Investigation of polar low formation and development over the Nordic Sea: Synergetic approach using the Arctic System Reanalysis, Microwave satellites and Radiative Transfer Simulations

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Due to the complex interaction of atmospheric processes with ice and ocean in the Arctic region and the lack of observations, severe storms such as polar lows (PLs) are still hard to predict. In order to improve their forecasting and detection, it is of high importance to gain better understanding of their formation and development. Furthermore, the question how PL occurrence and strength will change in future climate is still debated and better representation of PLs in climate models is necessary.

First, we use Arctic System Reanalysis (ASR) to analyze PL's environment at its genesis and maturity stage by identifying set of conditions (e.g. difference between sea surface temperature and temperature at 500 hPa (Tdiff)), near-surface wind speed (WSP), lapse rates (LR), humidity (RH)) to infer their single or combined relevance. A first analysis has been performed for 33 January cases over the course of 13 years (2000-2012). It reveals that for the cases with higher low-level static stability, Tdiff < 37K, LRs throughout boundary layer were steeper and therefore these PLs were fostering convective development. It was also noted that high amount of RH, > 90 %, at lower levels at genesis stage promotes stronger WSP intensity at the mature stage.

Second, due to their good coverage and sensitivity to snowfall, passive microwave radiometers such as the Microwave Humidity Sounder (MHS) are well suited to investigate PLs realization in ASR. For this, we use Passive and Active Microwave Radiative Transfer Model (PAMTRA) simulator. The results shows that synthetic observations from MHS represent PLs signatures well showing strong brightness temperature (BT) depression and PL convective cores due to snow scattering effects.

However, some simulations especially of multi-low PLs show less satisfactory performance. Furthermore the relation between BT and precipitation associated with PLs is not straightforward and therefore there exist many open questions on how PLs develop and which amounts of precipitation they bring. The long term availability of satellite observations will allow us to address these questions in more detail by combining reanalysis and observations in a synergetic approach using the PAMTRA simulator.