ESA DUE GlobSnow: Features of the Final SWE Product and Possibilities for Additional Products

Jouni Pulliainen

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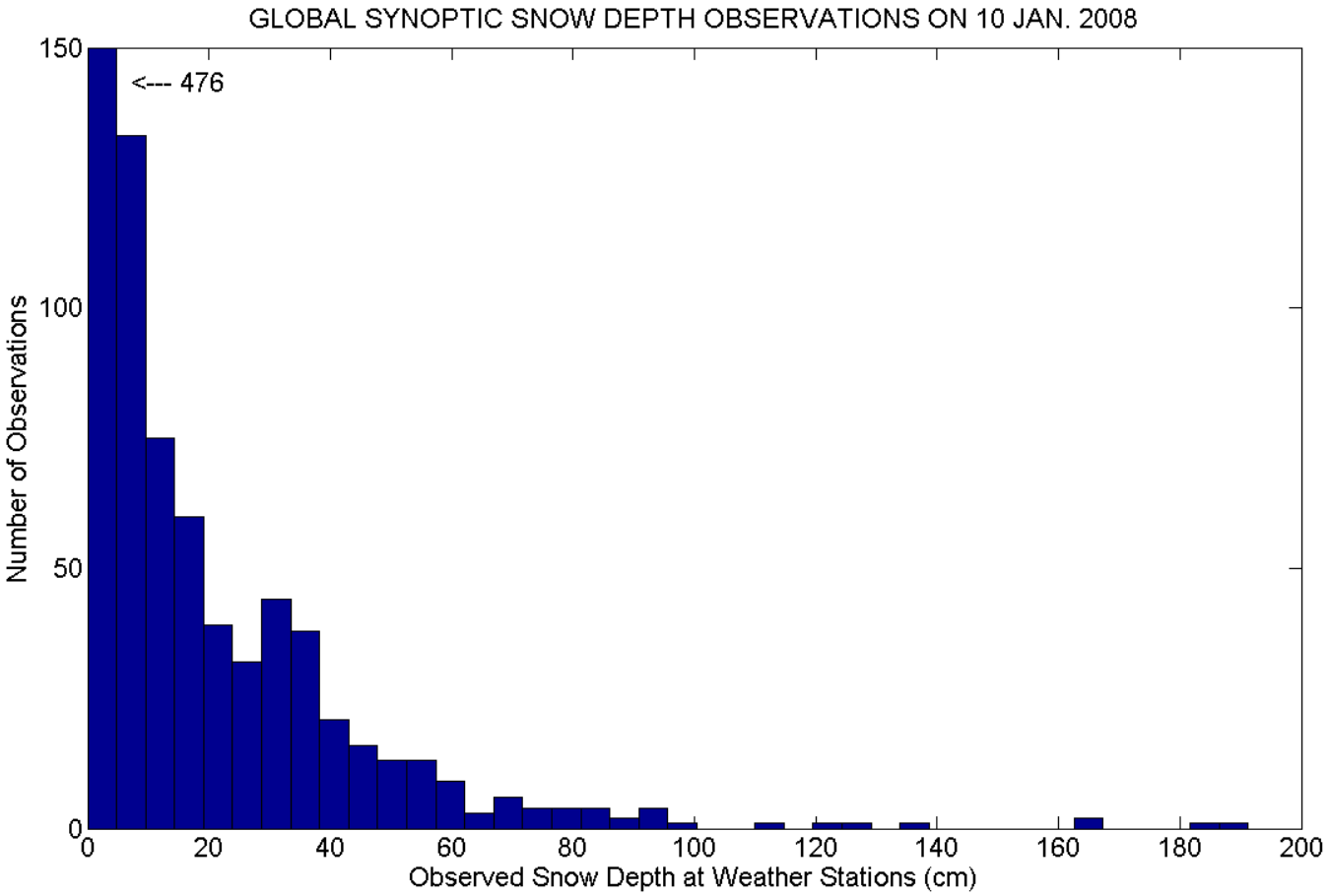
Planned Improvements to Prototype Product (I)

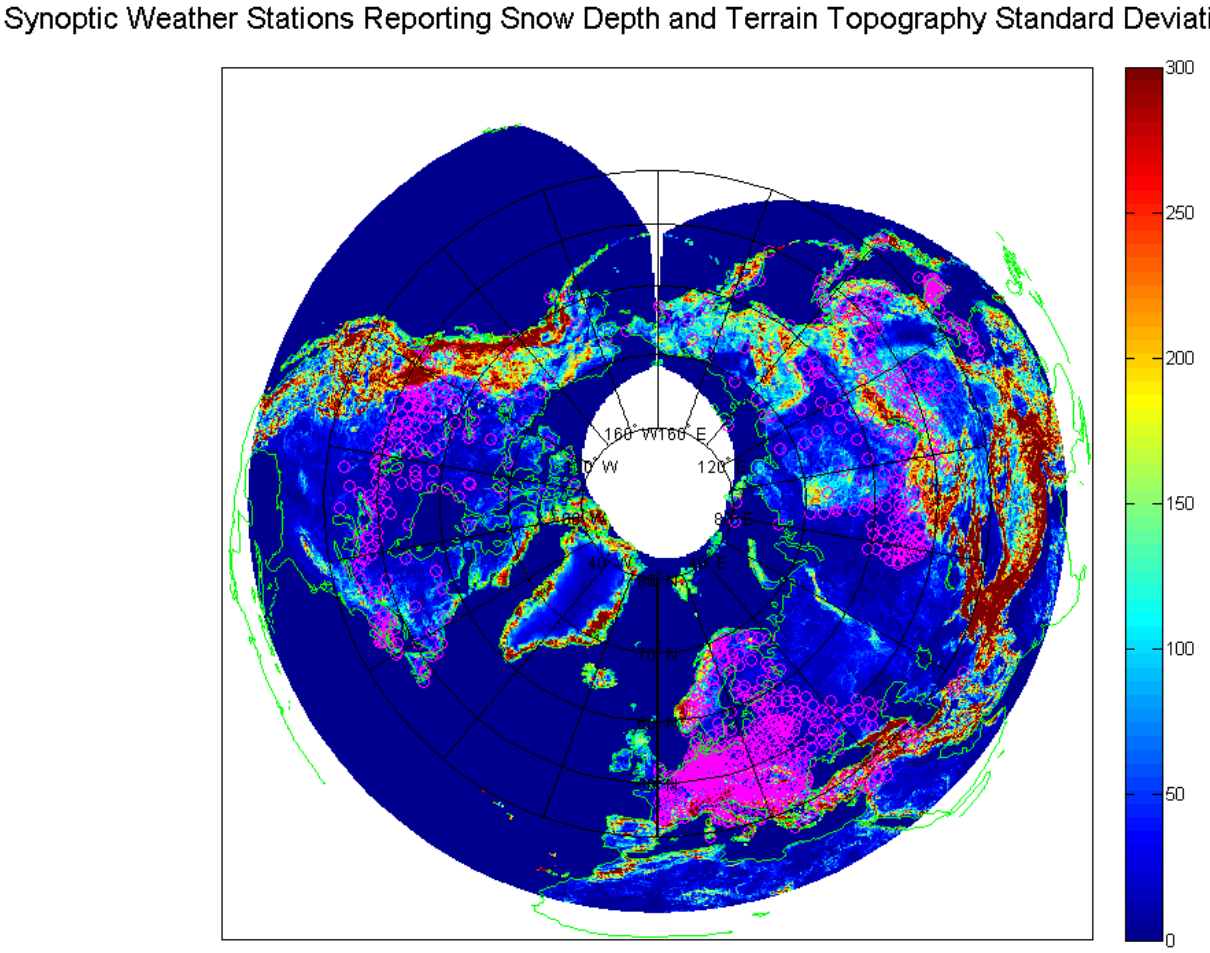
- **Filtering of suspecious weather station observations**
  - Prototype system filters out weather stations indicating snow depths higher than 200 cm
    - Removes false observations and typically some mountain/coastal zone observations
  - Current analysis indicates that the spatial quality of produced SWE maps drastically improves if stations with the highest snow depths are removed
    - 1.5% of stations from each ground calculation area (Eurasia-West, Eurasia-East and North America)

Histogram of Synoptic Observations

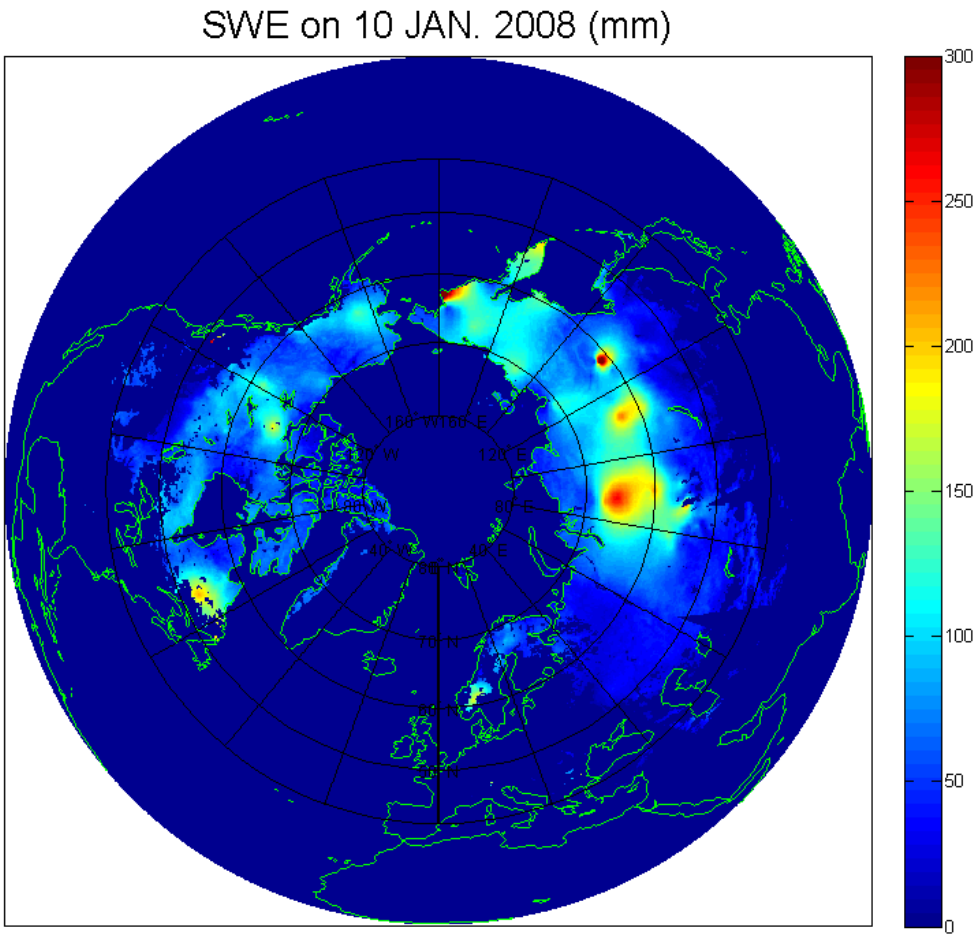
- **Example for northern hemisphere on 10 Jan. 2008 (1005 reported values from non-alpine areas)**



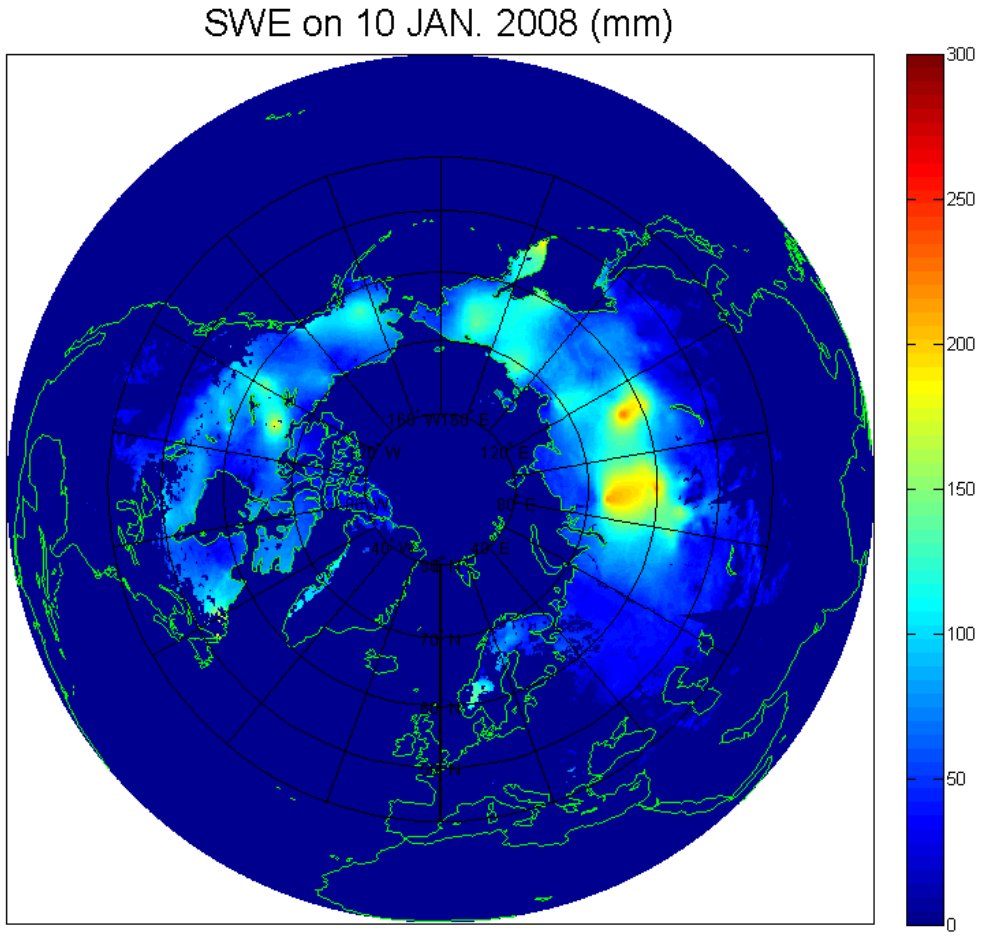
Distribution of Stations on 10 Jan. 2008



SWE without Station Filtering



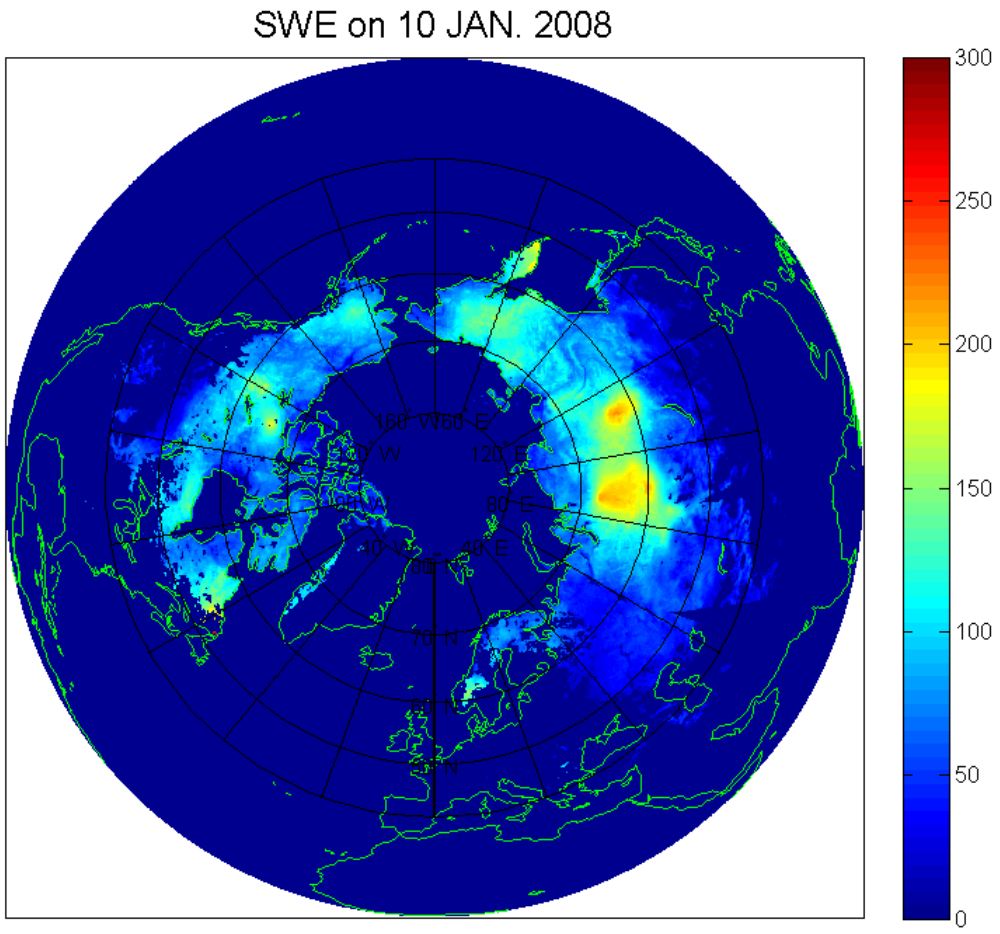
SWE with 1.5% Station Filtering



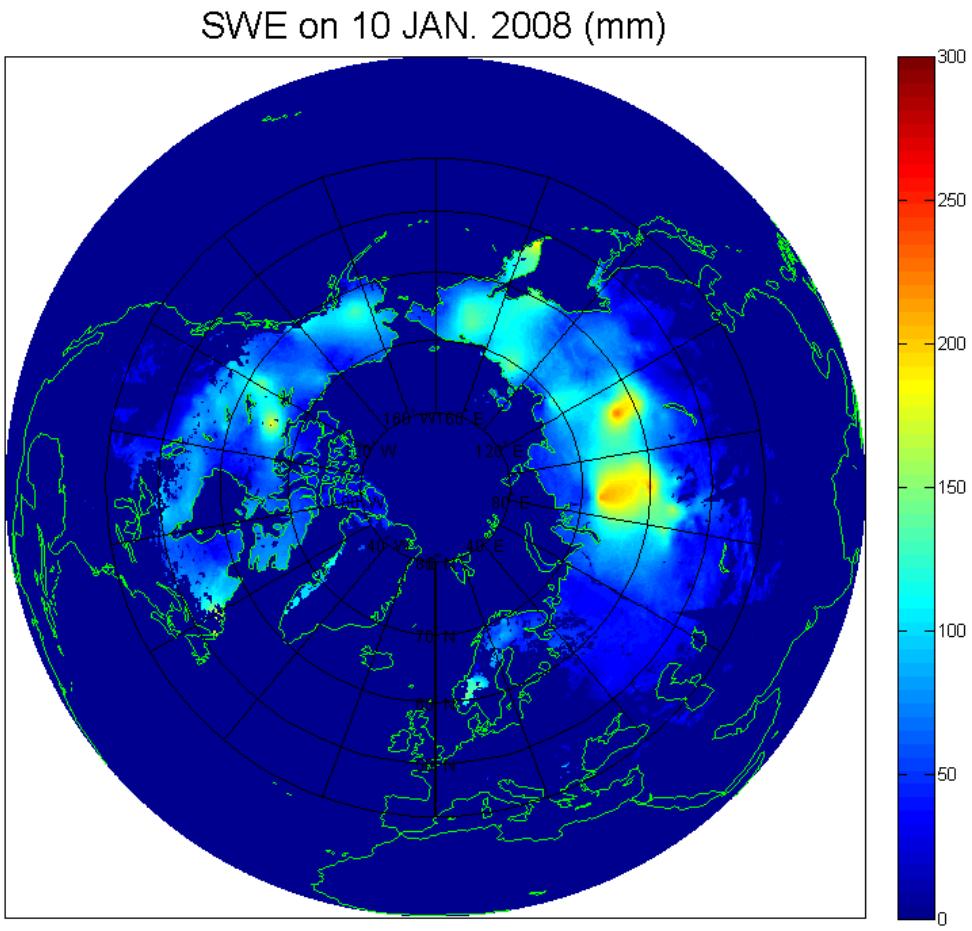
Planned Improvements to Prototype Product (II)

- **Consideration of the optimum parameter values**
  - Assumed accuracy of the weather station Snow Depth observation
    - Current DJF prototype product applies a RMSE value of 10 cm based on analysis on Finnish weather stations (RMSE indicating how well does a point-wise observation represent an areal Snow Depth observed along a 4 km-long track)

Estimation with VAR = 1000 mm^2



SWE with VAR = 100 mm^2



Planned Improvements to Prototype Product (III)

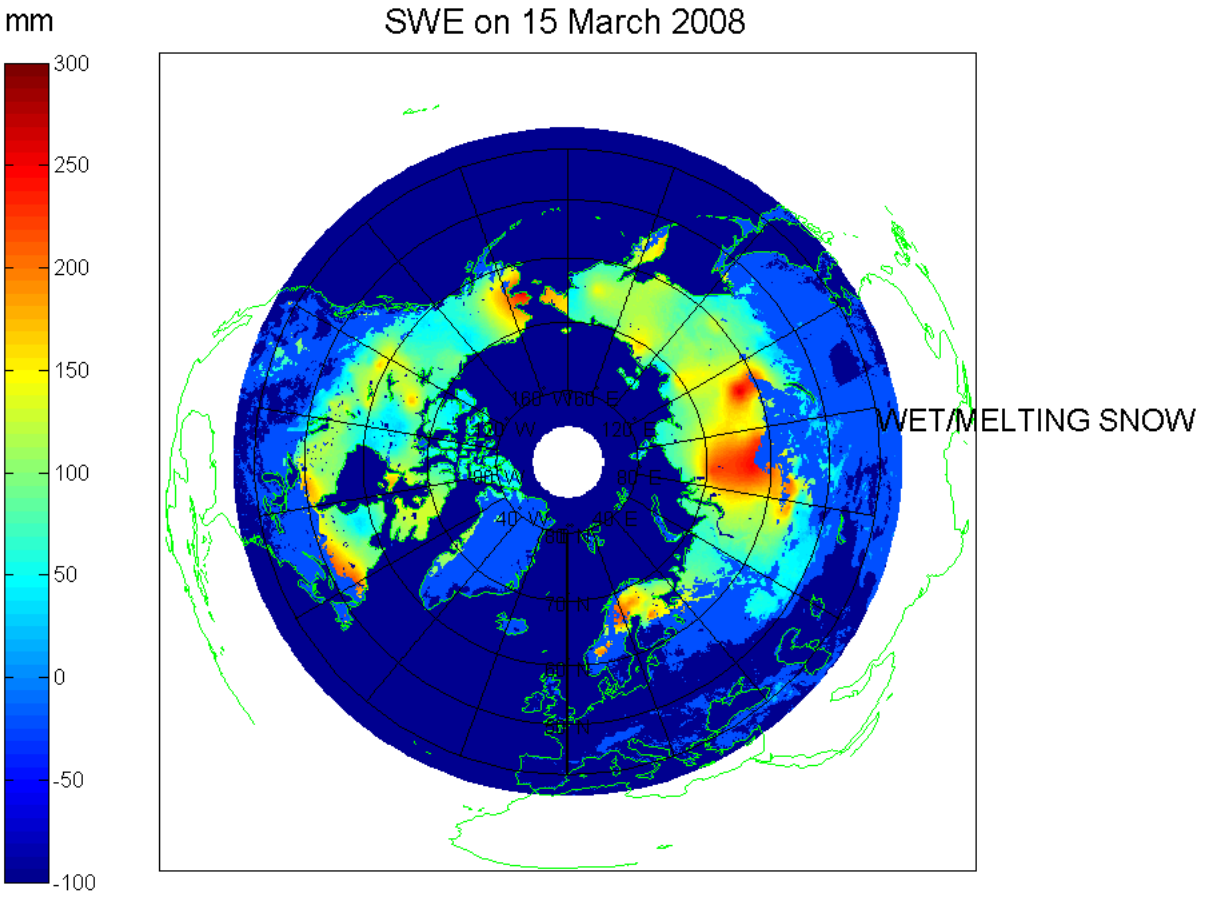
- **Wet snow masking**
  - Currently applied thresholding algorithm based on literature does not provide optimum results for some regions:
    - For example, Moscow region mapped to represent wet snow too frequently
    - Retuning of parameter values will be investigated
- **SWE estimates for wet snow regions**
  - Estimates calculated already
    - Can be included into the products
    - Quality poorer than for dry snow areas (are based only on ground data-derived background field)

Planned Improvements to Prototype Product (IV)

- **Detection of the southern border of wet snow area**
  - Final product differentiating:
    - Dry snow areas (SWE provided for each Easegrid cell)
    - Wet snow areas (optionally SWE could be provided, even though the spatial quality significantly poorer: product actually an interpolation of weather station data)
    - Snow-free areas; based on the detection of snow clearance
  - Snow only detected for regions that experience dry snow cover during the winter-period
- **Mountain mask will be added**
  - Exclusion of alpine regions

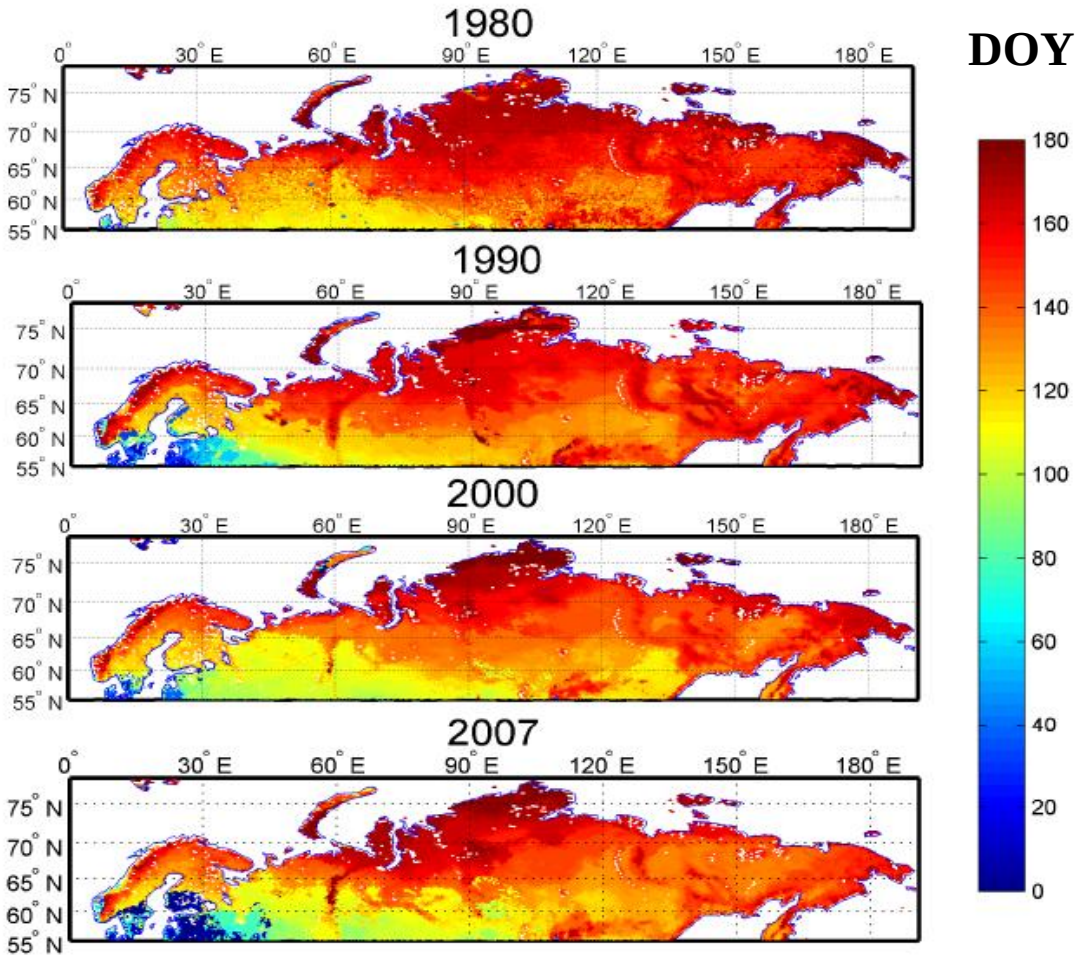
Planned Final SWE Product

- Possibly identifying different snow regions:
  - Dry snow area
    - Current dry snow detection limit propably too conservative (example on left)
  - Wet/melting snow region
  - Snow-free regions
- SWE can be also provided for the wet snow mapped region



Snow Melt Estimated from Radiometer Data

- Analysis of time-series of satellite data (change of emissivity due to the snow melt)
- Calibration here against ground-based observations at ~200 stations

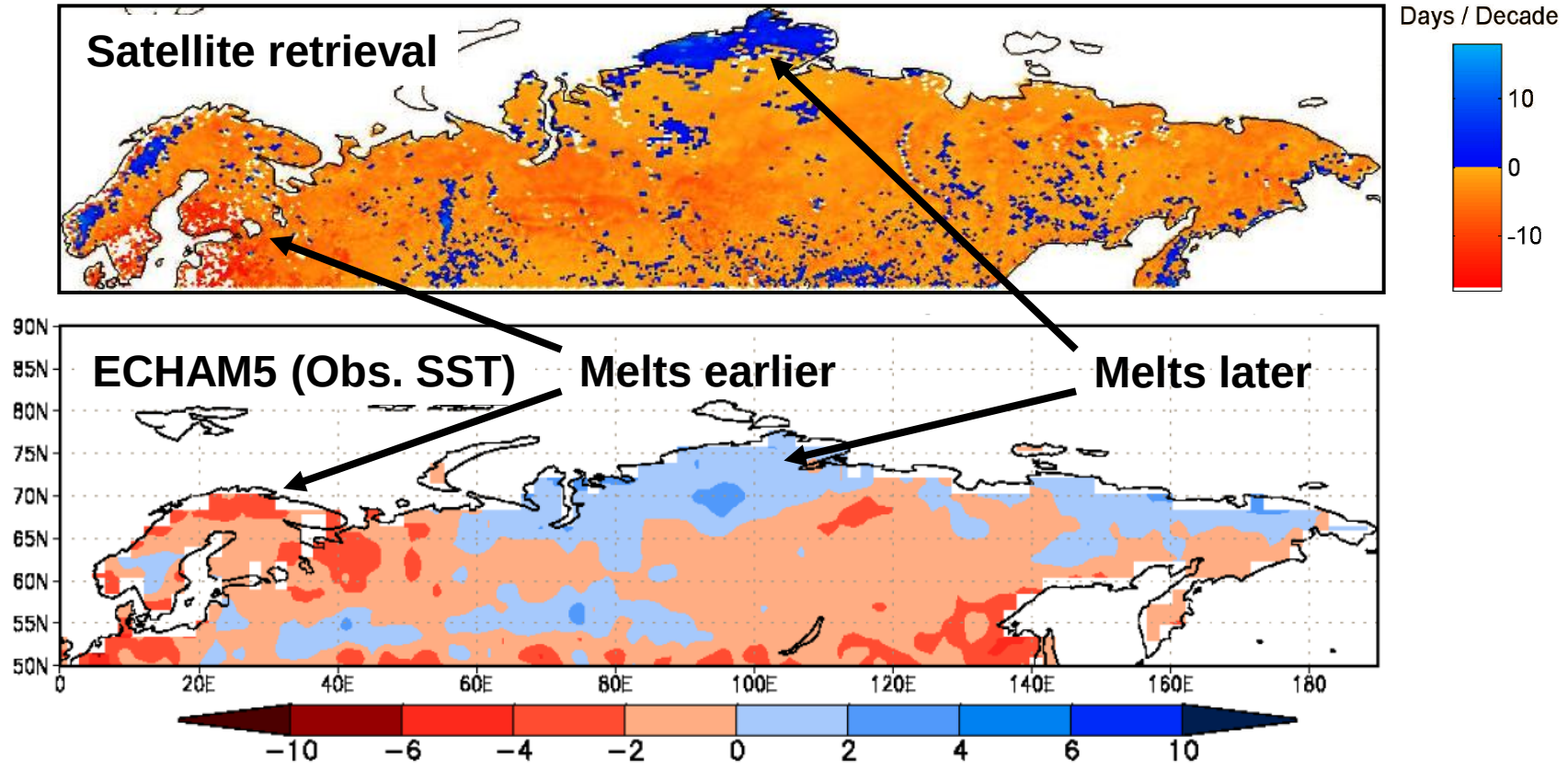


Reference:
Takala, M., Pulliainen, J., Metsämäki, S., and Koskinen, J. (2009), Detection of snow melt using spaceborne microwave radiometer data in Eurasia from 1979-2007. *IEEE Transactions on Geoscience and Remote Sensing*, 47: 2996-3007.

The color code is the number of the melt date since January 1.

Example on Trend Analysis

Change in snow clearance date in days/decade



Potential Additional Products (I)

- **Maps on the effective snow grain size maps**
  - Already calculated as a supplementary product required by the assimilation system
    - Correspondence to the real (mean) snow grain size in dry snow regions
    - However, incorporating the effects of deficiencies in the applied scene brightness temperature model (inaccuracies/simplifications related to: atmosphere, vegetation cover, lake ice, wetlandsand verical layering of the snow pack)
    - Prroduction of higher quality snow grain size maps especially requires the consideration of lake ice and wetlands in the emission modeling

Potential Additional Products (II)

- **Fusion of SWE and SE Products**
  - Could enable an advanced mapping of the southern border of the snow region
  - SWE product could be used as backgound field for SE product