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Remote sensing of severe storm systems

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The presentation is about the study of mesoscale atmospheric phenomena, e.g., Polar Lows or North Atlantic Cyclones, which have a strong impact on weather conditions in Europe. Optical and radar satellite data are used in combination with in situ data. The lower atmospheric boundary layer is studied to get a better understanding of processes, e.g., currents, waves, wind, up- and downwind systems of deep convective clouds in Polar Lows and their interaction and related transport processes. Polar Lows play an important but as yet unclear role in the climate system at high latitudes; for example, through a strong coupling of the polar atmosphere and ocean trough air-sea interactions. These storms are smaller and more transient than the more predictable synoptic-scale weather systems that are more familiar. Additionally storm events in the North Sea are used to investigate different meteorological events and their interaction with the sea surface. Synthetic Aperture Radars (SARs) are capable of imaging synoptic wind fields with a coverage of up to 500 km x 500 km and a resolution of down to 100 m. High resolution wind fields are derived from ENVISAT ASAR scene for several storm cases, e.g. in the North and Baltic Sea. For retrieving wind speeds from SAR data a model function (CMOD 4 and 5) relating the Normalized Radar Cross Section (NRCS) of the ocean surface to the local nearsurface wind speed, wind direction versus antenna look direction and incidence angle is used. The Medium Resolution Imaging Spectrometer (MERIS) that is flying on board the ENVISAT satellite provides an image over a specific region every three days in Full Resolution Level 2b mode. By synergetic use of ENVISAT ASAR and MERIS data the relationship between cloud patterns, cloud parameters, e.g. cloud top pressure, cloud optical thickness, topography, bathymetry and wind field structures is investigated. Particular attention is paid to the three dimensional structure of severe storm systems. Special features like the eye wall, rainbands, mesoscale vortices and roll vortices are examined. Correlations between atmospheric induced small scale patterns in MERIS and ASAR

data are investigated. A second issue of the study is the use of the upcoming X-band radar missions like TerraSAR-X for the investigations of atmospheric processes. This adjustment is based on ECMWF ERA-40 data for u10 wind speeds and the Shuttle Radar Topography Mission (SRTM) X-band data. ERA-40 datasets contain daily and monthly analysed values interpolated to a 2.5° x 2.5° regular latitude/longitude grid.