

Snow cover prototype dataset in development and other activities of FMI for ERA-CLIM2

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



Task 3.3: Boundary constraints and external forcing

- 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, with documentation (FMI, months 7 to 24)
 - 3.19 Quality controlled version of snow data base (in situ) and snow data product (D3.18), with documentation (FMI, with RIHMI, months 25 to 36)

FMI contribution in practice

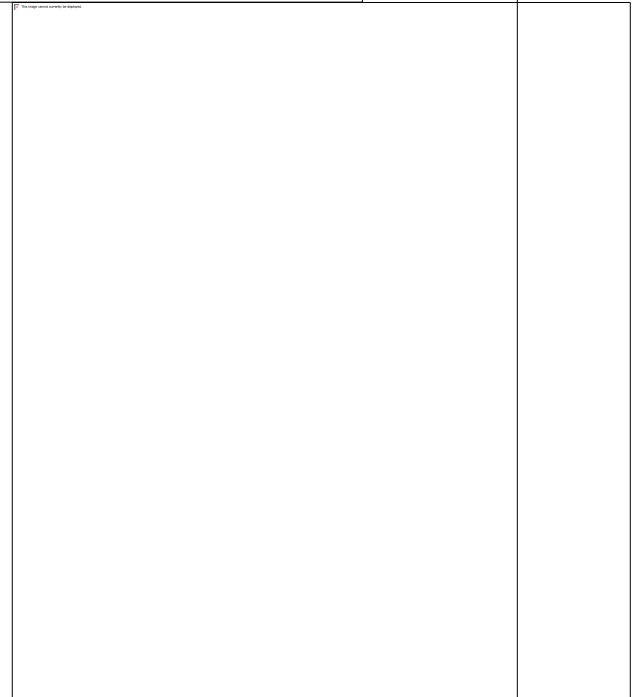
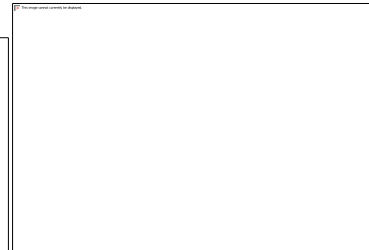
- Compilation of long-term in situ snow observations from different sources (up to ~100 years if possible and where possible)
 - Distributed snow course observations from Eurasia and North America on Snow Water Equivalent (SWE)
 - Point-wise weather station observations on Snow Depth (SD)
- Development of optimized spatio-temporal snow cover information starting from 1980 based on combined use of satellite data (passive microwaves and optical) and in situ data
 - GlobSnow-type variational data assimilation (method for SWE product)
 - Product neglecting in situ data can be provided as well

Compilation of long-term in situ snow observations



Snow course observation spatial coverage

- Distributed snow course observations from Finland and North-West Russia on Snow Water Equivalent (SWE)



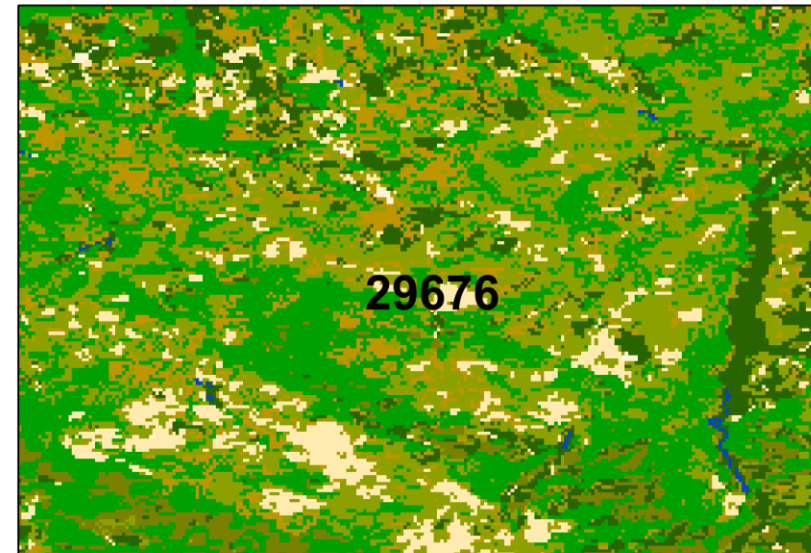
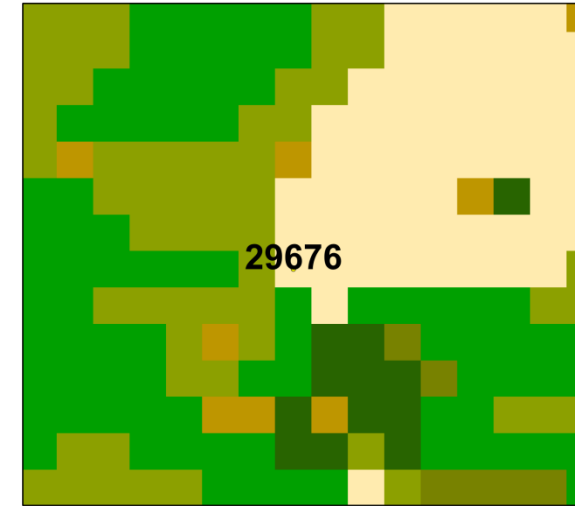


Snow courses at WMO stations and Finland

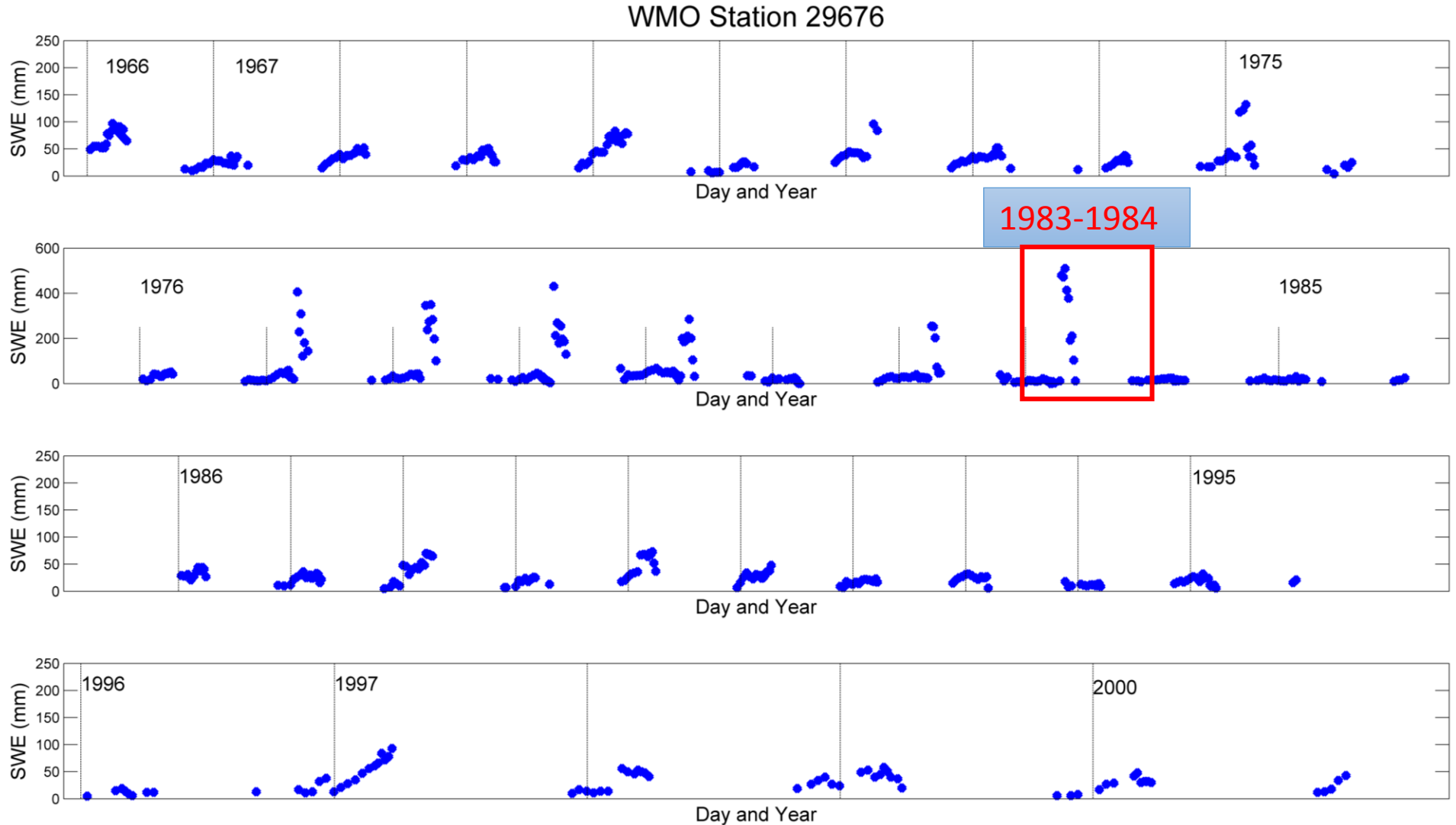
- Distributed snow course observations from Eurasia on Snow Water Equivalent (SWE), Snow Depth (SD) and density
- 
- 

SWE time series: WMO station 29676

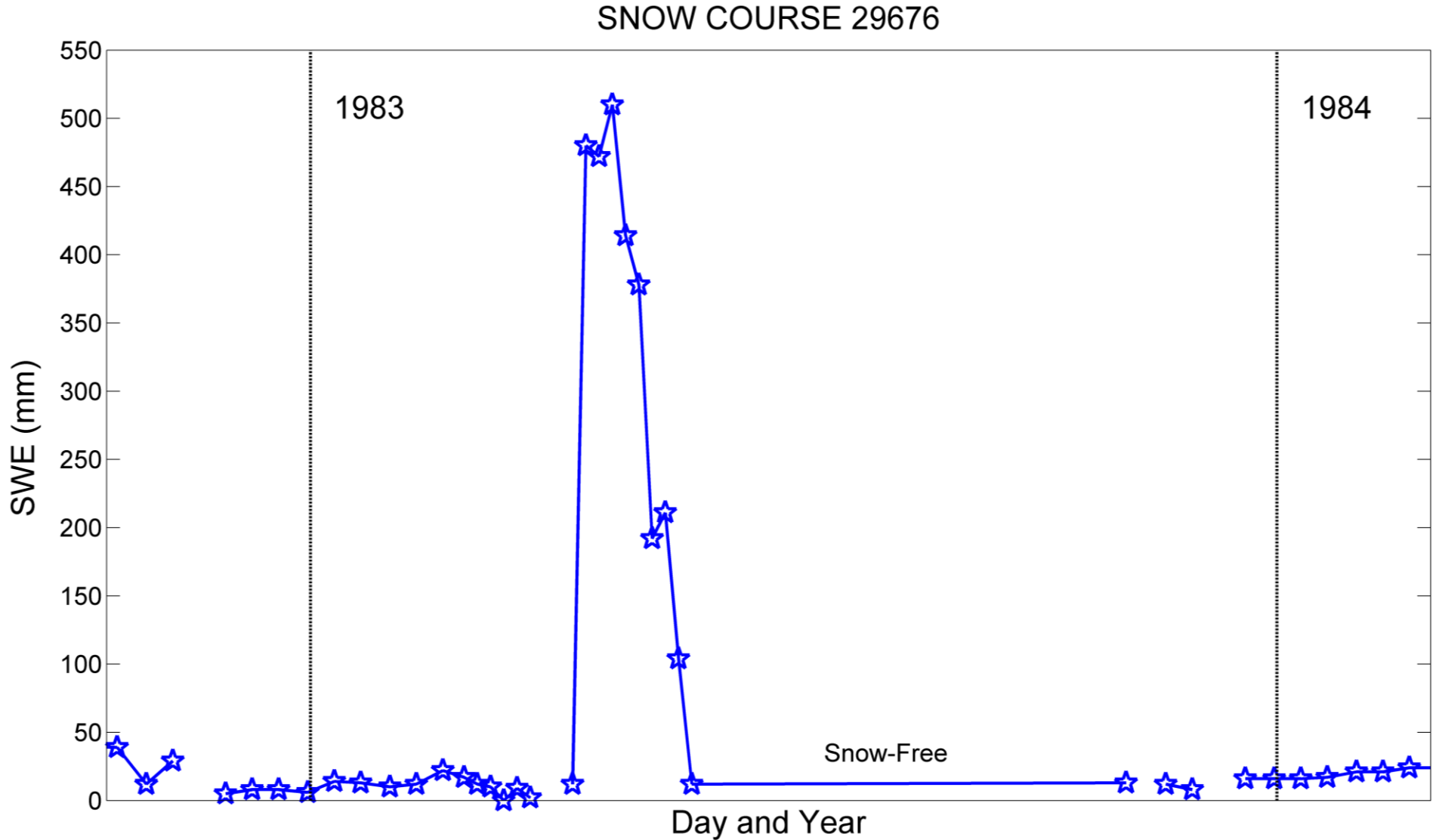
Field No	Contents
1	WMO station index
2	Year
3	Month
4	Day
5	Path type: 1 - field environment; 2 - forest environment; 3 - rawine (canions)
6	Day of path observations
7	Snow cover depth average (sm)
8	Snow density (g/sm ³)
9	Water equivalent of snow cover (mm)
10	General water amount (mm)
11	Flag for snow cover depth and snow density (Attention: this field reserved for the future expansions of coded situations)



SWE time series since 1966



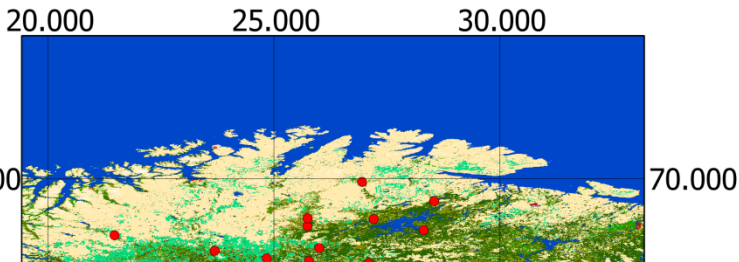
SWE time series: zoom to 1983-1984



Finnish Snow courses

Snow Water Equivalent (SWE)

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



Example: snow course in
Tähtelä, Sodankylä

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)***

Snow courses near WMO stations

Snow Water Equivalent (SWE)

- 1966-2009
- Over 700 000 observations


INTAS-SCCONE data extended to year 2009

Extension 2000-2009





Prototype SWE dataset: Distribution for all data 1966-2009

- Total number of WMO weather stations over 1300
 - Time period 1966-2009 (10 stations in Finland until 2014)
 - Total number of observations over 700 000
 - Variables
 - Snow Water Equivalent (SWE)
 - Snow Dept (SD)
 - Snow Density
- 

Point-wise Snow Depth 1881-2001

Total number of observations over 5 million

Max. 80 000 observations yearly



Prototype point-wise SD dataset: Distribution for all data 1881-2001

- Total number of WMO weather stations 223
- Total number of observations over 5 million
- Variables
 - Snow Dept (SD)
 - Fractional Snow Cover information
- Data origin: Former Soviet Union (FSU)
- Currently archived in FMI database

Distributed snow courses

Course	LAT	LON	DOY	SWE	RHO	SD	Julian Day	Year

- Code -99 for missing data
- Separate metadata file
- DOY and Julian day included
- WGS-84 latitude and longitude in decimal degrees

Point-wise SD

Station	LAT	LON	DOY	SD	FSC	SD Flag	Julian Day	Year

- Code -99 for missing data
- Separate metadata file
- DOY and Julian day included
- WGS-84 latitude and longitude in decimal degrees



Development of snow data product (satellite and in situ data)

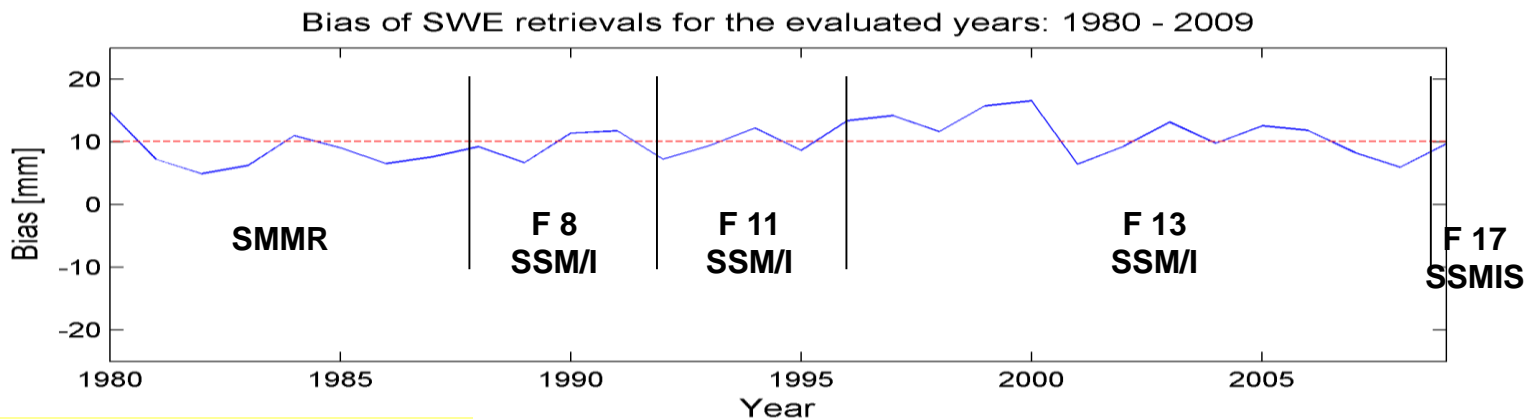
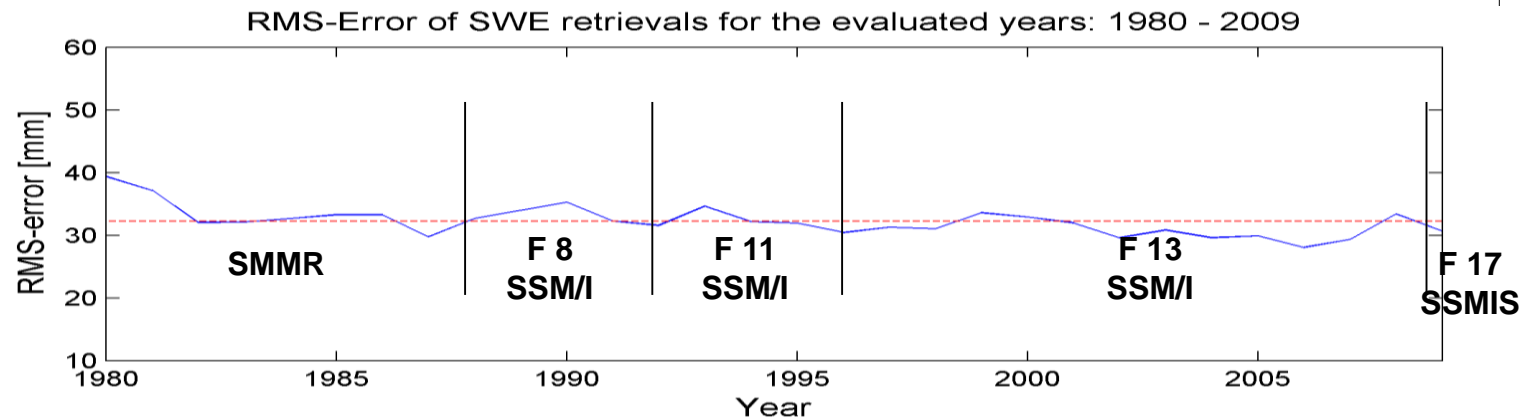
- GlobSnow development product: combined SE & SWE
- Starting from 1980 based on combined use of passive microwave GlobSnow SWE CDR reprocessed product and optical NOAA Snow CDR and in situ data
 - GlobSnow-type variational data assimilation (method for SWE product)
 - Product neglecting in situ data can be provided as well i.e. GS data with no weather station data as input

30 year-long CDR time series on snow conditions of Northern Hemisphere

- First time reliable daily spatial information on SWE (snow cover):
 - Snow Water Equivalent (SWE)
 - Snow Extent and melt (+grain size) 25 km resolution (EASE-grid)
 - Time series for 1979-2012
- Passive microwave radiometer data combined with ground-based synoptic snow observations
 - Variational data-assimilation
- Available at open data archive:
www.globsnow.info
- Demonstration of NRT processing since October 2010 (Greenland, glaciers & mountains masked out)

Long term consistency of SWE v2.0 FPS

- RMS error and retrieval bias calculated independently for each year 1980-2009
- Reference data: snow courses from Russia (INTAS-SCCONE)



SWE < 150 mm; 146.000 samples

Fusion of GlobSnow SE and SWE product for concise snow cover 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!