From L1 to L2 for sea ice concentration

Rasmus Tonboe
Danish Meteorological Institute
EUMETSAT OSISAF

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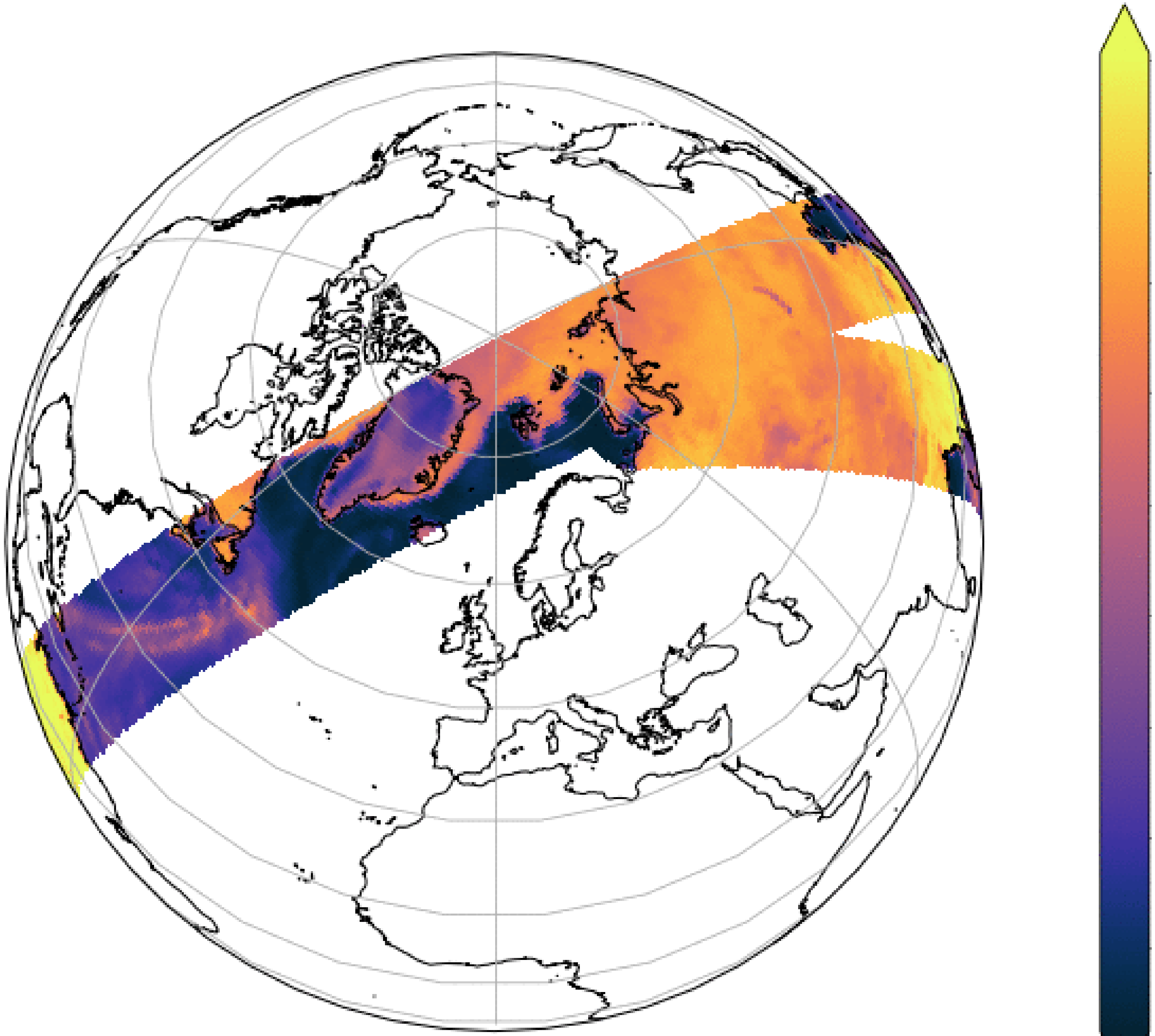
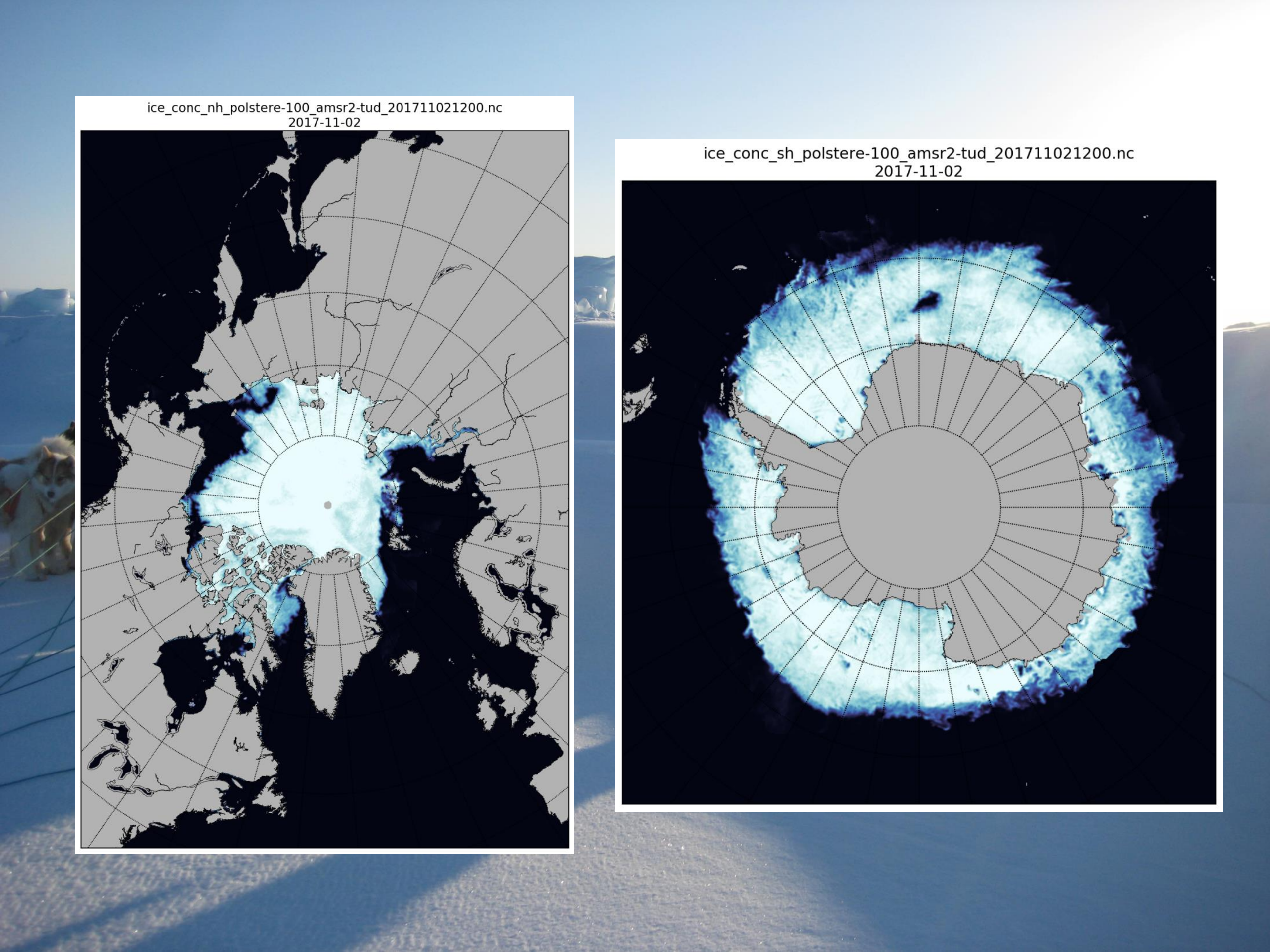
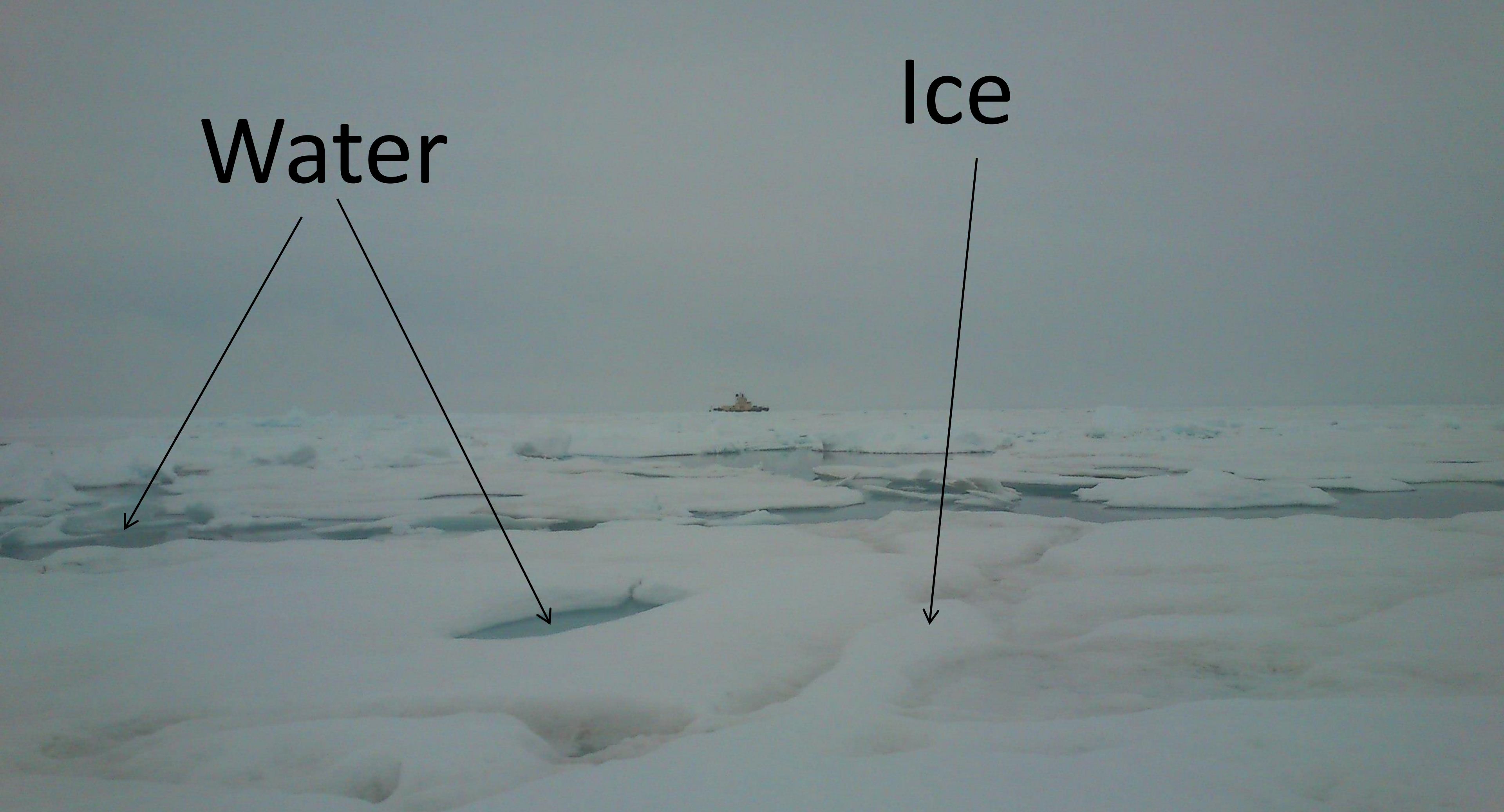
OSI SAF
OCEAN AND SEA ICE

Brightness Temperatures (K) for the 19 GHz (H) Channel
2018-01-05T10:00:40Z to 2018-01-05T12:10:03Z




ice_conc_nh_polstere-100_amsr2-tud_201711021200.nc
2017-11-02
ice_conc_sh_polstere-100_amsr2-tud_201711021200.nc
2017-11-02

”Sea-ice concentration = sea-ice surface fraction”



e.g. Kern et al. 2016, The Cryosphere

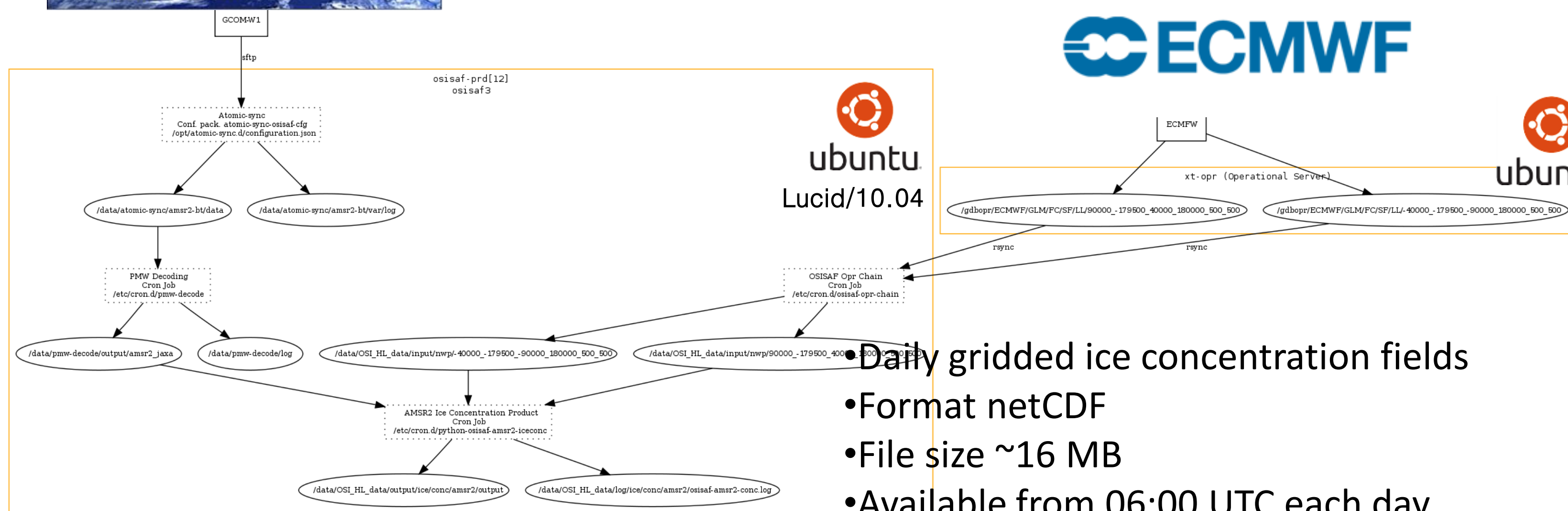
Requirements

- **Consistency** between different SIC products, SST and SI products, and between operational and climate processing.
- **Spatial resolution:** future models and operational ice charts <5km
- **Uncertainties** on every measurement
- **Continuity and stability** future microwave radiometers
- **Validation**
- **Timeliness**
- **Implementation of new sensors**

Sea ice concentration procedure

- Algorithm selection to avoid noise
- Explicit noise reduction using NWP or other auxiliary data
- Algorithm calibration
- Quantification of residual uncertainties

The AMSR-2 Sea Ice Concentration Operational Chain

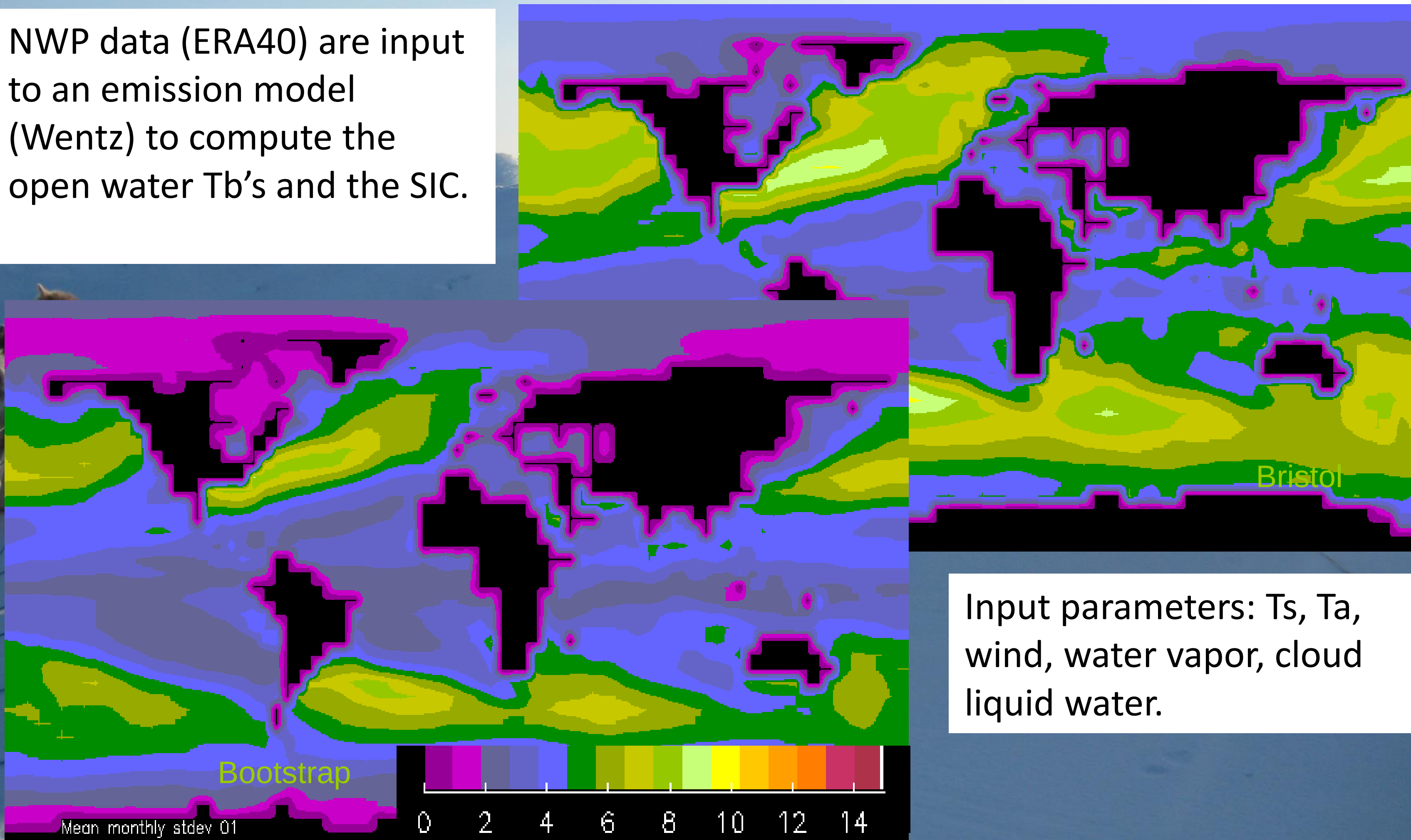


- Daily gridded ice concentration fields
- Format netCDF
- File size ~16 MB
- Available from 06:00 UTC each day

John Lavelle

Atmospheric noise open water

NWP data (ERA40) are input to an emission model (Wentz) to compute the open water Tb's and the SIC.



Input parameters: Ts, Ta, wind, water vapor, cloud liquid water.

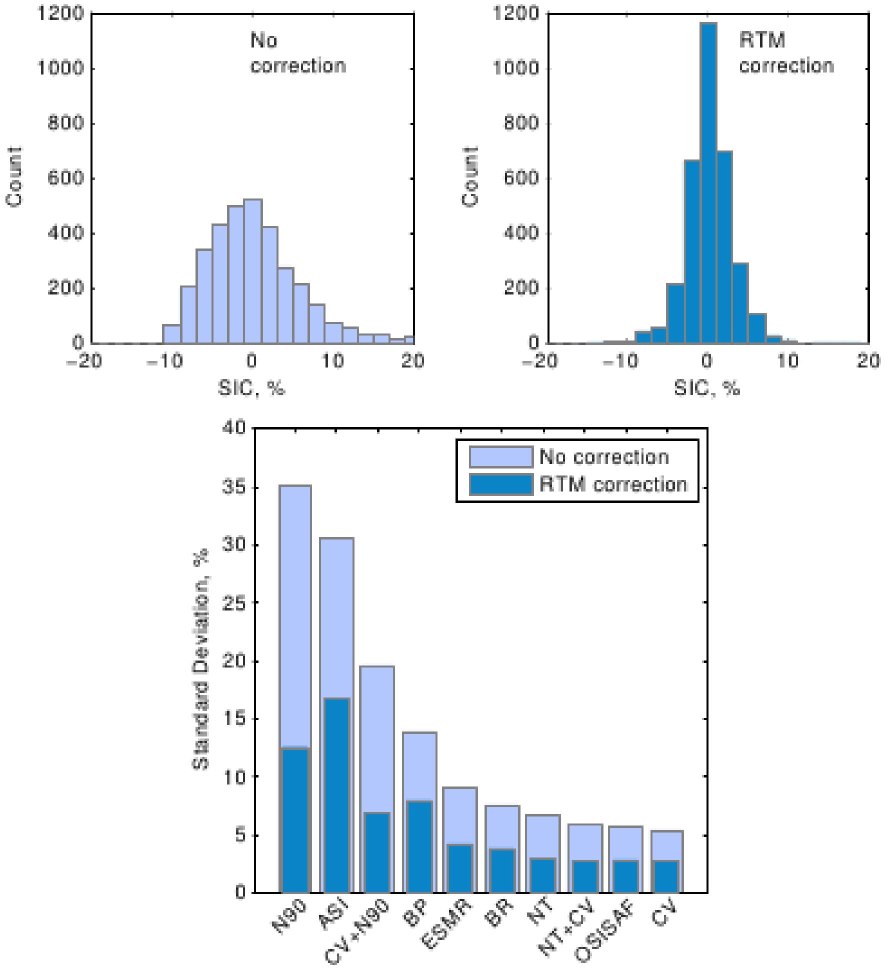


Figure 6. Histograms for SSM/I sea ice concentration (SIC) obtained by the OSISAF algorithm over open water (SIC = 0 %) in the Northern Hemisphere in 2008 (entire year) without correction (upper panel, left) and with radiative transfer model (RTM) correction (upper panel, right). The histograms contain 21 bins of 2 % SIC. Bottom panel: decrease in standard deviations for 10 SIC algorithms due to the atmospheric correction of the measured brightness temperatures.

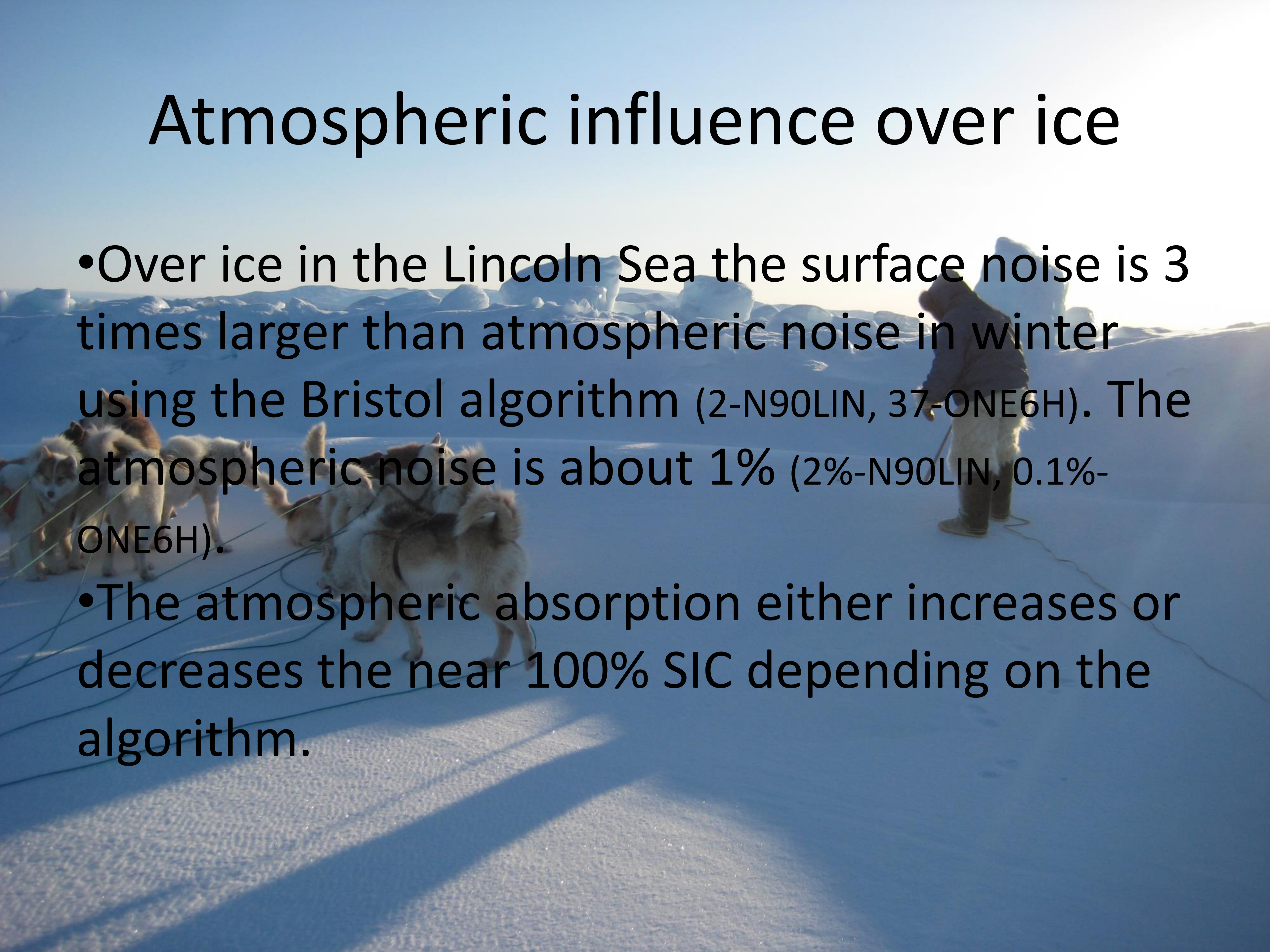
Ivanova et al. 2015, The Cryosphere

Correction of the Tb's

Tb=f(Water_vapor, wind, temperature …)

Radiative transfer model and NWP data for regional error reduction.

Ivanova et al. 2015



Atmospheric influence over ice

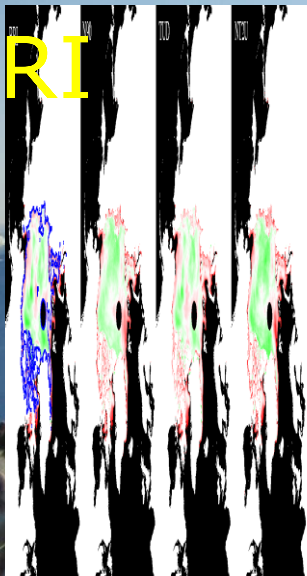
- Over ice in the Lincoln Sea the surface noise is 3 times larger than atmospheric noise in winter using the Bristol algorithm (2-N90LIN, 37-ONE6H). The atmospheric noise is about 1% (2%-N90LIN, 0.1%-ONE6H).
- The atmospheric absorption either increases or decreases the near 100% SIC depending on the algorithm.

100%

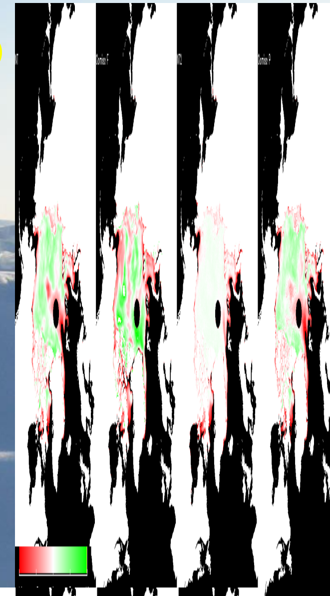
Winter concentration anomalies

31 Oct 2000
–
31 Mar 2001

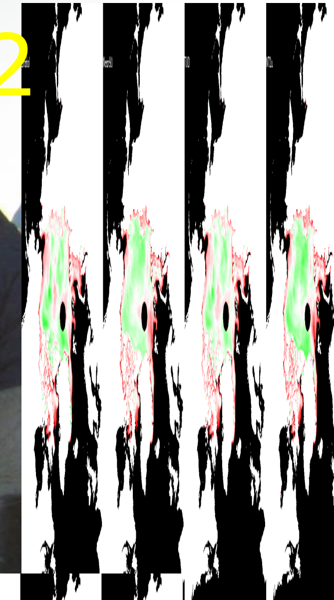
BRI



CP



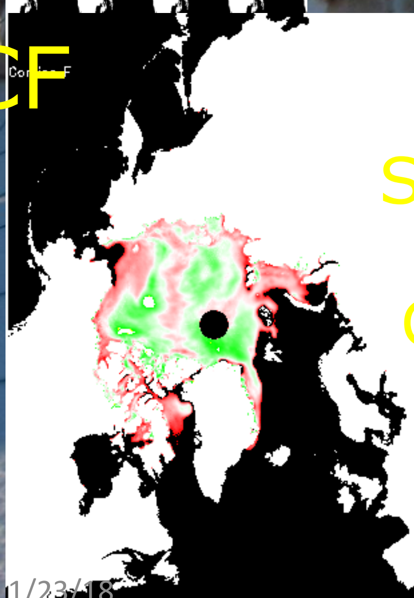
NT2



Layering

Pol.

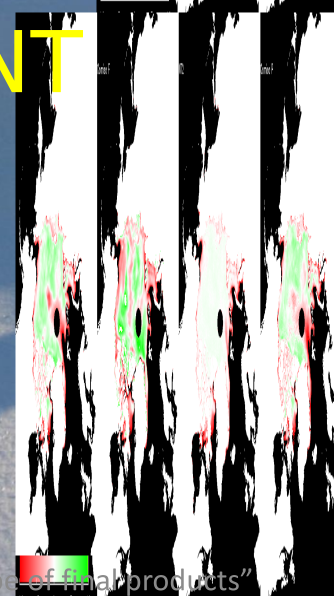
CF



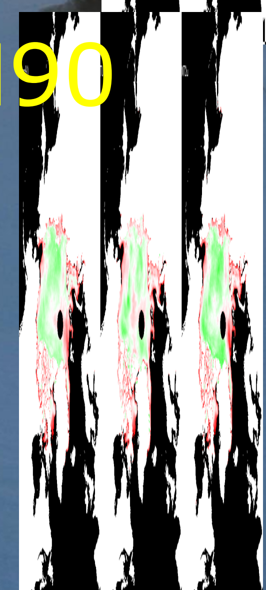
Scattering

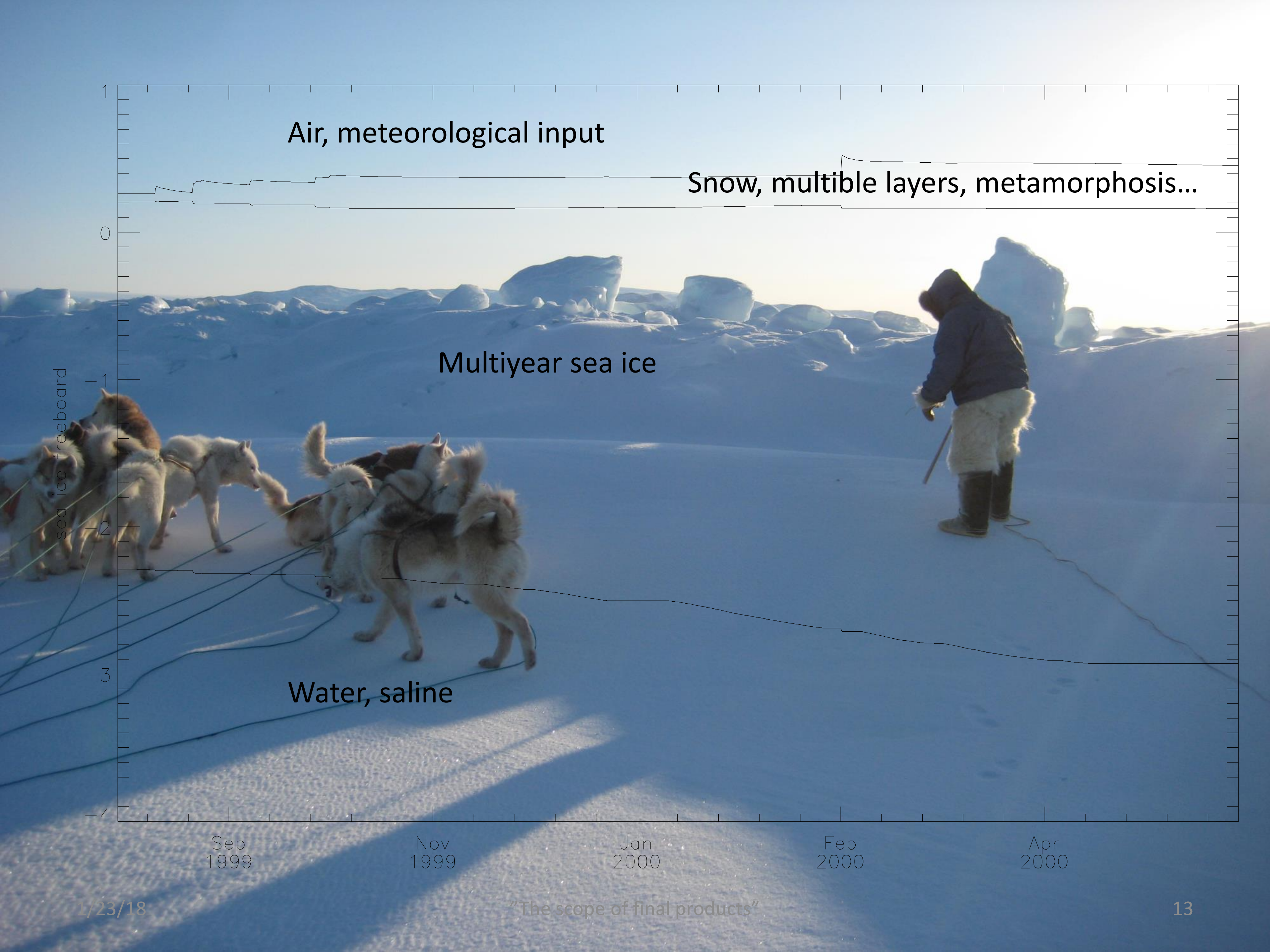
Gradient

NT



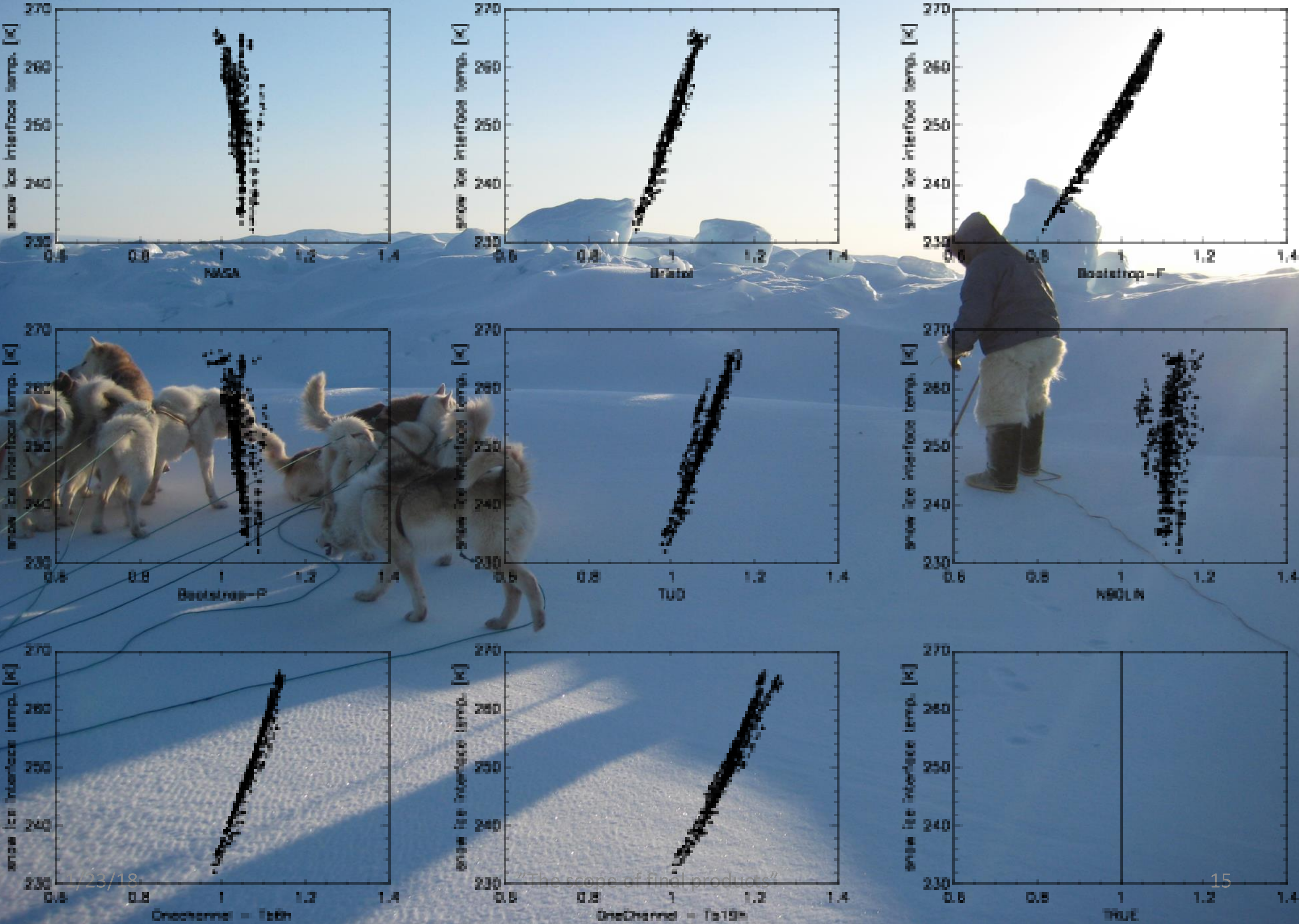
N90



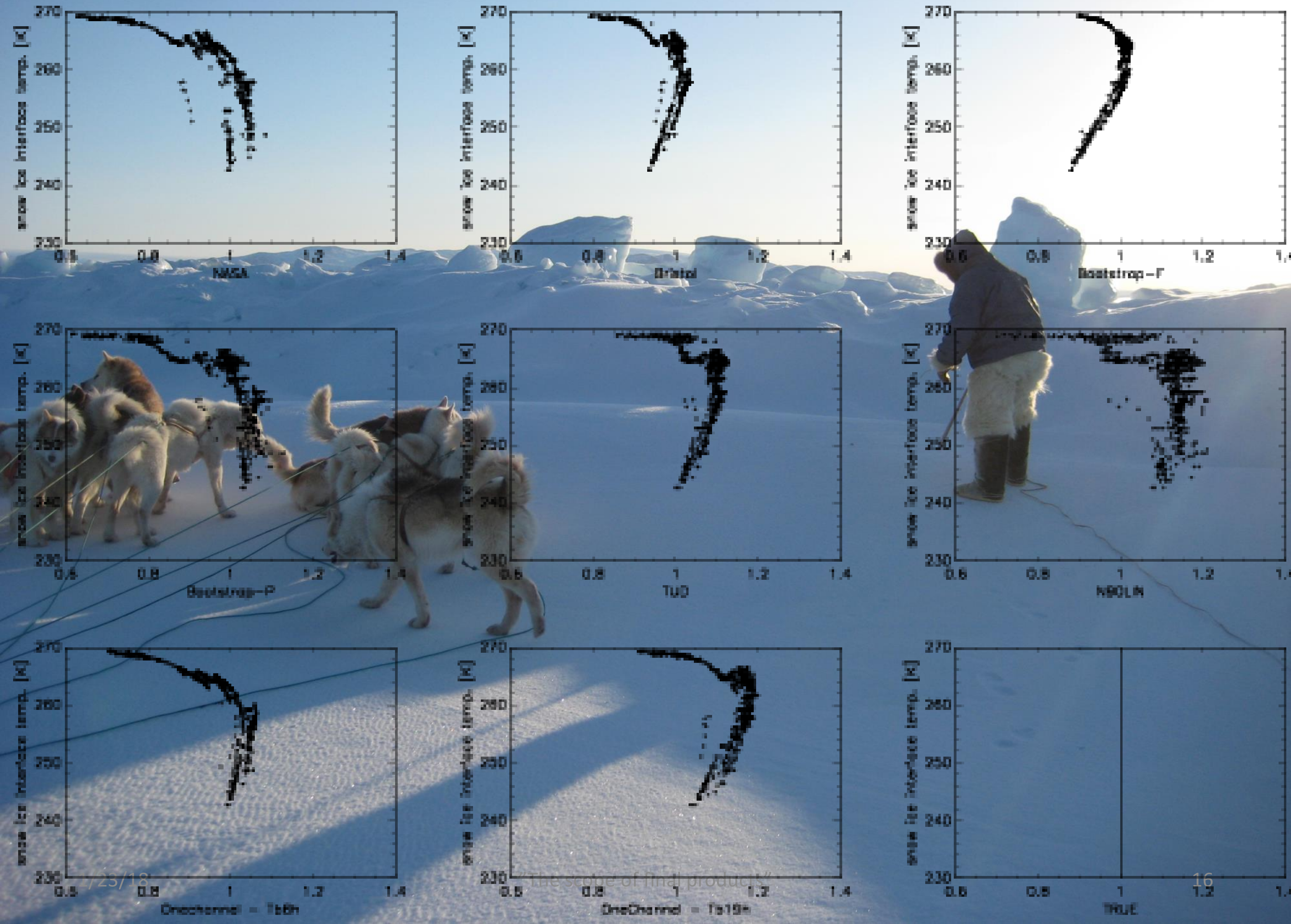

Air, meteorological input
Snow, multible layers, metamorphosis…
Multiyear sea ice
Water, saline
sea ice freeboard
1
0
−1
−2
−3
−4
Sep 1999
Nov 1999
Jan 2000
Feb 2000
Apr 2000


1.5
1.0
0.5
0.0
sea ice conc.
Sep 1999
Nov 1999
Jan 2000
Feb 2000
Apr 2000
NASA
Bristol
Bootstrap−F
Bootstrap−P
TUD
ASI
Near90
Near90LIN
UMass
NORSEX
OneChannel − 6h
P90
PR
OneChannel − 19h

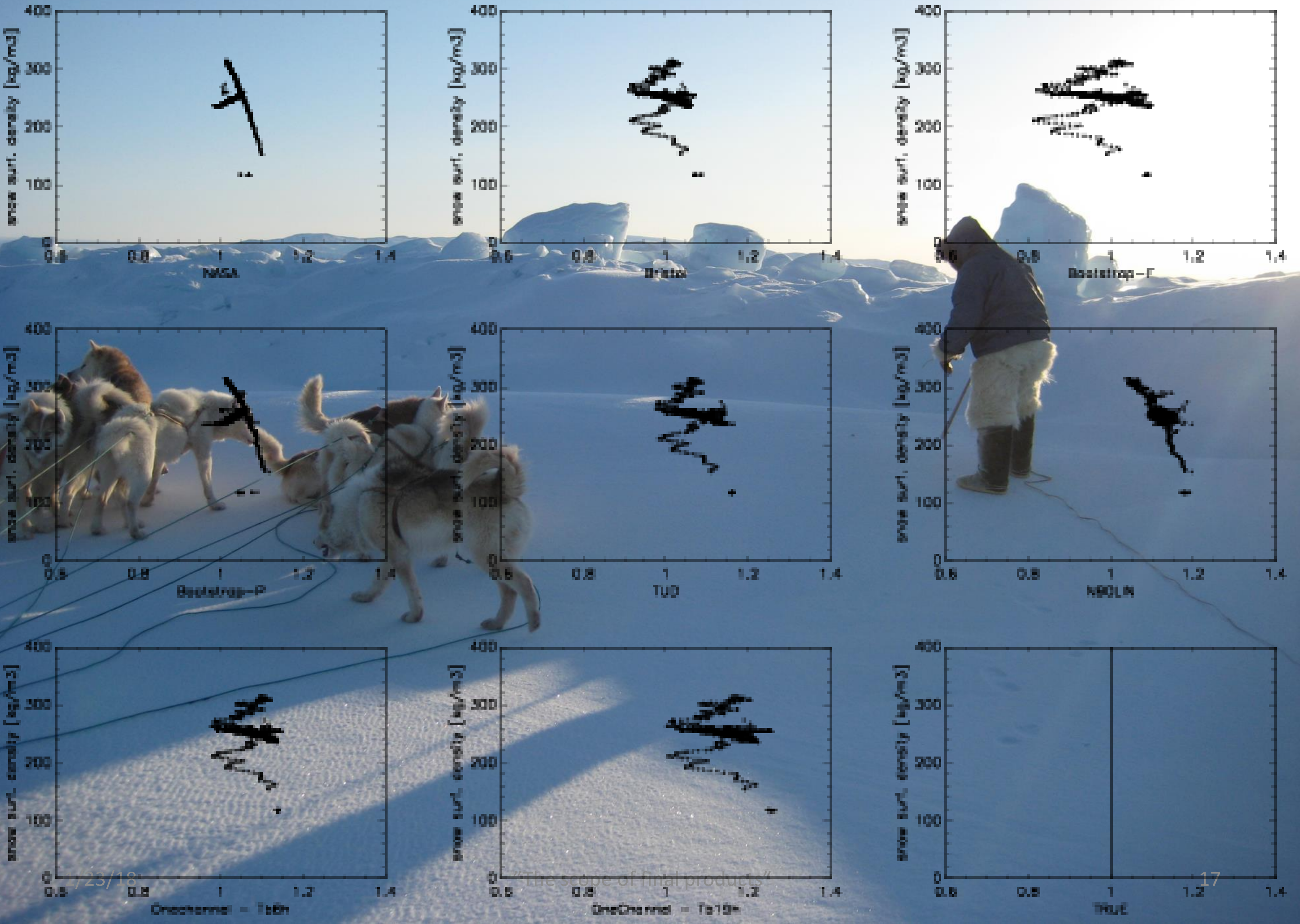
Snow ice interface temperature vs. IC



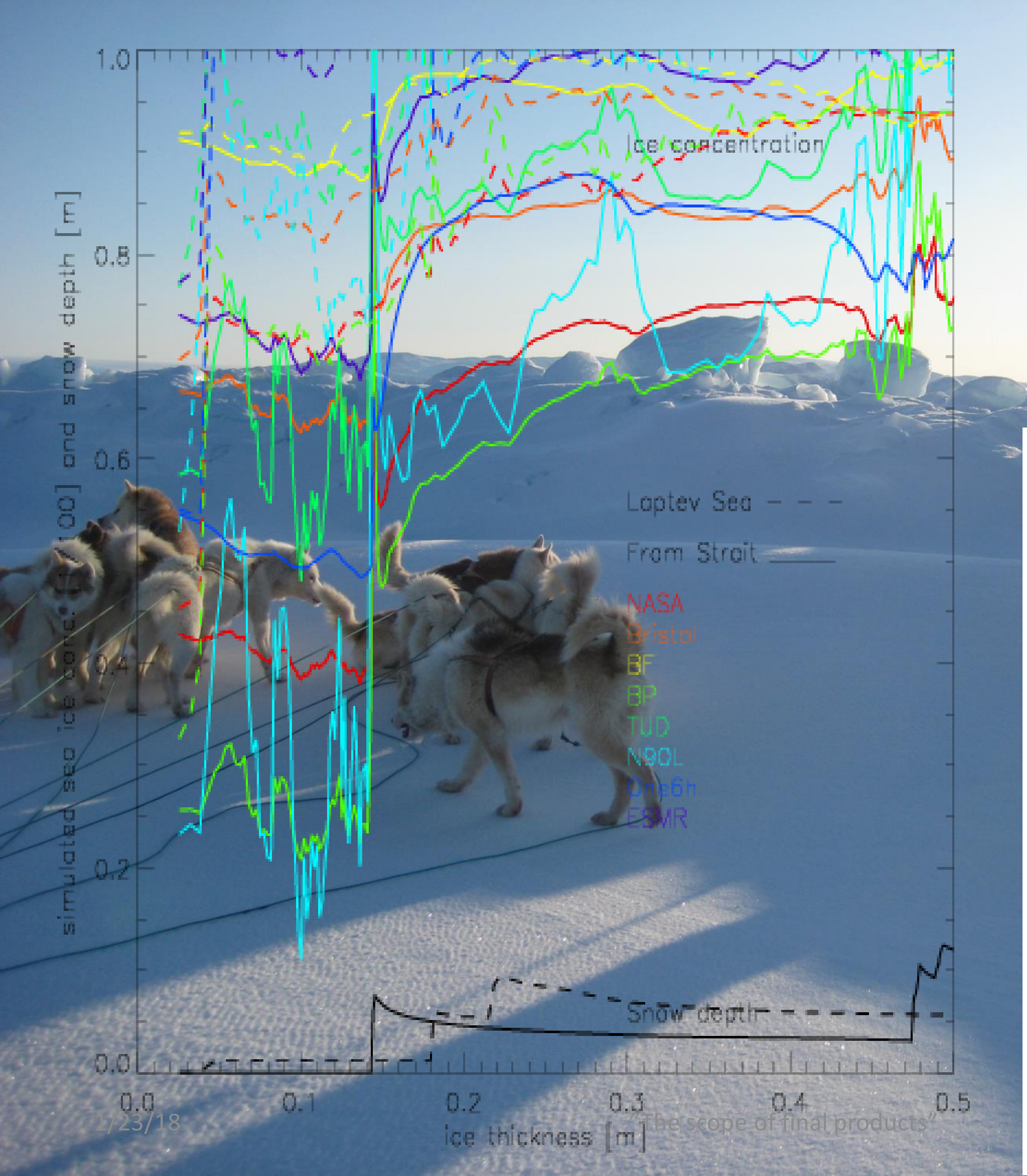
First-year ice: Ross Sea



Snow surface density



Thin ice



The simulated sea ice concentration is lower than 100% for thin ice. This seems to be related to the (missing) snow cover and also ice thickness.

In the real world thin ice is also sometimes low concentration ice and bare ice and the things are difficult to separate.

Improving the effective temperature estimation over sea ice using low frequency microwave radiometer data and Arctic buoys

Lise Kilic

June 29, 2017

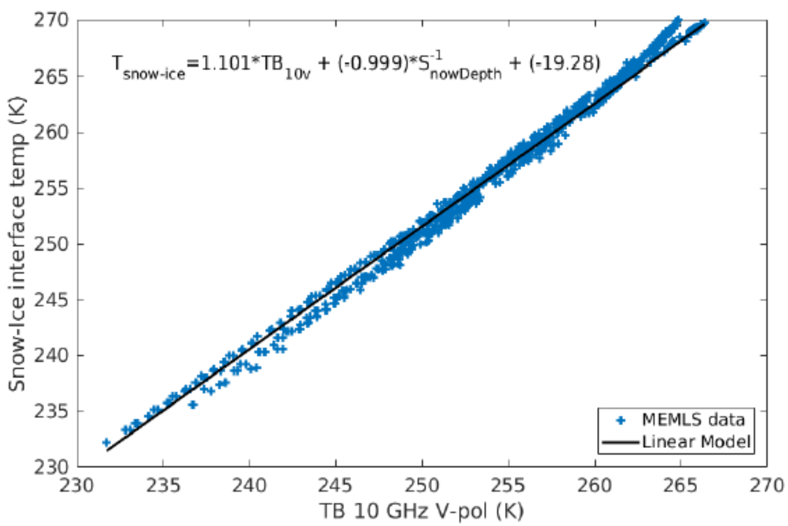


Figure 14: Snow ice interface temperature from memls data as a function of the brightness temperature at 10.65 GHz in blue points, and the multi-linear regression for the mean snow depth in black line.

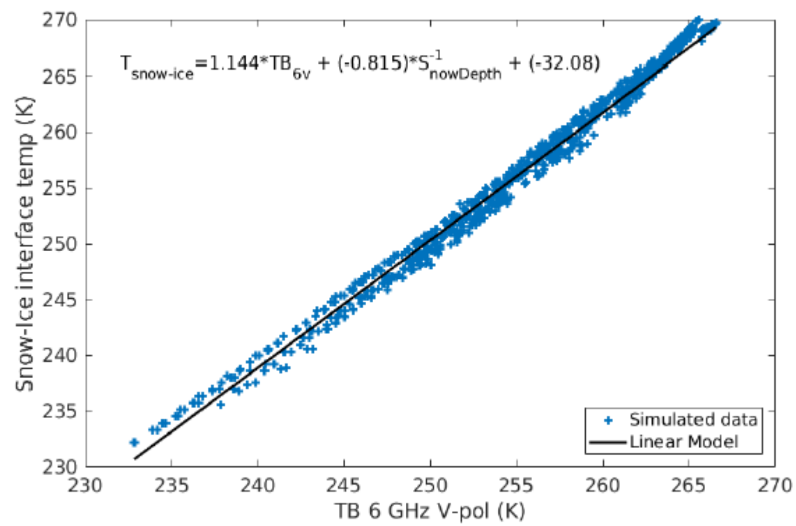


Figure 15: Snow ice interface temperature from memls data as a function of the brightness temperature at 6.9 GHz in blue points, and the multi-linear regression for the mean snow depth in black line.

Weather filter

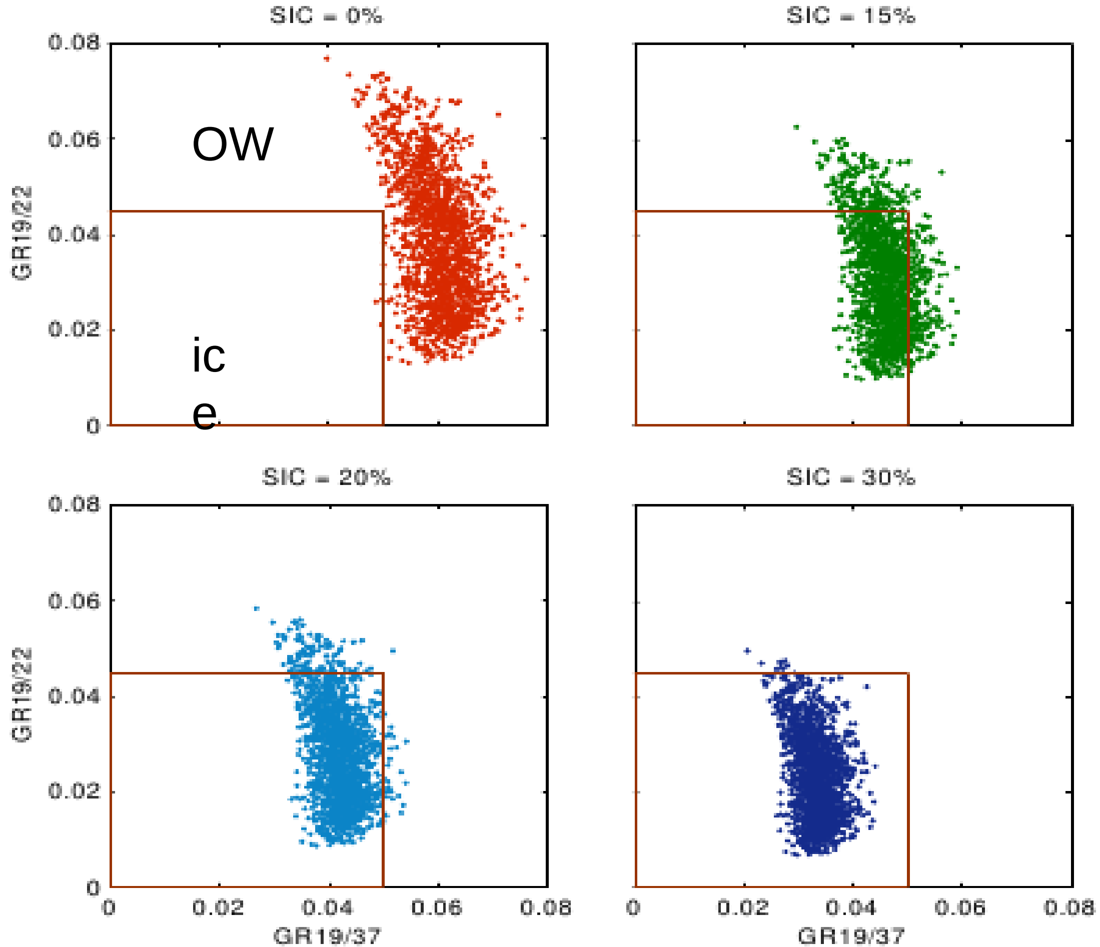
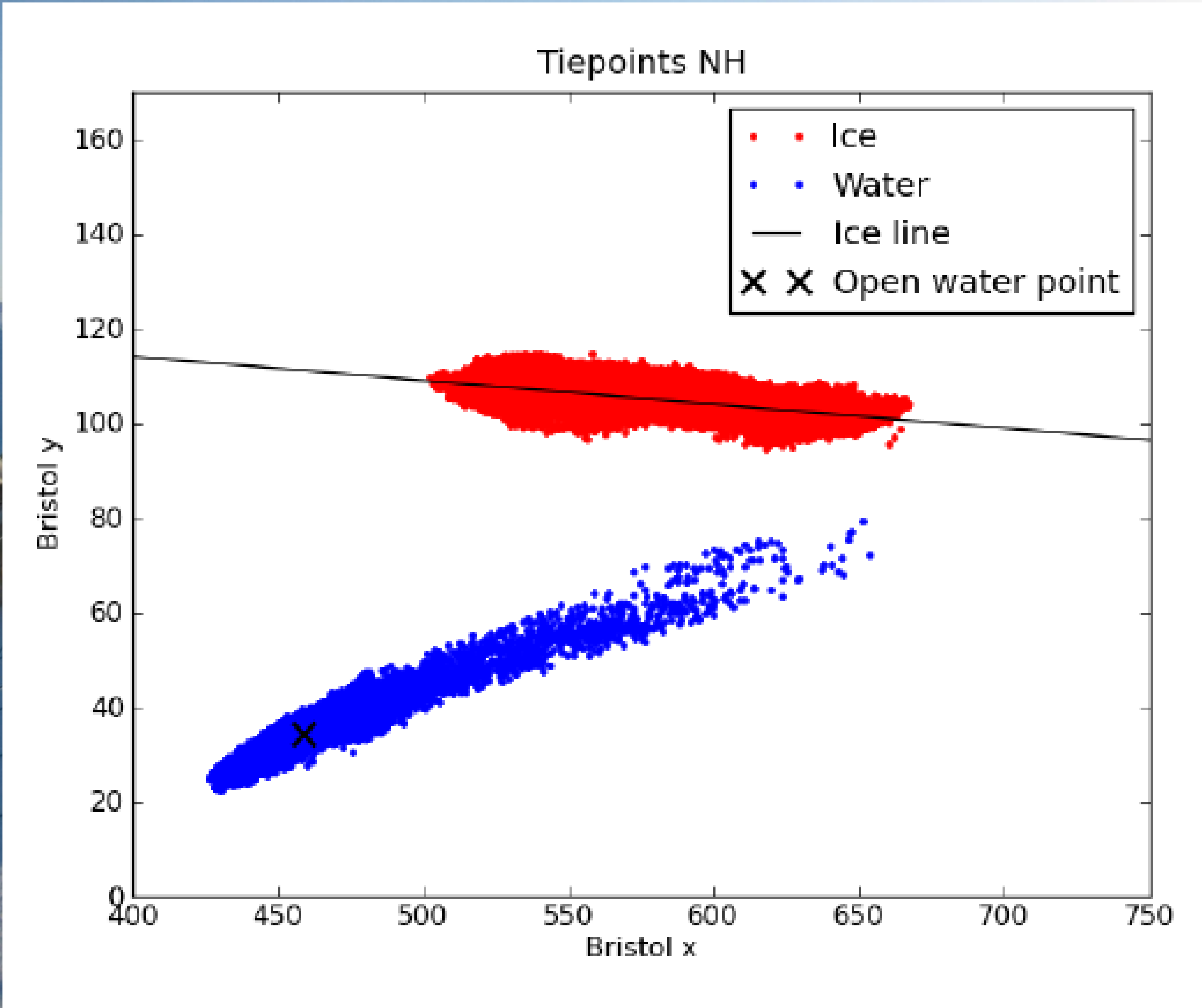


Figure 5. Demonstration of the open water/weather filter performance: gradient ratio (GR) 19/22 is plotted as a function of GR19/37 for SSM/I data in 2008 (entire year) for the Northern Hemisphere for sea ice concentration (SIC) of 0, 15, 20, and 30 %. The red square shows the value range outside which the open water/weather filter sets SIC values to 0 % (open water).

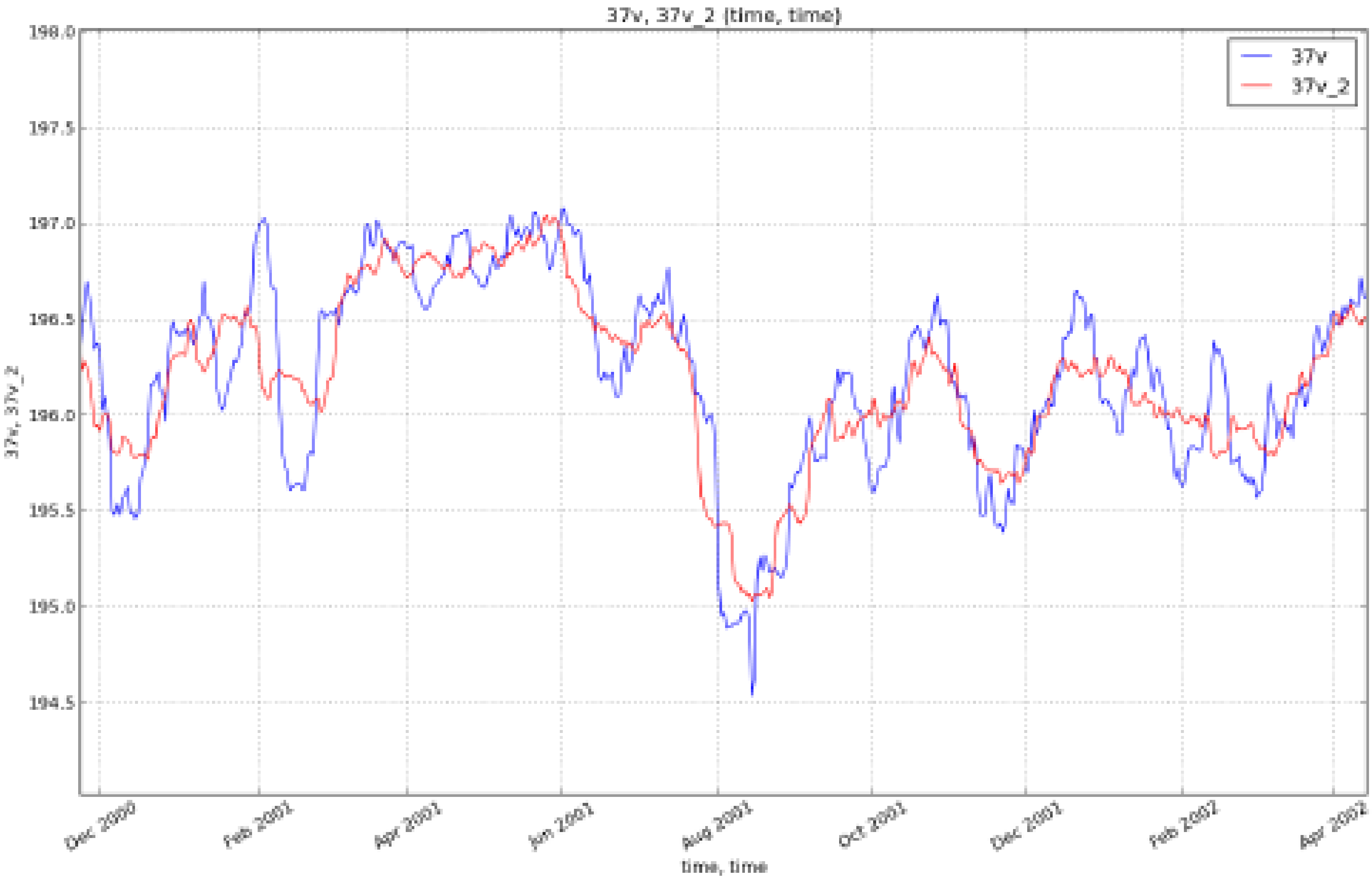
Ivanova et al. 2015

Dynamical tie-points

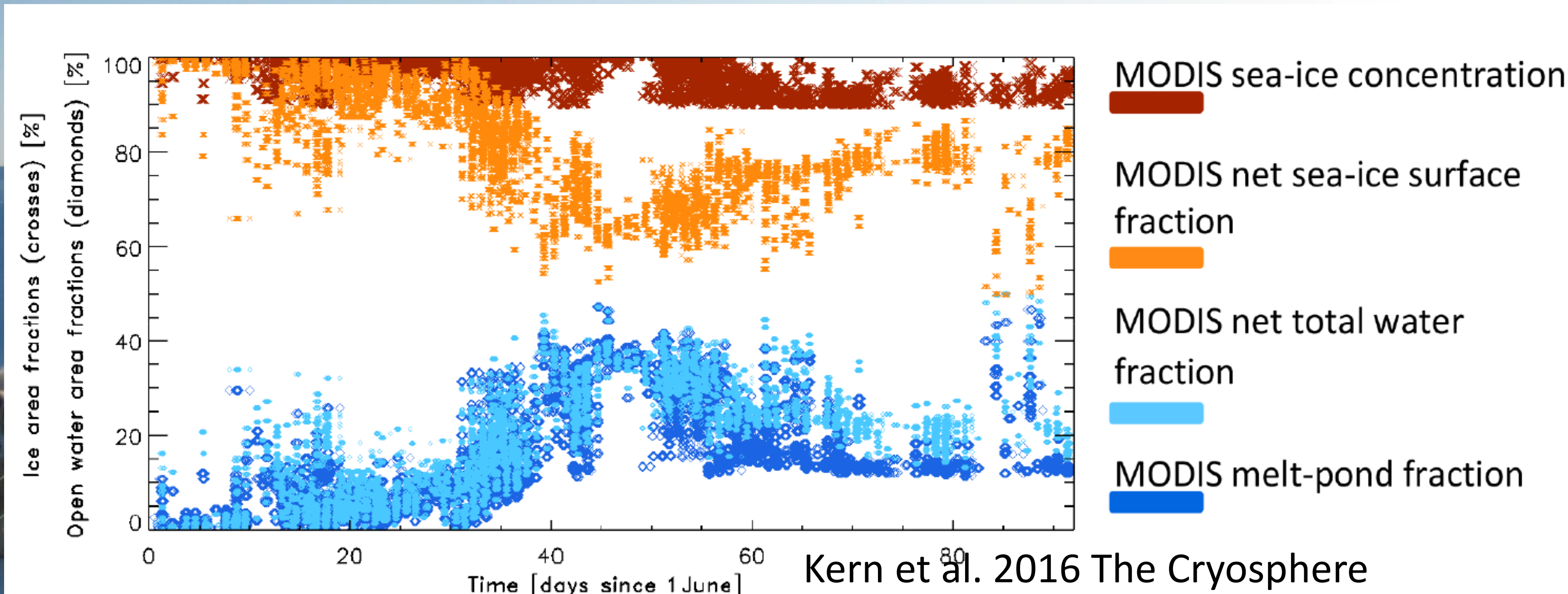
- Minimize SIC sensitivity to: climatological trends and sensor drift,
- year to year changes in ice emissivity and temperature, and
- seasonal emissivity changes
- Necessary when doing Tb correction
- Necessary for doing uncertainties


Tiepoints NH
Ice
Water
Ice line
Open water point
Bristol y
Bristol x
0
20
40
60
80
100
120
140
160
400
450
500
550
600
650
700
750

Dynamical tie-points



Summer sea ice tiepoints

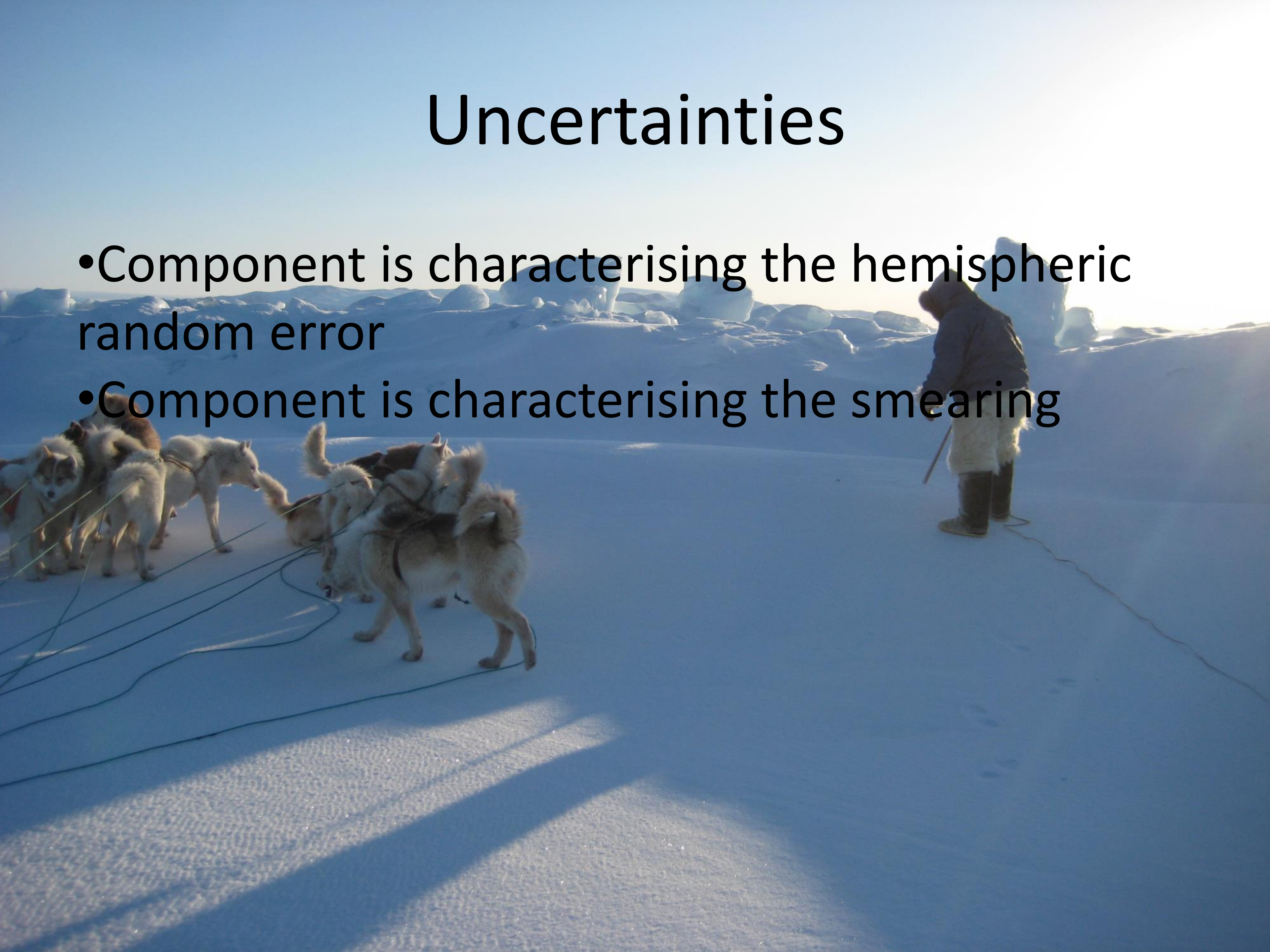


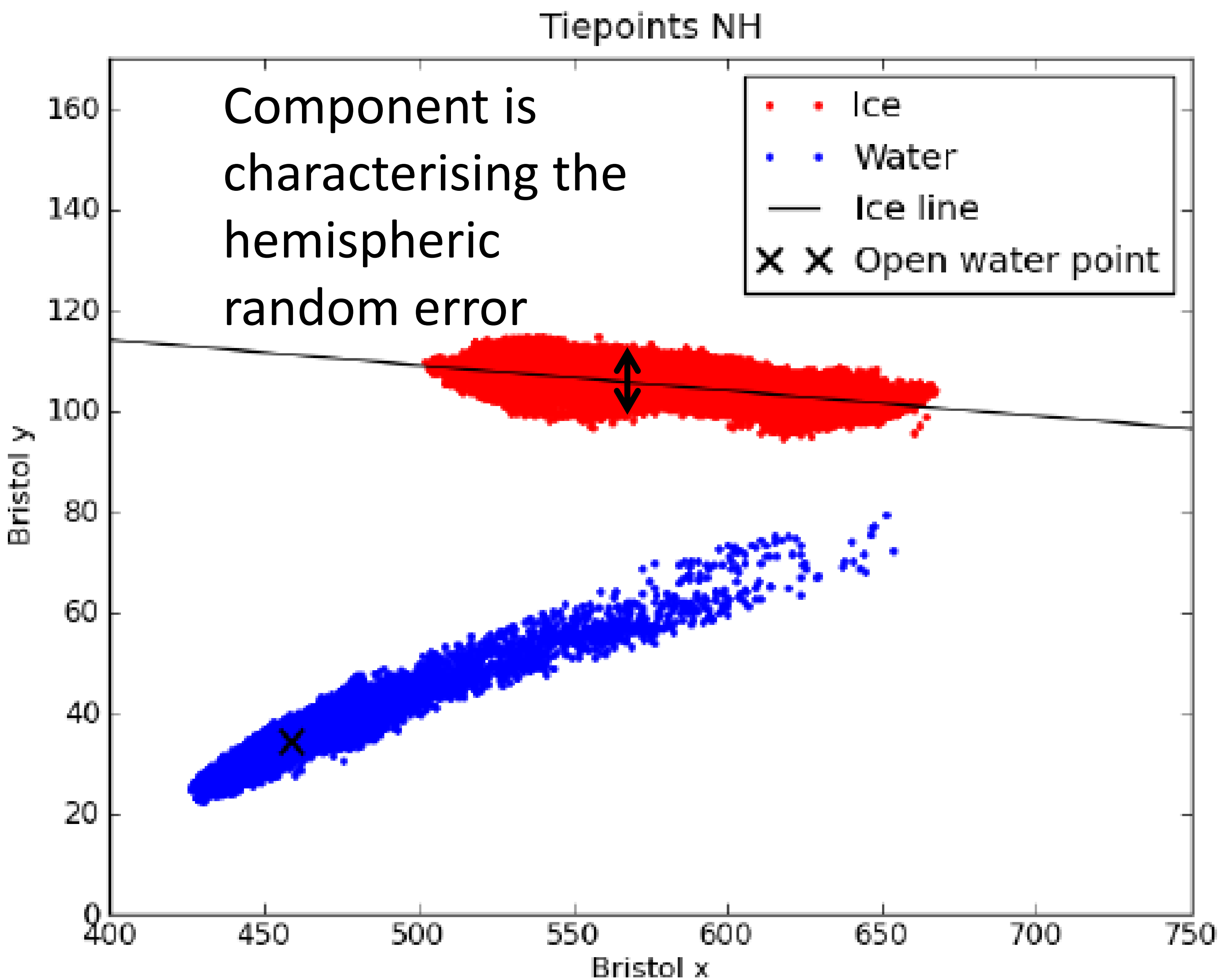
Kern et al. 2016 The Cryosphere

Carolina Gabarro (2016): The dynamical estimation of summer sea ice tie-points using low frequency passive microwave channels. OSISAF VS scientist study.

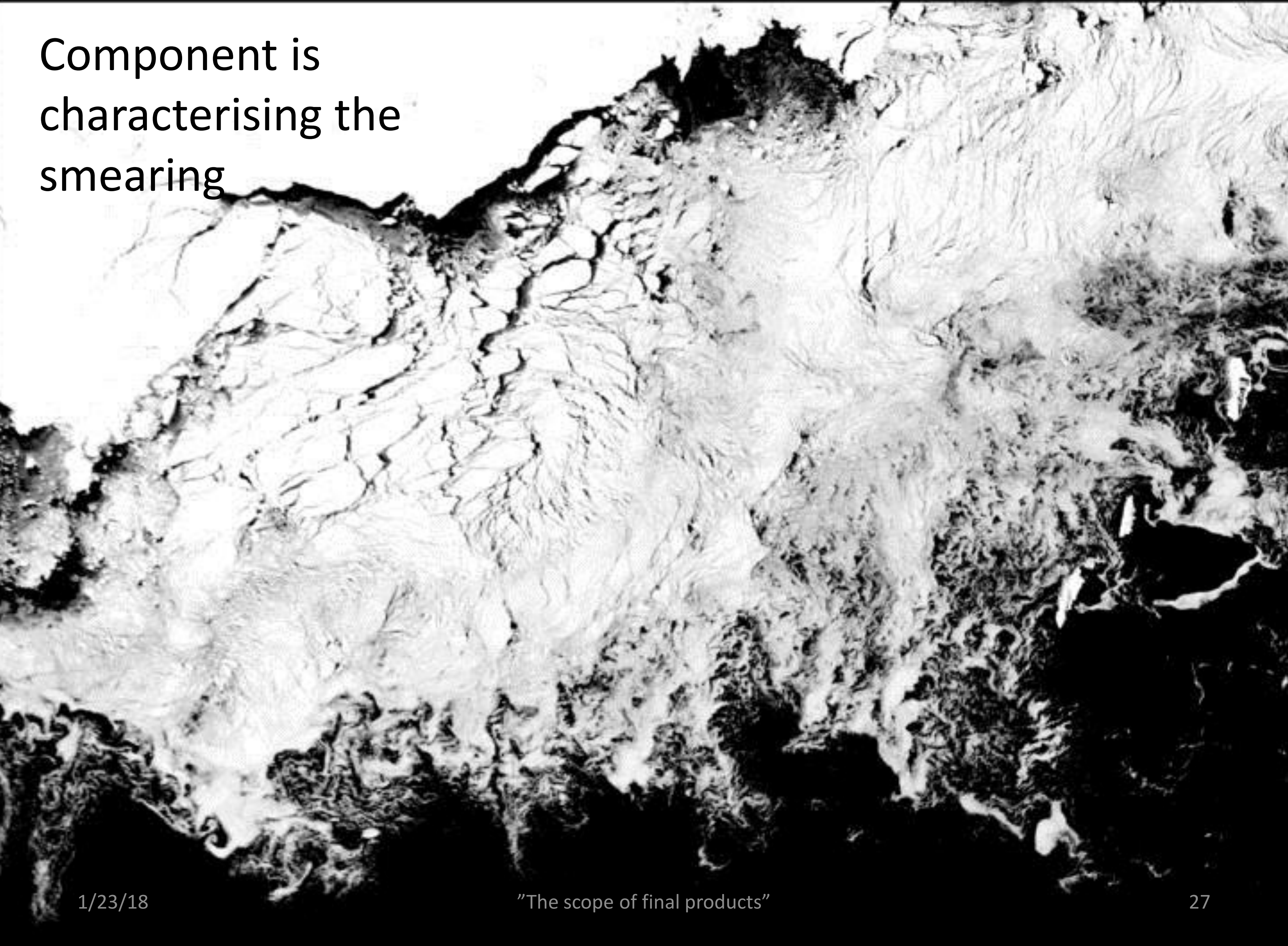
Uncertainties

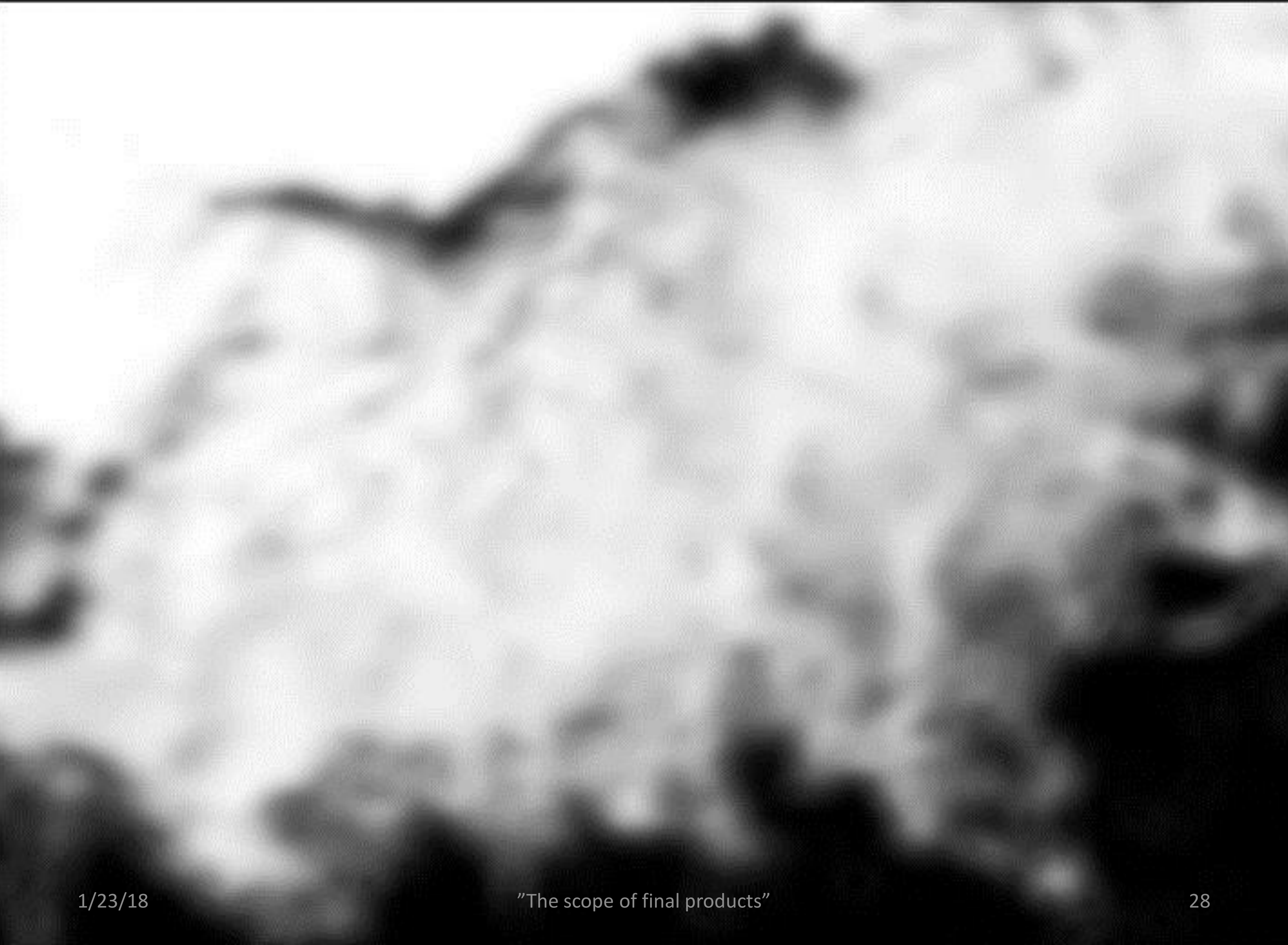
- Component is characterising the hemispheric random error
- Component is characterising the smearing



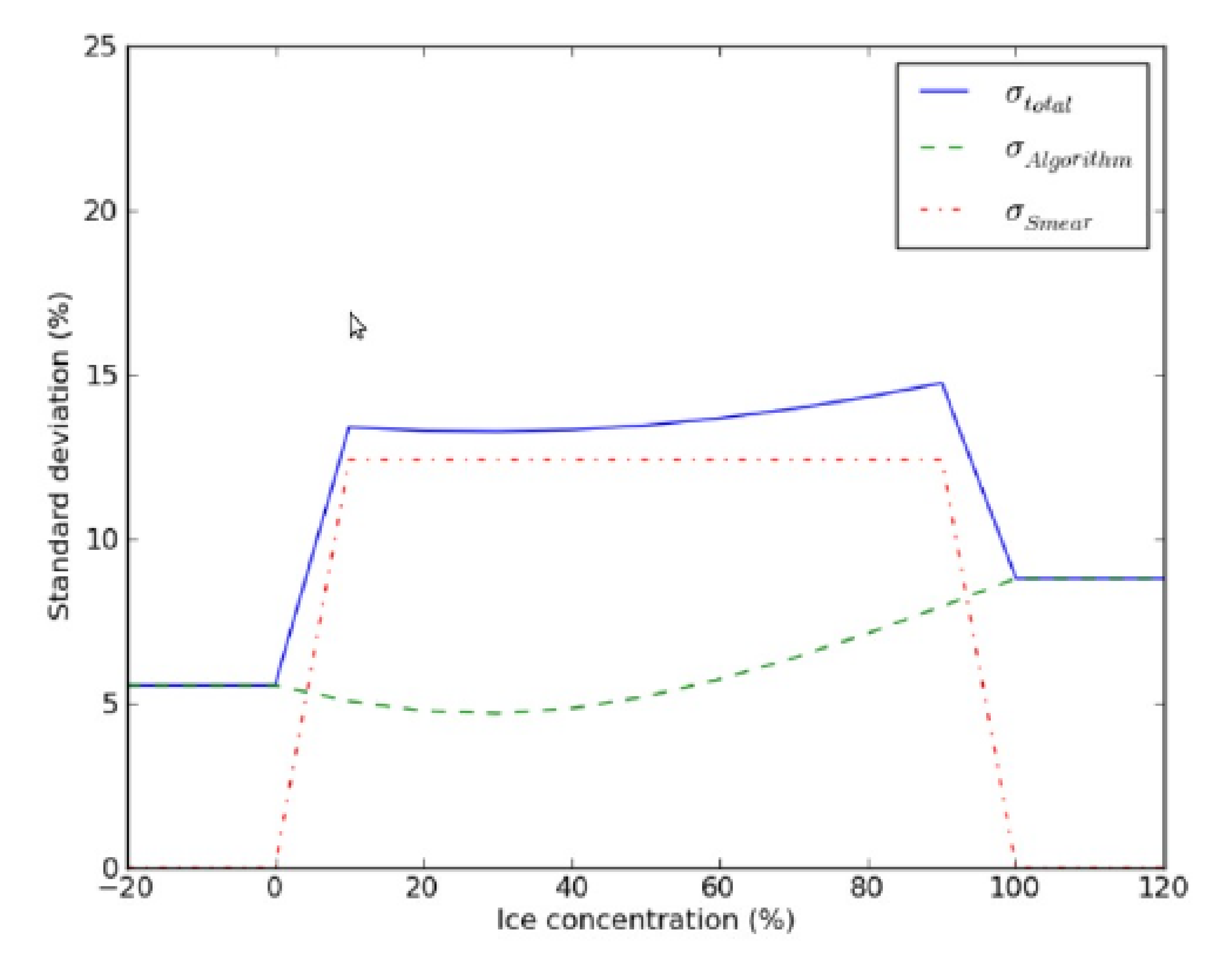

Tiepoints NH
Component is characterising the hemispheric random error
Ice
Water
Ice line
Open water point
Bristol y
Bristol x
0
20
40
60
80
100
120
140
160
400
450
500
550
600
650
700
750

Component is characterising the smearing





Uncertainty model



Tonboe et al. 2016 The Cryosphere

Land-spill-over-correction and masking

- Distance to coast is classified
- Evaluation of coastal pixels by:
  - – comparing to expected land-spill-over
  - –comparing with neigboring pixels

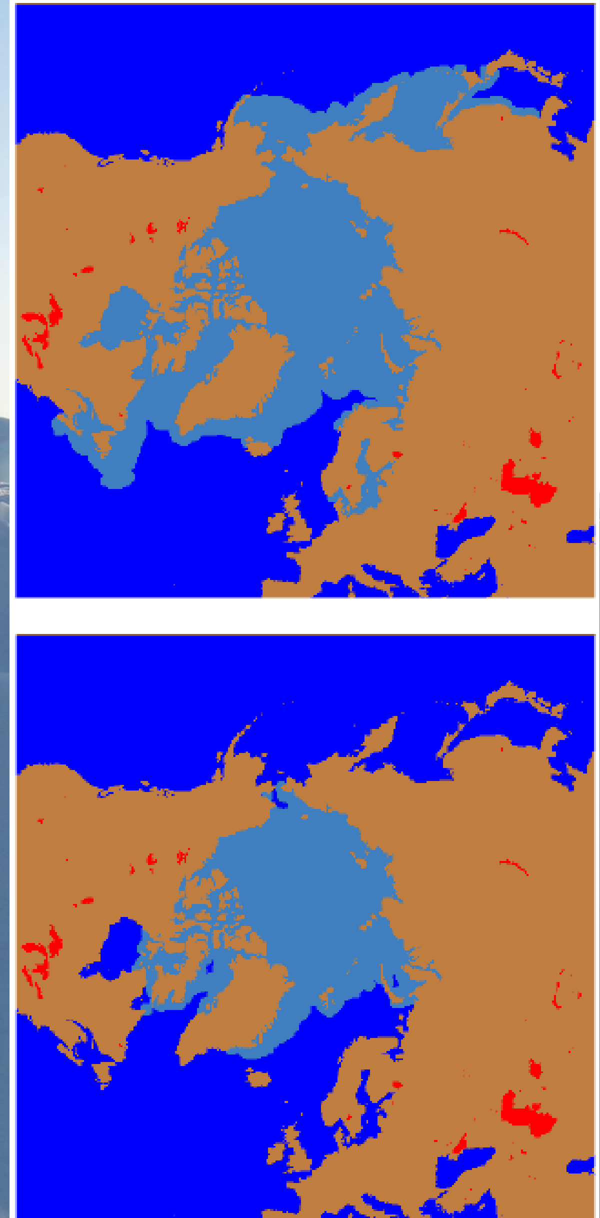


Figure 6: Climatological maximum sea ice extent during March (upper) and September (lower)

Eastwood et al. 2017 OSISAF report

Ongoing development and future

- Additional physical correction especially over ice e.g. sea ice Teff we are experimenting with optimal estimation and forward operator development something that brings us closer to the numerical modelling community and data assimilation. Initiatives like the virtual sea ice mission are helpful
- Eventually this could lead to running the SIC algorithm within the numerical model assimilation system.
- Developing the uncertainty model further and urging the use of uncertainties.
- L2 swath sea ice concentrations (timeliness)