Geophysical Research Abstracts,
Vol. 10, EGU2008-A-02975, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-02975
EGU General Assembly 2008

Understanding the range of simulated regional climate change among CMIP3 models: the role of tropical SST anomalies

I. Watterson

CSIRO Marine and Atmospheric Research, Aspendale, Victoria, Australia
(ian.watterson@csiro.au / Fax: 61 3 92394444 / Phone: 61 3 92394544)

For many regions, much of the uncertainty in the projections of climate change is due to the range of change simulated by different climate models. In particular, in projections based on the probabilistic pattern scaling approach of Watterson and Whetton (2008) the 5 and 95 percentiles for any change are influenced by the high or low values of 'trends' (changes standardized by the global mean warming) among the 23 GCMs from CMIP3 (see Meehl et al, 2007). What causes these regional responses to warming to differ among models?

There is some evidence that the range of trends relates to variation in skill in simulating the present climate (Whetton et al., 2007). Nevertheless, local rainfall and temperature responses in many regions over the globe (defined using simple rectangles here) are better correlated, across the 23 results, to trends in large-scale pressure patterns, and to remote rainfall and sea surface temperatures (SST). To give some examples (all annual cases), rainfall in southeast Australia (and the Murray-Darling Basin) is negatively correlated with SST trends in the equatorial west Pacific (r =-0.72) and positively correlated with those in the Tasman Sea (r=+0.48). Rainfall in northern Brazil relates to equatorial Atlantic SSTs (r=-0.72), while temperatures around Britain relate to those in the northwest Atlantic (r=0.76).

Some of these apparent relationships resemble teleconnections associated with interannual or interdecadal variability. The degree that models simulate an 'ENSO-like' pattern in the Pacific or changes in the overturning of the Atlantic has been a focus

of research. The standard deviation of the 23 standardized trends for SSTs in the west Pacific and the NW Atlantic are, indeed, particularly large. Nevertheless, relationships may be coincidental (due to other influences) or merely statistical accidents (given the small 23-member set of results).

To investigate the role of the regional SST differences in forcing climatic anomalies elsewhere, a series of eight experimental runs of the CSIRO Mk3.5 AGCM has been performed. Fixed SST anomalies, typically +1K over regions of 10 degrees of latitude and 30 degrees of longitude, have been added to climatological SSTs. Differences between 20-year averages of a perturbed simulation, compared to a control run, should indicate a potential role for this SST anomaly in driving differential changes. They will be of interest to interannual predictability, also. In each of five cases with equatorial SST anomalies, air temperature and local rainfall is substantially enhanced. Dynamical anomalies resemble planetary waves (with some interesting differences among the seasons) and lead to remote temperature and rainfall changes. In many cases these are consistent with the above correlations. A west Pacific anomaly leads to less rainfall in SE Australia, and more in southern Asia. An equatorial Atlantic anomaly makes Brazil wetter and cooler, central Africa warmer and drier, with some weak perturbations in Europe and elsewhere. However, three cases with midlatitude SST anomalies produce only weak perturbations locally, and little remote response. A warmer Tasman Sea appears to result in a slight drying of Australia (rather than increased rainfall). A NW Atlantic anomaly (of -2K, extending to 20W) has remarkably little effect on Britain, Europe or elsewhere.

Feedbacks associated with a dynamical ocean may modify such influences in the coupled system, and the underlying cause of the SST anomalies needs to be pursued. Nevertheless, the experiments demonstrate the importance of equatorial SSTs and rainfall, including ENSO-like change, to the patterns of climate change over Australia, and other, mostly low-latitude, regions. The potential for reducing uncertainty in projections based on this will be considered.

References

Meehl, G.A., T.F. Stocker, W.D. Collins, P. Friedlingstein, A.T. Gaye, J.M. Gregory, A. Kitoh, R. Knutti, J.M. Murphy, A. Noda, S.C.B. Raper, I.G. Watterson, A.J. Weaver and Z.-C. Zhao (2007): Global Climate Projections. In: *Climate Change 2007: The Physical Science Basis.* Cambridge University Press.

Watterson, I. G. and P. H. Whetton (2008): Uncertainty of decadal means of temperature and precipitation change under global warming based on CMIP3 models, EGU Gen. Assem. 2008

Whetton, P., I. Macadam, J. Bathols, and J. O'Grady (2007): Assessment of the use of current climate patterns to evaluate regional enhanced greenhouse response patterns of climate models. Geophys. Res. Lett., v34, L14701.