Methodology for Polar Low studying for the Arctic region using retrieved water vapour from satellite passive microwave data

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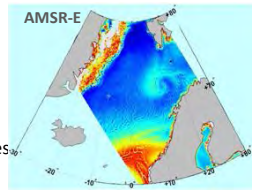
METHODOLOGY

I. Satellite passive microwave data use for polar low detection, tracking and study

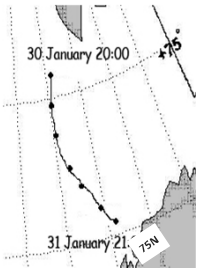
1. Retrieval (**using precise algorithms**) of atmospheric total water vapor content fields from SSM/I(IS) and AMSR-E
2. Detection of vortex structures in these fields, identifying them with polar lows and trajectory tracking



31 January 2008, 11:14 UTC

II. Retrieval algorithms

1. Are based on numerical simulation of brightness temperatures and their inversion by means of Neural Networks
2. Have high retrieval accuracies under wide range of environmental conditions
3. Are validated by means of comparison with polar island station radiosonde data

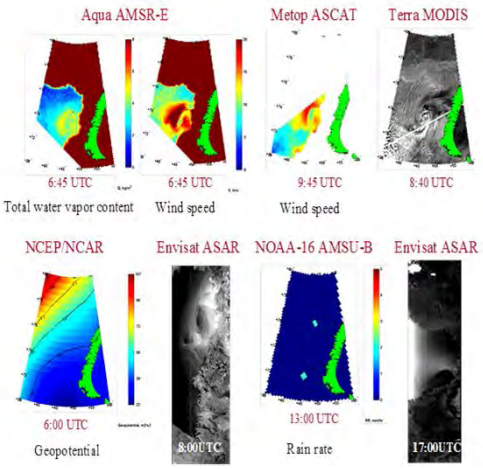


III. Synergistic use of data

Comprehensive study of polar lows requires multi-sensor approach with combined use of data from various sensors taking advantage of each of them, complemented with in-situ data:

1. Envisat ASAR – for high resolution wind speed retrievals using existing CMOD-4 model for wind retrieval
2. QuikSCAT (before the end of 2009) and Metop ASCAT (after 2009) low resolution wind speed additional data
3. Terra and Aqua MODIS, NOAA AVHRR data for confirmation and study of polar low cloud structure
4. **DMSP SSM/I and SSMIS, Aqua AMSR-E – for geophysical parameter estimation**
5. NCEP/NCAR reanalysis data
6. Surface analysis maps

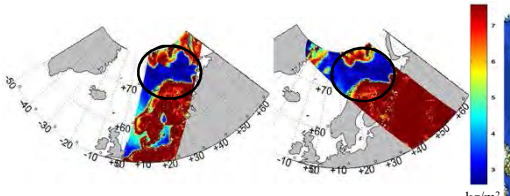
5 March 2010, Barents Sea



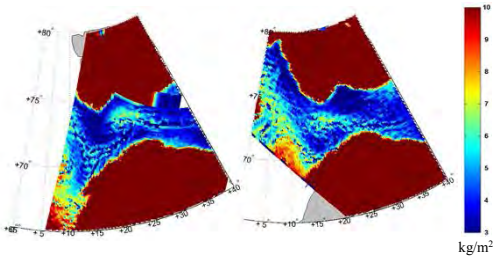
Synergistic use of data – polar low is detected at MODIS, AMSR-E, Metop ASCAT and Envisat ASAR

Data

- Period of the research: 1995-2009
- Used data: SSM/I paths (28 paths per day)
  ftp.remss.com/ssmi: Daily (morning/evening) passes
- Estimated SSM/I data of water vapor fields and cloud liquid water for whole Arctic from 1995-2009: 306 768 images



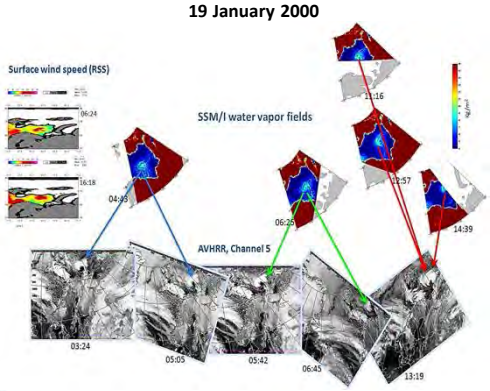
- Processed data of vortices in water vapor fields for identification of polar lows for whole Arctic from 1995-2009: 153 384 images



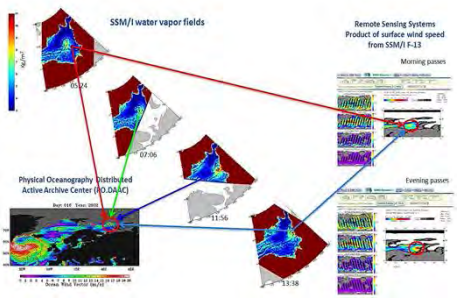
- Examined and processed data of polar lows in water vapor fields for Nordic seas of winter season (September – April) from 1995-2007 – 94 976 images

VERIFICATION

Polar low in the Barents Sea 19 January 2000



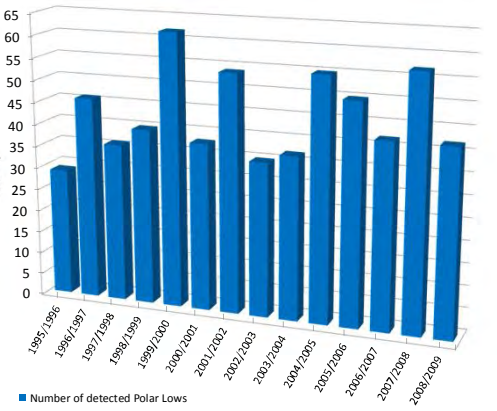
Polar low in the Barents Sea 16 January 2002



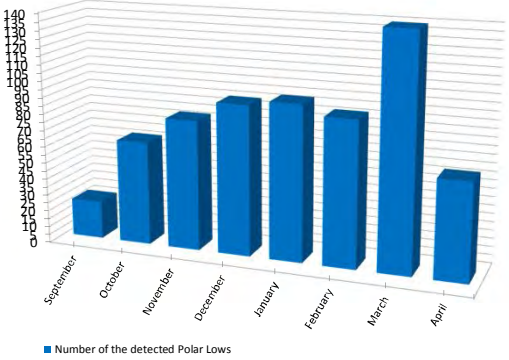
POLAR LOW CLIMATOLOGY

Trajectory of Polar lows over the Nordic Seas for the period 1995-2009

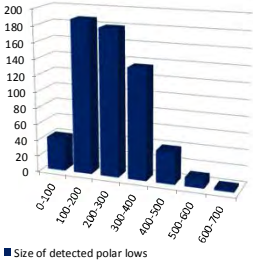
Number of detected Polar Lows during the winter season (from September to April) above the Nordic seas for the period 1995-2009



Number of the detected Polar Lows for each month during the winter season (from September to April) above the Nordic seas for period 1995-2009



Size of detected polar lows during the winter season (from September to April) above the Nordic seas for period 1995-2008



Lifetime of detected polar lows during the winter season (from September to April) above the Nordic seas for period 1995-2008 using AVHRR