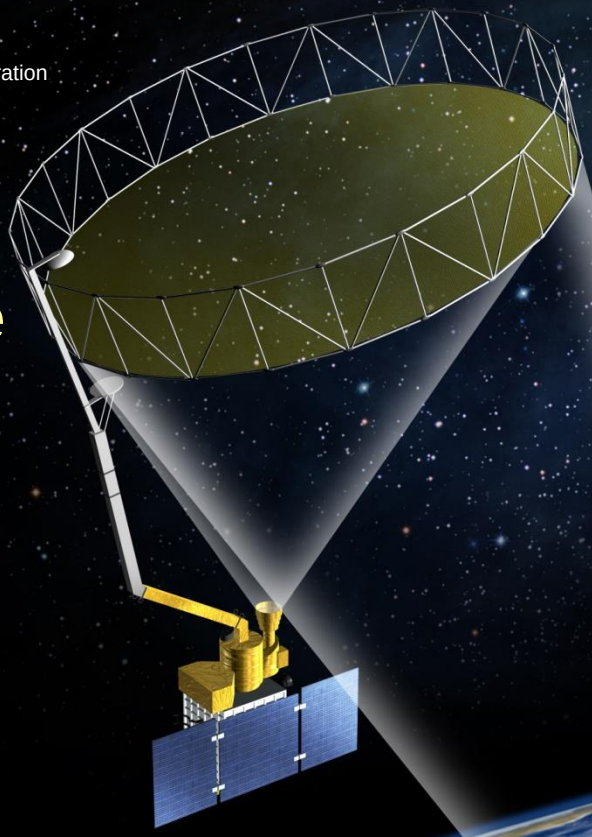
National Aeronautics and Space Administration

Soil Moisture Active Passive Mission

SMAP



L3_FT_P & L3_FT_P_E status

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SMAP Canada Workshop

May 16-17, 2017

L3_FT_P(_E) Status

- Data released at NSIDC in December 2016, which completed the validated transition from a radar to radiometer based product
- Seasonal threshold algorithm; Normalized Polarization Ratio (NPR) inputs
- 20 highest (lowest) NPR values retained and averaged to define reference states: July and August 2015 (thaw) and January and February 2016 (freeze)
- Thresholds: fixed at 0.5
- Current false flag mitigation: brightness temperature at either V or H pol >273, pixel is set to thaw; fixed AMSR-E derived 'never frozen' mask
- Current analysis focussed on determining strength of NPR response to freeze/thaw across the domain :
  - Future 'insufficient FT signal' flag
  - Preparing implementation of weekly AMSR-E masks to further mitigate false flags
  - Determining impact of updating references to 2016 (thaw) and 2017 (freeze)
  - Response during transition periods: slope Tair (-10 to +5 °C) versus NPR

Passive Algorithm Overview

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- Baseline seasonal threshold algorithm for L3_FT_P(_E) using L1C_TB(_E) inputs:

$$FFrel = \frac{FF(t) - FF_{fr}}{FF_{th} - FF_{fr}} \qquad FF_{NPR} = \frac{TB_V - TB_H}{TB_V + TB_H} * 100$$

$$FFrel(t) > T(=0.5), thaw$$

$$FFrel(t) < T(=0.5), freeze$$

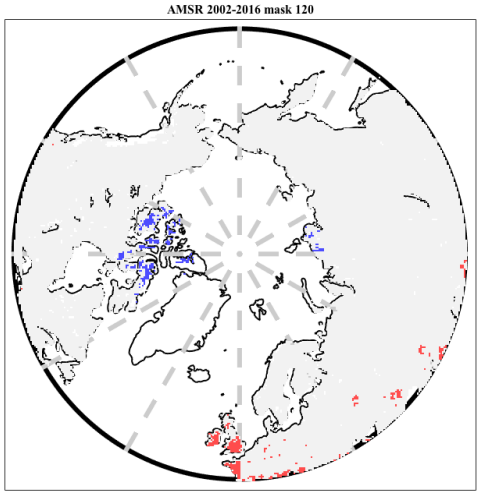
- FF_{thaw}: Thaw reference (Average top 20 SMAP NPR value from Jul./Aug 2015)
- FF_{freeze}: Freeze reference (Average lowest 20 SMAP NPR value from Jan/Feb 2016)
- Thresholds: fixed at 0.5
- False flag mitigation: Tbv or Tbh >273 = THAW
- Daily AMSR-E masks: Over a 31 day window, identify pixels that were never classified as frozen/thawed over 2002~2015 period (AMSRE/AMSR2):

$$NF(doy) = \sum_{i=doy-15}^{doy+15} Freeze\_AMSR\_flag(i) \qquad NT(doy) = \sum_{i=doy-15}^{doy+15} Thaw\_AMSR\_flag(i)$$

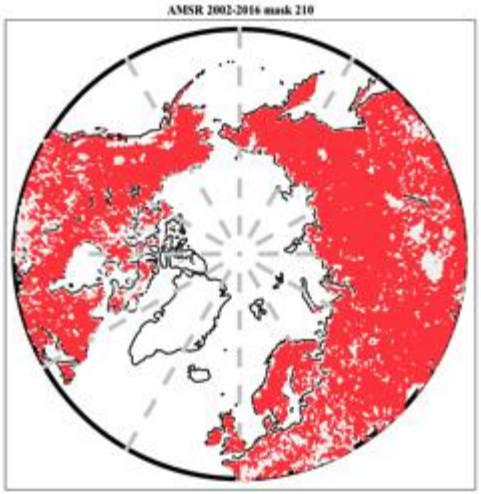
$$NF\_mask = (NF == 0) \qquad NT\_mask = (NT == 0)$$

Example AMSR-E Masks

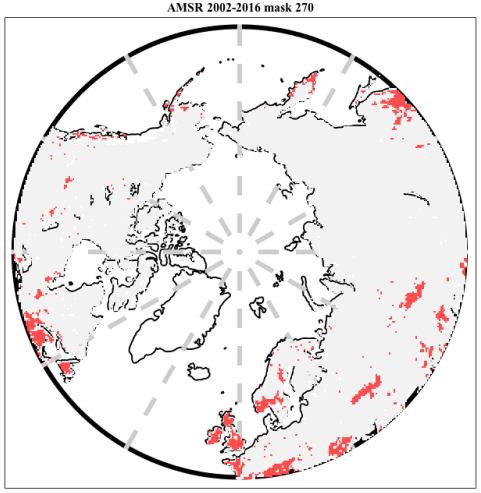
Spring



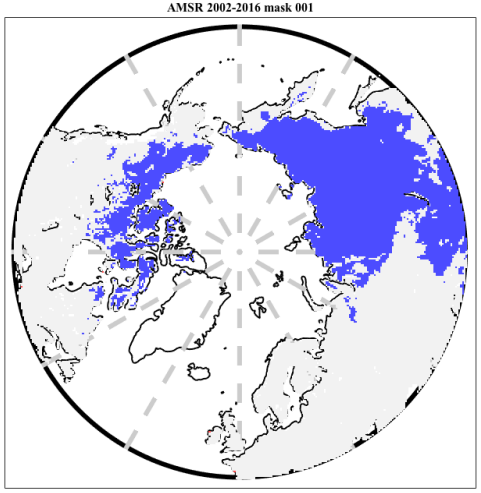
Summer



Autumn



Winter



AMSR-E Mask Performance Comparison

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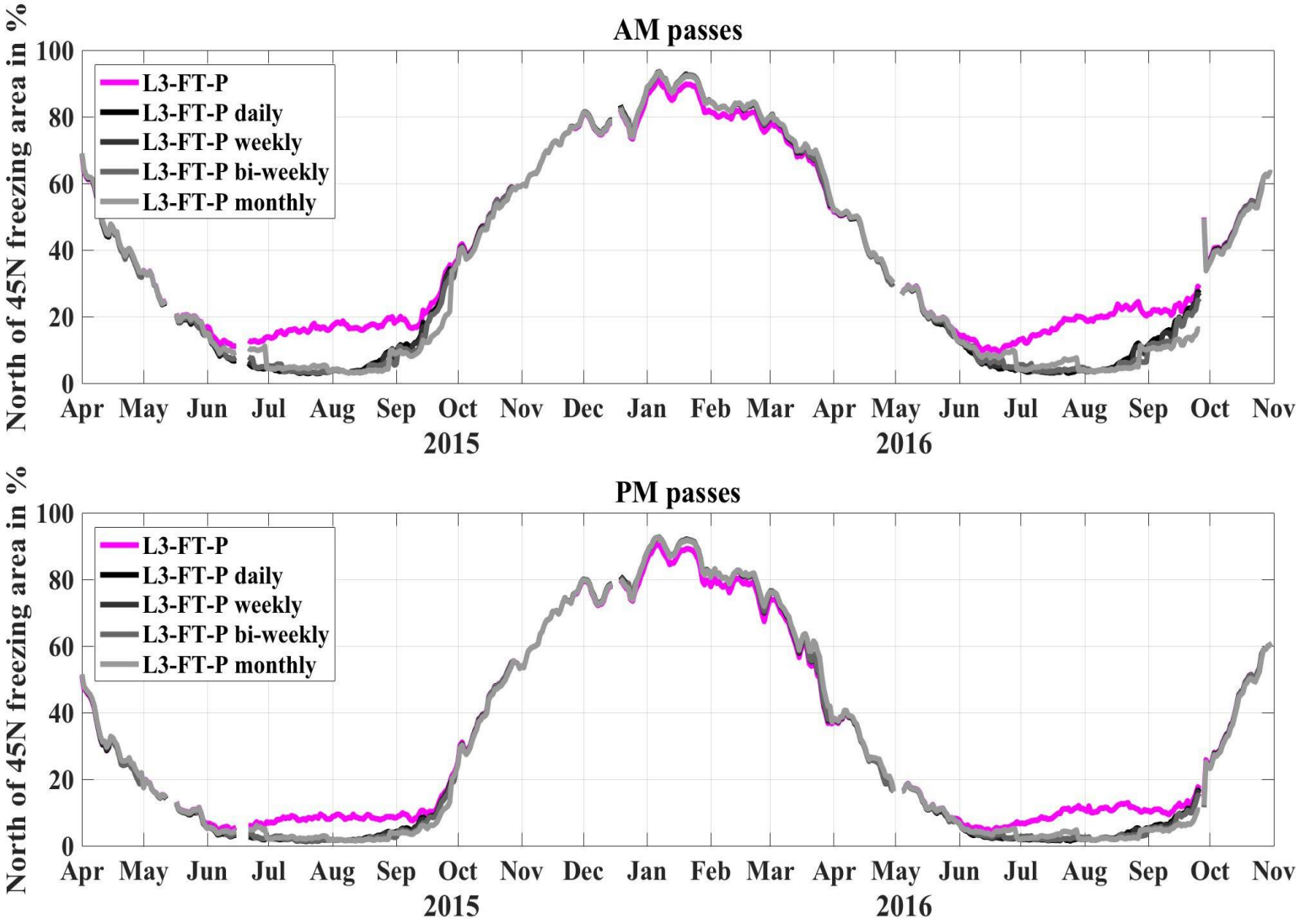

Weekly Mask

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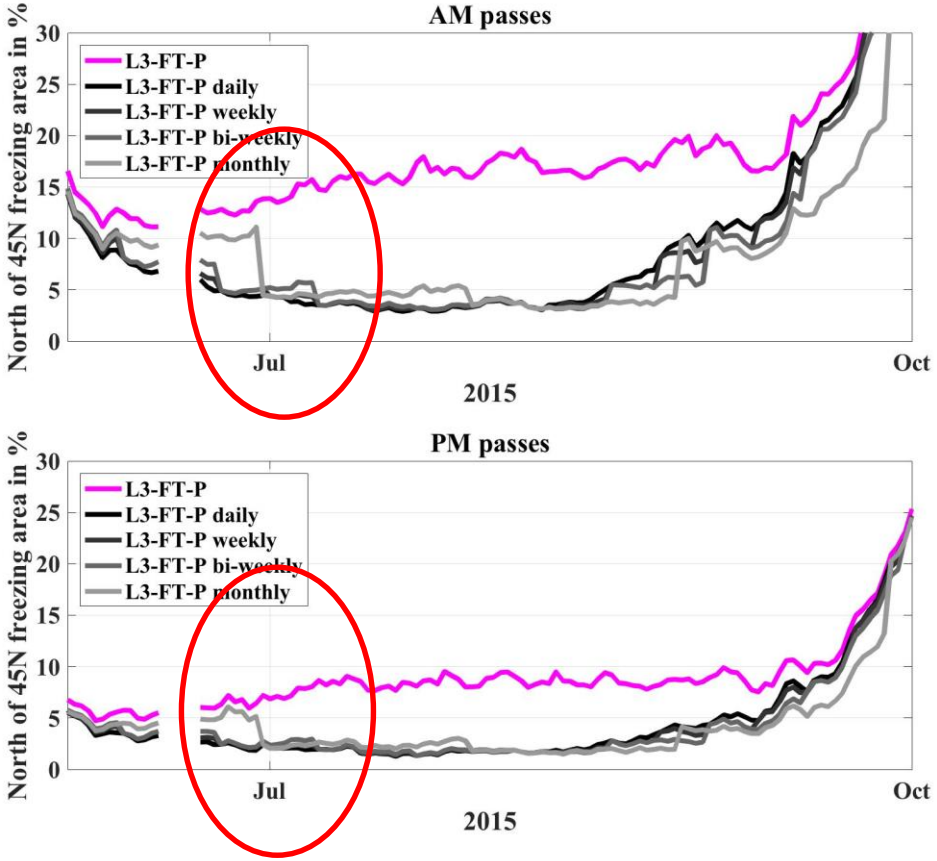
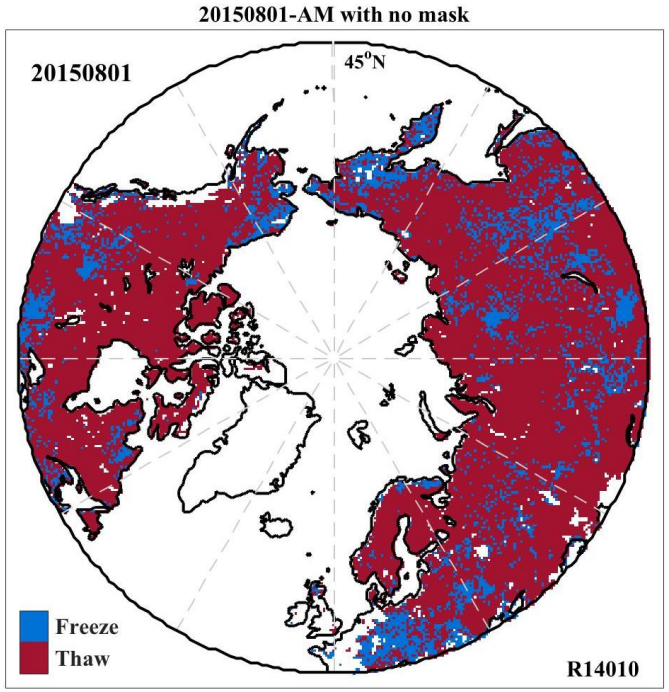
- Weekly masks are appropriate to minimize the step changes evident with monthly masks, yet maintain a manageable look up table size

- Weekly Mask Implementation
  - add two more layers (NF, NT) in reference table
  - 64 bit represent 52 weekly masks

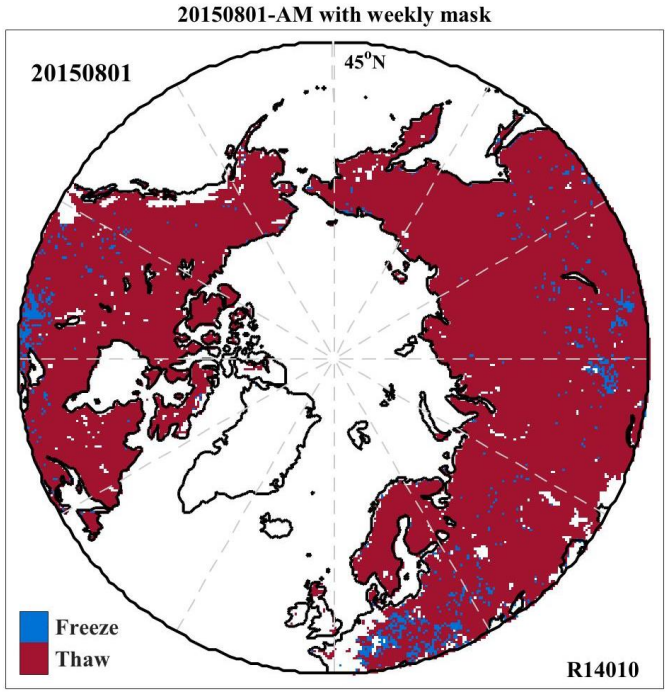


AMSR-E Mask Snapshot

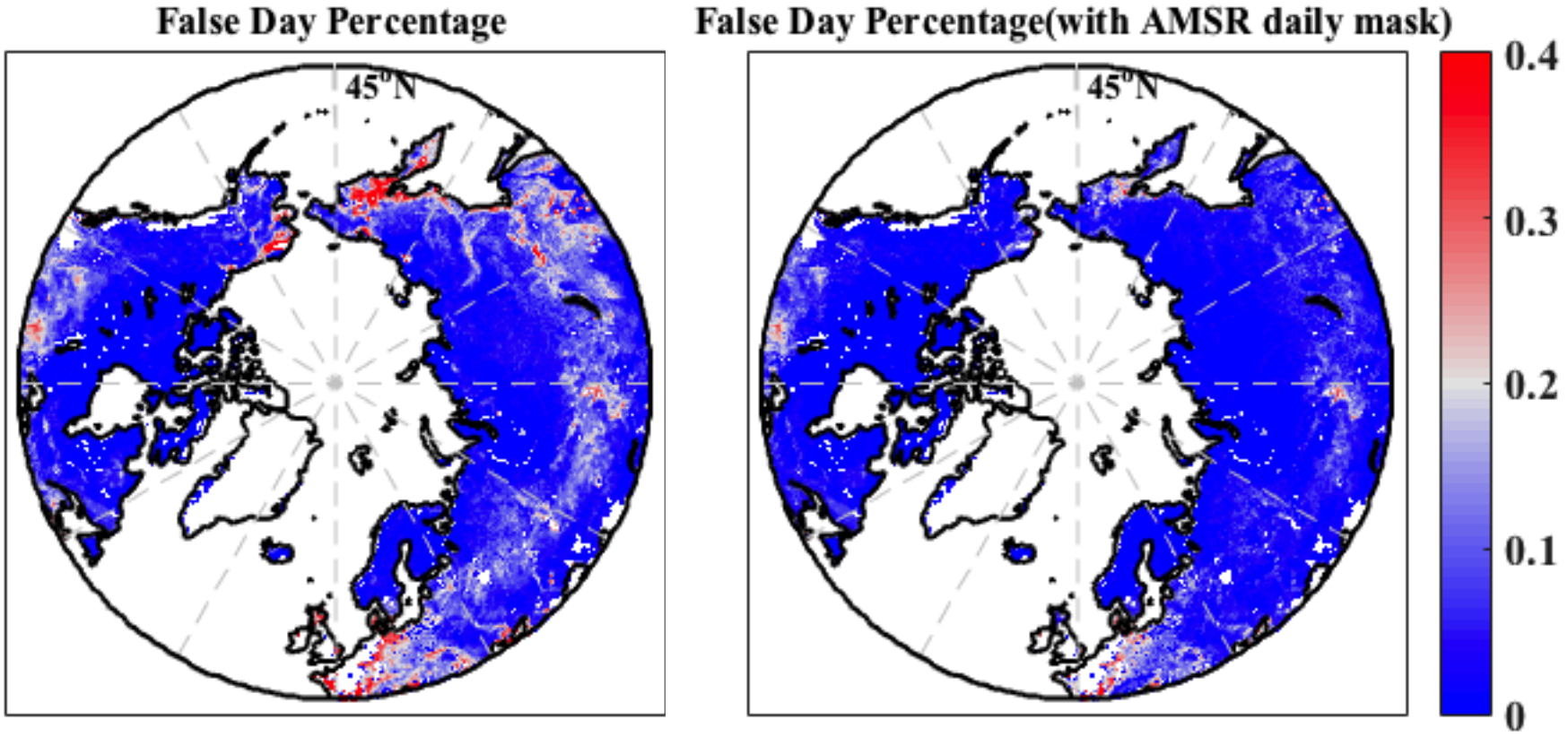
No mask



Weekly mask



AMSR-E Mask Influence on False Flag %



Reference Difference Between Two Consecutive Years

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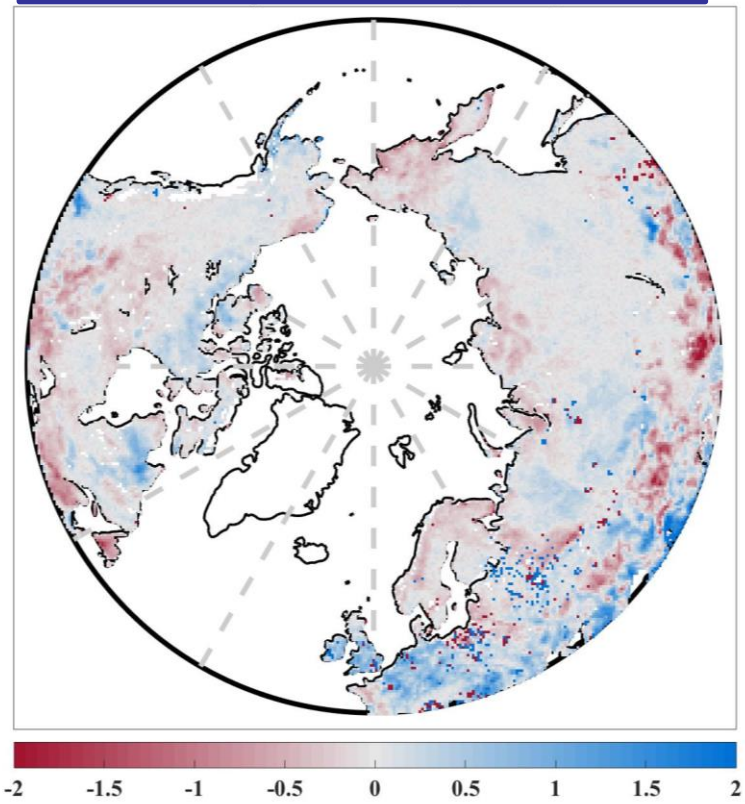
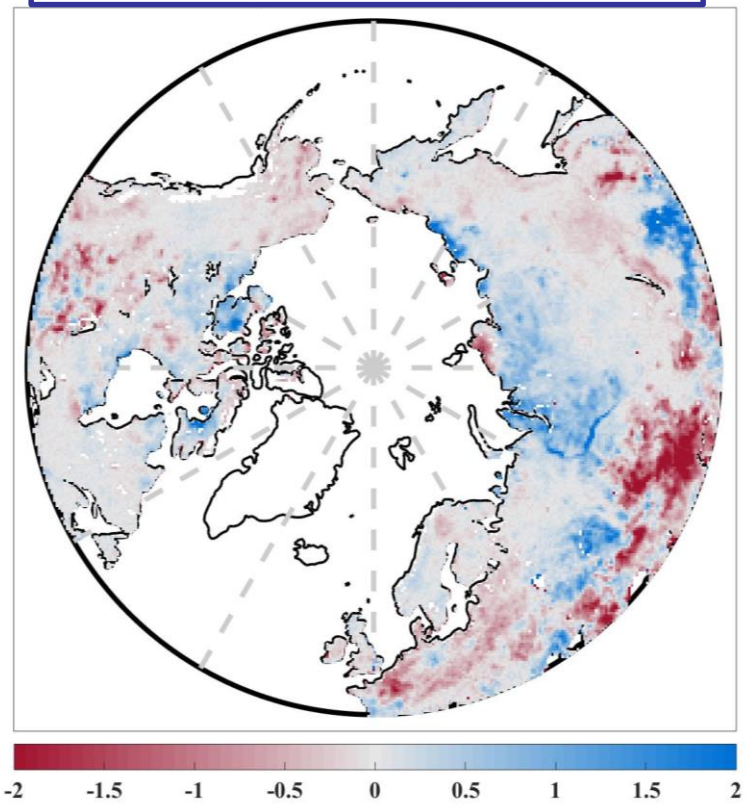
Freeze difference (2017-2016)

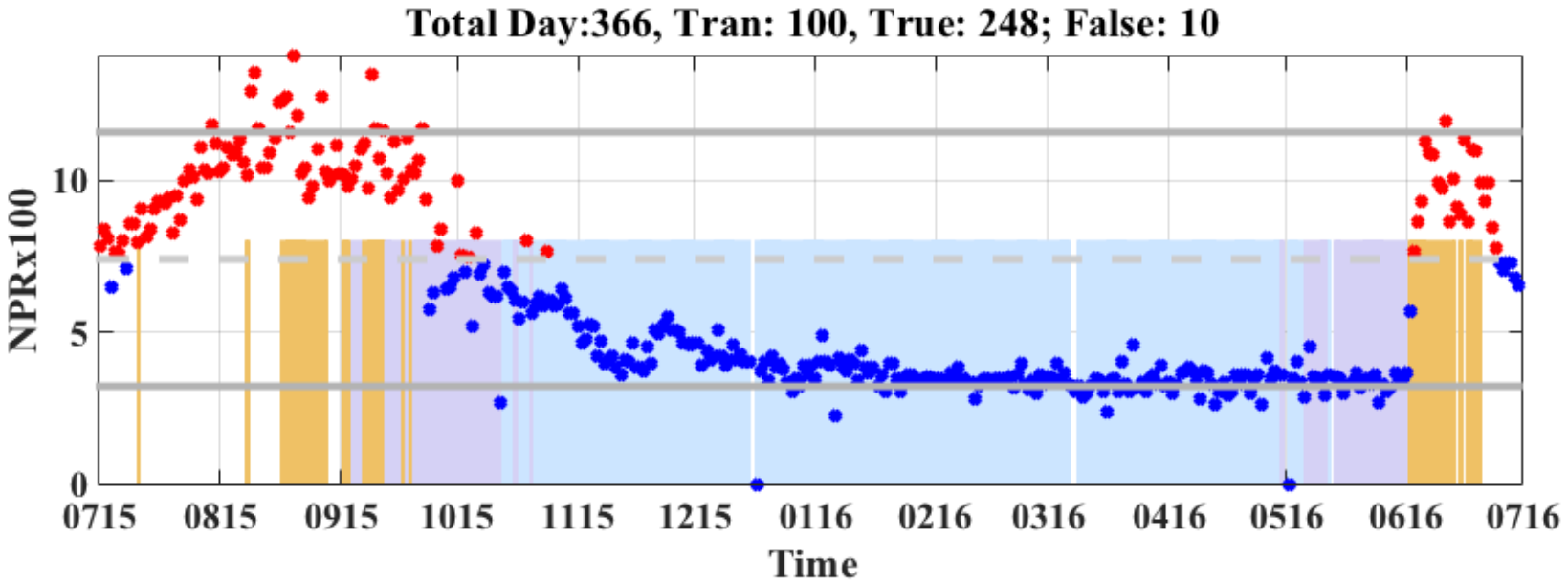


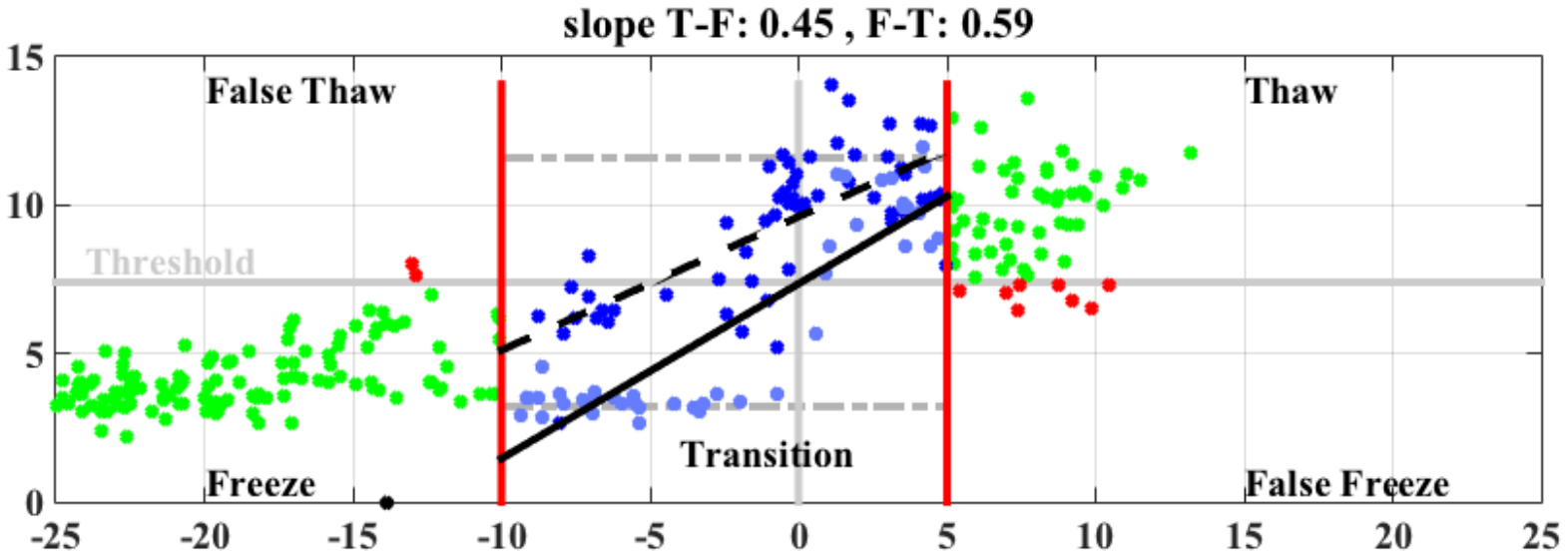
Thaw difference (2016-2015)



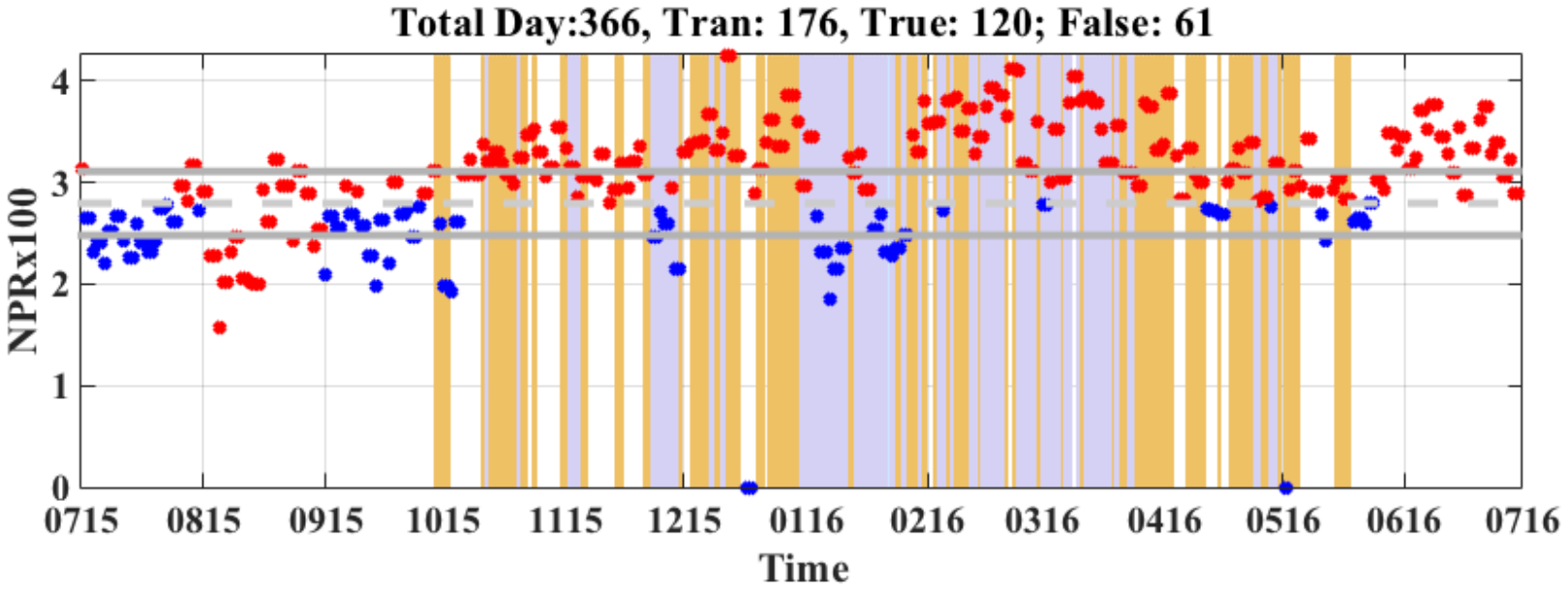
The thaw reference difference shows more variation. The references in lower latitude are more dynamic from season to season. The references are updated when a new season becomes available.

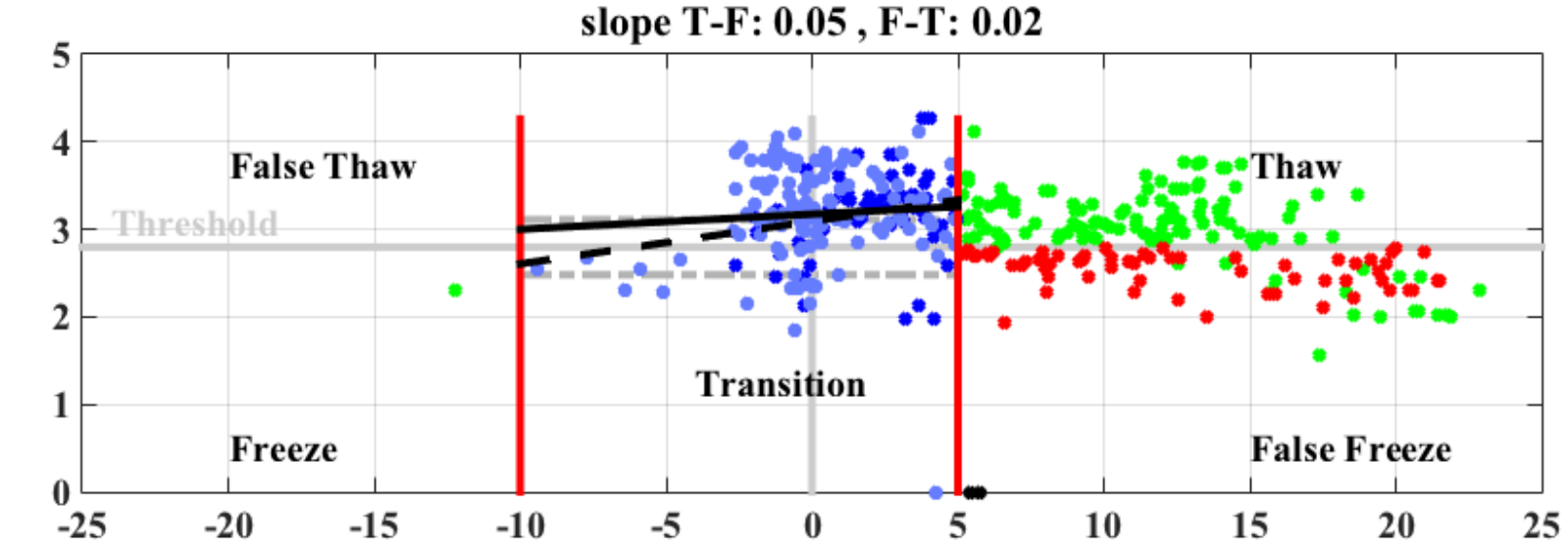
NPR versus GMAO Tsurf (AM):Cambridge Bay





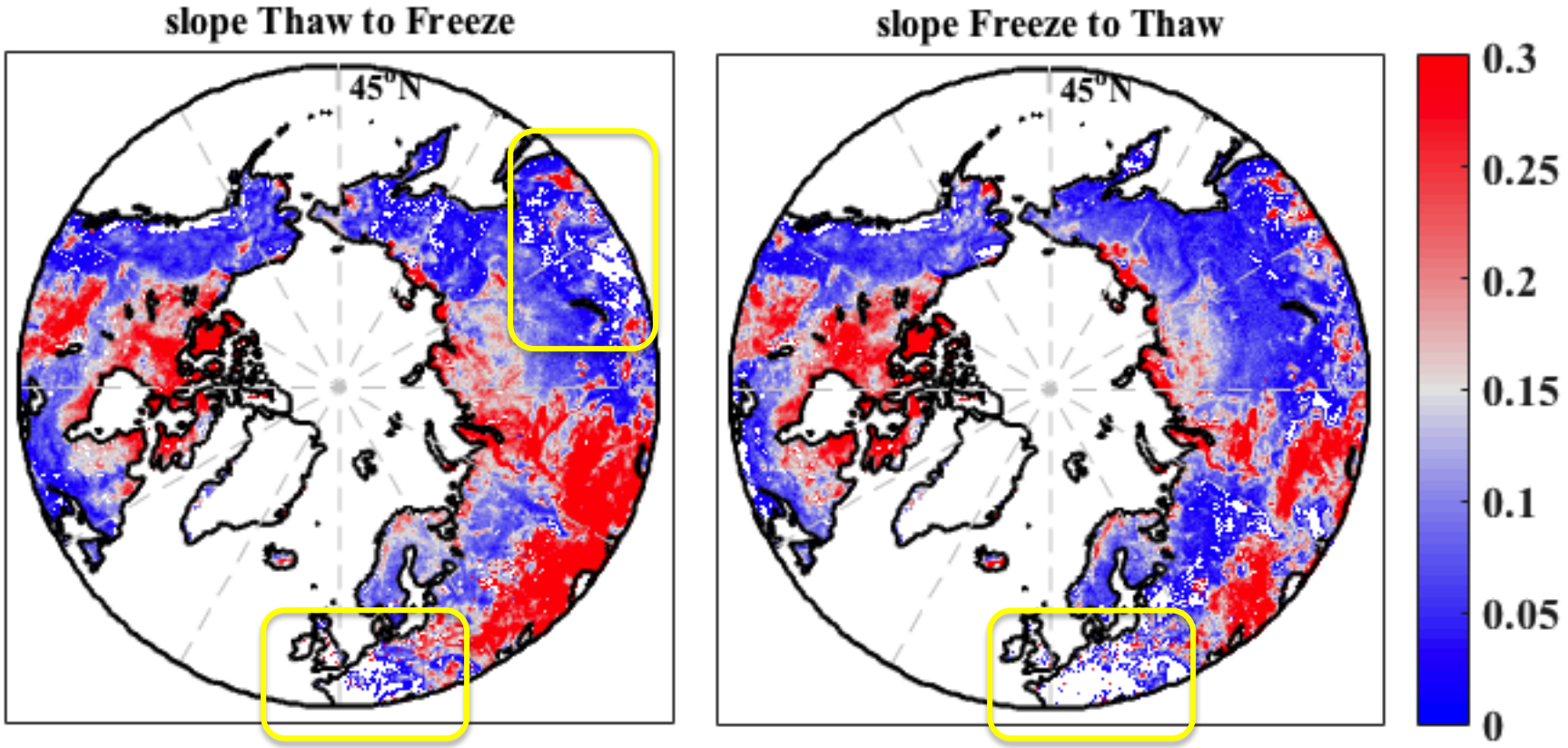
Example: Insufficient NPR Signal



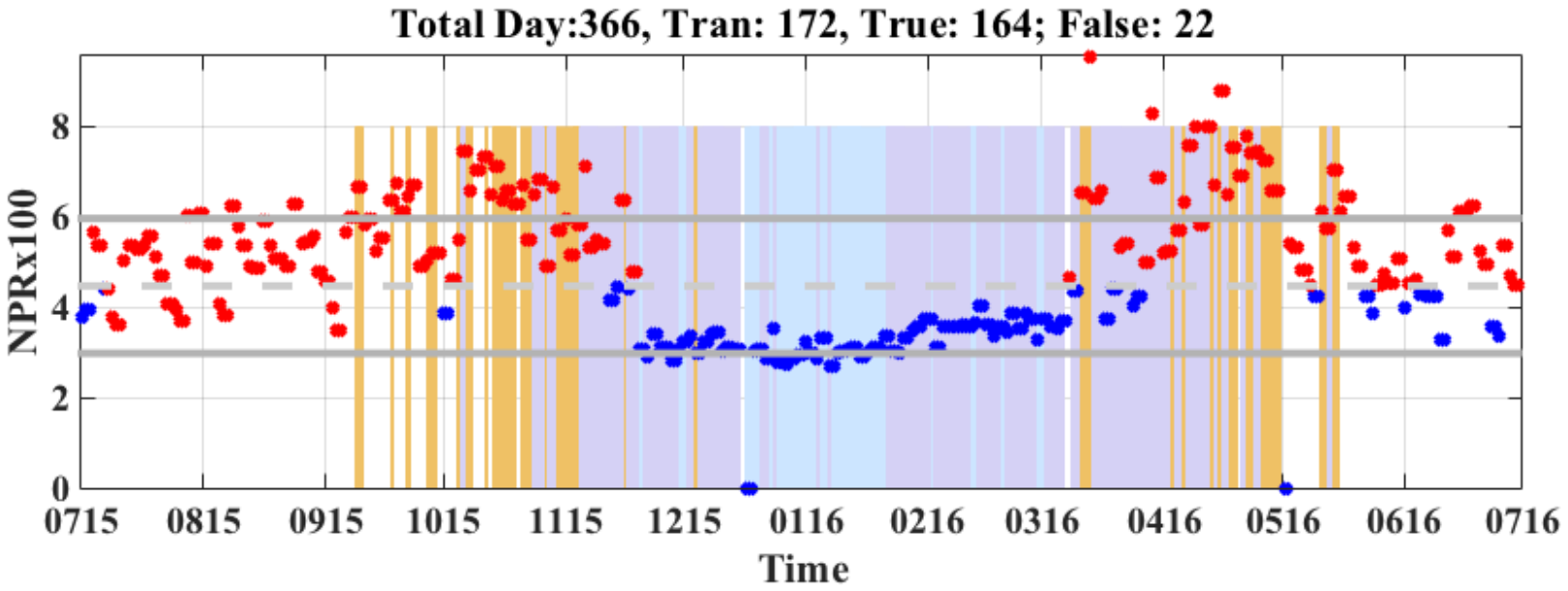


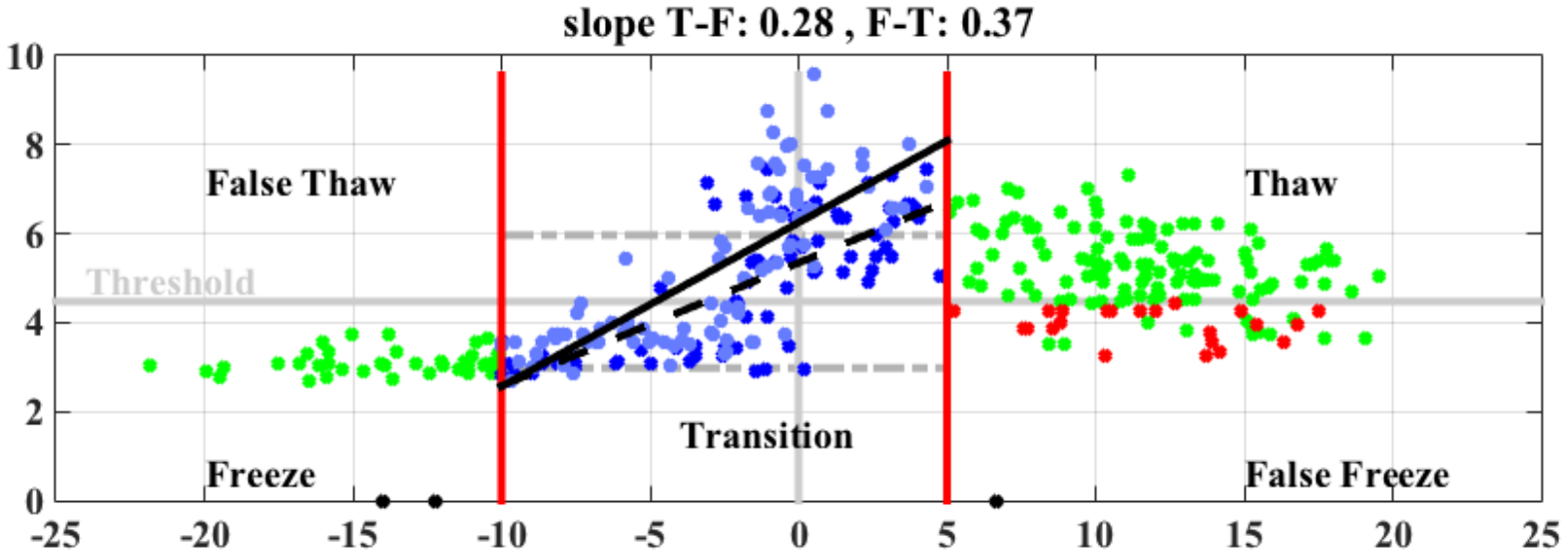
Tair Transition Period Slopes

Insufficient FT signal flags



Prairie Challenge: Kenaston





L3_FT_P Cal/Val Summary: Assessment Report v1

L3_FT_P	Cases	Agreement SMAP Tair	Agreement SMAP Tsoil
Des	3852	0.83	0.78
Asc	3852	0.88	0.81

L3_FT_P_E	Cases	Agreement SMAP Tair	Agreement SMAP Tsoil
Des	3823	0.82	0.77
Asc	3829	0.86	0.79

Better flag agreement with Tair compared to Tsoil:

- Early winter flag agreement with Tsoil measurements are weak because the soil at depth remains unfrozen (due to the insulating effect of snow cover/organic layer). The landscape is effectively 'frozen' but not necessarily captured by Tsoil measurements.
- In spring, soil remains frozen after air temperatures increase above zero and snowmelt starts (SMAP NPR responds to wet snow).

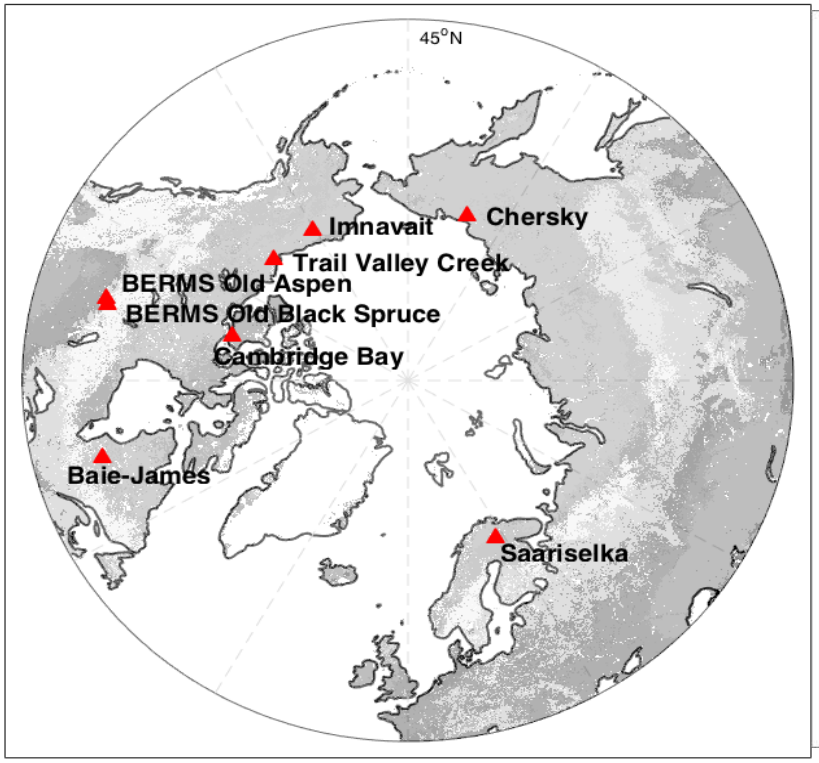
Better flag agreement for ascending orbits:

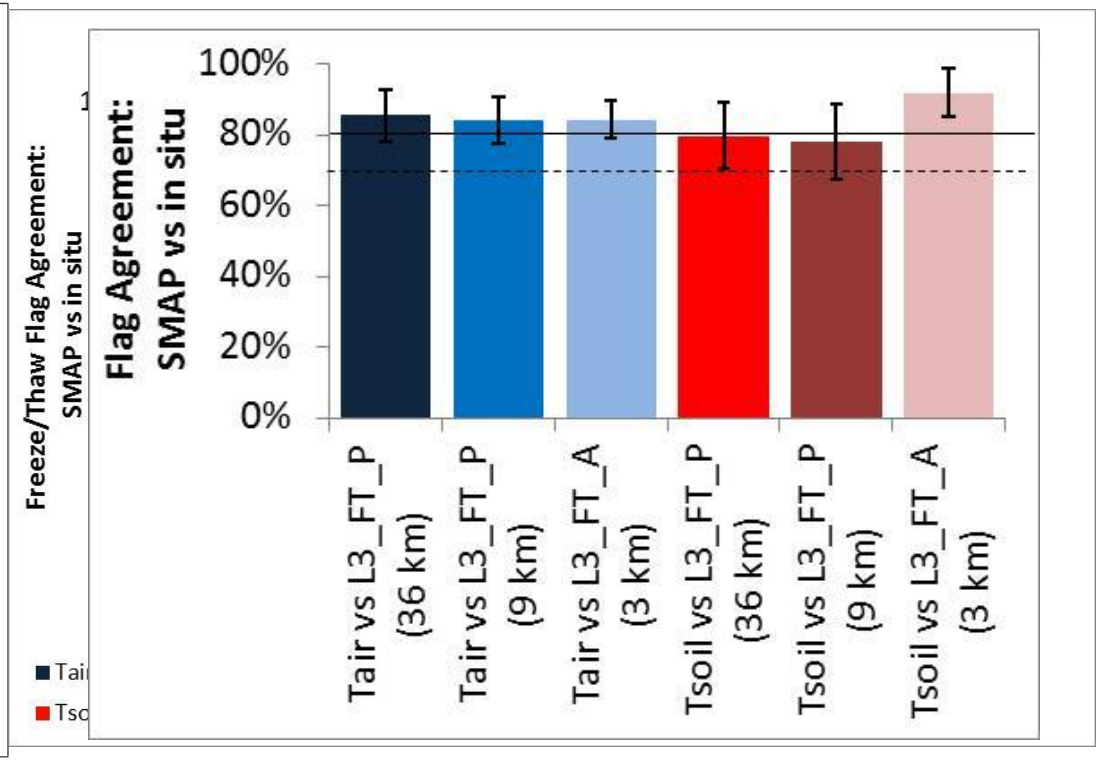
- NPR response is not always sufficiently strong to capture ephemeral/transitional diurnal freeze events during which the in situ measurements indicate frozen conditions in the morning and thawed conditions in the afternoon. When the SMAP retrievals remain 'thawed' during these events, they disagree with the in situ measurements at the time of morning overpass (when in situ measurements are frozen), but agree at the time of afternoon overpass (when in situ measurements are thawed).

L3_FT_P versus L3_FT_P_E:

- Poorer performance at 9 km potentially related to noise in V-H differences

L3_FT Cal/Val Summary: Input to Senior Review





Summary

- Analysis of overlapping radar and radiometer time series complete (RSE paper accepted)
- Initial release of L3_FT_P and L3_FT_P_E in December 2016
- Weekly AMSR-E masks and 'insufficient FT signal' flag to be implemented in next product release (fall 2017) to mitigate false freeze and thaw
- Analysis of SLAPEx ground/SMAP data nearly complete; still waiting on airborne data
- Above/below canopy dual radiometer experiment at BERMS old black spruce site ongoing (see presentation by A. Roy)

EXTRA

Radiometer FT Retrievals

L3_FT (polar grid) → Retrieval validation over 45N
-sound physical basis (generally good SNR)
-standalone retrieval possible (masks required)
-comprehensive cal/val sites available, supported by field campaigns
→ Flags for L4_C
→ FT science

L2_FT (global grid) → Global retrieval validation
-weak basis for retrievals south of 45N (poor SNR)
-masks and ancillary data required
-validation based primarily on Tair
→ Flags for L2_SM