Potential of AMSR-2 emissivity for Freeze/Thaw states detection

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Freeze/Thaw detection from Tbs

$$TbP = Tsurf \times emisP \times e^{-\tau(0,H)/\mu} + Tatm\_down \times (1 - emisP) * e^{-\tau(0,H)/\mu} + Tatm\_up$$

$$\Delta T_{bp}(x,t) = \frac{(T_{bp}(x,t) - \mathrm{FrozRef}(x))}{(\mathrm{ThawRef}(x) - \mathrm{FrozRef}(x))}$$

Atmospheric effects could be significant with Tbs.

Emissivity is free from temperature and atmospheric effects.

Tbs exhibit diurnal variations, but emissivities don't.

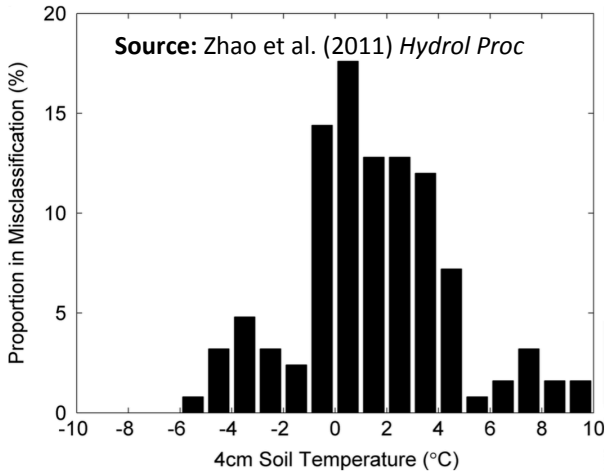


Figure 8. Frequency histogram of 4-cm soil temperature in misclassifications

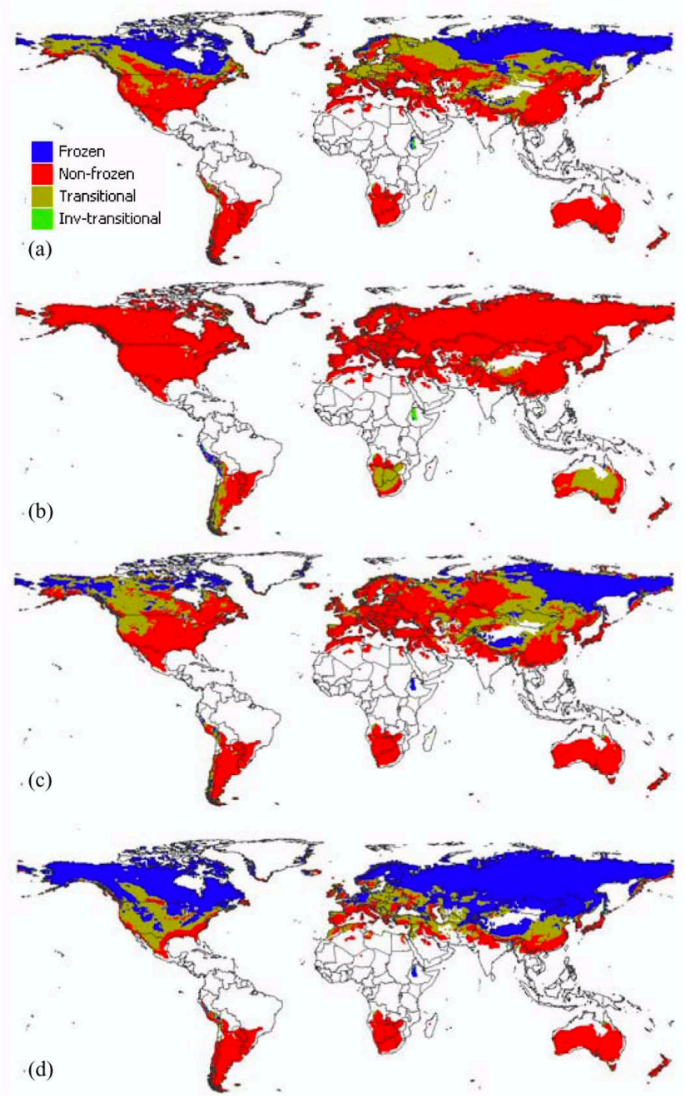
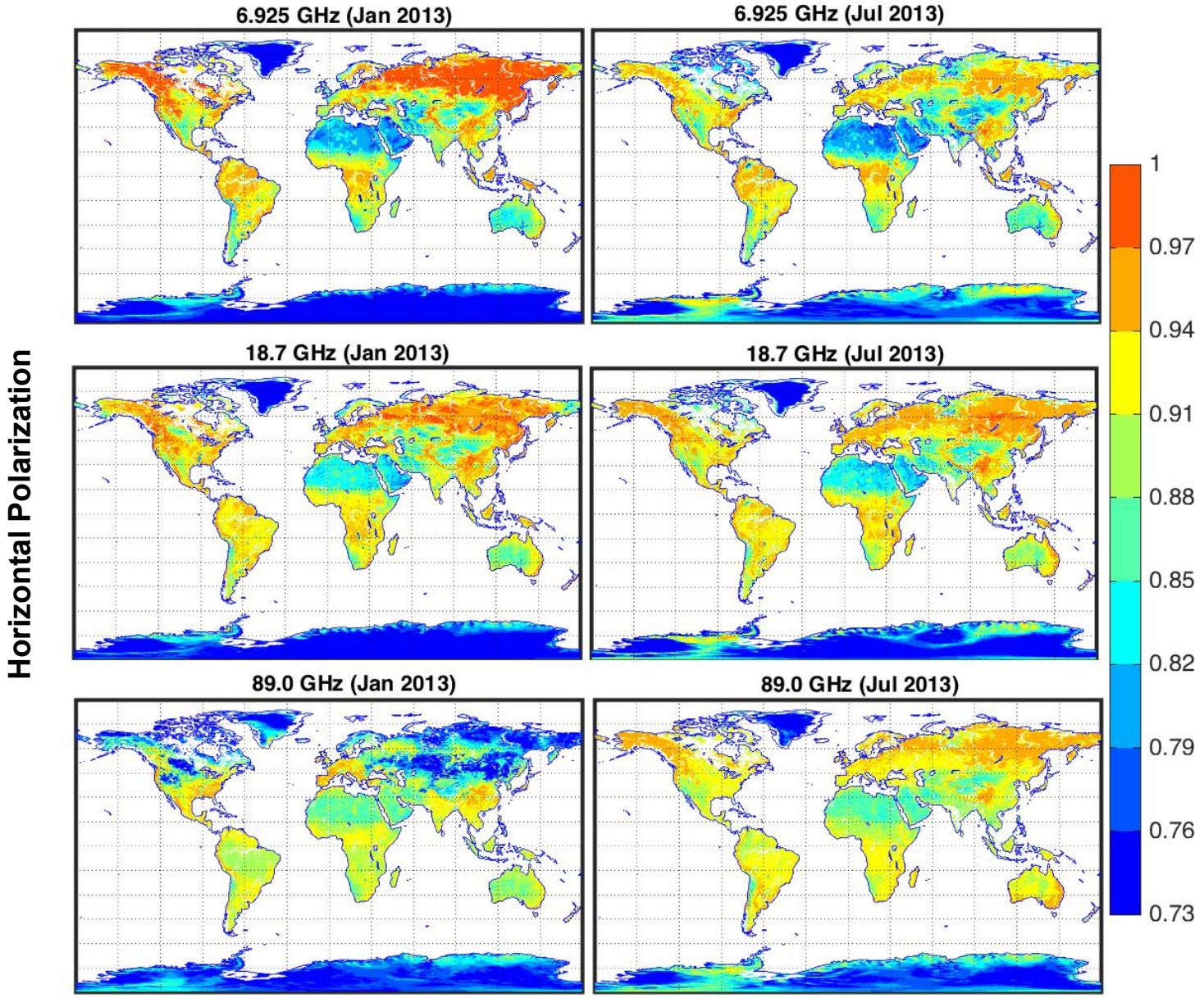


Fig. 6. Selected daily combined SSM/I F/T classification results for 2004, where (a) DOY (Day of Year) = 100, (b) DOY = 200, (c) DOY = 300, and (d) DOY = 360. Areas in white are outside the FT_ESDR domain.

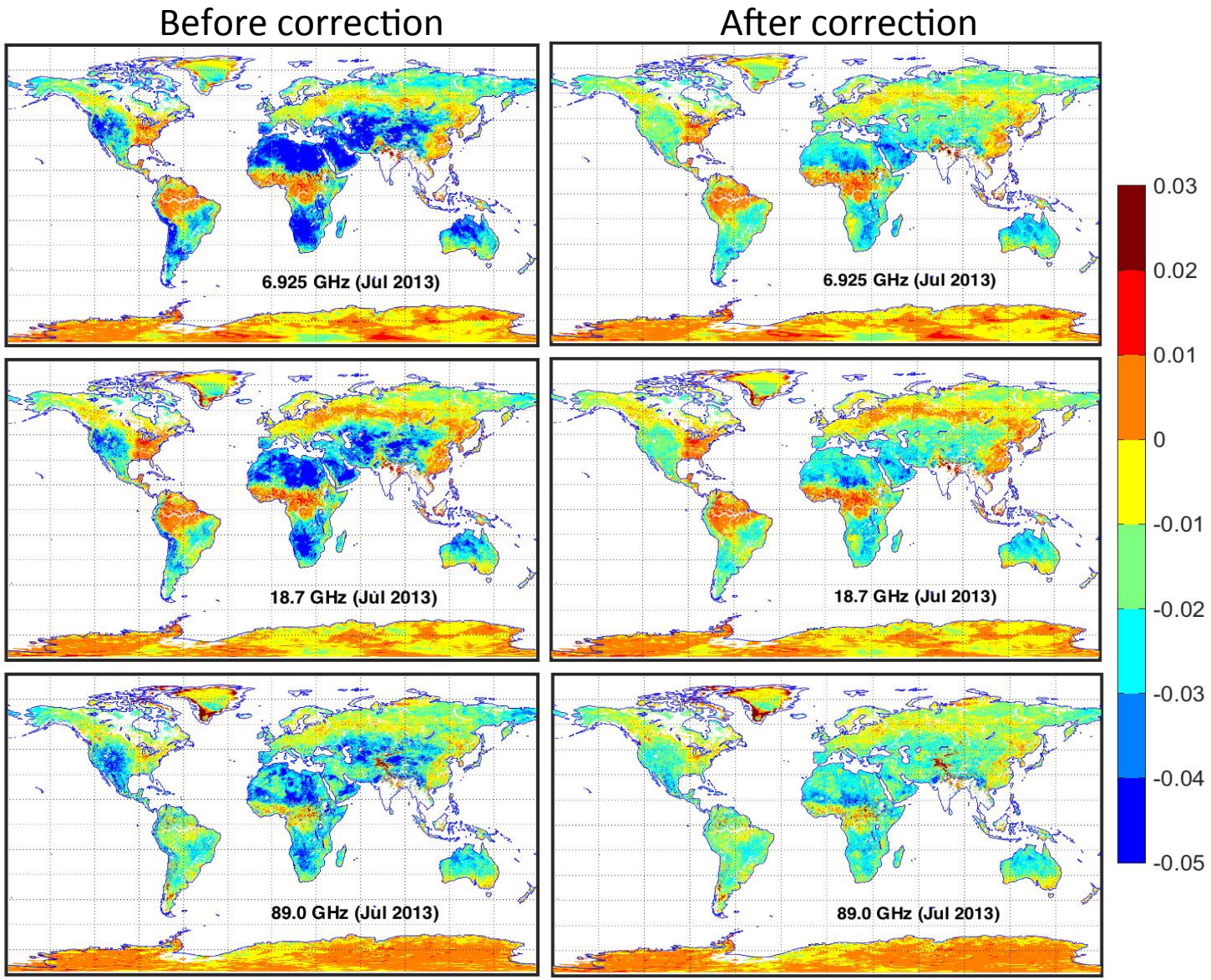
Source: Kim et al. (2011) *IEEE TGRS*

Land emissivity retrieval from AMSR-2



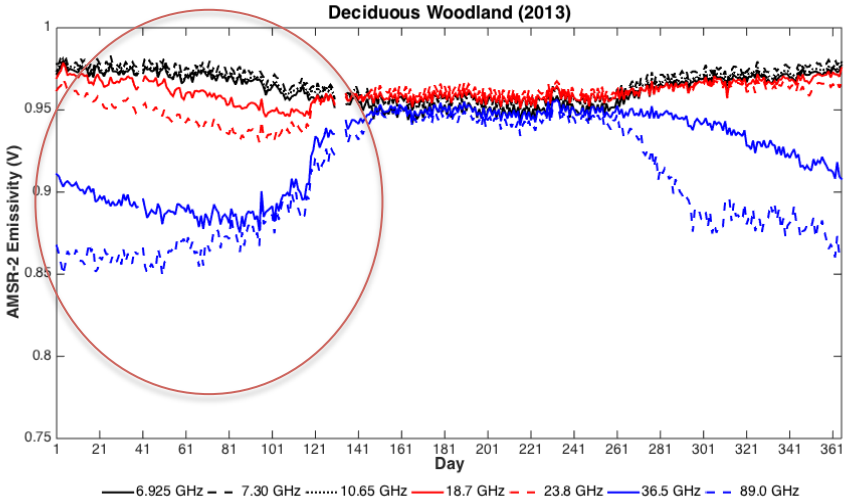
Norouzi et al. (2015) *to be submitted*

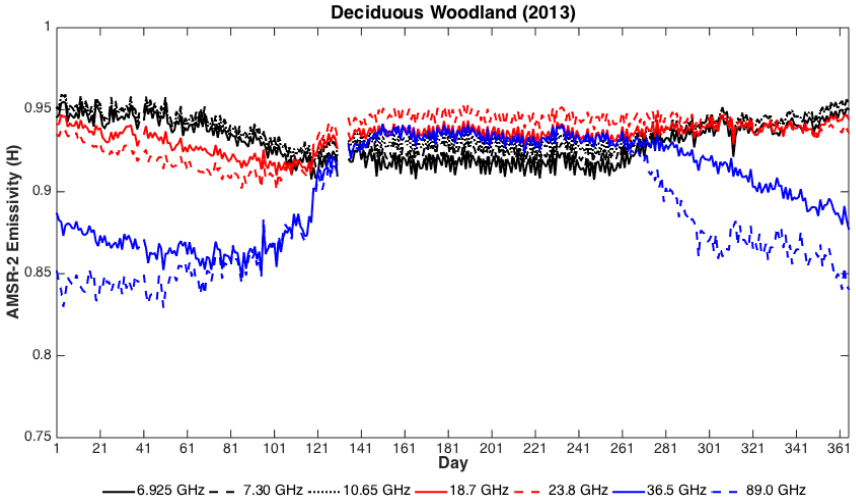
Difference between Ascending & Descending

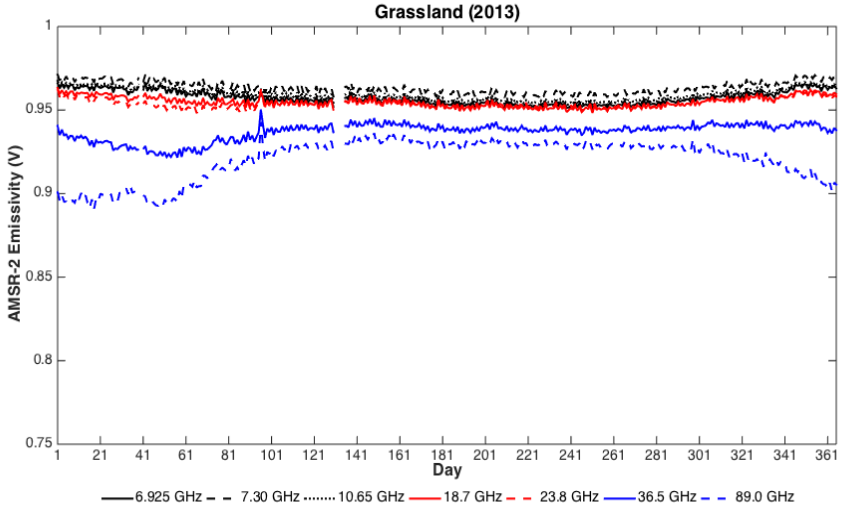


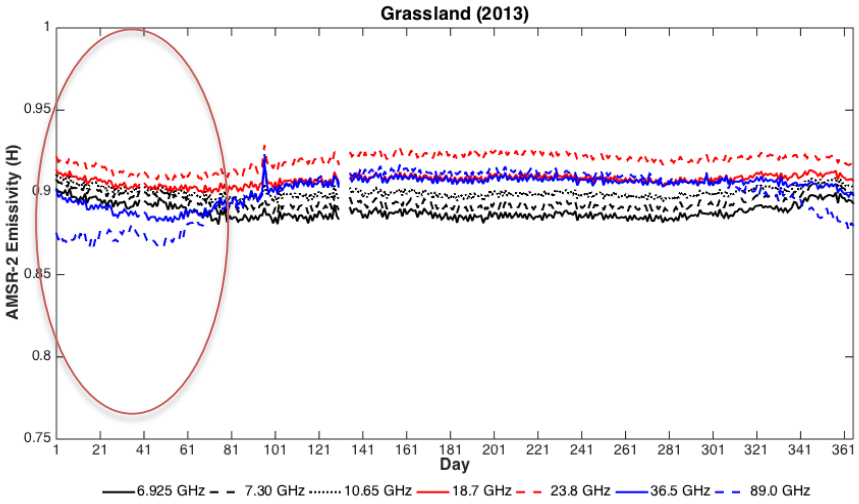
Norouzi et al. (2012) *RSE*

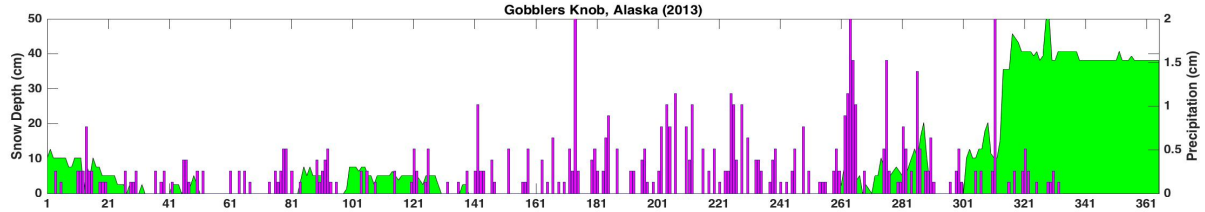
AMSR-2 emissivity at different land cover types

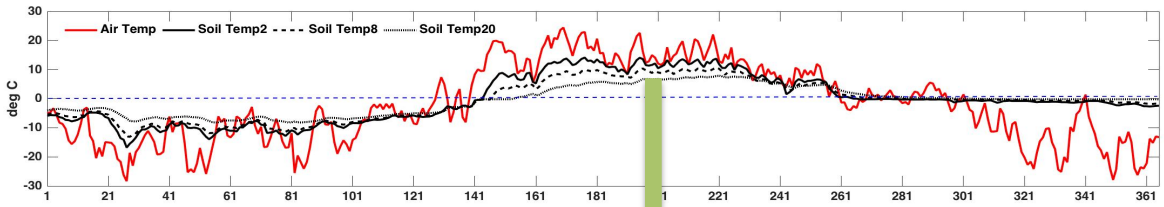


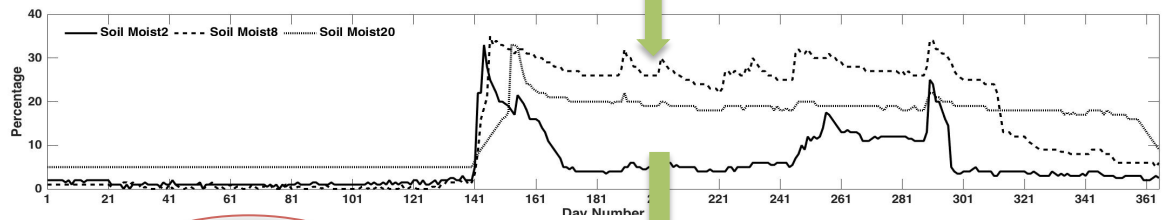


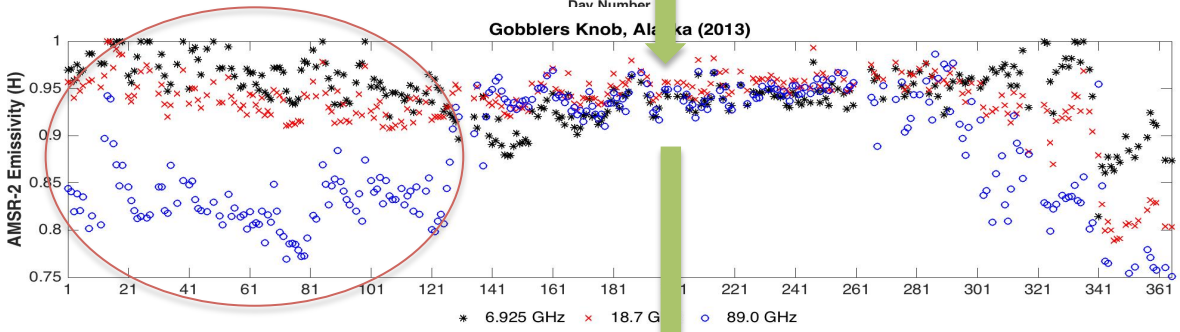






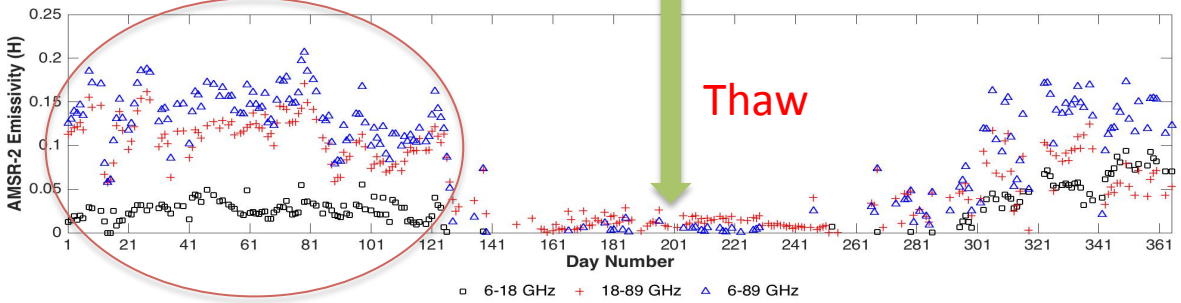




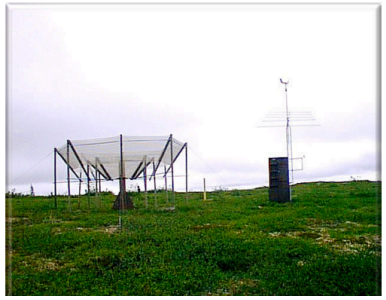


Freeze

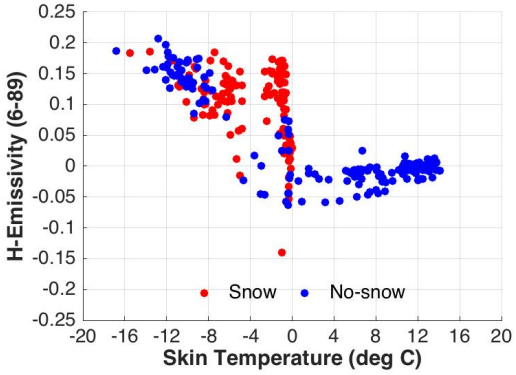
Thaw

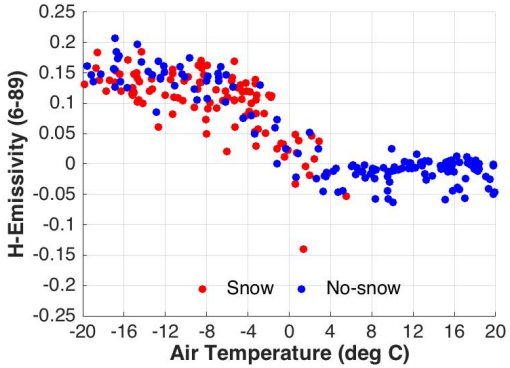


Grassland

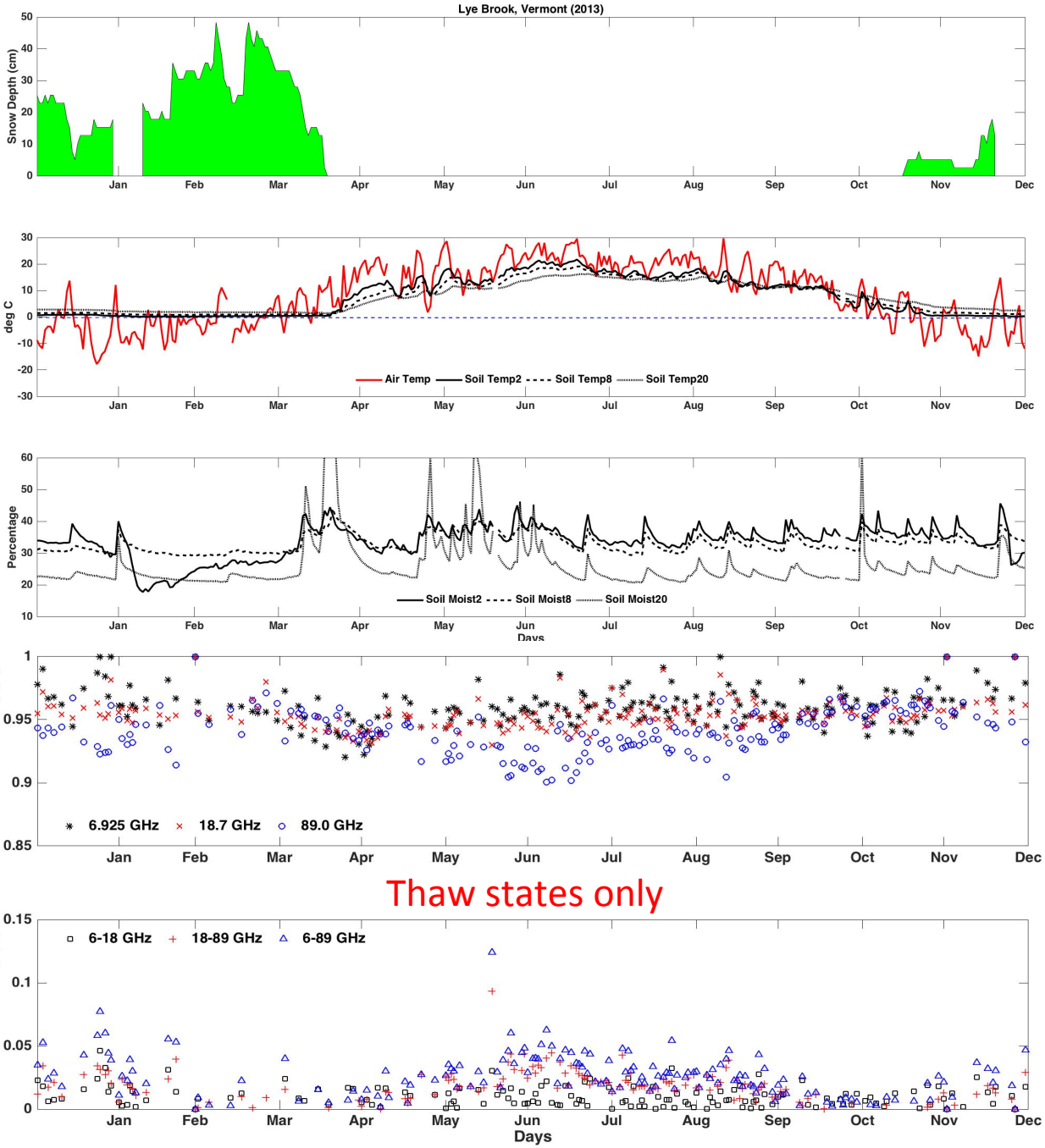


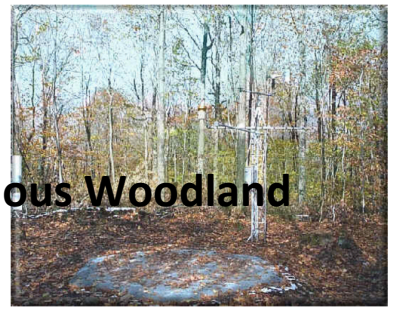
SNOTEL Site: Gobblers Knob
State: Alaska
Site Number: 962
County: Yukon-koyukuk
Latitude: 66 deg; 45 min N
Longitude: 150 deg; 40 min W
Elevation: 2030 feet





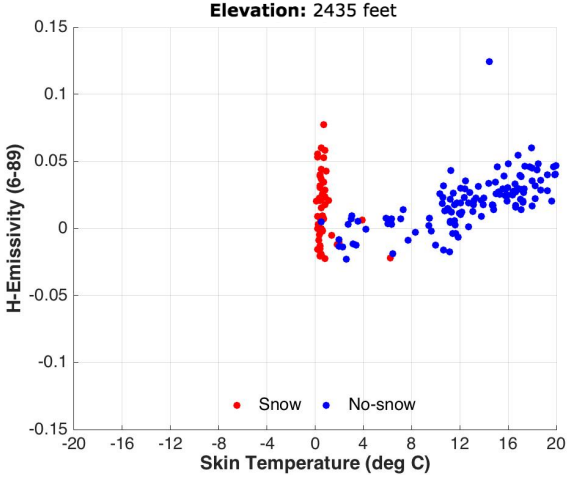
Norouzi et al. (2015) *In preparation*

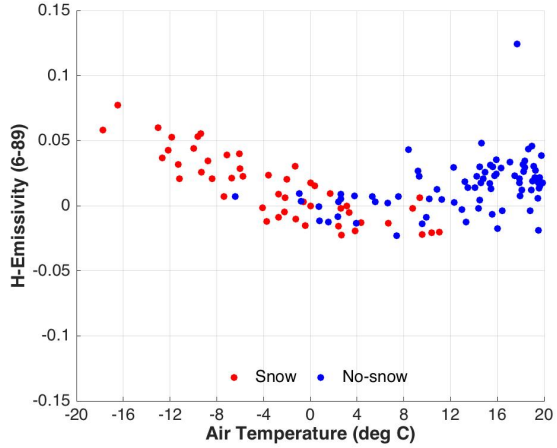


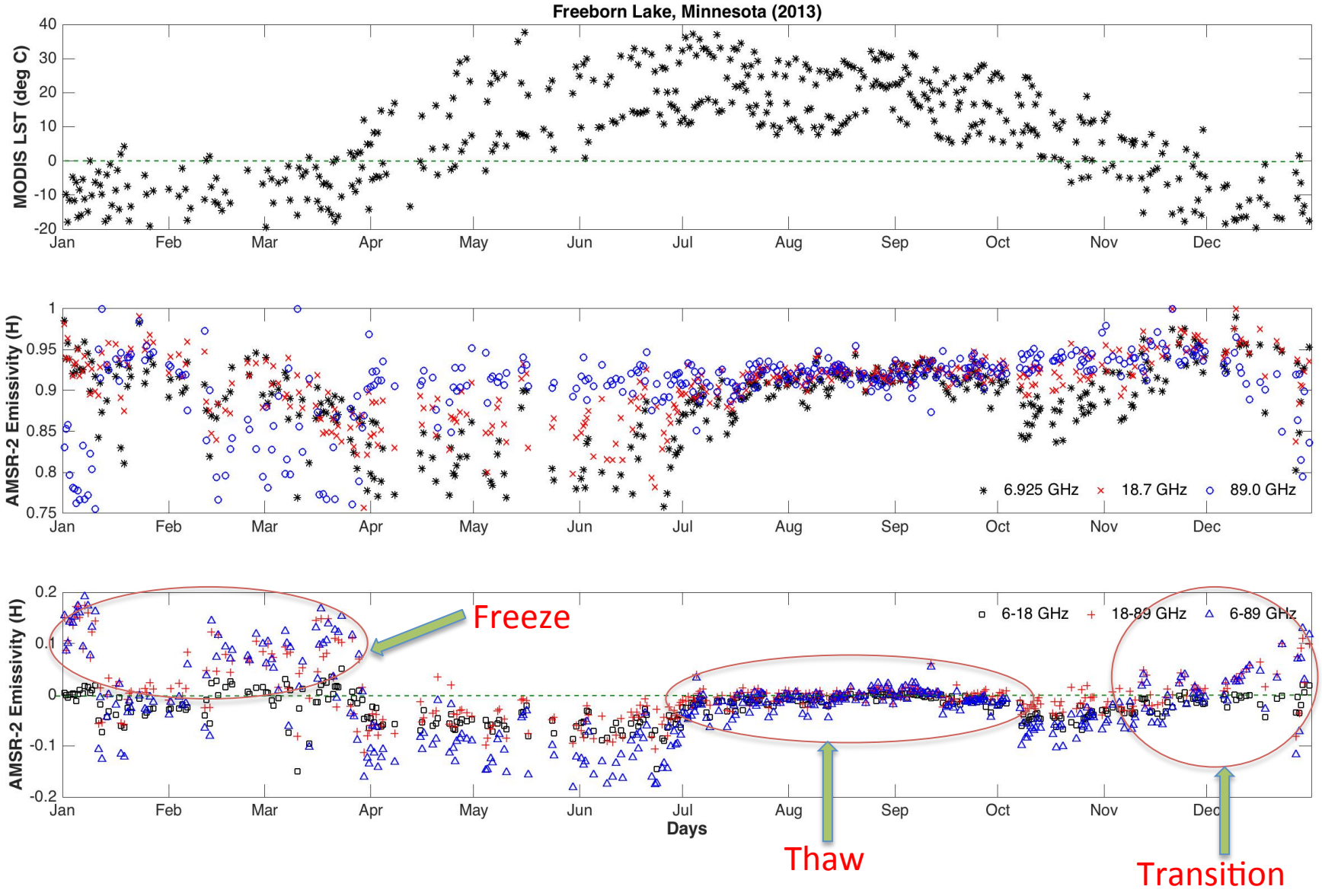


Deciduous Woodland

SCAN Site: Lye Brook
State: Vermont
Site Number: 2042
County: Bennington
Latitude: 43 deg; 3 min N
Longitude: 73 deg; 2 min W
Elevation: 2435 feet






Freeborn Lake, Minnesota (2013)
MODIS LST (deg C)
40
30
20
10
0
-10
-20
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
AMSR-2 Emissivity (H)
1
0.95
0.9
0.85
0.8
0.75
6.925 GHz
18.7 GHz
89.0 GHz
AMSR-2 Emissivity (H)
0.2
0.1
0
-0.1
-0.2
6-18 GHz
18-89 GHz
6-89 GHz
Freeze
Thaw
Transition
Days

Conclusions & Future Work

Emissivities have potential for freeze/thaw states detection as they are not affected by temperature and atmospheres.

Different land cover types might have different thresholds for freeze & thaw states.

An algorithm for freeze/thaw states detection for different land cover types is under development.

Merging of multi-sensor PMW emissivities derived from a common algorithm have potential to study the diurnal characteristics of freeze/ thaw states.

Uncertainty in emissivity retrievals due to ancillary data is a challenge.

Thanks