Vienna University of Technology
Institute of Photogrammetry and Remote Sensing

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Comparison of 2 approaches for freeze/thaw detection from ASCAT data.

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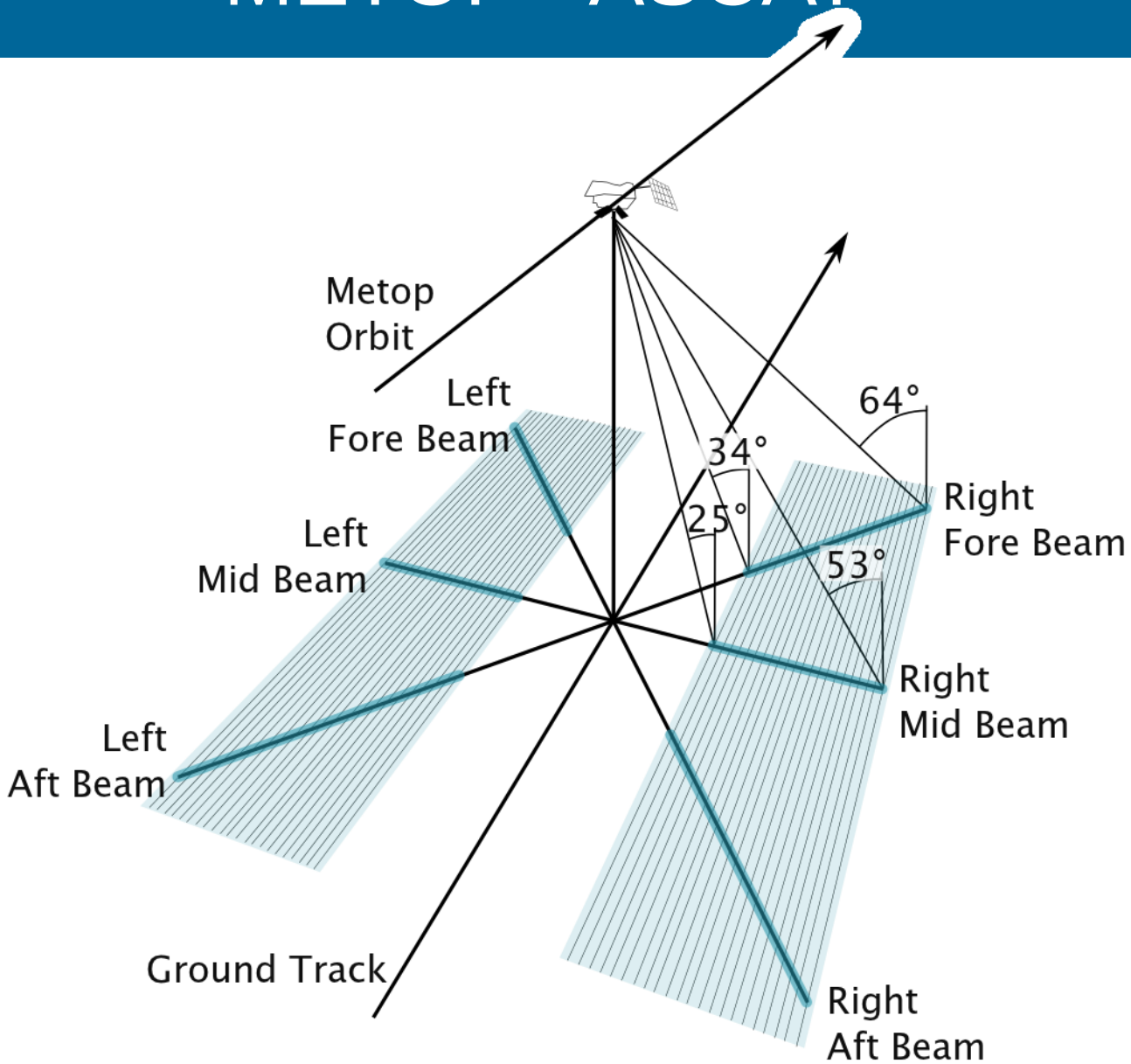
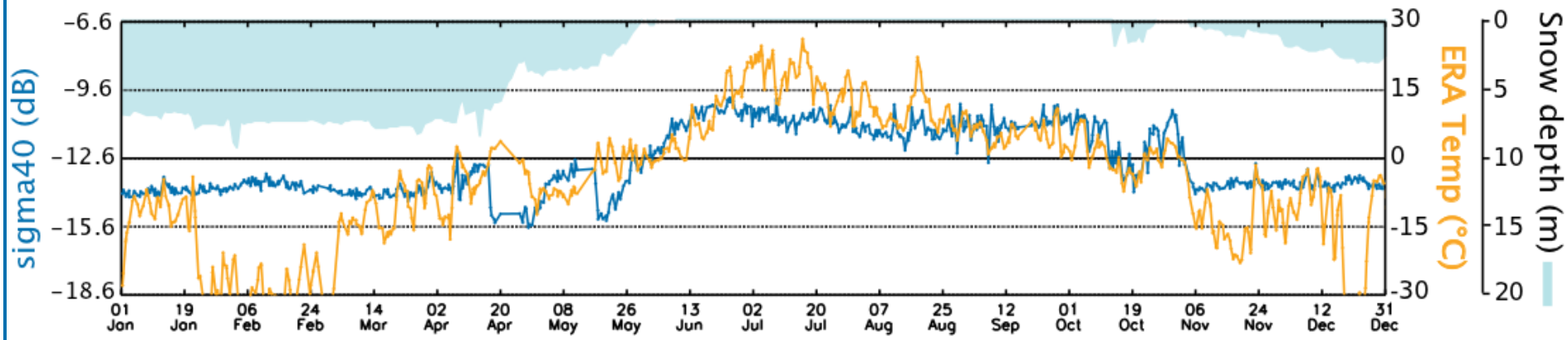
Freeze Thaw State

- Hydrological cycle
- Plant growth season
- Global carbon and methane budgets
- Flagging of soil moisture measurements

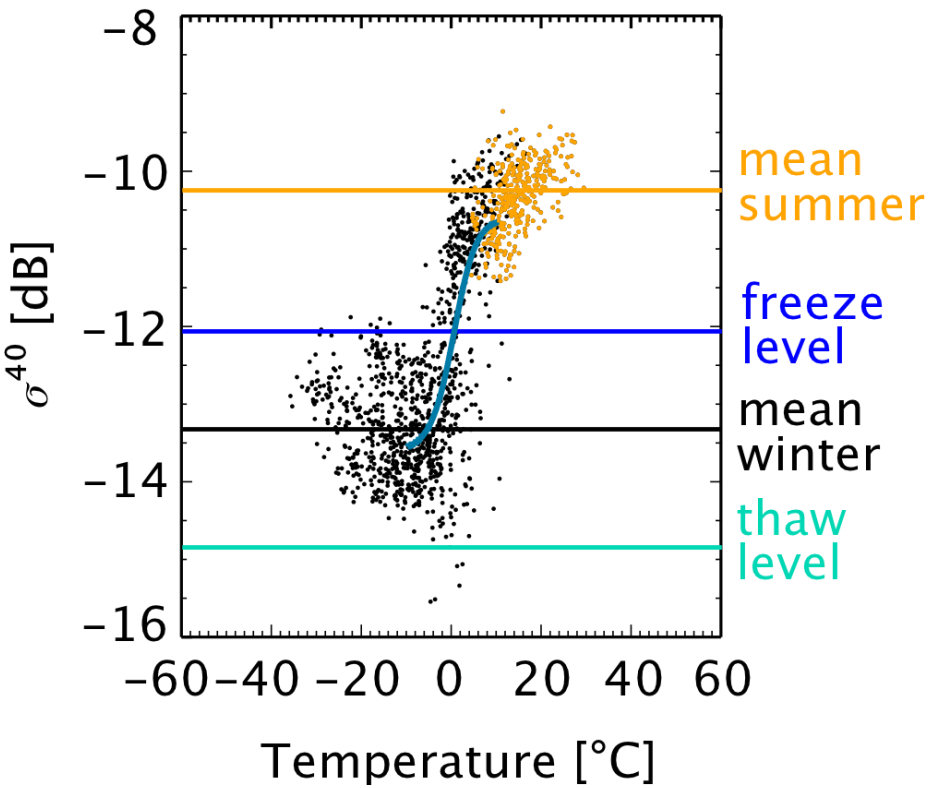
METOP - ASCAT

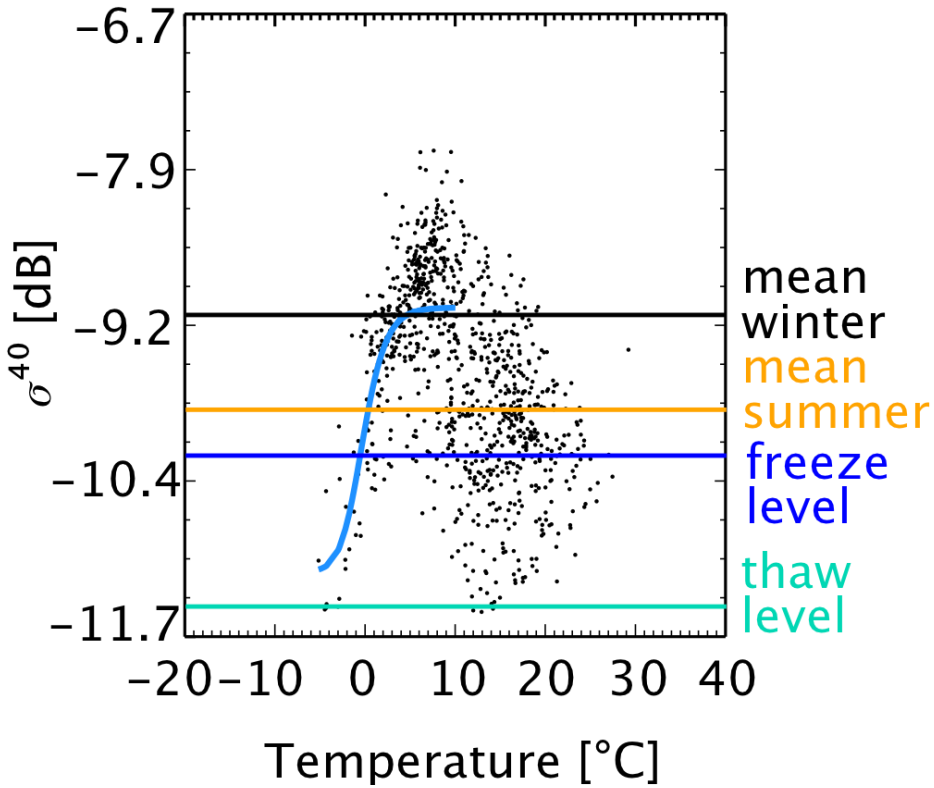

Metop
Orbit
Left
Fore Beam
Left
Mid Beam
Left
Aft Beam
Ground Track
34°
25°
64°
53°
Right
Fore Beam
Right
Mid Beam
Right
Aft Beam

Backscatter behaviour



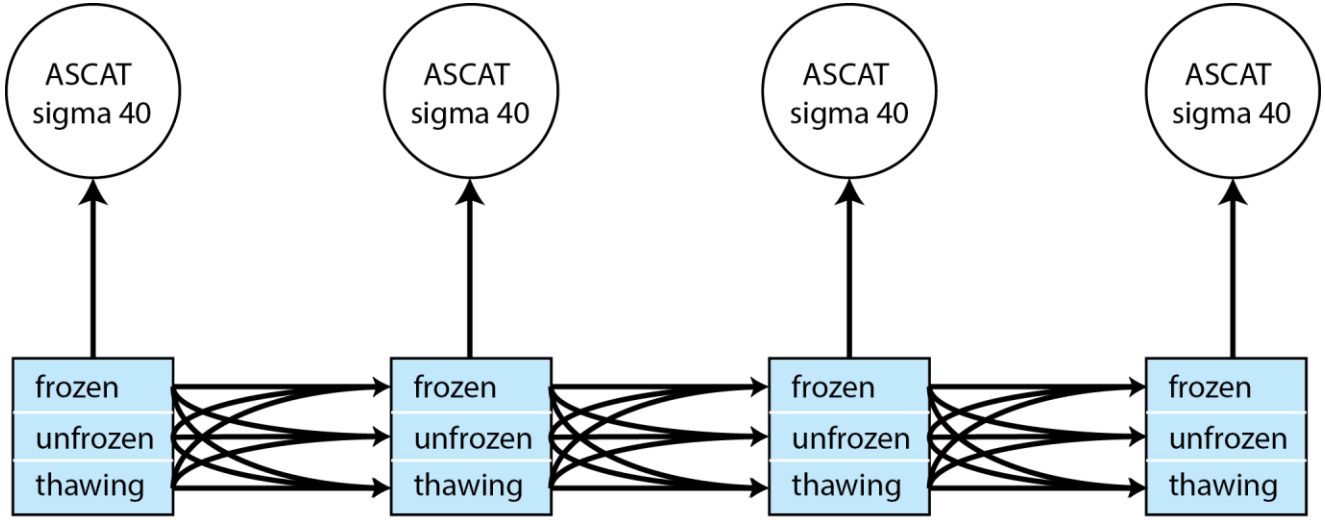
Decision Tree method





Naeimi, V., Paulik, C., Bartsch, A., Wagner, W., Member, S., Kidd, R., Park, S., et al. (2012). **ASCAT Surface State Flag (SSF): Extracting Information on Surface Freeze/Thaw Conditions From Backscatter Data Using an Empirical Threshold-Analysis Algorithm.** IEEE Transactions on Geoscience and Remote Sensing.

HMM method



$$\begin{pmatrix} \exp(aT) & \exp(\alpha T) & \exp(aT) \\ \exp(bT) & \exp(\beta T) & \exp(bT) \\ \exp(cT^2 + dT) & \exp(\gamma T^2 + \delta T) & \exp(cT^2 + dT) \end{pmatrix}$$

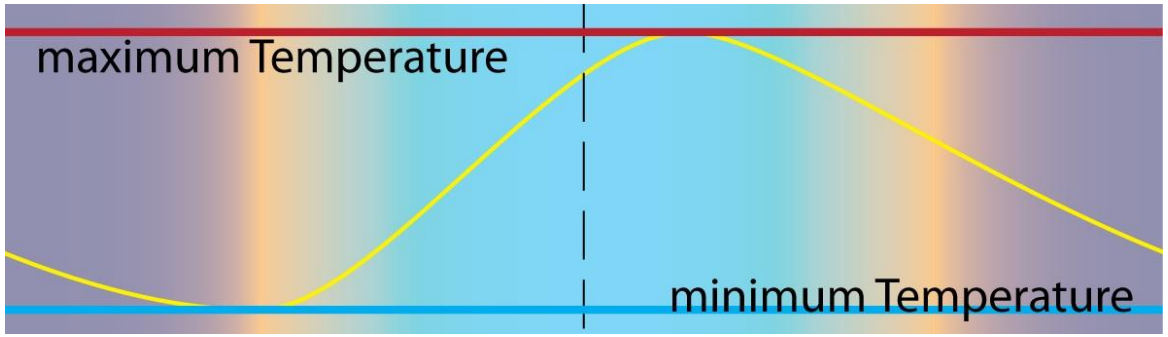
ERA-Interim Temperature T

Validation strategy

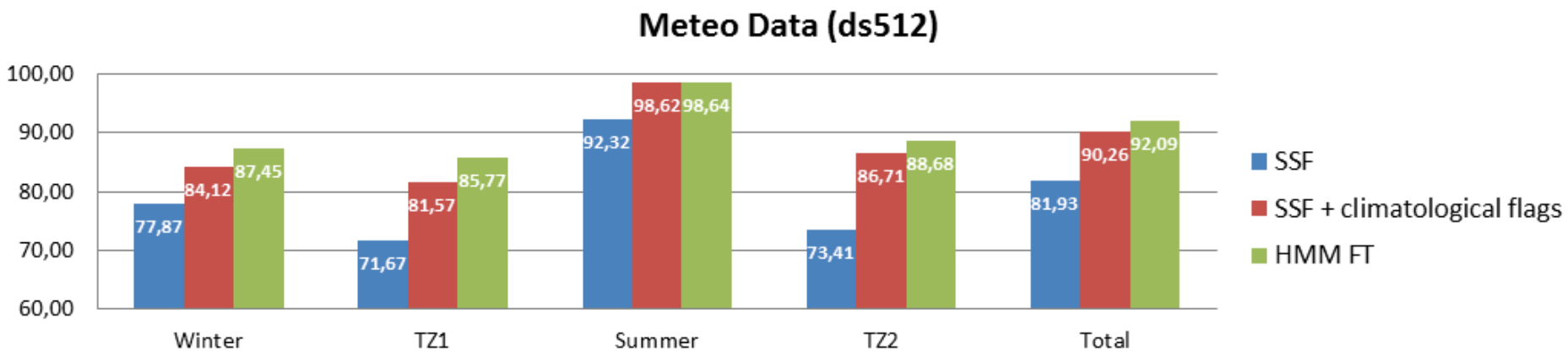
Compare Surface State Flag (SSF) and Temperature Data

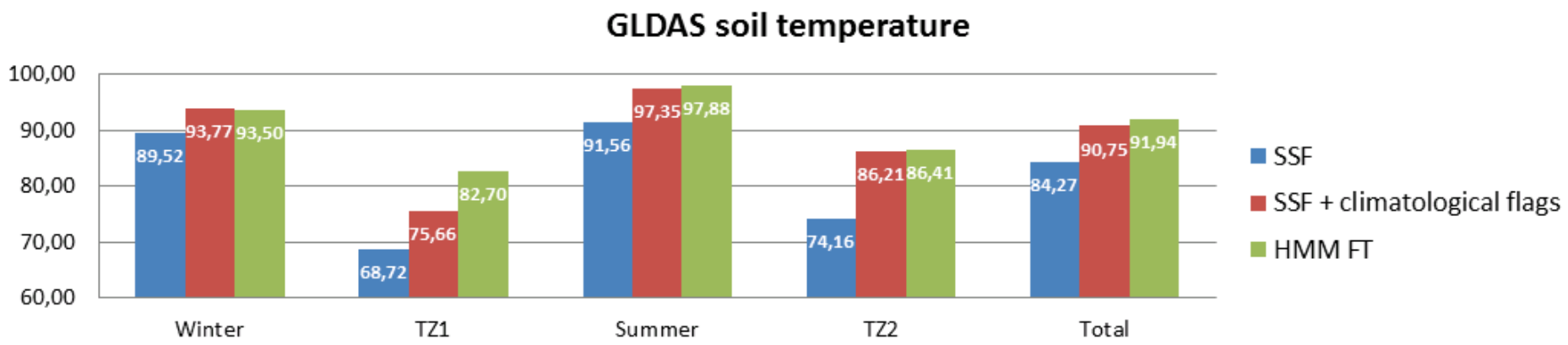
Flag Value	255	0	1	2	3
Surface State	Not valid	unknown	unfrozen	frozen	Temporary water surface/melting condition

Class	Agreement	Disagreement
Condition	Temperature < 0°C and SSF 2 Temperature > 0°C and SSF 1/3	Temperature < 0°C and SSF 1/3 Temperature > 0°C and SSF 2

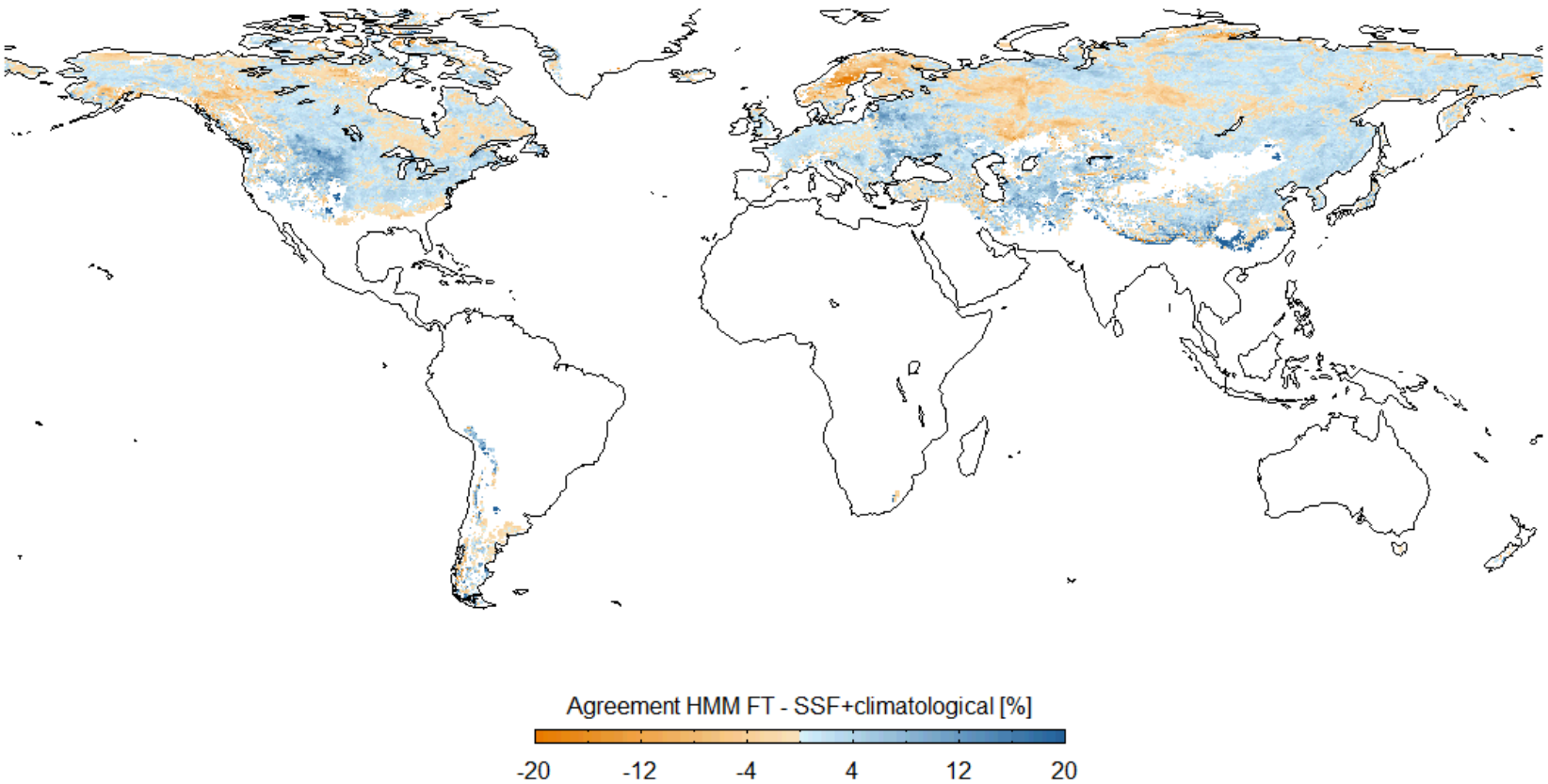


Agreement with temperature data





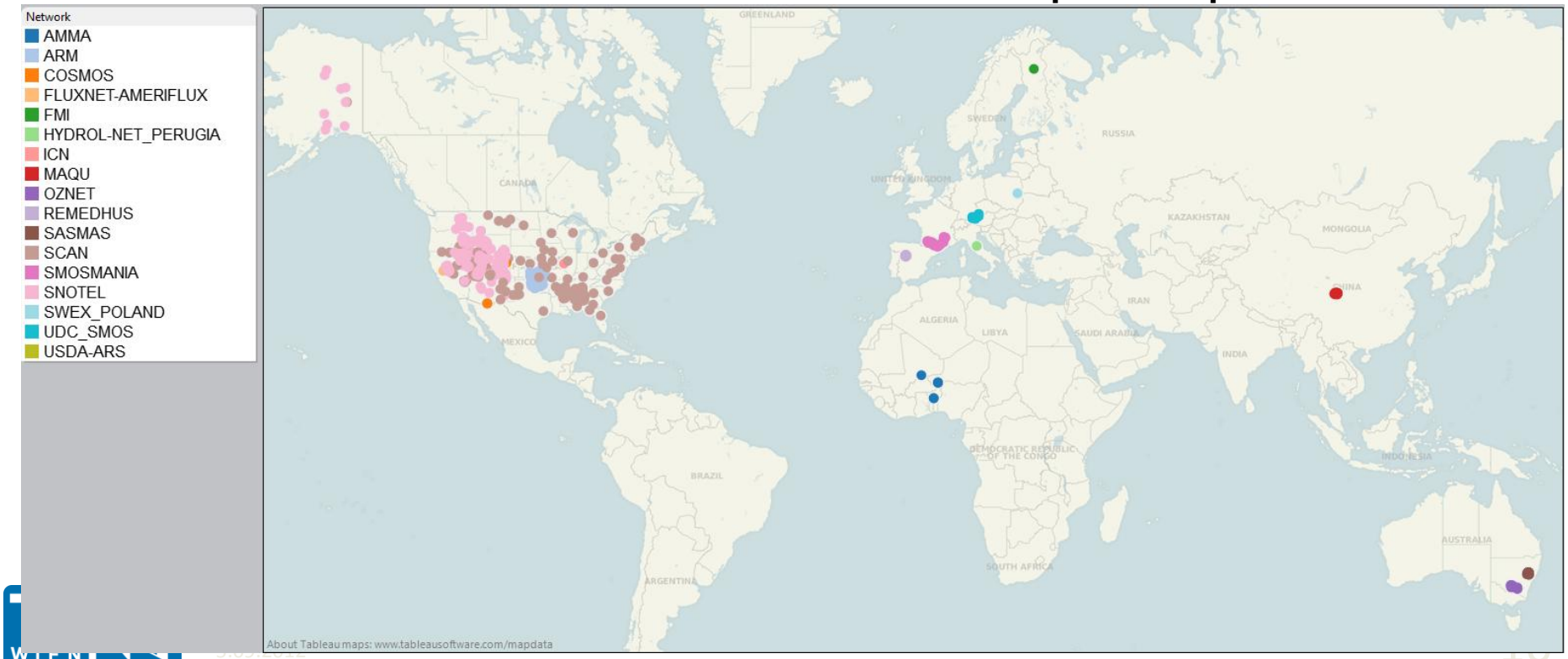
Difference



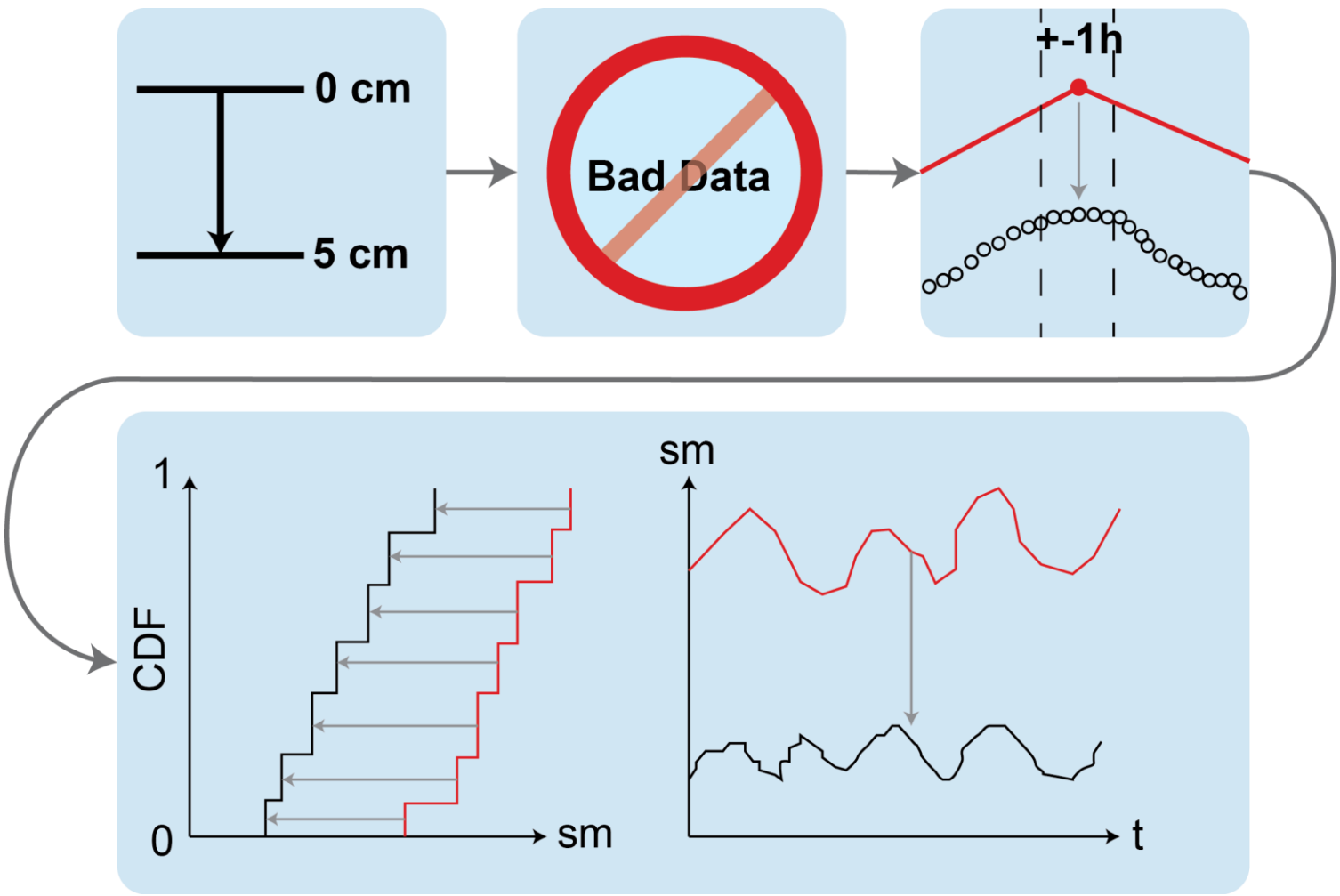
Influence on soil moisture retrieval

- Data from ISMN
  - 17 Networks
    - 500 Stations

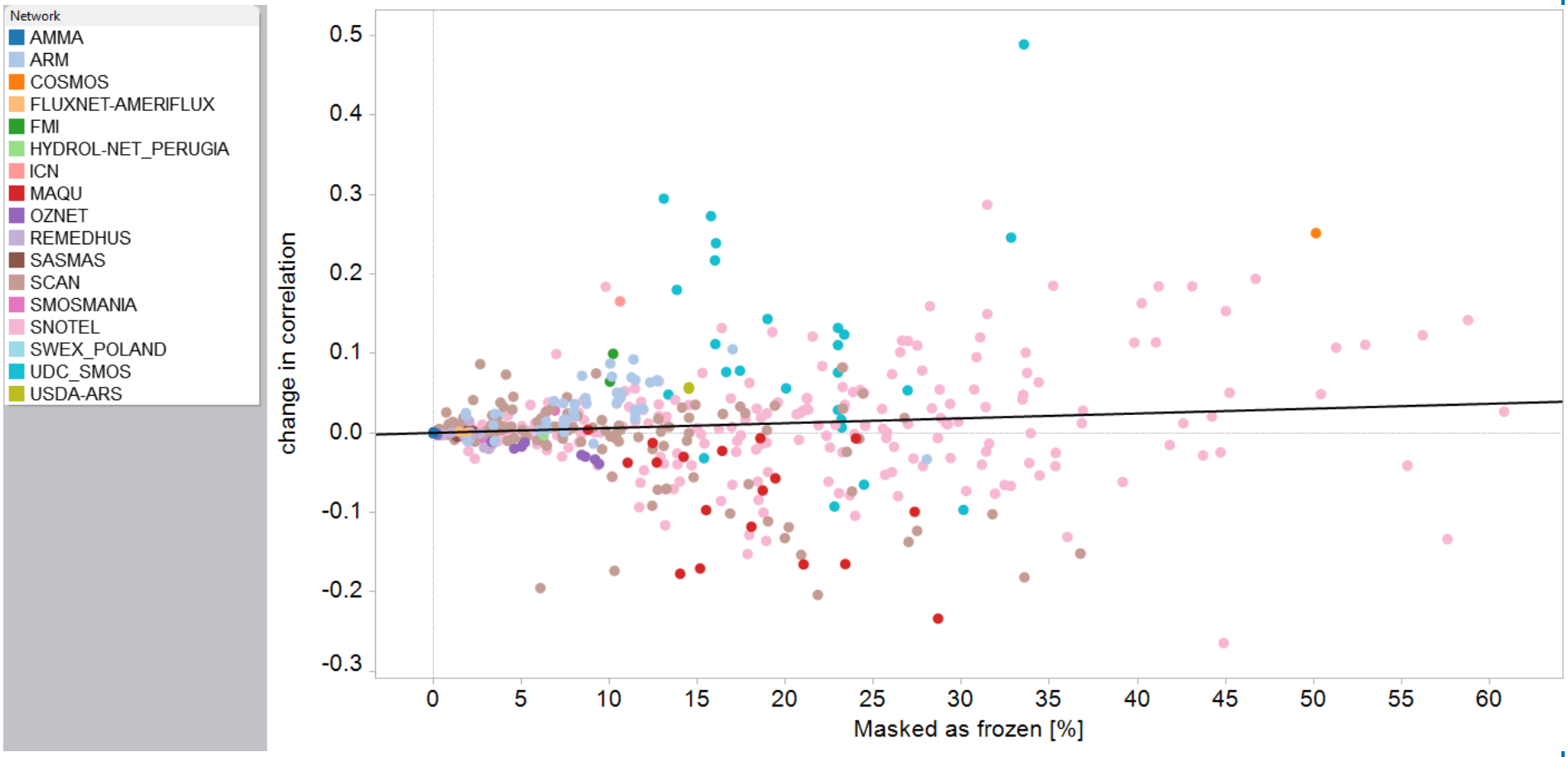
http://www.ipf.tuwien.ac.at/insitu/



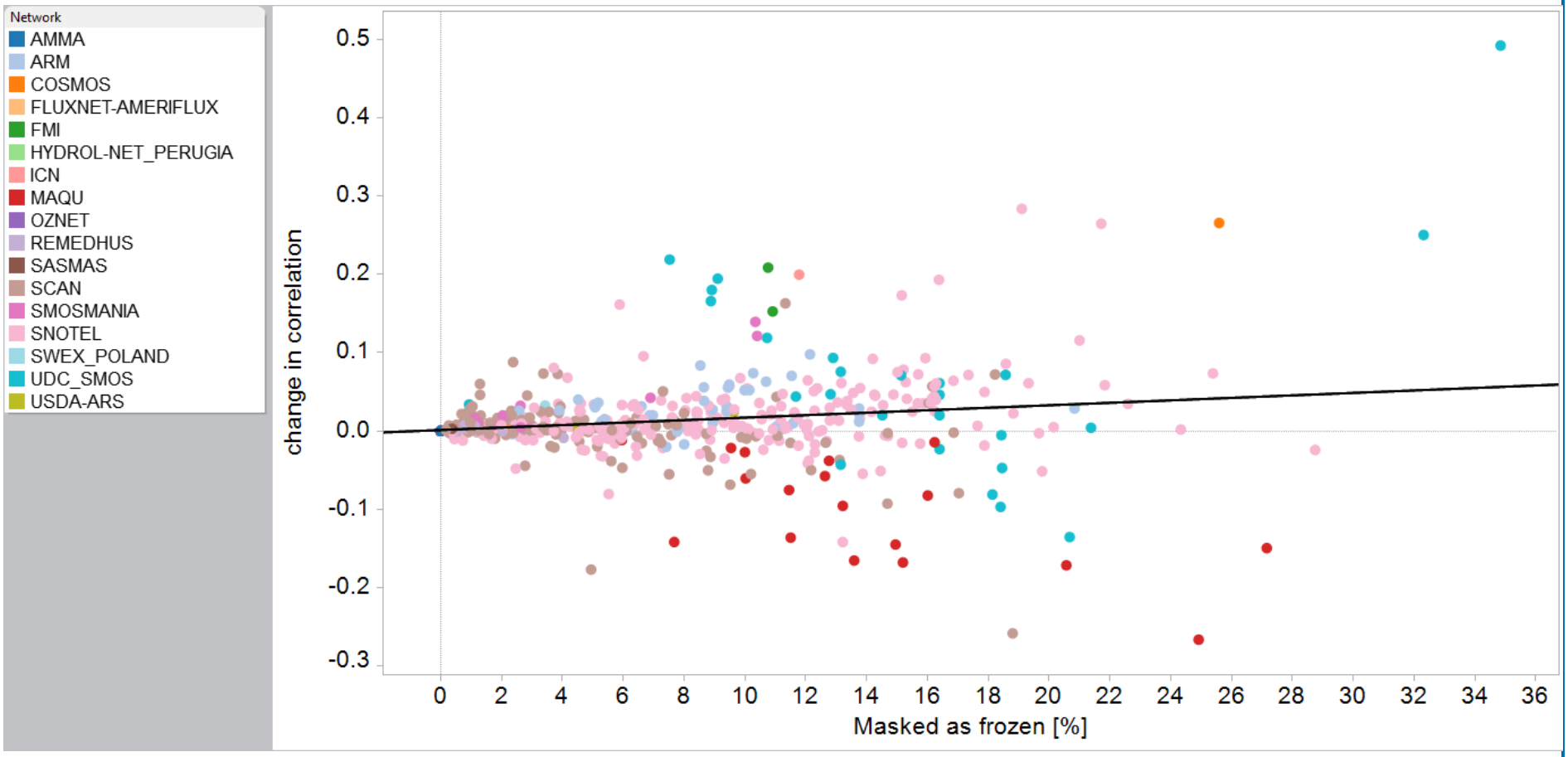
Influence on soil moisture retrieval



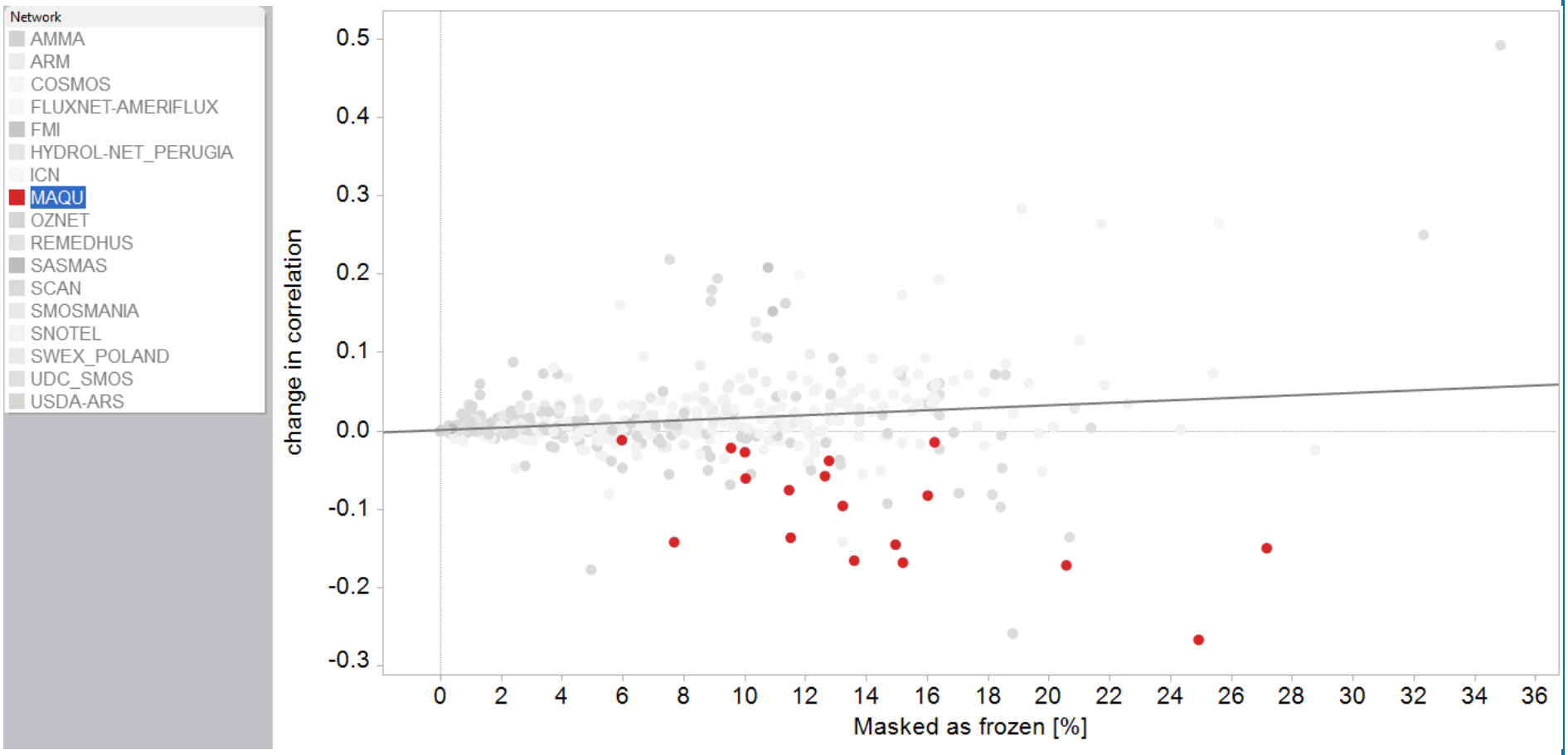
Surface State Flag + climatology vs. No FT



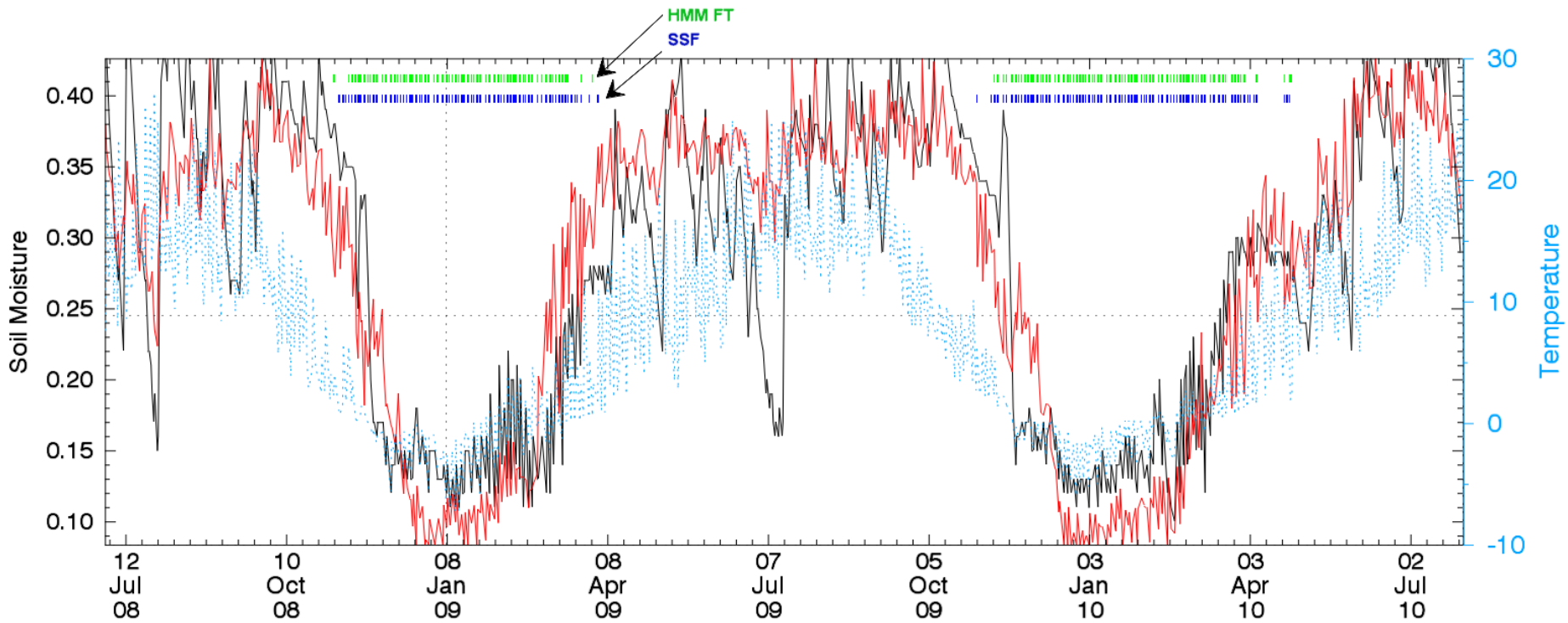
HMM FT vs. No FT



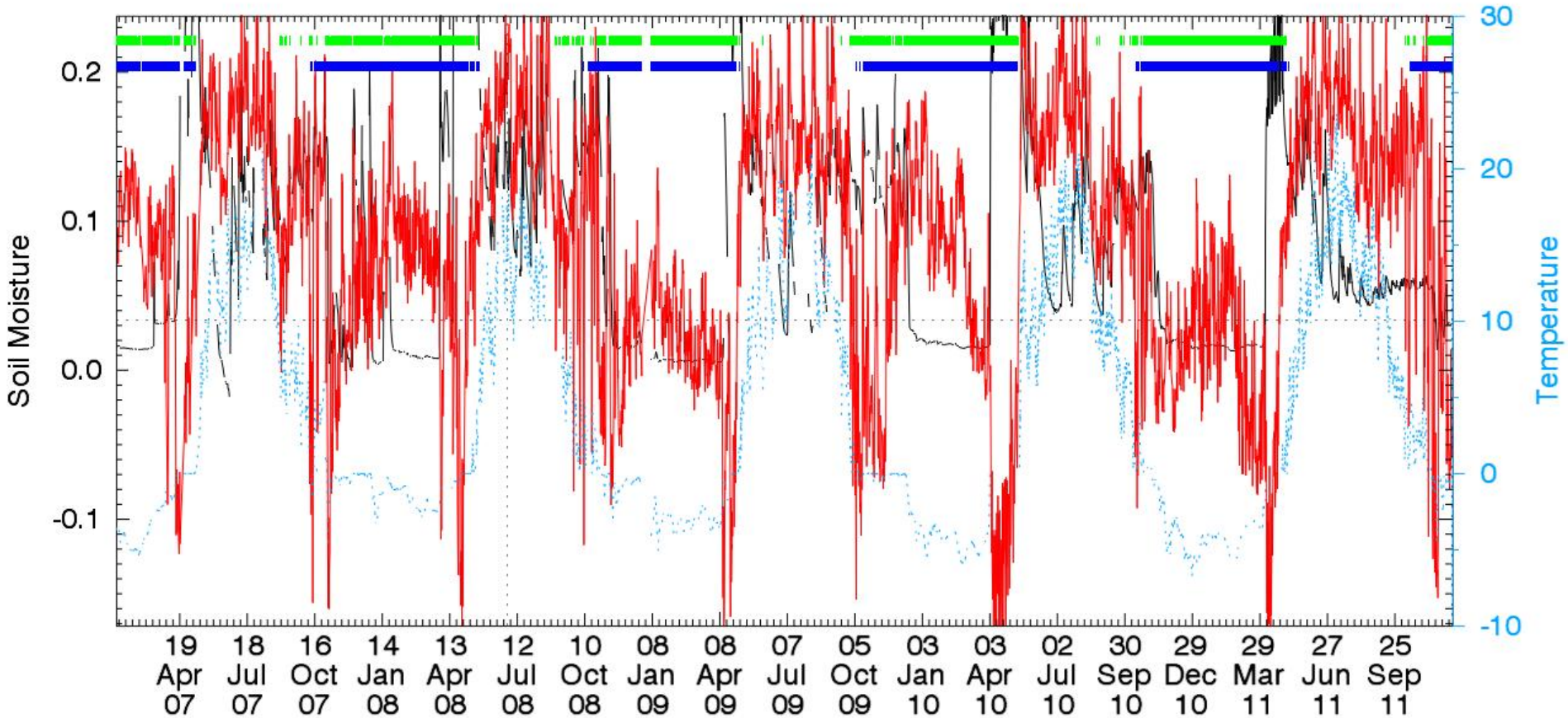
HMM FT vs. No FT



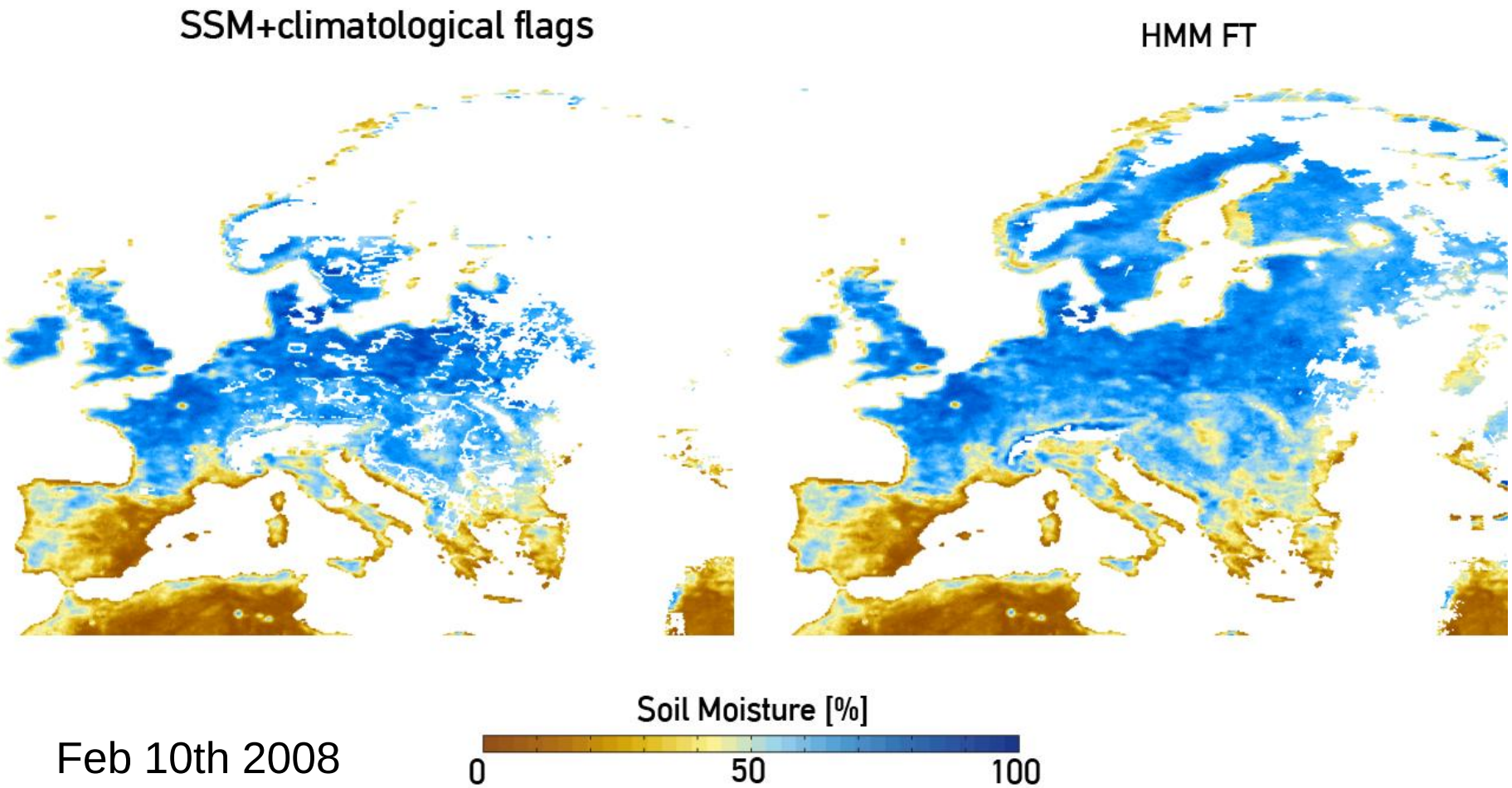
MAQU – NST_13


HMM FT
SSF
Soil Moisture
0.40
0.35
0.30
0.25
0.20
0.15
0.10
Temperature
30
20
10
0
-10
12 Jul 08
10 Oct 08
08 Jan 09
08 Apr 09
07 Jul 09
05 Oct 09
03 Jan 10
03 Apr 10
02 Jul 10

FMI Maws


Soil Moisture
0.2
0.1
0.0
-0.1
Temperature
30
20
10
0
-10
19 Apr 07
18 Jul 07
16 Oct 07
14 Jan 08
13 Apr 08
12 Jul 08
10 Oct 08
08 Jan 09
08 Apr 09
07 Jul 09
05 Oct 09
03 Jan 10
03 Apr 10
02 Jul 10
30 Sep 10
29 Dec 10
29 Mar 11
27 Jun 11
25 Sep 11

Consistency



Feb 10th 2008

Conclusions

- Validation of Freeze/Thaw products is problematic
- Operational use in soil moisture flagging demands global coverage
- Both algorithms have issues over certain areas
- HMM FT method provides stable results
  - Computational expensive
  - Needs temperature timeseries (NRT)
  - Parametrization needs fine tuning
  - Trial with soil temperature instead of air temperature
- SSF+climatological flags
  - No fitting of logistic function leads to inconsistent flagging
  - Investigate problems in spring

Thank you