sein

Max Planck Institute for Meteorology, Hamburg, Germany (laura.niederdrenk@zmaw.de)

Modeling the Arctic hydrologic cycle implies big challenges because of the non-linear behavior and interplay of its elements on different scales. Additionally, the Arctic environment is rapidly changing due to global warming and so are the freshwater components. Global general circulation models show remarkable differences in modeling the Arctic freshwater cycle. While they agree only on the general sinks and sources of the freshwater budget, they differ largely in the magnitude of the mean values as well as in the variability of the freshwater terms. Regional models can better resolve the complex topography and small scale processes, but they are often uncoupled, though missing the air-sea interaction. Additionally, regional models do mostly use any kind of salinity restoring or flux correction, thus disturbing the freshwater budget. Our approach to investigate the Arctic hydrologic cycle and its variability is a regional atmosphere - ocean model setup, consisting of a global ocean model with high resolution in the Arctic coupled to a regional atmosphere model. To account for all sinks and sources of freshwater, we include a discharge model providing lateral terrestrial waterflows. We run the model without salinity restoring or freshwater correction inthe Central Arctic, which allows for the analysis of a closed freshwater cycle in the Arctic region with a fully coupled high

resolution model. Since freshwater is exported from the Arctic Ocean to regions in the North Atlantic where deepwater is formed, and the deepwater formation is sensitive to changes in (temperature and) salinity, only small changes in the amount of this exported freshwater can influence the global climate via the global ocean circulation. Thus, we use our model setup not only to calculate changes in the mean values but also to understand mechanisms behind the variability of these freshwater components. More precisely, we investigate how variations in the atmospheric circulation influence the variability in the freshwater components.

As our model is regional, we need external forcing that is provided by data from a global model run. It is difficult to quantify by how much the model's variability is driven by the variability in the external forcing (external variability) and by how much the model develops internal variability. The influence of the forcing is for instance strongly dependent on the size of the model domain. To distinguish the model's internal variability from a signal in the Arctic climate we perform more than one simulation. Since these simulations, so-called ensemble members, are driven by the same forcing, they are not fully independent from each other. This makes it difficult to define statistical significance in order to distinguish between "noise" within the model and a signal in the variability of the freshwater components.

ICYESS2013-117
Poster: P64
Correlation estimation between two climate time series with improved uncertainty measures

K. B. Olafsdottir (1,2), M. Mudelsee (1), and M. Schulz (2)

(1) Climate Risk Analysis, Schneiderberg 26, 30167 Hannover, Germany (olafsdottir@climate-risk-analysis.com), (2) MARUM, Center for Marine Environmental Sciences, University of Bremen, 28334 Bremen, Germany

Climate time series provide information about the natural system that generated them. Some time series are based on proxy data, used to reconstruct climate fluctuations of the past, output from numerical models which simulate the climate system, or instrumental measurements that cover the most recent time period.
It is often useful to compare two climate time series to gain deeper understanding of the underlying processes that generated them. The most commonly used statistical methods involve estimating the correlation parameter between two time series. The correlation parameter gives information about the influences of one time depended variable on another. The most common method is to estimate the Pearson's correlation

coefficient between two time series. Additionally the association can be evaluated in the frequency domain via coherency spectrum, which measures how well the two time series co-vary at different frequencies. In both cases it is necessary to include error estimates and hypothesis testing to evaluate how reliable the estimate is.
It can be challenging task to make accurate error measurements for climate time series as the time series is only one realization of the system aimed to be reconstructed. Information about the natural system that produced the time series may be lacking, for example the statistical distribution behind the data is usually unknown. The number of data points is often limited and may be unevenly spaced in time. In addition, climate time series do usually contain memory as there is natural inertia in the climate system.
Here we present two different methods to give improved estimates of the relationship between two climate time series, where data properties common to climate time series are taken into account. The first method estimates Pearson's correlation coefficient between two time series with accurate calibrated bootstrap confidence interval (Mudelsee, 2010). This method offers robustness against data distribution and takes the memory of both time series into account. The second method estimates coherency spectrum between two unevenly spaced time series, where the level of significant coherency is approximated with Monte Carlo simulations. These methods have been developed and adapted on the basis of existing software, PearsonT (Mudelsee, 2003) and REDFIT (Schulz and Mudelsee, 2002).

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ICYESS2013-118
Poster: P65
Reducing uncertainties in earth system sciences by optimizing model parameters and measurements

J. Reimer

Future Ocean - Kiel Marine Sciences , Christian-Albrechts-Universität zu Kiel Department of Computer Science 24098 Kiel Germany (jor@informatik.uni-kiel.de)

The aim of my work is to optimize parameters and conditions for measurements for different models of parts of the Earth system. Models play a key role in describing and studying the Earth system. Often these models contain parameters which are only vaguely known. If these parameters are insufficiently determined, this leads to inaccurate models. Therefore, the parameters are adjusted so that the model describes the reality sufficiently accurate. Using mathematical optimization method parameters can be computed, so that the model reproduces the reality as closely as possible.

For this purpose, usually measurements of the modeled entities are performed. However, these measurements may require a considerable amount of resources, such as time or money. Therefore only necessary measurements should be carried out and these should provide a maximum information gain.

Using statistics, it can be determined how many measurements are needed to achieve a given accuracy for the model parameters. Further, the conditions under which the measurements are carried out can be optimized so that the obtained measurement results contain as much information about the model parameters as possible. Examples of optimizable measurement conditions are where and when measurements are performed for spatial and temporal models.

In my work I have developed a Matlab toolbox which allows to optimize measurement conditions in a simple way. I recently optimized parameters and measurement conditions for a model which describes sediment concentration in seawater which floods salt marshes. It had to be determined at which high water levels of the tidal inundation and what time the laborious measurements have to be performed at the best. Currently I am working with a global model of phosphate and dissolved organic matter in the ocean and have to determine where and when the costly measurements for its parameter optimization have to be performed.

Uncertainties is the central topic in my work. As models of the Earth system play an important role in its investigation, it is important that they are reliable.

The uncertainty associated with a model can be minimized by optimizing their model parameters. Furthermore, by optimizing the corresponding necessary measurements the available resources are used in an optimal way. This makes it possible to accurately determine the parameters with minimal resource cost.

ICYESS2013-119
Poster: P66
Need for simple models in climate prediction

J. O. Haerter

Center for Models of Life, Niels Bohr Institute, Blegdamsvej 17 ,2100 København Ø, Denmark (jan.haerter@gmail.com)

Climate prediction is a field of research of tremendous societal importance. Yet, the task of reliably predicting potential future climate change is hampered by the extreme complexity of the climate system, with interactions on vastly varying temporal and spatial scales and physical mechanisms of often compensating net effect. Currently, the climate modeling community is focusing its efforts on obtaining more and more detailed simulations taking into account a growing number of processes. In keeping with the increasing amount of detail in computation, the analysis of model data output – its processing and compression to meaningful statistical quantities – becomes a cumbersome task in itself.

While more detailed simulations can in principle allow some model parameters to be removed from the simulation, tracing features of the data produced by today's global climate models to the action of underlying physical processes is nearly as cumbersome as the analysis of observational records themselves. This means, the original aim of using a model as a simplified view on the basic processes driving climate change is becoming more and more challenging in the light of growing computational and model complexity.

Meanwhile, the large number of uncertain modeling parameters (e.g. those in cloud microphysics) has led to statistical efforts to quantify model output uncertainty as far as it relates to such uncertain parameters. However, such "perturbed physics" approaches have generally led to limited insight, as uncertainty ranges of parameters, let alone their prior distributions, are largely unknown. Quantification of structural uncertainty, the "evil twin" of parametric uncertainty, is inherently unquantifiable and thereby renders quantitative uncertainty bounds of future climate projections improbable at this point.

In an attempt to take advantage of the original benefit of models as simplified descriptions of the physical system, we propose to exert more effort in the construction of effective models capable of producing qualitative relations between observables in isolated processes. The number of parameters in these models should be small so that the models can be understood in detail by computer simulations and (in limiting cases at least) remain analytically tractable. We try to motivate the construction of such models for the case of precipitation extremes, often triggered by processes of relatively local extent. While convective precipitation appears to be a result of both thermodynamic and dynamical processes - in principle requiring detailed microscopic modeling - current research initiatives highlight the system perspective of cloud fields with convective plumes as relatively organized, yet laterally interacting entities. Such descriptions build hope for obtaining qualitative effective interactions, possibly reducing the complexity implied by the microscopic physics.

ICYESS2013-126
Poster: P67
Quantifying uncertainty in global climate models when predicting species distributions: a case study in South-Eastern Australia

K. J. McGregor and T. J. Regan

The School of Botany, The University of Melbourne, Melbourne, Australia (karenm@student.unimelb.edu.au)

Effectively managing biodiversity in the face of climate change requires an understanding of how and when future climates may alter species' ranges. Typically this is done using species distribution models (SDMs) which predict suitable habitat based on correlations between known occurrences of species and climatic and/or other environmental characteristics. These models are projected into the future using global climate models (GCMs), which characterize changes in climatic variables through time. Multiple GCMs have been produced, relying on different parameters and functions. This results in considerable variation among GCMs. The influence of GCM choice on predicted habitat suitability in the future is not well understood. In order to effectively manage for the continued survival of species it is important to understand how the choice of GCM influences predicted species distributions, and what environmental drivers are causing any differences.
This study aims to quantify the influence the choice of GCM has on predicted species distributions under climate change and to understand the underlying environmental drivers of any differences. We developed a presence-only

maxent model for Xanthorrhoea resinosa, a long lived plant species found along the east coast of Australia. We projected the model into the future using five GCMs: the IPCC ensemble, CSIROMk3.5, GFDL 2.0, Max Planck and HadGEM1, for the A1FI emissions scenario. Results suggest there is large variation in how suitable habitat will change over time depending on the GCM used. Further interrogation highlighted that precipitation of the driest period, influenced the differences the most. This research draws general conclusions regarding the choice of GCM for species whose distributions are driven by similar climatic conditions. When projecting SDMs into future climates we recommend several exploration tools to better understand future predictions and to guide evaluation and model development.
Uncertainty is fundamental to this research, as the many available global climate models produce very different maps of future species distributions. There is considerable uncertainty as to which GCM is most appropriate to use. This research uses a range of metrics to quantify the differences between the GCMs, attempting to focus on what is most variable between alternative GCMs. It also looks into the predictor variables of the GCMs, to see what is driving these differences and considers what could be done to remove some of this inconsistency. This study will contribute to understanding and providing guidance to users of GCMs as to the level of certainty with which they interpret maps of species' future distributions, and what they can do to remove some of that uncertainty.

ICYESS2013-72
Poster: P68
Uncertainties in empirical downscaling of land surface temperature

B. Bechtel (1), K. Zaksek (2), and S. Wiesner (3)

(1) Institute of Geography, University of Hamburg, Germany (benjamin.bechtel@uni-hamburg.de), (2) Institute of Geophysics, University of Hamburg, Germany, (3) Meteorological Institute, University of Hamburg, Germany

Land surface temperature (LST) is an important quantity in land surface-atmosphere interaction can in principal be well monitored by thermal infrared satellite remote sensing. Especially the diurnal temperature cycle (DTC) reveals information about relevant surface characteristics like thermal inertia. However, the acquisition is severely restricted by the orbital parameters of the sensors. The high temporal resolutions required for DTC monitoring can only be achieved from geostationary satellites at an altitude of about 36000 km and hence a poor spatial resolution (about 3 to 5 km depending on sensor and latitude). On the other hand, sensors in geostationary orbits with

small swath width have higher spatial resolution (about 100 m) but a long revisit time of one to two weeks.
To close this gap, in this case study a downscaling scheme for LST from the SEVIRI sensor on board the geostationary meteorological Meteosat Second Generation to spatial resolutions of down to 100 was developed and tested for Hamburg. Therefore, aggregated parameters from multi-temporal thermal data were applied like following. First, the predictors were upscaled to the coarse resolution, then a relationship between predictors and LST was empirically calibrated, which eventually was transferred to the higher resolution domain.
The downscaling was validated with LST data from ASTER and ETM+ for single times as well as longer time series of in situ LST measurements for single locations.
The validation with the ASTER data showed good results with a high R^2 of up to 0.71 % and relatively low RMSE of about 2.2 K. The results with the ETM+ data were slightly worse due to the limited quality of the LST retrieval algorithm. Compared to the in situ data the DTC were essentially well represented but the downscaling did not improve the accuracy.

The proposed downscaling scheme can contribute to decrease the uncertainty in high spatial and temporal resolution LST estimation and overcome physical restrictions which prevent the application of such data in relevant fields like urban climatology. On the other hand, both systematic and statistical errors are introduced by the scheme.
The downscaling shows a considerable warm bias (1.3 K for ASTER, 0.7 K for ETM+) which partly can be explained by the viewing geometry (i.e. the geostationary satellite views more southern orientated slopes and facades). However, since first tests indicated that additional factors must be considered, the bias will be investigated in a more extensive study. Further systematic errors result from transferring the annual warming patterns to the diurnal cycle thus introducing annual effects like phenology and seasonal thermal stratification of water bodies.
Statistical errors are introduced by noise in both the SEVIRI data (accuracy of about 2 K) and the predictors, the geometrical precision and the approximation of the SEVIRI point spread function, and the linearity of the empirical model. To estimate magnitude and propagation of these errors, additional noise and locational offsets are added to the LST measurements and predictors in a sensitivity study.
Eventually, the comparison with the in situ data revealed that these also contain errors which raises the question whether direct measurements can really be considered as "ground truth" like common in remote sensing.

ICYESS2013-131
Poster: P69
Initialization strategies for decadal climate predictions

I. Polkova (1), A. Köhl (2), D. Stammer (1,2)

(1) Max Planck Institute for Meteorology, Hamburg, Germany (iuliia.polkova@zmaw.de), (2) Institute of Oceanography, CEN, University of Hamburg, Hamburg, Germany

We test three different initialization approaches for a coupled climate model to improve decadal climate predictions. At the timescale, decadal predictions come between seasonal-to-interannual (S2I) forecasts and long-term climate change projections (CCP). To date, several operational S2I forecast systems provide climate information, which can be useful for adaptation strategies, food production, managing extreme weather events etc., whereas long-term CCP provide information on possible climate far into the future under different emissions scenarios. Similarly to S2I prediction systems, operational decadal prediction systems are expected to find application in economic sector for timescales from a couple of years to several decades into the future. The uniqueness of decadal predictions is that they incorporate some features from both S2I and CCP, namely the dependency of S2I forecast on a starting point – an initial state of a climate system and the dependency of CCP on changes in atmospheric composition.

Previous studies suggest that at decadal timescales, in contrast to natural climate variability, the signal from changes in external forcing is relatively small and internal variability uncertainties dominate the total uncertainty of decadal predictions. On the other hand, perfect model studies have shown that predictability due to initialization is dominant in the first years of 10yr simulations and the external forcing becomes more relevant to the end of simulations. A common practice in assessing how good decadal predictions perform, is to carry out an ensemble of model simulations for the past climate (hindcasts) and compare decadal hindcasts against observations. It is also known that due to systematic errors decadal hindcasts will drift away from their initial state and therefore it is necessary to remove this drift or use alternative initialization approaches that account for drift. It is expected that proper initialization with accurate observations might reduce the uncertainty due to internal variability. Though much effort has been spend to improve decadal prediction, the question remains about the best initialization approach for decadal predictions.

Hence, we investigate the sensitivity of a climate model to three different initialization approaches; specifically, we are interested in regions and timescales at which initialized hindcasts show significant predictive skill taking into account details of a particular initialization method. We found that

for the current climate model, the initialization method that keeps the model closest to the mean state of the real climate system shows the highest predictive skill for several important climate variables. Moreover, on decadal timescales the properties of the ocean that are under the direct influence of the atmosphere (or climate noise) yield shorter predictability time than those that are shielded from the atmosphere by the ocean mixed layer. After identifying regions and duration of high predictive skill, we perform an analysis to explain physical causes of predictability on decadal timescales.

ICYESS2013-63
Poster: P70
Incorporating uncertainty into the estimation of slip during pre-instrumental earthquakes

A. Lindsay, J. Mccloskey, S. Nalbant, S. Murphy, N. Simao, and M. Nic Bhloscaidh

(lindsay-a5@email.ulster.ac.uk)

Slow plate motion (e.g. 45mm/yr) is continuously loading faults causing them to catastrophically release this stored energy during earthquakes. Resolving the location and the amount of slip occurring during a sequence of earthquakes constrains the size and location of future events along the fault. In particular, detecting areas where the fault has accumulated large amounts of slip deficit (i.e. the amount of slip required for the fault to 'catch up' with the plate motion) allows us to define areas which could potentially produce large earthquakes in the future. GPS and seismic networks are successfully used to resolve the slip distribution of modern earthquakes. However, to explore size and distribution of slip for pre-instrumental events dating back hundreds of years we need to exploit proxy sources of data.
Coral microatolls growing in the intertidal zone of the outer island arc of the Sunda trench act as long term geodetic recorders; their growth influenced by the tectonic flexing of the continental plate beneath them. Spread over large areas of an active subduction zone, they offer the possibility of high resolution reconstructions of slip for a number of pre-instrumental earthquakes.
The sparse, distributed nature of the corals and the fact that all observation points are located some distance from the event (i.e. on the earth's surface) means that the inversion is an under-determined system which produces non-unique slip distributions. To overcome this difficulty a Monte Carlo Slip Estimation (MCSE) technique is used, whereby many models are produced and tested to identify those best replicating the observed displacement data. A Genetic Algorithm (GA) is employed to accelerate the identification of suitable models and a catalog of slip distributions can be constructed.

The displacement measurements for each coral location have an associated range of uncertainty. Successive iterations of the GA each sample a different set of displacement values from within this range. As a result, the GA produces a collection of possible models based on the full range of measured uncertainties. These models can be stacked and a weighted average calculated to give a high resolution estimate of the distribution of slip for each event. Furthermore, areas of high confidence in the weighted average model can identified where the standard deviation of values is low. Similarly, where the standard deviation is high confidence in the weighted average model will be low. These high resolution models can be used to construct a history of slip along the fault, both identifying and quantifying of slip deficits and constraining confidence in the accuracy of the modelled information.

Session IV: Innovative presentation formats

Chairs
Ulrike Holzwarth (uholzwarth@marum.de)
Alice Lefebvre (alefebvre@marum.de)

Presentations that are usually performed during meetings and conferences feature a more or less pre-defined linear structure. Sometimes, even very important scientific results can look rather boring and meaningless. There is therefore a need to present scientific work in a more stimulating fashion. Furthermore, the increasing multidisciplinarity in the science-policy-society interface makes it absolutely necessary that colleagues from other fields really listen and understand each other - and get at least the core of the message. This requires presentations to be easy to understand and interactive.

The innovative presentations offer the possibility to communicate scientific results in a professional yet exciting way.

What exactly is innovative? Something new, creative, original and special. Three possibilities of innovative presentation styles were suggested to the participants of ICYESS 2013: (1) twin talks where one presents the results of a colleague and vice versa; (2) PechaKucha, a fast-paced and engaging style that makes presentations concise and keeps things moving at a rapid pace; and (3) non-linear presentations, which make use of a virtual map on which the content is presented by zooming in and out.

We believe that the ICYESS 2013 is an ideal platform to break new ground in terms of innovative science communication.

ICYESS2013-56
Poster: P71
Sahel greening due to increasing CO_2 in CMIP5 Earth System Models

S. Bathiany (1), M. Claussen (1,2), and V. Brovkin (1)

(1) Max Planck Institute for Meteorology, Hamburg, Germany (sebastian.bathiany@zmaw.de), (2) Meteorological Institute, University of Hamburg, KlimaCampus Hamburg, Germany

The Sahel is a climatic transition region where water and food supply are particularly vulnerable to climatic fluctuations and changes. Poverty, low development and political conflicts tend to enforce this vulnerability. The agricultural yield in the future will depend on the prosperity of vegetation in a changed climate with higher CO_2-levels. As Northern Africa was substantially greener and wetter some thousand years ago the question arises whether the Sahel will become green again due to man-made climate change. In our study we assess the results of three complex climate models and current literature to investigate the crucial sources of uncertainties involved in answering this question.

We find that the three models agree on a substantial Sahel greening in the next decades because atmospheric CO_2 acts like a fertiliser. In two models this trend is reversed under prolonged climate change, especially in the western Sahel, where it becomes too dry. However, this apparent model agreement hides the large uncertainty involved in different processes such as precipitation changes and CO_2-fertilisation, which tend to oppose each other so that the question about future vegetation changes in the Sahel remains unsolved. In particular, two of the three models indicate that the vegetation expansion into the desert has a cooling effect due to the plants' transpiration, but also that the importance of this effect crucially depends on the location.

ICYESS2013-15
Poster: P72
Current Societal Interpretation of Scientific Knowledge And Its Limits in Third World Contries

A.Y. Obeng

Foresight Generation Club ,Tema,Ghana (albertobeng@yahoo.com)

Modern and better understanding and interpretation of how the Earth is changing and its related adverse consequences for life on Earth for humans and other inhabitants is very evident.

A particular focus on developing countries with a key interest to enabling a better prediction and mitigation of attached undesirable consequences is critical to survival in many developing countries presently.
Whiles developing countries continue to face adverse climatic variability and Changes including other challenges such as Earth Hazards like earthquakes, volcanoes and hurricanes, there is the need for improved Earth-Atmosphere observation, its improved analysis and a much better scientific prediction in developing countries with interests in technology transfer from developed countries with existing programs.
Citizen volunteers from developing countries can be trained to support scientific data gathering for the purposes of skills transfer to less skilled local volunteers for existing and ongoing projects to be able to predict better adverse climatic conditions for developing nations.

The resultant adverse effects on populations and citizens in developing countries has particularly in situations such as earthquakes, flooding including other adverse climatic conditions affecting the environment and thereby creating food insecurity and enormous hardships in such countries and settings.
Knowledge Exchange and Effective Technology transfer in the area and usage of key tools and systems is key to an improved understanding of physical, economic biological and chemical laws in the use of mathematics in describing the process with the many spheres and associated interactions.

It is through the better understanding of such complex interactions that credible and accurate predictions can be achieved.

ICYESS2013-45
Poster: P73
Examining uncertainty in design rainfalls in Australia

F. Johnson

University of New South Wales, School of Civil and Environmental Engineering, Sydney, Australia (f.johnson@unsw.edu.au)

Engineers use estimates of extreme rainfalls for the design of infrastructure and to guide planning of appropriate land use decisions by local and regional governments. Intensity-Duration-Frequency (IDF) design rainfall relationships relate the intensity and length of the rainfall events to the frequency of occurrence. IDF relationships are then used to estimate the size and extent of future floods. The IDF relationships are derived by applying a number of statistical models to time series of data measured at rainfall gauges. However there are many uncertainties resulting from the way that IDFs are derived due to errors in observations, assumptions in the statistical models and finally due to the possible impacts of climate change. This research looks at the practical implications of attempts to quantify these uncertainties.

Uncertainty in data and models has a large impact on the practical implementation of hydrological research. Decisions on appropriate flood planning and infrastructure inherently require consideration of the concepts of risk and uncertainty. In theory, levels of acceptable risk are decided by the community and infrastructure design accounts for this accordingly. However in many cases engineers are poorly equipped to consider risks or uncertainties due to the historic rigidity of engineering design guidelines and community consultation is not always successful. The ability of the community and members of the public to understand risks is also variable and depends, for example, on how recently flooding has been experienced in a particular area.

The key question is - would decisions be made differently if estimates of uncertainty in design rainfalls were available? For example if there are large uncertainties in the estimate of a rare flood, would a certain community prefer to adopt higher design standards? How would the decision differ in the rainfall intensity was known perfectly, with no uncertainty? Are there cases where uncertainties are too large to assist in decision making? What is the best way to communicate uncertainty – in terms of probability or in terms of scenarios of impacts? This presentation will consider some of these questions with respect to hydrological analysis and engineering design.

The questions that are being considered in this research are important for scientific research in disciplines where community safety and infrastructure investment decisions will be made based on the outcomes of the research. Statistical models can quantify at least some of the uncertainty in the processes of interest to a particular research discipline but to be useful this

uncertainty should be able to be used in decision making or to guide future investment or future research questions.

ICYESS2013-115
Poster: P74
Ideal Inundation Simulation using Numerical model and SAGA GIS in Pearl River Delta

L. Li

Department of Geoscience , KlimaCampus, University of Hamburg, Germany, 20146 (Email: li.li@uni-hamburg.de)

Climate change contributes an important part for sea level rise and the intensities of the storm surge (Typhoon or Hurricane). Therefore the coastline area suffered a big threaten of the sea level rise and storm surge, for example, the increasing intensive flooding and rainfall. My research focuses on the impact and influence by the sea level rise and storm surge in coastline area. Briefly, how the ocean actions (sea level rise and storm surge) affect the landscape.
The Pearl River Delta, located in south-eastern China, is one of the most economic regions in China with a long coastline. Due to the low lying topography of the Pearl River Delta, major risks and threats are sea level rise and increasing typhoon events (i.e. accelerated storm surges) and inland flooding (i.e. heavy rains and peak flows).
This research aims are to analyze and assess how much landscape influenced by storm surges (Typhoon), using numerical modeling approaches based topological analyses to identify areas, which face highest risks under present and future sea level rise scenarios in climate conditions.

ICYESS2013-130
Poster: P75
Going back a step - Parameter Uncertainty in Global Hydrology Modelling

K. Smith

University of Nottingham, England (lgxkas@nottingham.ac.uk)

This PhD project aims to investigate the overlooked issue of parametric uncertainties in global hydrological modelling. The effect of climate change on global hydrology has been a popular topic in climate research over the

past few decades. Projections of increased temperature and altered rainfall patterns have raised concerns over water security, flood risk, and the occurrence of extreme weather events. Future river discharge studies have previously been at the catchment, or regional scale, and are rarely globally applicable. However, with rapid developments in computational abilities, large scale studies that couple Global Circulation Models with Global Hydrological Models have recently produced global projections of future water availability and flood risk. But how reliable are these estimates? This PhD project has taken the MacPDM.09 Hydrological Model, and subjected it to rigorous testing of its sensitivities to model inputs, and the uncertainties within its outputs. Uncertainty Analysis has been carried out using the Generalised Likelihood Uncertainty Analysis method. The results from this analysis will be taken forward to produce 'uncertainty informed' projections of future global hydrology for 21 major global river basins. This research will lead to more informed future hydrology projections than have been previously available, and will provide methodological guidance for the future testing of other global hydrological models.

This PhD goes back to the very beginning of the uncertainty problem. For any model, be it a climate model or an impacts model, different configurations of the model parameters can produce very different estimates of global futures. In this case, a hydrological model is assessed to investigate the impacts of model calibration on future hydrology projections. Many "model comparison/multi-model" studies have been undertaken in order to address the issue of model uncertainty (e.g. the EU WATCH project), but just one model can be calibrated (set up) in many different ways, and this type of uncertainty has not yet been investigated in this field. Requiring extensive computing power to assess, parametric uncertainties have been largely overlooked in the field of global hydrological science. This project has run 100,000 different hydrological model parameterisations to assess the variance in model output. This type of assessment should ideally be carried out on all models, preferably in the model development stage, and should be documented in the model literature to allow users a full understanding of model uncertainty. Smaller experiments will be done to determine the feasibility of integrating such assessments into the model calibration process, and how many runs are necessary to get an understanding of parameter uncertainty. This work will then go on to investigate the appropriate presentation of uncertainties in this field to the model users, be it averages, ranges or probability distributions.

ICYESS2013-89
Poster: P76

Separating direct acidification response signal from variability in plankton dynamics.

M. Moreno (1), M. Schartau (2), and K.W. Wirtz (1)

(1) Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Geesthacht, Germany (frauleinnoether@hotmail.com), (2) GEOMAR, Helmholtz Centre for Ocean Research, Kiel, Germany

Motivation of my research.
Ocean acidification is one of the major anthropogenic stressors on ecosystems because it perturbs the cycling of carbon. The concentration of atmospheric carbon dioxide (CO_2) has increased since the Industrial Revolution at an unprecedented rate and oceanic water has become 30% more acidic. It is largely unknown how phytoplankton respond to ongoing acidification. Phytoplankton comprise about 5000 species that are diverse in morphology (with cell diameters ranging from 1 to 10000 μm) and in physiology. They are not only main primary producers of the aquatic food web but also exert a tight control on oceanic and planetary biogeochemistry. Many studies on ocean acidification were conducted as mesocosm experiments, where enclosed water volumes were exposed to different CO_2, light, and temperature conditions. Mesocosm studies typically exhibit variability even within similar treatments, which makes it complicated to identify exclusive responses to acidification. This variability emerges from uncertainties in internal community structure and phytoplankton physiology. We need to understand the origin and extent of ecological and physiological uncertainties to explain the observed changes in biogeochemical processes and specify variability in model simulations.

How we address uncertainty.
We approach uncertainties by analyzing sensitivities of model results and relate these to the variability observed in data from mesocosm experiments. We developed a model that resolves organism size as the trait determining characteristics of plankton community. Cell size affects many processes in marine systems as nutrients uptake, energy allocation, interaction with grazers, aggregation and sedimentation, and it is specially important for phytoplankton since they are mostly unicellular organisms. The advantage of this size-trait modeling approach is that the community is not split in size classes with different mathematical expressions. In contrast, only one equation for the mean size evolution is required and the community size distribution emerges as model solution. Moreover, our size-trait model is adaptive, continuously refining calculations of relevant production and loss processes. By monitoring the community size evolution, the model mirrors how individuals, seeking optimum growth rate under environmental changes,

are selected. It has been shown that subtle differences in size-trait dynamics alone can give rise to large differences in growth and decay biomass, compared to variations due to external environmental factors, as light and temperature. The solutions depend on initial community composition and initial physiological rates. This sensitivity can explain differences between model results in spite of similar environmental conditions. Using a combined data-model approach, we can validate our model by comparing observed with simulated trajectories and unravel needs in terms of data accuracy for the initial period of an experiment. The expected outcomes of our sensitivity and uncertainty analysis are: i) to identify major sources of variability in mesocosm experiments, ii) to quantify uncertainties (noise), iii) to relate these uncertainties to the direct response to perturbation (signal-to-noise ratio), iv) to design experimental setups that may potentially reduce this signal-to-noise ratio.

ICYESS2013-23
Poster: P77
Global North and South: Conflicting aspirations, deprived participation, what the future of Global Environment holds?

A. Muzenda

University of Zimbabwe, Rural and Urban Planning, Harare, Zimbabwe (amuzendah@gmail.com)

Global environmental governance (GEG) has been a driving factor of environmental management as well as driving the sustainable development agenda, the global north-south politics has been inevitably persisting pointing on legitimacy and effectiveness of GEG. The study explores how the global environmental discourse shapes the future of GEG using the analytical lenses of north-south politics. The paper analyses the journey of the environmental politics of conflicting aspirations in relation to the participation of local communities in GEG and explores the recent Rio+20-earth summit to forecast the future of GEG. Highlighting conflicting aspirations, the paper charts the three key global environmental conferences (Stockholm 1972; Rio de Janeiro 1992; Johannesburg 2002) which note progressive changes in the involvement of the global south from contestation, participation, and engagement. It identifies the recent Rio+20 Earth summit 2012 as a disengaging phase from global to local in a contradicting manner in the name of "the future we want". Questions regarding this study proliferate to: How has the post Rio+20 transformed the global environmental discourse? How are aspirations conflicting? How are the local communities participating and how can they cushion the conflicting aspirations? Using a qualitative methodological approach, the study

analyses the post Rio+20 global south policies' motives. Informal interviews with policy makers of the global south were used regardless of the methodological challenge of political connotations to portray rational views. Local communities' participation was mapped in rural Zaka using participatory observations and informal interviews. The study notes key observations as; the global south deriving from the notion "the future we want" is enacting policies that are contradictory to the global agenda. As well local communities of the global south are deprived participation through information unawareness, autocracy, institutional and legislative suppression in the discourse to share the local aspirations, knowledge and practices to the global platform.

As the north-south aspirations persist to conflict, while local communities' participation is deprived, the future of GEG is turning vaguer. GEG as the main driving force of all environmental management practices and development initiatives, the continual conflicts of global north and south becomes focal point to unlock the tied values of environment and development. Thus, the paper calls for adoption of common uncommon treatment and collaborative action. It identifies the need to enact local policies as auxiliary to the global objectives where the notion "think globally, act locally" (top-down approach) applies to the environmental partners at local scale to keep the global agenda in motion in global south. In regard to the global environmental institutions, the paper elucidates that the notion "think locally, act globally" (bottom-up approach) needs to be adopted to apprehend decentralised approaches which witness positive collaboration, where locally enacted ideas are appreciated and incorporated into the global environmental initiatives so as to gain support of both partners towards one future. It concludes that this all together apprehend legitimacy and effectiveness of GEG from both the global south and north towards a common future thereby witnessing a balance of environment and development towards global consensus.

ICYESS2013-58
Poster: P78
The cloud lifetime: modeling and remote sensing framework

I. Stepanov and H. Russchenberg

Delft University of Technology, Geoscience and Remote Sensing, Delft, Netherlands (i.stepanov@tudelft.nl)

Depending on the cloud's height in the atmosphere, it consists of variously shaped ice crystals (cold cloud) or spherical liquid water droplets (warm cloud). Droplets grow by condensation becoming heavy enough to be pulled

down by the gravity in the form of drizzle or rain, precipitating towards the ground. Stratocumulus cloud is a type of a warm cloud that demonstrates this process frequently, stretching thousands of kilometers far and wide in the horizontal direction, much like a sheet. Due to its property to reflect a great part of the incoming solar radiation and its vast horizontal spatial coverage, the droplet and cloud evolution play a role in the large scale radiative balance. The connection between the micro-scaled cloud droplet evolution and thousands of kilometers of cloud variable radiative properties can be related through the definition of the term the cloud lifetime.
To observe the stage of the cloud evolution, remote sensing instruments are used to profile its structure. Ground based active instruments radar and lidar in synergy compose the ratio of observables that discriminates between the gradually evolving categories of drizzling clouds. In this project we used a large eddy simulation to construct limited domain cloud scenes that reproduce a well behaving Stratocumulus cloud evolution. We apply a separate synthetic remote sensing observations retrieval model of the EarthCARE (Earth Cloud, Aerosol and Radiation Explorer) to the cloud scene and relate it to the top of the cloud reflectance, made by using the satellite mode of the simulator. The advantage of this mode is the compatibility in the sensitivity and configuration of the existing satellite imagers. They provide an overview of the horizontal structure and variability change of the cloud sheets that the ground sensors lack hence, a combination of both the ground and space-borne instruments perspective is used.

Uncertainties in this project framework can arise from two sides: the fact that atmospheric model output is used as a frozen in time cloud scene creates possibilities for shortcomings due to preset interaction of the cloud droplets evolution and interaction with the environment in the model, based on mean statistics; and from the assumption that the synthetic observations are true, because they are in principle an array of models: scene creation model, forward model and the custom configuration for hardware details of the instrument. Placing this framework in the context to categorize the cloud lifetime based on the size of its droplets and their evolution, even when both uncertainties are combined we still get a correlation between the variables we observe using synthetic observations. This matches the case as it would appear using real instrument setup and observations. Is it the case due to artificially perfected model parameterizations? A possible indicator would be a cross-combined platform
where either a modeled cloud is used to which real instrument retrievals are applied or a reverse layout where synthetic observations are applied to a real cloud. However, the proposed test would have a questionable amount of uncertainty of its own due to the artificial combination of the real and synthetic data.

Session V: Uncertainties in environmental impacts, their perception and communication

Chairs:
Diana Süsser (diana.suesser@zmaw.de)
Tjado Barsuhn (tjado.barsuhn@studium.uni-hamburg.de)
Ines Schaudel (ines.schaudel@uni-hamburg.de)

Interactions between ecosystems and social system are complex, and the understanding of feedbacks between the two systems if of high interest for the understanding of environmental changes.

This session provides different perspectives, approaches and methods for exploring environmental impacts, their perception and communication and addresses related uncertainties.

Firstly, this session addresses various impacts of environmental changes on ecosystems and social systems, and covers the limited understanding of and the societal response to these impacts. The presentations focus on adaptive river and forest management, ecosystem services, desertification and erosion, forced migration and displacement.

Secondly, the participants provide different approaches for studying the communication and perception of Earth system science and environmental risks. The presentations address various issues of what humans know about environmental changes, how they perceive environmental risks, and how knowledge and perception influence their valuing and management of the Earth system.

We think that the diversity of presentations will help to increase the understanding of complex human-environmental interactions in the Anthroposphere and provides valuable input for the discussion within the poster session afterwards.

ICYESS2013-20
Poster: P79
Uncertainty recognition, understanding and assessment supporting the climate change adaptation in forest management

M. Petr (1,2), L. Boerboom (1), A. Veen (1), and D. Ray (2)

(1) ITC, Twente University (m.petr@utwente.nl), (2) Forest Research, UK

Uncertainty recognition, understanding and assessment supporting the climate change adaptation in forest management

Our research focuses on the climate change adaptation in forest management and planning with the main emphasis on climate change uncertainty understanding and management in the decision-making process. Climate change is one of the key drivers affecting forests, such as reduction of tree growth due to extreme drought, but how forest managers interpret, understand and make decisions with climate change uncertainty is still limited. We therefore investigated first changes in forest planners' perceptions of climate change risks over time to support long-term robust and adaptive forest management. Planners' perceptions mostly influence whether or not they will apply adaptive measures, such as a choice of resilient tree species on suitable sites, or follow business as usual approach. Our findings show that forest planners are very concern about pests, drought and wind risks as climate change progress. Not only risk perceptions but also what climate impacts they might expect in the future will influence their decision-making. For example, impacts of extreme heat waves and droughts, such as in 2003 caused 30% reduction in primary productivity (Ciais et al., 2005). Hence, second we assessed the drought risk as one of the expected climate change hazards which can cause large reductions of tree growth rates. Our findings indicate a large decrease in forest production for the major tree species in British forests with diverse responses in different locations and futures represented by emissions scenarios (SRES) (Nakicenovic, Alcamo, & Davis, 2000). This information is crucial for the sustainable forestry and adaptation process helping forest managers target vulnerable locations and apply appropriate adaptation measures at national and regional scales. Better understanding of risk perceptions and drought impacts in British forestry should provide manageable information to forest managers for the climate change adaptation endeavour, support development of new decision support systems and provide information for new climate change forestry policies.
Uncertainty, described as a limited knowledge about a system under study (Brugnach, Dewulf, Pahl-Wostl, & Taillieu, 2008) remains a challenge in climate change adaptation endeavour with salient questions how, when and where to adapt. This uncertainty, represented either from a decision-maker or from a modeller's perspective (Walker et al., 2003) will change how

researchers should address it and communicate to the stakeholders and policy-makers. We investigated uncertainty using an analytical uncertainty framework within the forest planning process in which planners indicated different recognition of diverse uncertainty types with high uncertainty understanding about climate change and diverse risk perceptions. With the drought risk assessment we investigated how climate change uncertainty from the probabilistic climate change projections UKCP09 (Murphy et al., 2009) changes the tree growth rate. Furthermore, our limited knowledge about trees response especially to extreme drought conditions influences what degree of risk trees might be exposed to in the future.

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ICYESS2013-83
Poster: P84
Collective Efforts of People to Reduce the Impact of Climate Change in Sundarban, India: a Study

Mr. Bera

Tata Institute of Social Sciences, Research and Development, Mumbai, India (mohan.bera@gmail.com)

The impact of disaster in south Asia has increased in last couple of decades. However changing climate is a major cause of disaster, daily difficulties of people in these areas are not different from disaster situation. Therefore, they find alternatives to manage the daily uncertainties of life and crisis of livelihood.
While the researchers concentrate on the impact of disaster on vulnerable people, it is important to see the ability of these people and their knowledge and perception against the disaster. The need of these people varies with their perception, experience and knowledge about the impact. Therefore it becomes priority for researchers to concentrate on the strategies of people and their ability in order to understand the impact of natural hazards.

I have been studying on disaster management in Sundarban region which is highly vulnerable to flood due to rising sea level. Embankment surrounded the islands beaches due to rapid land erosion at river bank which forces people to shift towards interior part of village. Breaching embankment and saline water floods cause loss of landmass and natural resources and also affects on local livelihood in the village. As the rate of land erosion is so high, reconstruction of embankment becomes expensive. Sometimes government also denies to provide support to protect villages from floods and land erosion. Though there are difficulties, people do not leave the place because they have seen the difficulties of their neighbours who have become environmental refugee. Therefore, people of frequently flood affected villages take their own efforts and strategies to avoid the impact of floods. They adopt their traditional skill and strategies before getting any support from the government and non-governmental organization. They also understand that individual efforts are not sufficient to avoid the increased magnitude of floods caused by tidal waves at the coastal areas. However they do not understand the concept of climate change, they experience its impact by loosing agricultural land, loss of fresh water, livelihoods activities and uncertainty of life. They also understand their individual incapability to reduce the impacts of saline water flood caused by rising sea level. Therefore, affected villagers take collective efforts and strategies to reduce the impacts of floods and to meet their needs. The collective efforts also help them to negotiate with the government to meet their demand in reducing the impacts of disaster. The ethnographic studies in Sundarban villages have

found that villagers able to avoid the flood risk and solve the chronic flood problem in village. They also collectively initiate a movement against the government to meet their demand and needs to reduce the impacts of chronic floods impacts in the village.

It is found that the individual efforts and strategies adopted by the government and people are not adequate to respond to increasing impact of natural hazards. However individual efforts and strategies get success for short period of time, it cannot be the solution. The solution will come while people take efforts collectively in order to reduce the uncertainty which is supported by the government.

Key words: Collective Efforts, Disaster, Climate Change, Sundarban, Environmental Refugee

ICYESS2013-21
Poster: P85

Amelioration of climate change uncertainties with indigenous perceptions in the Niger Basin, West Africa

G.T. Oyerinde (1) (ganiyuoyerinde@yahoo.com), F.C.C. Hountondji (2), D. Wisser (3), B. Diekkrüger (3), A. Afouda (1), E.A. Lawin (4), A.J. Odofin (5), and A.A. Adegbidi (6)

(1) GRP Climate Change and Water Resources, West African Science Service Center on Climate Change and Adapted Land Use, University of Abomey Calavi, Benin., (2) Ecole Nationale Supérieure des Sciences et Techniques Agronomiques de Djougou, University of Parakou, Benin., (3) Center for Development Research, University of Bonn, Germany., (4) Laboratory of Applied Hydrology, Faculty of Sciences and Technology, University of Abomey - Calavi Cotonou, Benin., (5) Department of Soil Science, Federal University of Technology, Minna, Nigeria., (6) Faculte des Sciences et Techniques Agronomiques, Universite d'Abomey-Calavi, Benin.

Since the 1970s, the Niger Basin has been characterized with significant regional hydro-climatic changes which come with high uncertainties on ecological systems at the local scale. A research aimed at integrating scientific observations with local perceptions for ameliorating the impacts of climate change uncertainties was conducted on two catchments located in the middle (Malanville, Benin) and lower (Kainji Lake, Nigeria) Niger Basin. Structured questionnaire on climate related issues, their methods and challenges of adaptations was used to evaluate the perceptions of 239 respondents from thirty communities. Historical rainfall, temperature and river discharge were analyzed from 1950-2010 in the two catchments.

Results show that the two catchments are adhered with high uncertainties that the local people are sensitive and have grown indigenous mechanisms of resilience to their impacts. Higher rainfall variability was domiciled in Malanville which was reported by 97% of the respondents and lower rainfall variability was prominent in Kainji Lake environments (29% respondents). Additional uncertainties were revealed through the influence of 'Flow regulation' on stabilization and aggravation of floods at the upstream (19.1% respondents) and downstream (84% respondents) the Kainji Lake respectively. The two catchments were also identified with increasing unforeseen floods during the White Flood season (August to November) which comes with great influence on economic activities. Despite reported high awareness of climate change and its impacts, adoption of methods of adaptation was generally low in the two catchments (48% in Malanville and 51% in Kainji). The most prominent observed local resilience to drought was the use of irrigation, diversification of activities and water treatment. Drainage channels, small dams and dikes are often deployed to ameliorate impacts of floods in the catchments. Reported challenges of adaptation include inadequate early warning systems to climate change extremes (43% and 51%) and low assistance by government in the provision of sustainable mechanisms of resilience to the adversities of climate change. Based on our findings we proposed the integration of local knowledge into climate change science in order to combat adversities of climate change and its uncertainties in data scarce region. Involvement of NGOs and empowerment of existing regional integration to be able to combat local adversities of climate change along with other methods of sustainable integrated Niger River Basin management were proposed.
Keywords: Climate Change, Perceptions, Uncertainties, Adaptations.

ICYESS2013-106
Poster: P86
Uncertain Climate Change; Certain Natural Hazards: Perception and Communication of Climate Change Risks in the Coastal Regions of Bangladesh and India

S. Mahmud

Institute of Journalism and Communication Studies/KlimaCampus, University of Hamburg, Germany (shameem.mahmud@uni-hamburg.de)

While the science of anthropogenic global warming is gaining increasing scientific validity, its effect in the form of 'climate change' is still debated and a matter of 'uncertain science'. The causal relation between climate change and natural hazards isyet to establish, but there are increasing trends linking these two phenomena together in media and policy discourses with possible

impacts on public perception. Within this context, HazMan - 'Adaptive Hazard Management and Climate Change Communication' project is concerned with understanding public perception and communication about risks of 'climate change' and 'natural hazards'. This research project considers public risk perception and communication as two integral and important components of hazard management, which can influence policy decisions as well as people's behavioural actions in dealing natural hazards.

HazMan takes two geographically similar coastal regions of India and Bangladesh as the cases, which are considered as highly vulnerable to natural hazards (e.g., storms and storm surges). To add to their constant hazard vulnerabilities, possibility of human-induced climate change has become a new threat to millions of people living in these coastal areas. The regions are considered as most vulnerable because of geographic locations, high dependency on nature for livelihood activities, and low socio-economic resilience against geo-hazards. The two study locations are politically divided and parts of two different media systems, but share common geographic, socio-economic and cultural conditions, and experience similar kinds of climatic risks (e.g., cyclones and tidal surges).

The HazMan project mainly aims at understanding how people construct meanings [through communication] about risks originating from certain climatic conditions (geo-hazards) and how these meanings influence their behavioral actions in specific situational contexts of climate change debate. It also emphasises on the process (communication) of meaning construction and how the people understand (perceive) and act (livelihood behavior) within their constructed realities.

Based on grounded theory method of data collection and analysis, in-depth interviews (n=38) are the main source of data of this study, supplemented by participant observation and field notes. The study cases are two coastal regions – Gosaba in West Bengal of India and Satkhira district of Bangladesh.

As the study result shows respondents in both cases demonstrate an increased level of familiarity with the term 'climate change'. The study also identifies critical roles of media as well as NGO campaigns and local opinion leaders in the communication channels of climate change information when acquired knowledge is reconstructed both individually and socially within the socio-cultural and geographical domains of the respondents. However, such familiarity with the topic does not translate into knowledge about causes and consequences of climate change. Although respondents show an overwhelm tendency to link local weather variances with the issue of climate change, they are largely 'confused' and 'uncertain' about possible impacts of climate change in their respective locality and what solutions are appropriate to adapt with changing climatic conditions.

ICYESS2013-46
Poster: P87
Uncertainty in weather forecasts and warnings. Perception, communication and application.

T. Kox (1,2)

(1) Freie Universität Berlin, Institute of Meteorology, Berlin, Germany (thomas.kox@fu-berlin.de), (2) Hans-Ertel-Centre for Weather Research, Optimal Application of Weather Forecast Branch, Berlin, Germany

Using an inter-and transdisciplinary approach, meteorologists and social scientists at the Hans-Ertel-Centre for Weather Research in Berlin analyse weather warnings and their perception and use by stakeholders of civil protection authorities and the public. In the first project phase the emphasis is on storm events in the city of Berlin. The goal is to improve the warning process and the communication of warnings to reduce weather related damages. In cooperation with the German Meteorological Service (DWD) and different users of severe weather warnings, the project will develop recommendations for end-user-oriented information products. In detail, the here presented work deals with the communication and perception of weather warnings, particularly in terms of probabilistic information. The aim is to reveal the shortcomings in the communication of forecasts (uncertainties) and give suggestions for improvement if necessary. This is based on the assumption that the development and use of new technological possibilities for the prediction of complex atmospheric phenomena are of little value, if they are wrong or not understood by the receiver. This requires addressing the tools for communication as well as possible differences between the scientific practices of weather forecasts and the understanding and implementation of this information by the users. The analysis of effective communication strategies of weather warnings requires not only the knowledge how forecasts are understood cognitively, but also an analysis of the institutional factors that influence this communication.

The poster shows results of several studies that discuss the perception and use of uncertainties in weather warnings by experienced users from emergency management using a mix of quantitative and qualitative methods. In detail, first expert talks and an expert survey using an online questionnaire were conducted to get access to the research field. Highlighted topics are addressed in several qualitative interviews with representatives from emergency management (ongoing task). In addition, non-participatory observations (fire brigade control centre) complete the methodological triangulation.

First results show that emergency managers are aware of uncertainties in weather forecasts. But most of them are not willing to react to forecasts

based on low probabilities. However, this is in opposition to the scientific orthodoxy" and to societal emphasis of taking "early and proactive actions" (Demeritt 2012: 5).
Information about uncertainty in weather forecasts can be presented in many different ways. Probabilistic information is one way to indicate the level of uncertainty. It can be communicated by numeric information as well as by a verbal statement. Nevertheless, it is unclear which form is the most appropriate way to communicate warnings even to experts (Handmer & Proudley 2007), and whether the information is properly understood by the receiver (Gigerenzer et al. 2005). Often the chosen format is a further source of uncertainty. In particular verbal statements themselves are highly uncertain (Sink 1995). Survey results show that the verbal statements used in DWD's 7-days forecasts - in particular the term 'possible' - scatter and overlap.
To satisfy diverging users' needs and to meet different risk perceptions, tailored warnings could be an appropriate way to communicate severe weather warnings.

ICYESS2013-111
Poster: P88
Uncertainty, Climate Science, and the Divine: Interdisciplinary Understanding of Blue Holes in The Bahamas

S.P. Wise (1,2)

(1) MARUM, GLOMAR, Bremen International Graduate School for Marine Sciences (swise@marum.de), (2) ARTEC, Institute for Sustainability Studies Universität Bremen

This paper addresses the role of interdisciplinarity in mitigating uncertainty within scientific research. Using the example of aquatic cave exploration in Andros Island, The Bahamas, I argue that the ways in which interdisciplinary research is conducted can mitigate or contribute to uncertainty within particular areas of research. This paper is based on ethnographic research conducted in conjunction with a high profile interdisciplinary project examining geo-chemical and biological conditions of Bahamianaquatic caves (commonly known as blue holes). Blue holes are tidal caves, sometimes reaching 100s of meters deep, found on land and in the sea throughout the Bahamian archipelago. Blue holes are valuable sites for knowledge production for natural, social, and climate scientists, as well as Bahamian residents. Natural scientists are interested in blue holes because of their unique geo-chemical, biological, and ecological characteristics. Climate scientists examine the material evidence of long term climate variation. Highly stratified and anoxic water conditions in some blue holes are ideal

conditions for fossil preservation informing natural and human historical records. Our team of social scientists and students documented stories, uses, and meanings of blue holes in Andros Island using a mixed-method approach including semi-structured interviews and participant mapping. This paper reflects on two findings of that research with respect to the dynamic process of interdisciplinary research more generally. First, results of the ethnographic research indicate that the perceptions of blue holes have shifted among residents overtime–away from spaces associated with mystery and the divine, toward the mapped, measured and scientifically known world–possibly in connection with recent scientific explorations. As scientists dive 100s of meters underground to harvest stalactite formations to document rates of climate change and sea level rise, residents have historically engaged with blue holes for survival, and as community sites with supernatural and divine meaning. Aquatic caves were used by residents as geographic and social landmarks in numerous ways, such as: fresh water sources, hiding places, boundary markers, waste disposal, resource extraction, and recreation. These uses have changed as focus has shifted away from functional practice associated with daily survival, and toward commercial activities such as tourism and scientific discovery. Secondly, our research found strong opposition to the cave exploration project leading to reduced community participation and diminished trust in foreign research. While the interdisciplinary project resulted in significant contributions to climatological and biological science, our findings suggest greater uncertainty within the social science arena. Scientific uncertainty is inherent in any research process. Science relies on exploration and documentation of natural and social phenomenon with the goal of reducing uncertainty. Interdisciplinary approaches may face greater challenges with uncertainty. In some cases, interdisciplinary approaches may obscure valuable cultural and historical meanings while describing important bio-physical characteristics of the same sites, thereby only shifting the area of uncertainty. Cohesive methods, including integrative planning early on and throughout the process can more successfully mitigate uncertainty and generate richer knowledge of socio-ecological sites. This paper calls for greater collaboration across disciplines to facilitate a richer understanding of socio-ecological sites such as blue holes.

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