Towards a unified ice thickness product derived from SMAP and SMOS: First results of brightness temperature comparisons

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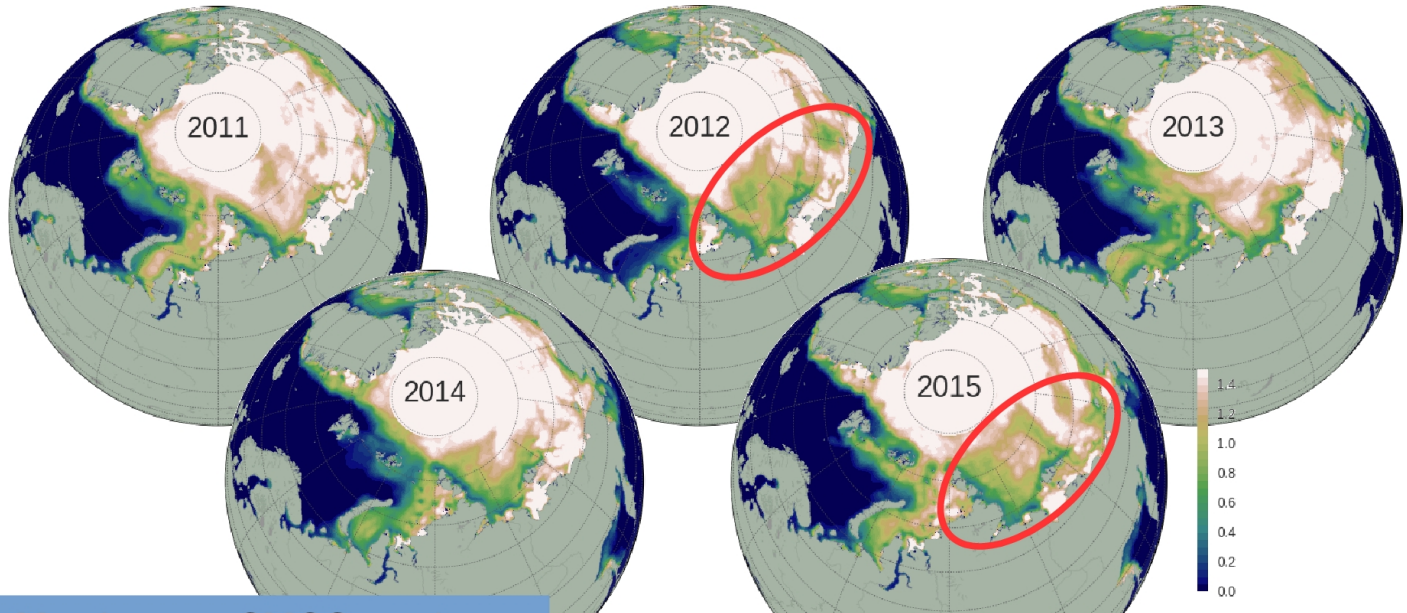
Sea ice thickness from SMOS



Feb.-March mean SMOS sea ice product University of Hamburg
http://icdc.zmaw.de

smosice
support to science element

Retrieval algorithm

based on brightness temperature (TB) intensity (0°–40°) → sea ice radiation model + thermodynamic model → account for subpixel-scale heterogeneity of ice thickness

→ **sea ice thickness of up to 1 m**

Data products

SMAP

- L1C Radiometer Half-Orbit 36 km EASE-Grid TB
- daily average

SMOS

- L1C TB
- daily values

$\longrightarrow$ 12.5 km polar stereographic grid (NSIDC)

Data products

SMAP

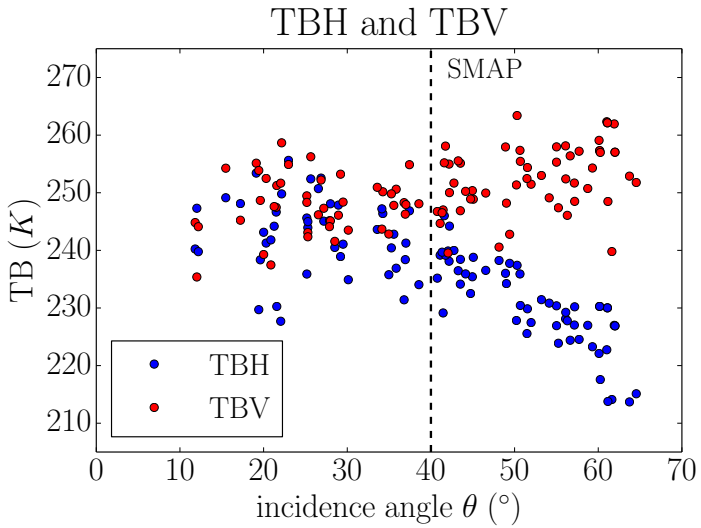
- L1C Radiometer Half-Orbit 36 km EASE-Grid TB
- daily average

SMOS

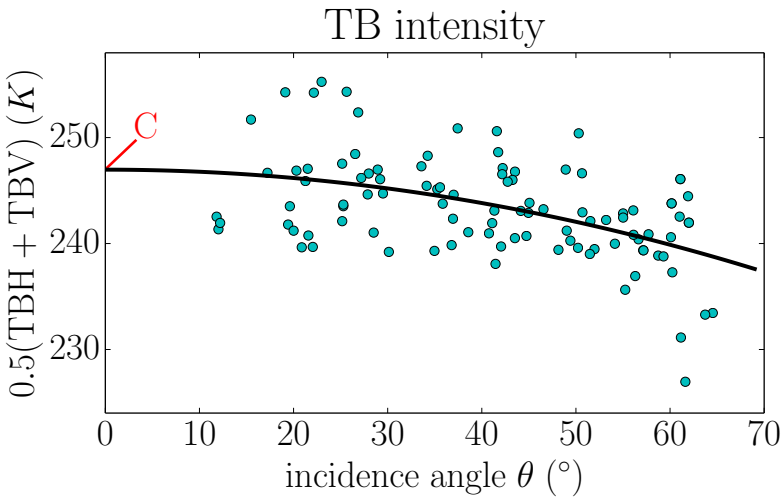
- L1C TB
- daily values

→ 12.5 km polar stereographic grid (NSIDC)

- incidence angle: 40°
- incidence angles: 0–65°



SMOS TB at 40°

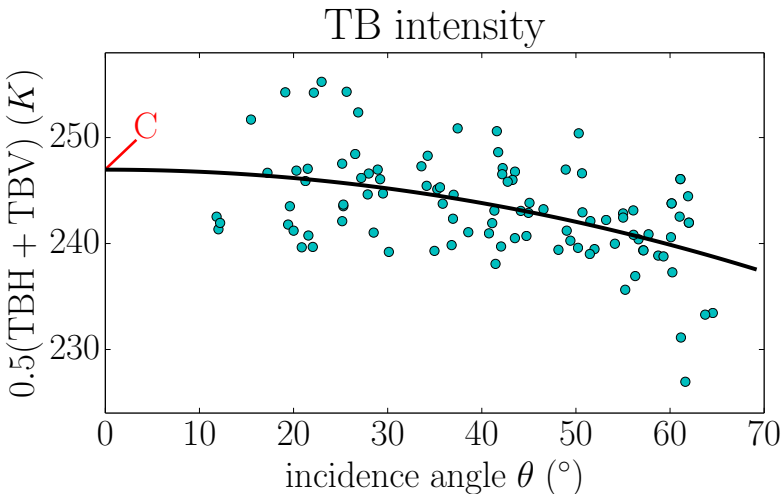


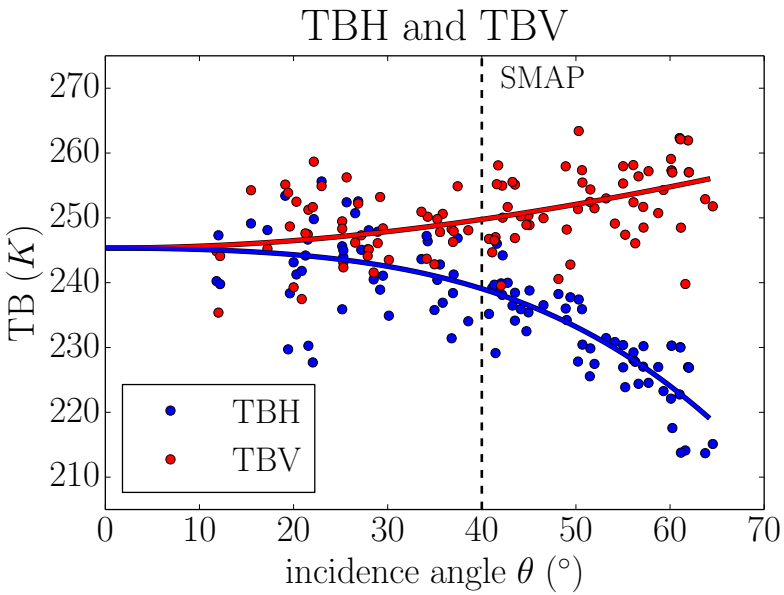
2-step regression after Zhao et al. (2015)

$$0.5(T_{b,h} + T_{b,v}) = A \cdot \theta^2 + C$$

Zhao et al.: "Refinement of SMOS multiangular brightness temperature toward soil moisture retrieval and its analysis over reference targets". IEEE (2015)

SMOS TB at 40°





2-step regression after Zhao et al. (2015)

$$0.5(T_{b,h} + T_{b,v}) = A \cdot \theta^2 + C$$

$$T_{b,h} = a_h \cdot \theta^2 + C\left(b_h \sin^2(\theta) + \cos^2(\theta)\right)$$

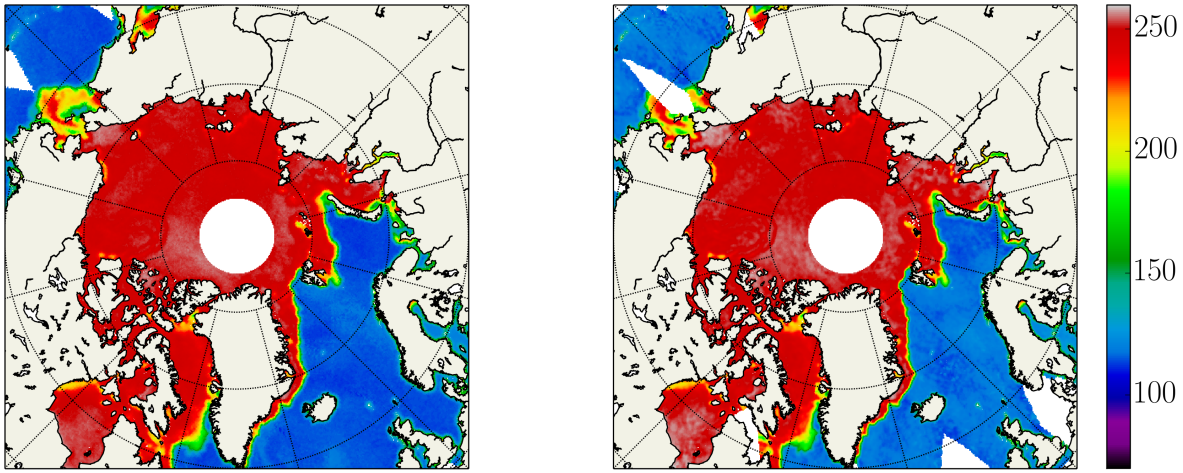
$$T_{b,v} = a_v \cdot \theta^2 + C\left(b_v \sin^2(d_v \cdot \theta) + \cos^2(d_v \cdot \theta)\right)$$

Zhao et al.: "Refinement of SMOS multiangular brightness temperature toward soil moisture retrieval and its analysis over reference targets". IEEE (2015)

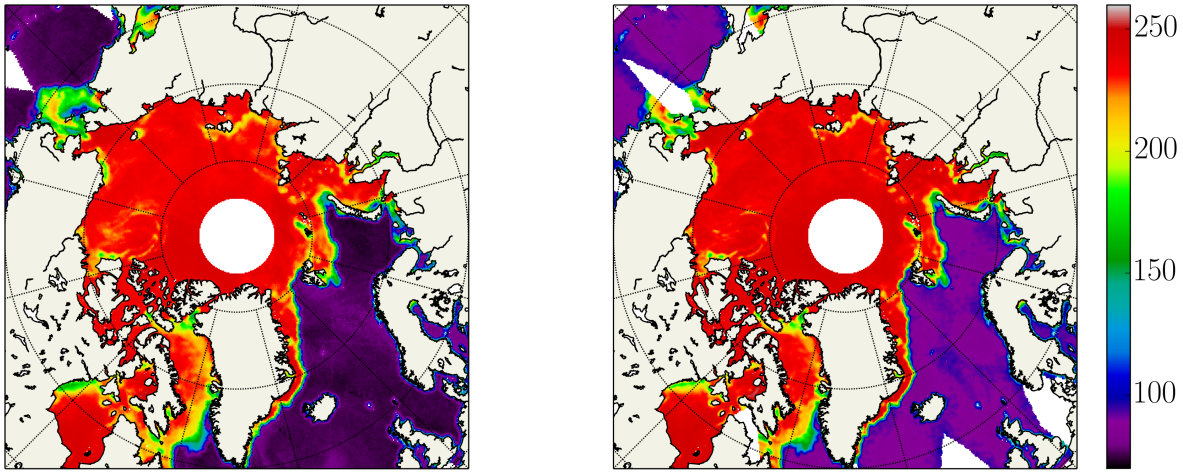
Qualitative comparison of SMAP and SMOS - 5 April 2015

SMAP SMOS

TBV



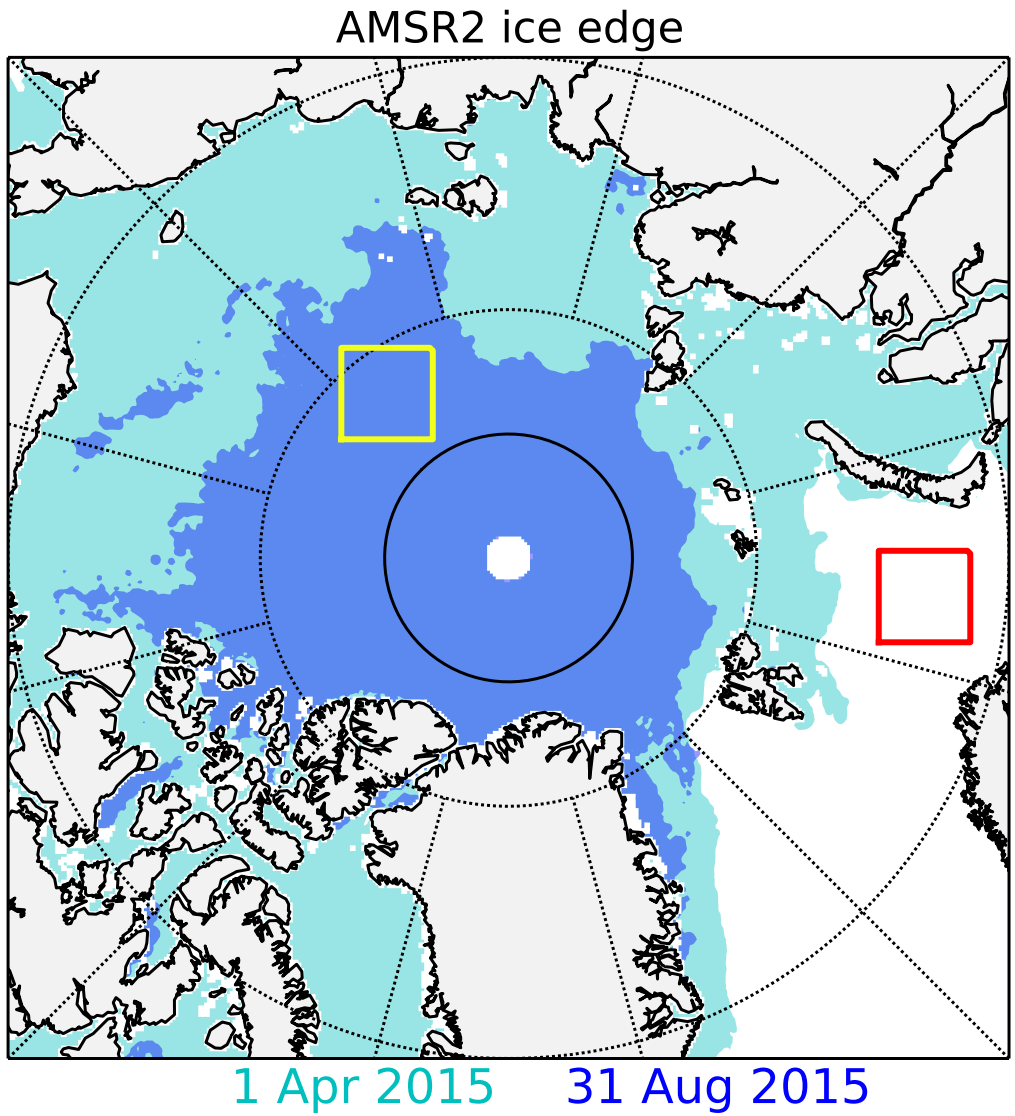
TBH



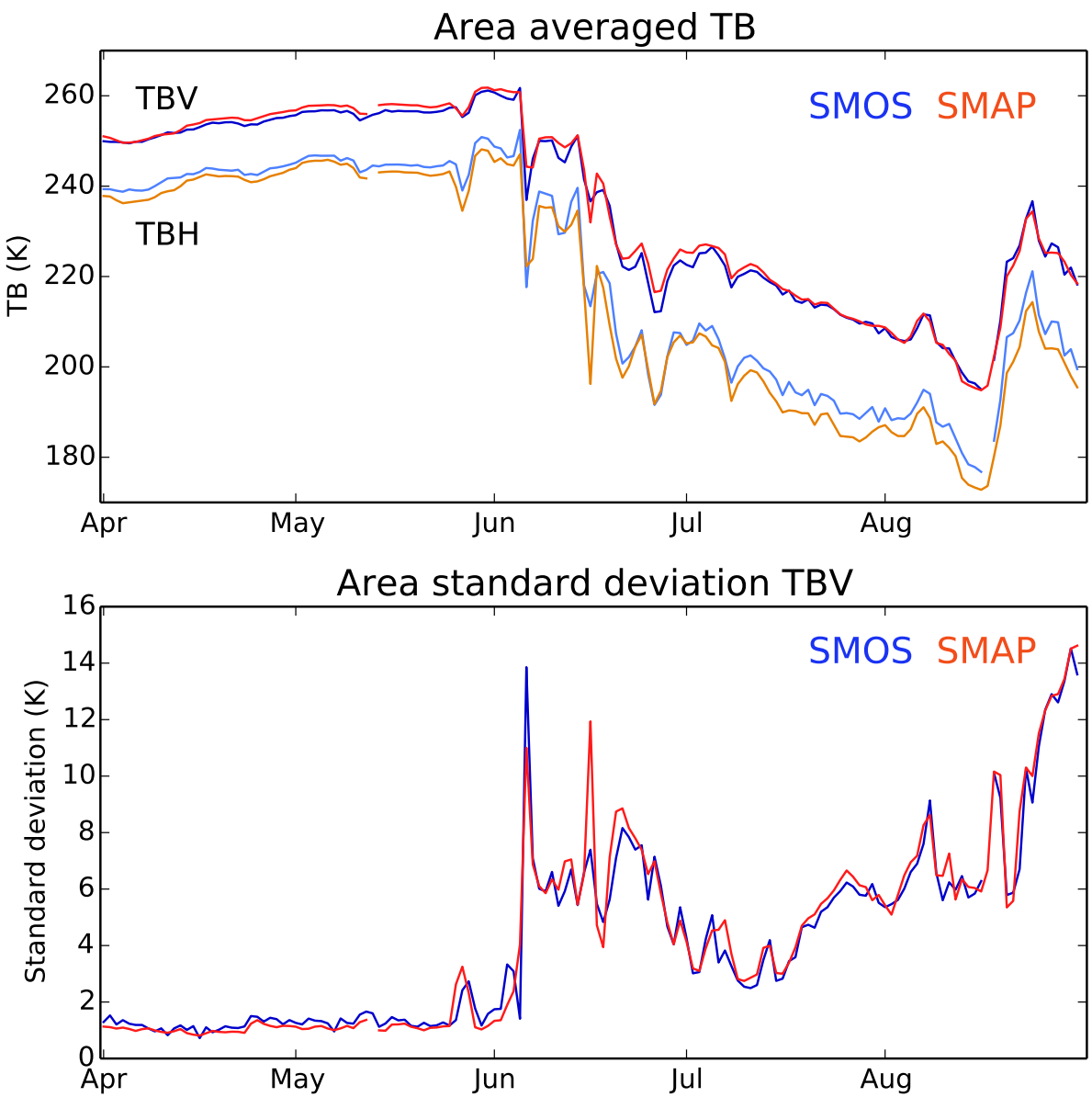
Quantitative comparison

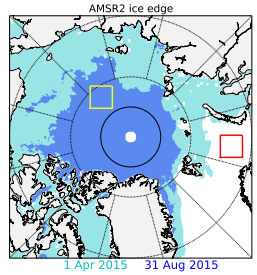
Selected regions over
ice and water

400 km × 400 km



Quantitative comparison - over sea ice





Average

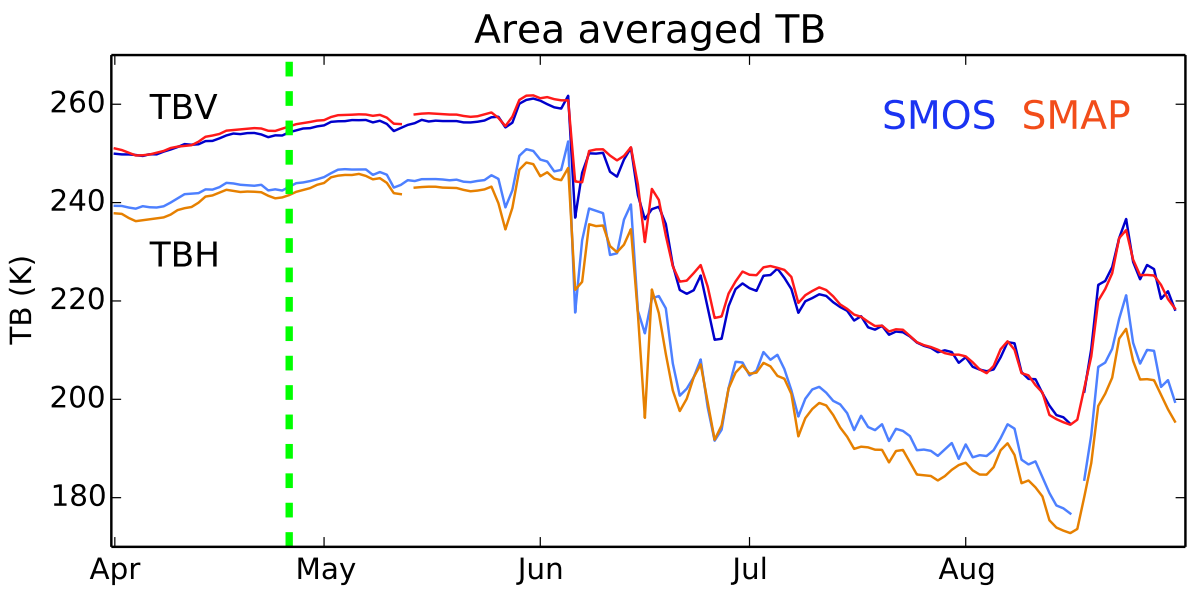
	TBV	TBH
RMSD:	1.7 K	3.7 K
bias:	-0.8 K	2.9 K

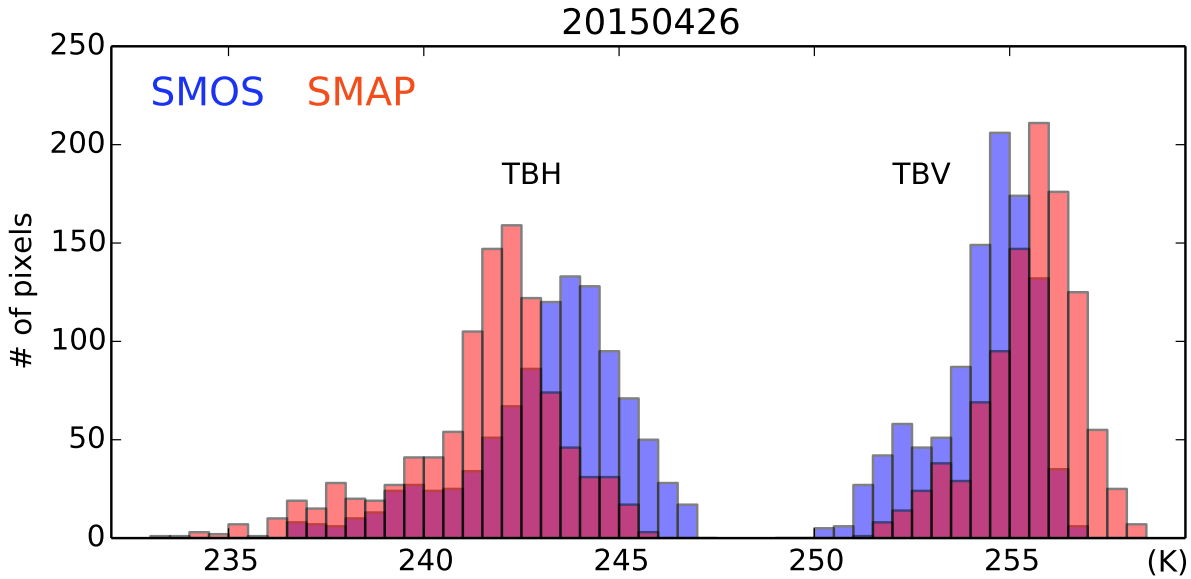
- pol. difference 3.7 K smaller for SMOS
- correlation $r > 0.99$

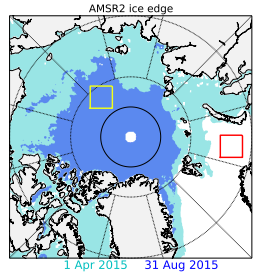
Standard deviation

	TBV	TBH
RMSD:	0.7 K	1.1 K
bias:	$<$0.1 K	
r:	0.98	0.97

Quantitative comparison - over sea ice







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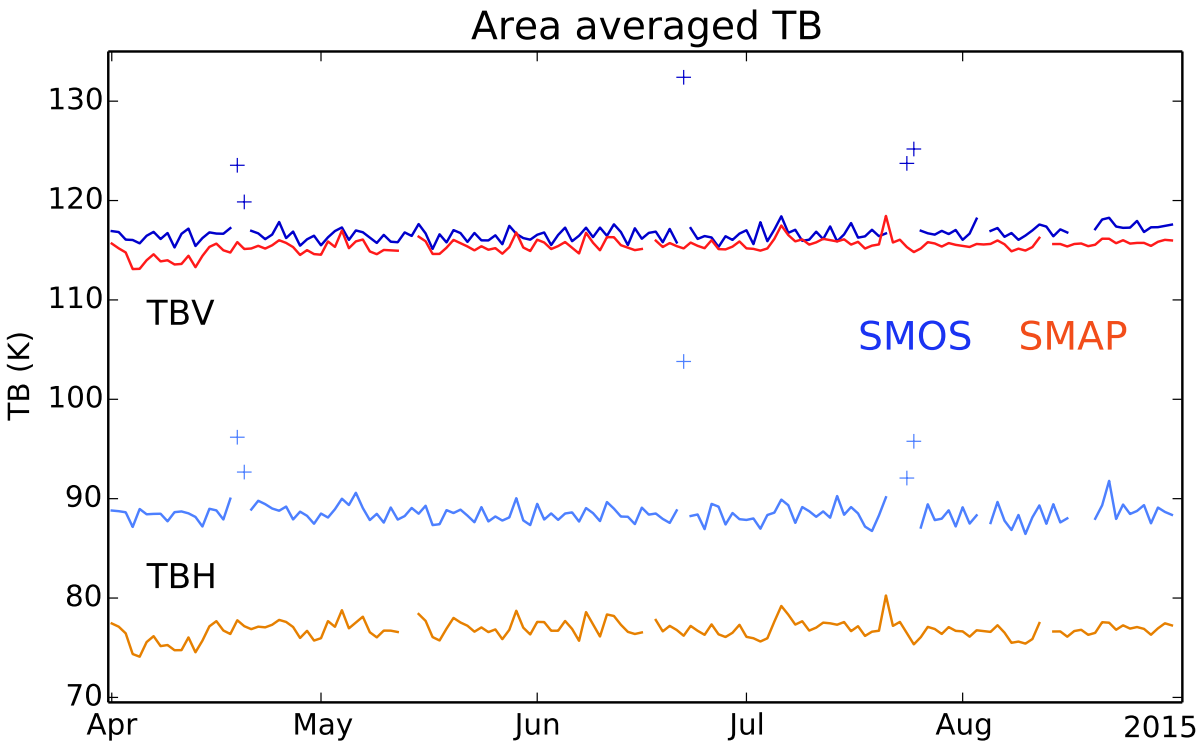
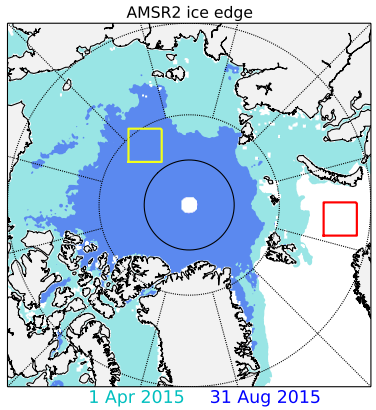
Quantitative comparison - over open water





- RFI contamination in SMOS +
- known issue in SMOS v620: ocean bias (but better long term stability)
- bias: 1.2 K (TBV), 11.6 K (TBH)
- noise in the signal $\longrightarrow r \sim 0.5$

Summary

1) Fit SMOS TB to 40°

2) Comparison between SMAP and SMOS TB:

- variability over sea ice: very good agreement
- 3.7 K smaller polarisation difference over ice for SMOS
- large bias (>11 K) in TBH for SMOS over water

Short term TB variability