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Enhanced Techniques for Mesoscale Cyclone Studies using Satellite Multi-sensor Approach

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Mesoscale cyclones, also known as polar lows, are short-living intensive mesoscale atmospheric low pressure weather systems, developing over marine areas in both hemispheres. They are usually accompanied by gale winds and intensive air-sea interaction. Conventional observations are too sparse in the areas of polar low development, and the spatial resolution of most numerical models are too low to catch even intensive small polar lows. The most informative polar low studies include the comprehensive joint analysis of satellite data from various instruments providing the most complete information about storm development A multi-sensor approach for polar low study, considered in the work, includes usage of most available data: Envisat ASAR, QuikSCAT SeaWinds and Metop ASCAT, Terra and Aqua MODIS, NOAA AVHRR, DMSP SSMIS and Aqua AMSR-E, NOAA AMSU-B, surface weather maps, NCEP/NCAR re-analysis data. Independence of time of the day and clouds, regularity and high temporal resolution in the polar regions make satellite passive microwave data one of the most appropriate information sources for study of polar lows. Advanced algorithms are considered for retrievals of several important parameters, used for polar low studies, such as sea surface wind speed, total atmospheric water vapour content, total cloud liquid water content. It is shown in several case studies that analysis of atmospheric water vapour fields allows detection of vortex structures accompanying polar low development whereas sea surface wind speed retrievals confirm high wind speeds typical for these events. Thus, satellite passive microwave remote sensing presents a promising tool for detection, study and monitoring of polar lows.