Historical snow *in situ* data set and snow cover satellite products
(Task 3.3: Boundary constraints and external forcing)

J.Pulliainen, M. Salminen, Finnish Meteorological Institute (FMI)

- Global estimates of snow extent and snow water equivalent (SWE) based on GlobSnow

- Development of a consolidated quality-controlled data base of in-situ snow observations in collaboration with NSIDC and RIHMI

- **Deliverables**
    - 3.18 Prototype snow data product (GlobSnow development product) for reanalysis
    - **3.19 Quality controlled version of snow data base (in situ) and snow data product (D3.18), first version released in April 2016, revised in September 2016**

SWE snow course observation data set

- Compilation of long-term in situ snow observations from different sources (up to ~100 years if possible and where possible)

- First version of snow course data archive established in 2016 by FMI as recommended by the EU FP7 Core-Climax coordination meeting (organized together with ERA-CLIM2 project)
    - Recommendation to focus on Snow Water Equivalent (SWE) from spatially distributed observations (regional averages for discrete days of observation)
    - Distributed snow course observations from Eurasia and North America:
        - Currently Russia/former Soviet Union, Finland and Canada

- Data set is available at: **http://litdb.fmi.fi/eraclim2.php**

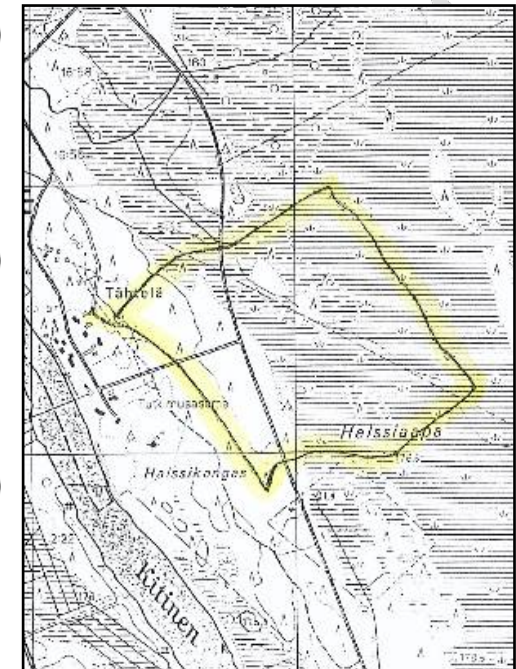# Example: Finnish Snow courses

Snow Water Equivalent (SWE)
- 1979-2014
- Some courses starting 1971
- Historical data available from early 1900's (not digitized)

- Monthly/bi-monthly measurements by SYKE
- National network of +100 snow courses
  - 2 - 4 km
  - 40 - 80 snow depth measurements points
  - 8 snow density measurements points
  - Distinction into five land cover classes

Finnish Snow Course data, Finnish Environment Institute (SYKE)
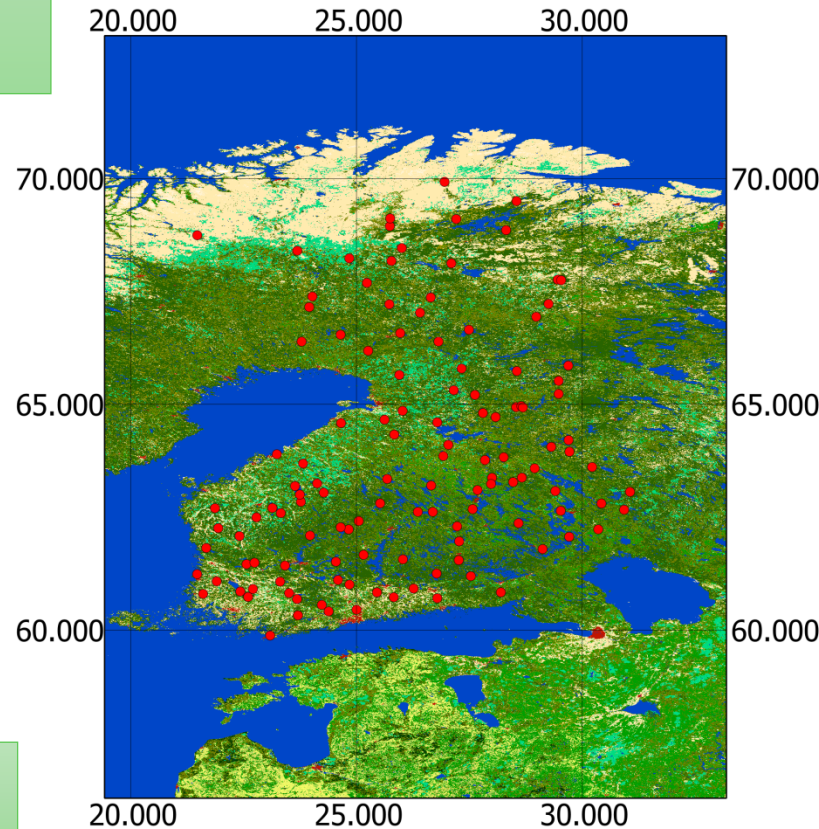
Example: snow course in Tähtelä, Sodankylä

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

OBSERVATIONS AT THE ARCTIC RESEARCH CENTRE
SODANKYLÄ, FINLAND, (67.367°N, 26.629°E, 179м)

HOME

CAMPAIGNS

SATELLITE ACTIVITIES

Measurement fields:

PALLAS

SAARISELKÄ

AUTOMATIC WEATHER STATION

CO$_2$ FLUX MAST

INTENSIVE OBSERVATION AREA

LICHEN FENCE

MICROMETEOROLOGICAL MAST
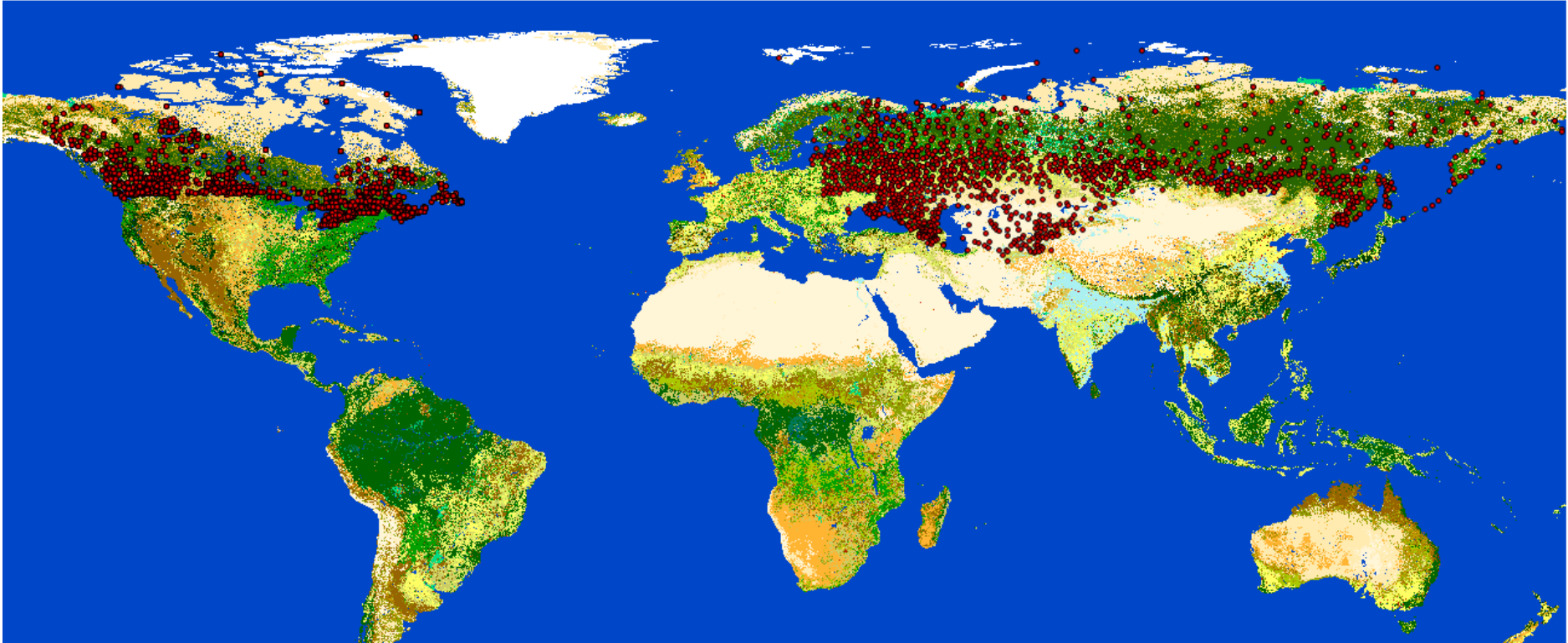
MICROMETEOROLOGICAL MAST FIELD

PEATLAND FIELD

RADIATION TOWER

ROAD WEATHER STATION

ERA-CLIM2

Description: Northern Hemisphere Snow Water Equivalent (SWE) data compiled by FMI-ARC for the ERA-CLIM2 project.

Data file columns:
1. Course (WMO station number or value based on national numbering or running number)
2. LAT (decimal degrees)
3. LON
4. DOY (day of year)
5. SWE (snow water equivalent, mm)
6. rho (snow bulk density, g/cm^3)
7. SD (snow depth, cm)
8. Julian day
9. Year
10. Snow course altitude (m)
11. Data Source (1=INTAS-SCCONE/RIHMI-WDC, 2 = Finnish Environment Institute, 3 = Environment Canada)

DATA FILES:
MAT-file
TXT-file

METADATA FILE:
TXT-file

For more information contact Miia Salminen (firstname.lastname@fmi.fi).

Page updated 19 April, 2016

http://litdb.fmi.fi/eraclim2.php

- Total number of snow course locations: 3589 (based on coordinates)
- Time period 1935-2014
- Total number of observations around 1.2 million
- Variables (average values for a snow course)
  - Snow Water Equivalent (SWE)
  - Snow Depth (SD)
  - Snow Density

Zoom for North America

http://litdb.fmi.fi/eraclim2.php
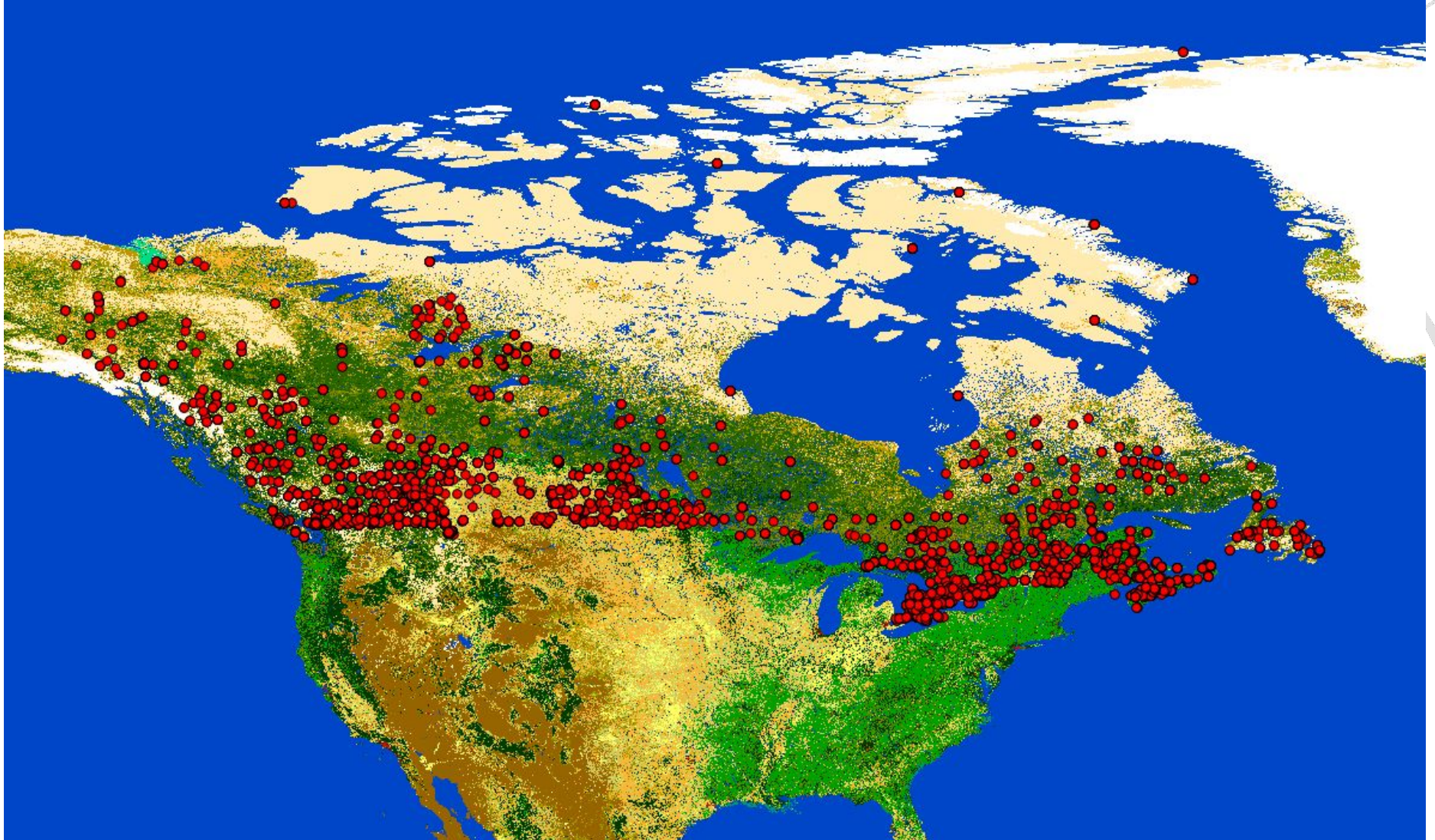
METADATA:

```
File description
ERACLIM2_SWE_rus_fin_can.txt

North Hemisphere SWE compiled by FMI-ARC for the ERA-CLIM2 project

Columns:
1.  Course (WMO station number or value based on national numbering or running number)
2.  LAT (decimal degrees)
3.  LON
4.  DOY (day of year)
5.  SWE (snow water equivalent, mm)
6.  rho (snow bulk density, g/cm^3)
7.  SD (snow depth, cm)
8.  Julian day
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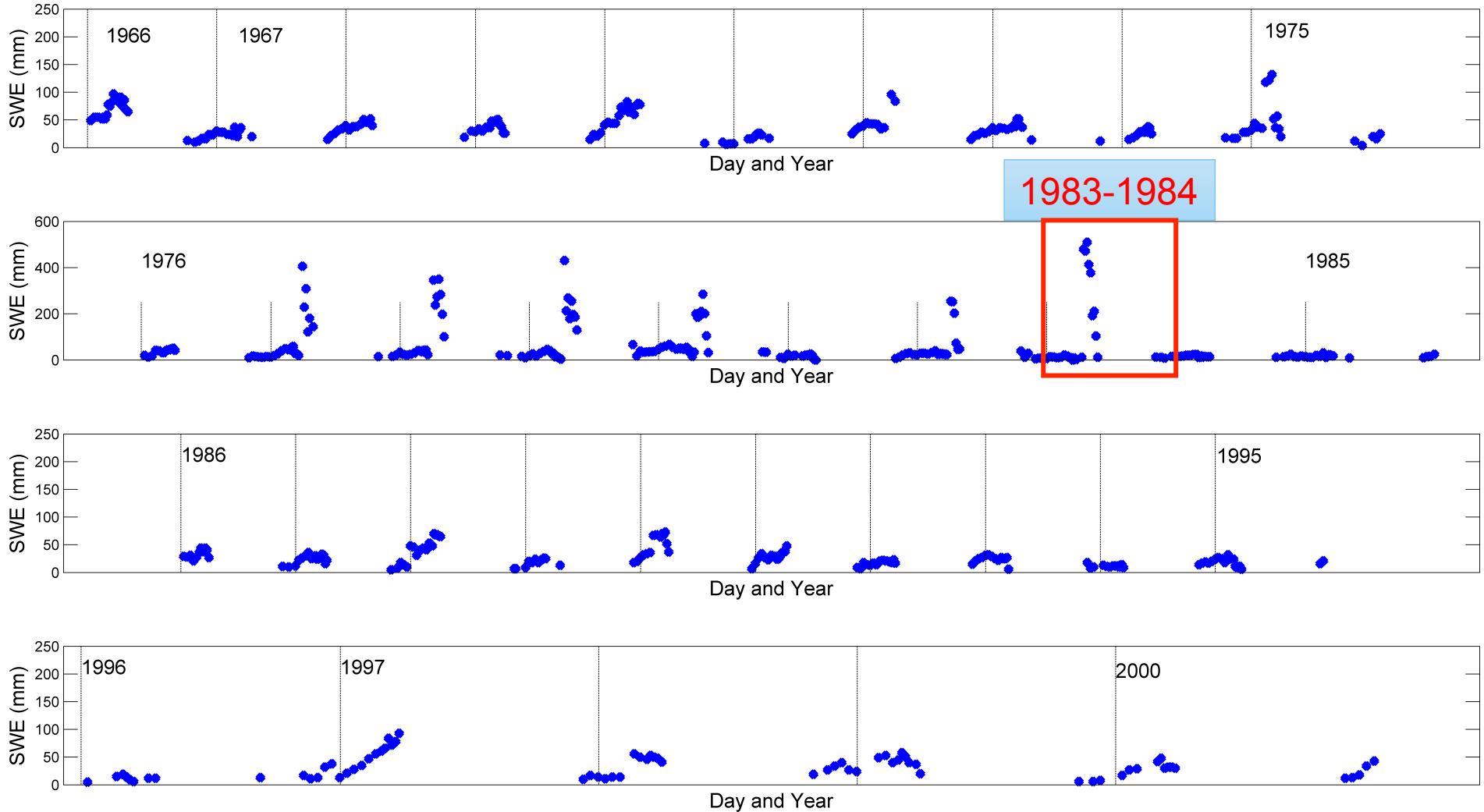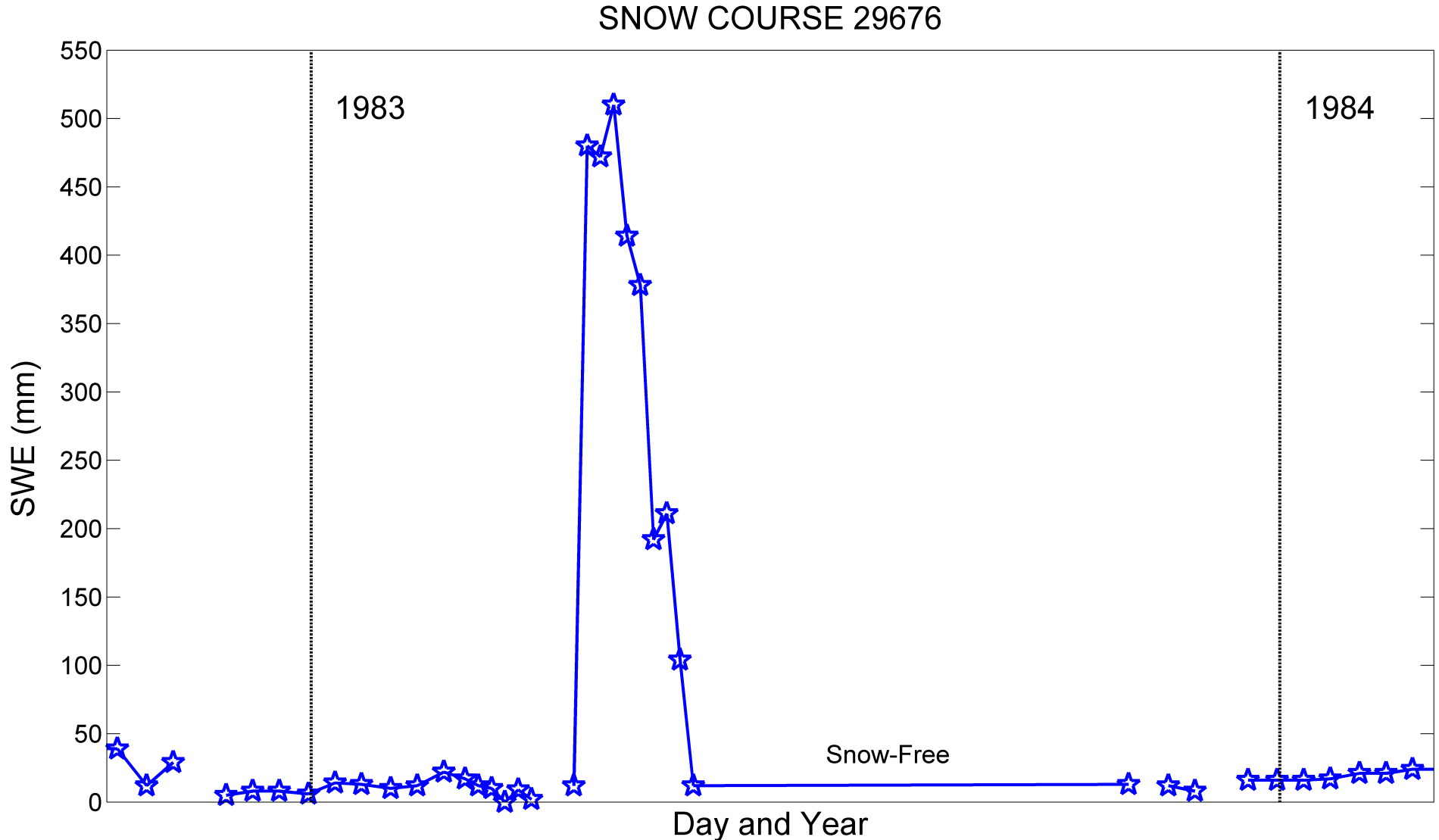
Example: WMO station 29676
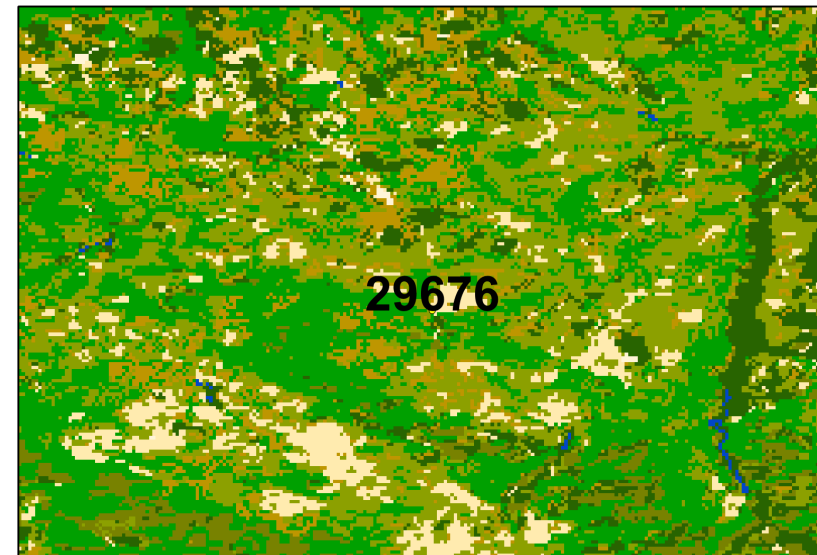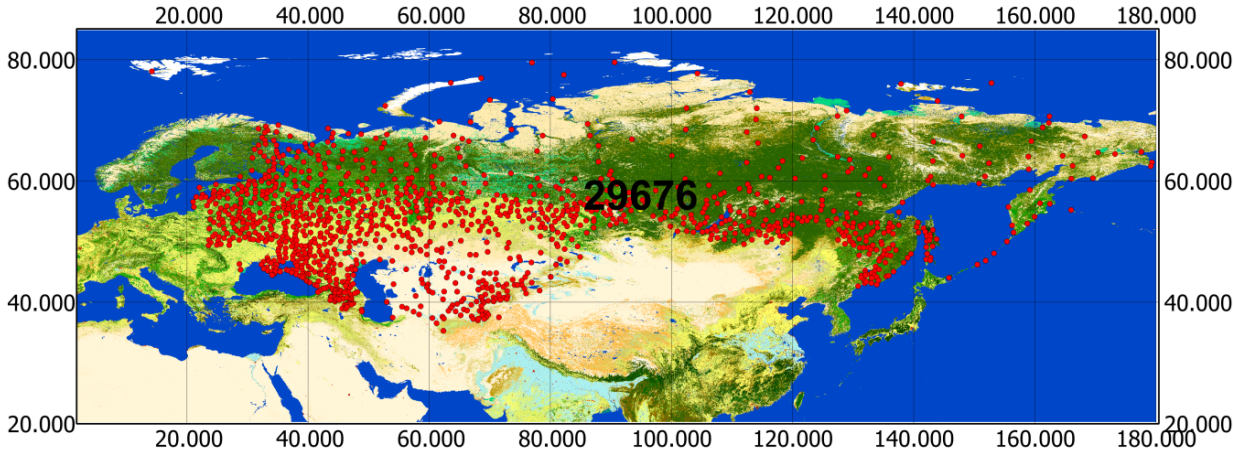
SWE time series since 1966

WMO Station 29676

SWE time series: zoom to 1983-1984


SNOW COURSE 29676

Snow cover satellite products

- GlobSnow development product: combined SWE & SE (Snow Extent)

- Starting from 1980 based on combined use of passive microwave data-based GlobSnow SWE CDR (reprocessed) and optical satellite data-based SE
    - Problems with SE product time-series
        - NOAA –CDR SE product first considered
            - Relibility problems concerning trends
    - => New JaXa SE product snow selected
    - Variational data assimilation with synoptic weather station observed single-point snow depth in generating SWE with passive microwave satellite data (GlobSnow methodology)

Influence of Observational Uncertainty on Determination of Trends 1981-2010

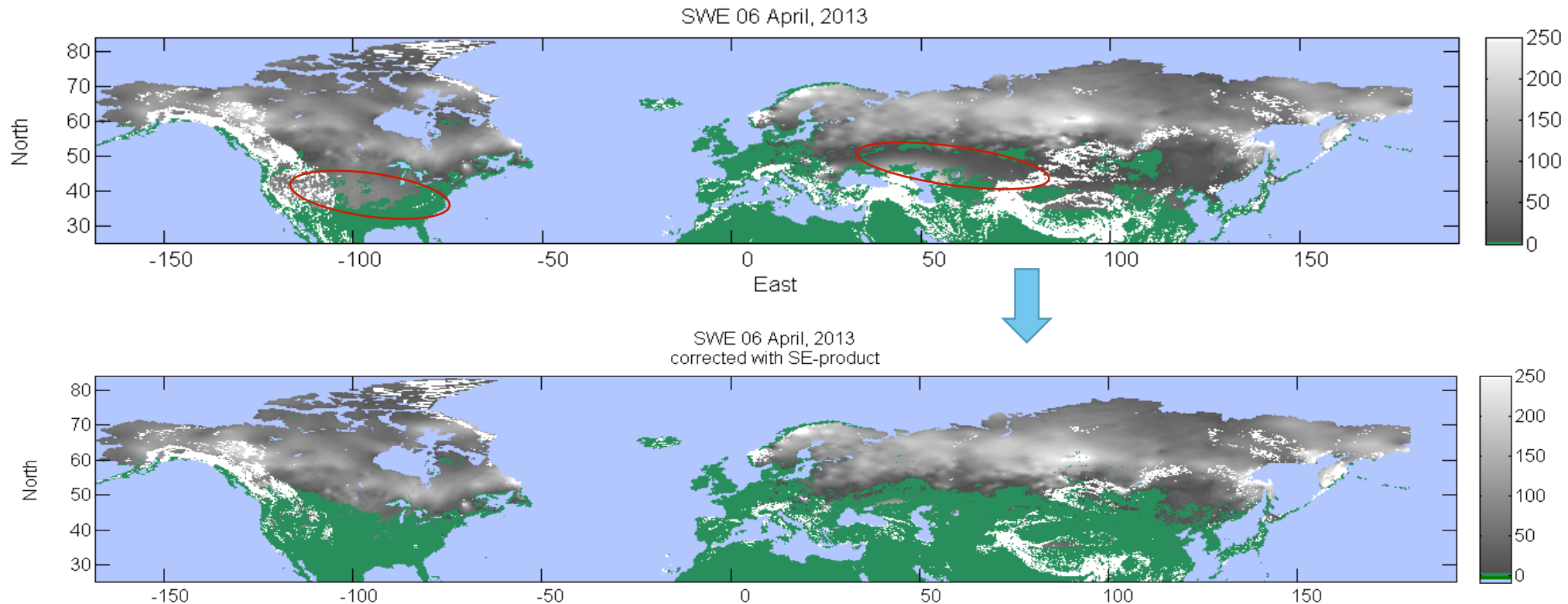Monthly NH surface temperature trends from CRU, NCDC, GISS and NCEP2m
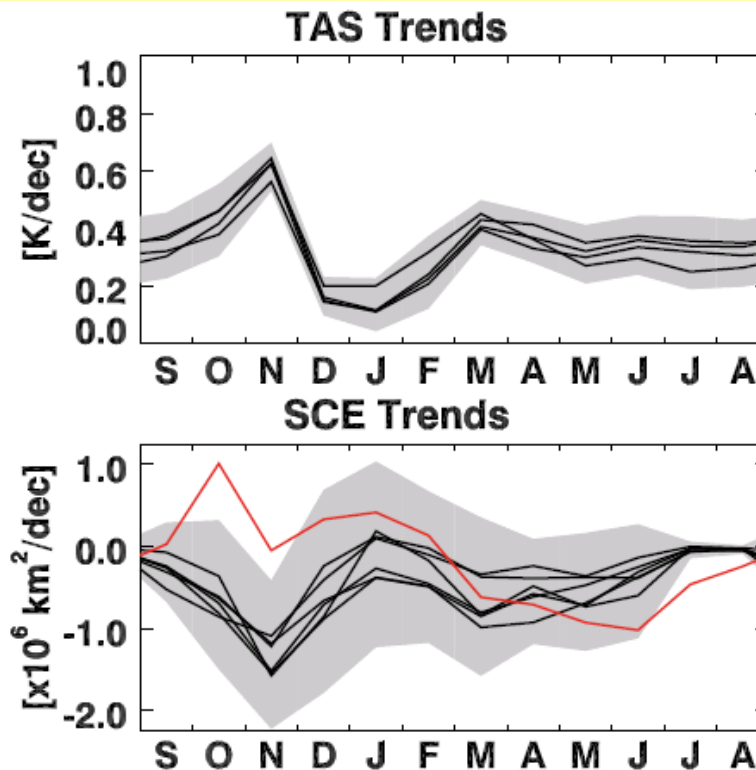
NOAA-CDR is outlier

Monthly NH snow cover trends from MERRA, ERA-I-Land, Crocus, GLDAS-2, Brown, GlobSnow, and NOAA

L. Mudryk, ECCC/CPS

Canada

Why optical SE is a useful addition to passive microwave data-based SWE/SE estimate information

GlobSnow SWE NRT-product has difficulties in detecting snow line in some cases
-> snow line identification from SE-product

Thank You for Your Attention!