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Detection of polar lows in satellite microwave radiometer data from AMSU-B

C. Melsheimer, T. Frost, and G. Heygster
Universität Bremen, Institut für Umweltphysik, Bremen, Deutschland (melsheimer@uni-bremen.de)

Polar Lows are intense mesoscale cyclones over Arctic seas, often associated with gale-force winds and intense snowfall. Because of their rather small size (diameter of a few hundred kilometers) and their short lifetime (typically less than one day), they are often not well resolved by the synoptic observation network and forecast models.
We have investigated the detectability of polar lows over the Nordic Seas and the Barents Sea in data from the microwave radiometer AMSU-B (Advanced Microwave Sounding Unit B) on the polar-orbiting satellites of NOAA (National Oceanographic and Atmospheric Administration), covering the years 2000 - 2009. Our starting point is a list of about 100 polar lows observed by the Norwegian weather service (met.no) in the years 2000-2009. About 90% of those polar lows are also visible in maps of integrated water vapor (IWV) retrieved operationally from AMSU-B at
the University of Bremen as small areas of extremely low IWV. The reason is that most polar lows are often associated with strong convection and thus high amount of cloud ice aloft. As ice clouds are strong microwave scatterers, radiation from below the ice clouds hardly reaches the satellite. As the IWV retrieval algorithm
relies on the microwave emission of water vapor, the water vapor below the ice clouds is not "seen" by the satellite. Likewise, polar lows are visible in the brightness temperature differences between the three channels near the 183.31 GHz water vapor absorption line by a reversal of the sign. This is similar to the tropical deep convection detection method described by Hong et al. (2005). Our investigation shows that in addition to the polar lows reported by met.no, a considerable number of possible polar low signatures were found in almost all months, with a marked peak in the winter months.
Making the polar low detection with AMSU-B (and its successor MHS - Microwave Humidity Sounder) operational is very promising as this would provide full coverage several times per day all year round and thus enhance observation capabilities.

References:
Hong, G., G. Heygster, J. Miao, K. Kunzi, "Detection of tropical deep convective clouds from AMSU-B water vapor channels measurements." Journal of Geophysical Research, vol. 110, D05205, doi:10.1029/2004JD004949, 2005.