



15 Years of Global Winter Sea ice Thickness & Volume from CryoSat-2, Sentinel-3A/B and SMOS (CS³SMOS)

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What is CS³SMOS?

CS³SMOS is a gapless winter sea ice thickness product based on optimal interpolation of CryoSat-2 & Sentinel-3A/B Ku-band radar altimeter and SMOS L-band radiometer data. It replaces and extends the CryoSat-2/SMOS (CS2SMOS) product (Ricker et al., 2017).

Product evolutions compared to CS2SMOS

- Sea ice thickness in southern hemisphere
- Addition of Sentinel-3A/B radar altimeter data
- Increase of spatial resolution to 12.5 km (from 25 km in CS2SMOS)
- SMOS uncertainties include effect of sea ice concentration
- New file format

General Information

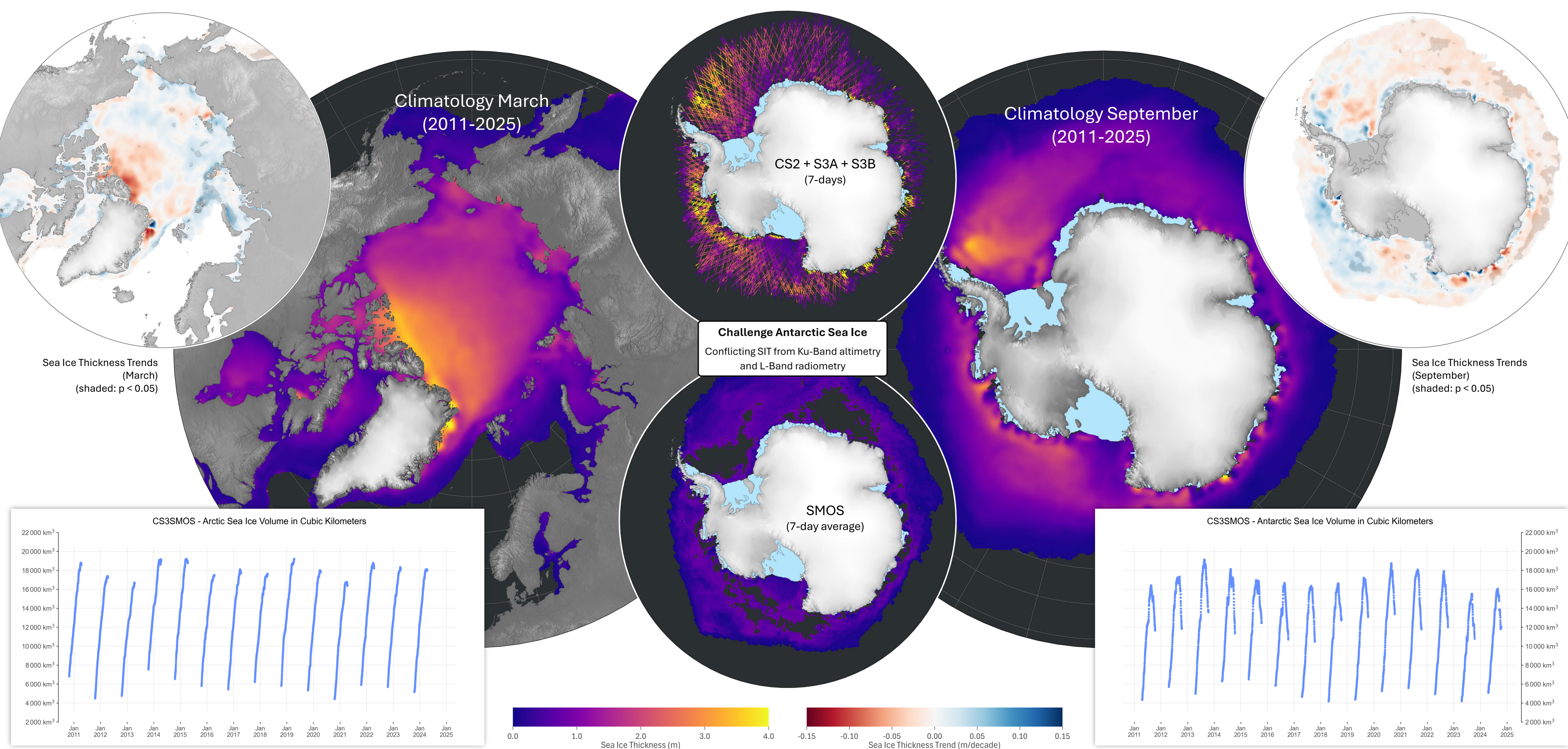
Multi-sensor sea ice thickness products are generated both in near real-time (+2d) and non-time critical timeliness (+45d). Each daily updated sea ice thickness field is based on an observation field of 7 days. Northern and southern hemisphere products cover the corresponding winter season. The change between target hemisphere in the SIT production is October 15 (start NH) and April 15 (start SH).

CS2SMOS / CS³SMOS can be obtained from AWI ftp server and ESA SMOS Online Dissemination Service. The dataset is also brokered to the Copernicus Marine Data Store (near real-time) and soon the Copernicus Climate Data Store.

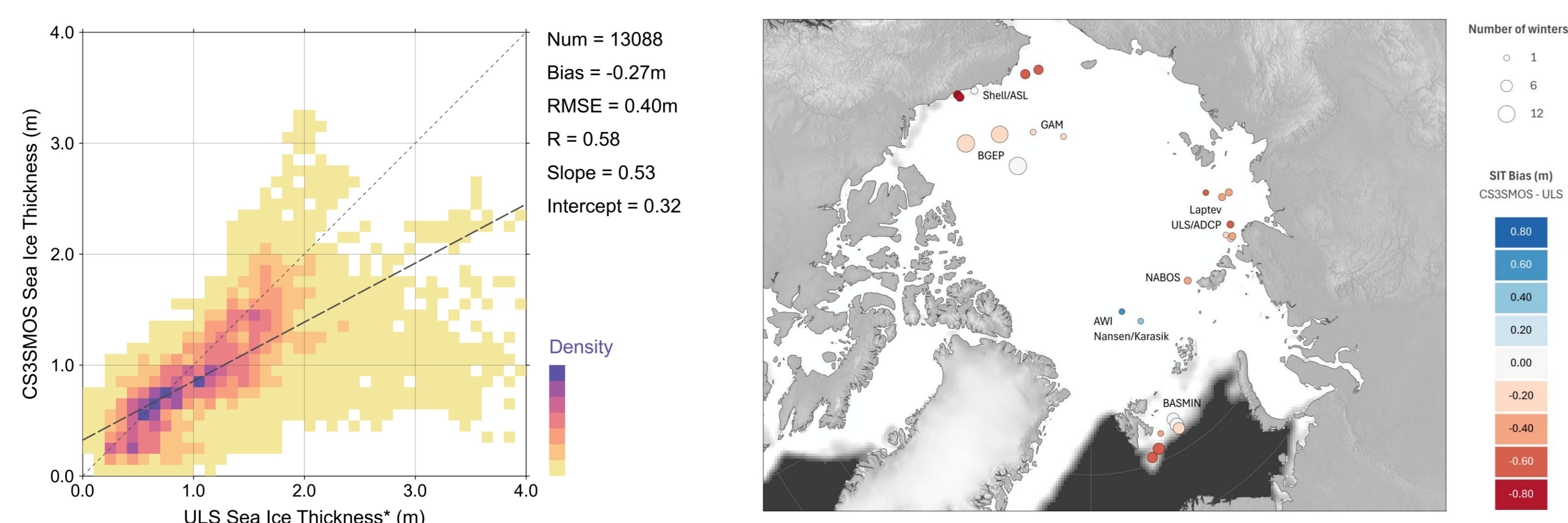
Data Access & Operational Updates

CS³SMOS is scheduled for release in Q4 2025AWI Operational News
and Analysis & FTP linkESA SMOS / CryoSat-2 L4 sea ice
thickness data catalog

Sea ice thickness variability of the last 15 winters masks sea ice volume trends but statistically significant sea ice thickness trends emerge in both hemispheres

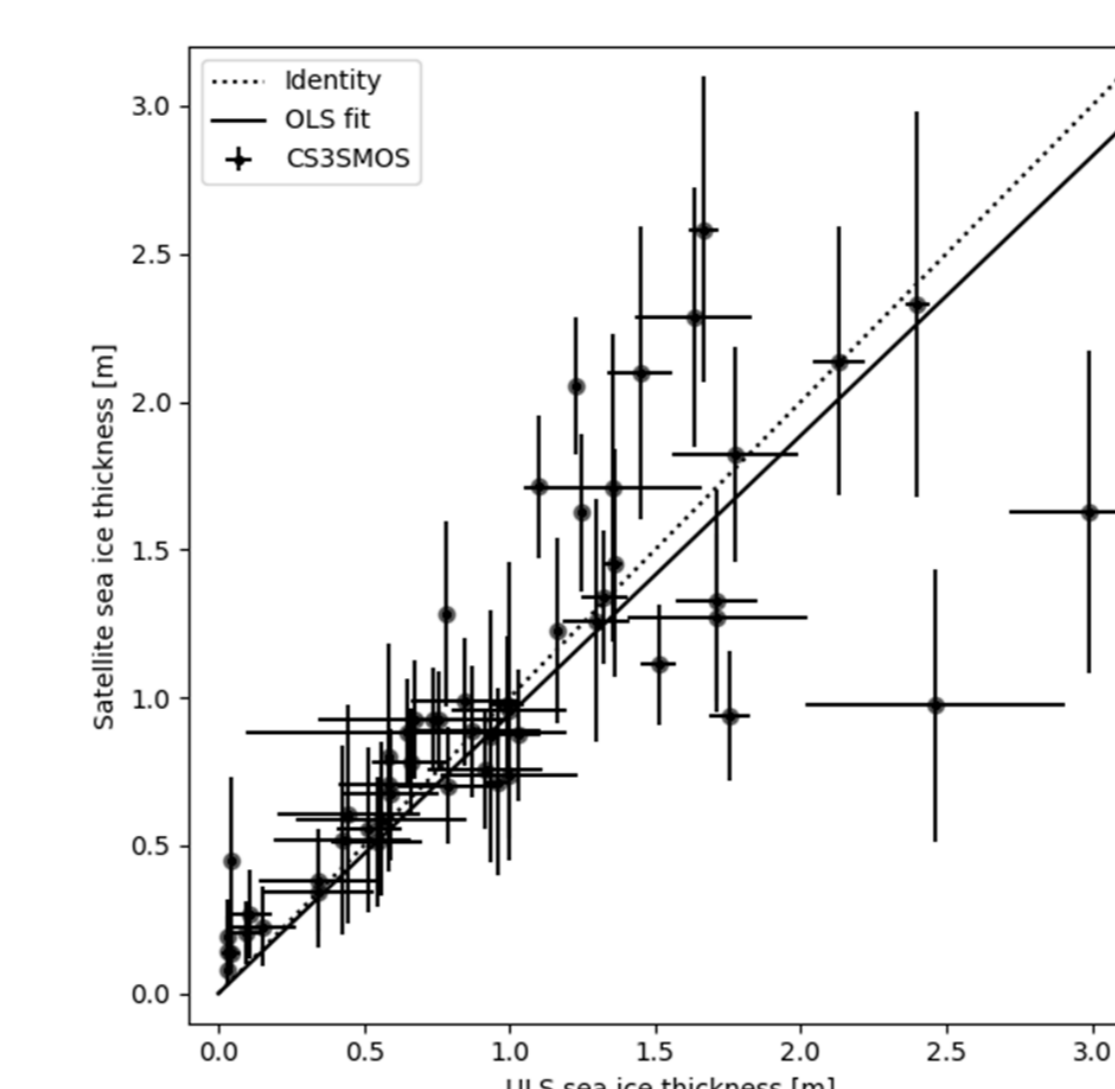


Product Quality



Sea ice thickness reference measurements coverage mainly in northern hemisphere. Above validation results from 27 upward looking moorings (ULS) with varying temporal coverage between 2010 and 2023.

Take-home message: CS³SMOS captures sea ice thickness patterns but is biased low in areas with low ice concentration of mixed surface conditions with thick and thin ice / open water.



CS³SMOS validation with monthly climatology of 7 ULS locations in the Weddell Sea .

Credits

CS³SMOS is based on

- ESA CryoSat-2 ICE L1b
- ESA SMOS L1C
- ESA / Copernicus Sentinel-3 Thematic Sea Ice Product
- OSI-SAF near real-time sea ice concentration and type
- OSI-SAF sea ice concentration climate data record
- C3S sea ice type climate data record
- Region & Land Ocean Masks from NSIDC and ESA CCI

Production and algorithm development is funded by

- CryoSat-2/SMOS production & dissemination service (CS2SMOS-PDS).
- ESA SMOS Expert Support Laboratories (SMOS-ESL)

References

Ricker, R., Hendricks, S., Kaleschke, L., Tian-Kunze, X., King, J., and Haas, C.: A weekly Arctic sea-ice thickness data record from merged CryoSat-2 and SMOS satellite data, *The Cryosphere*, 11, 1607–1623, <https://doi.org/10.5194/tc-11-1607-2017>, 2017.

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