

climate change initiative

→ LAND SURFACE TEMPERATURE

# Assessment of Sea-Ice Surface Temperatures (IST) in the Arctic

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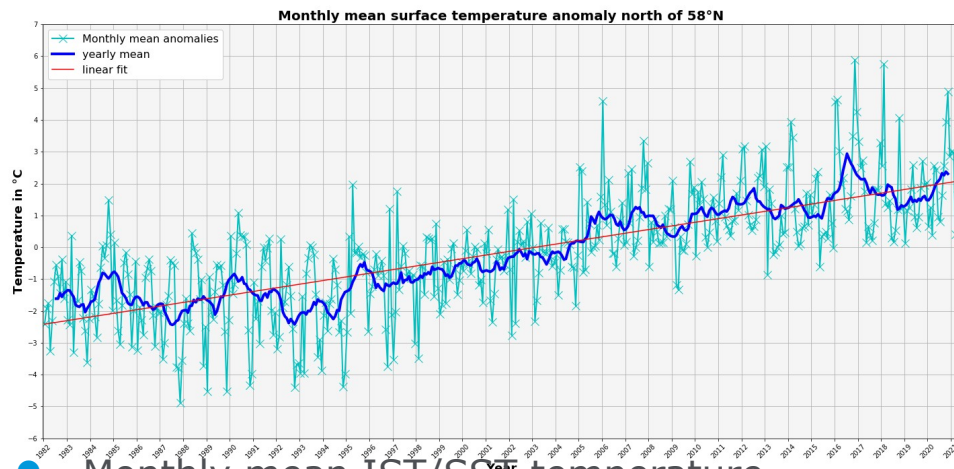
land surface  
temperature  
cci



# Introduction



- DMI a Production Unit (PU) for Copernicus Marine Service (CMS)
- Products delivered for the Sea Ice Thematic Assembly Center (TAC):
  - Near-Real-Time SEAICE SST/IST L4 (011\_008)
  - REAN SEAICE SST/IST L4 and L3S (011\_016\_021) 1982-2021, <http://dx.doi.org/10.48670/moi-00123>
- Ocean Monitoring Indicators



- Monthly mean IST/SSi temperature anomalies 1982-2021, from the REAN SEAICE SST/IST L4 product\*.

- \*Nielsen-Englyst P. et al., A combined sea and sea-ice surface temperature climate dataset of the Arctic 1982-2021, Rem Sens Env, 284, 113331, <https://doi.org/10.1016/j.rse.2022.113331>

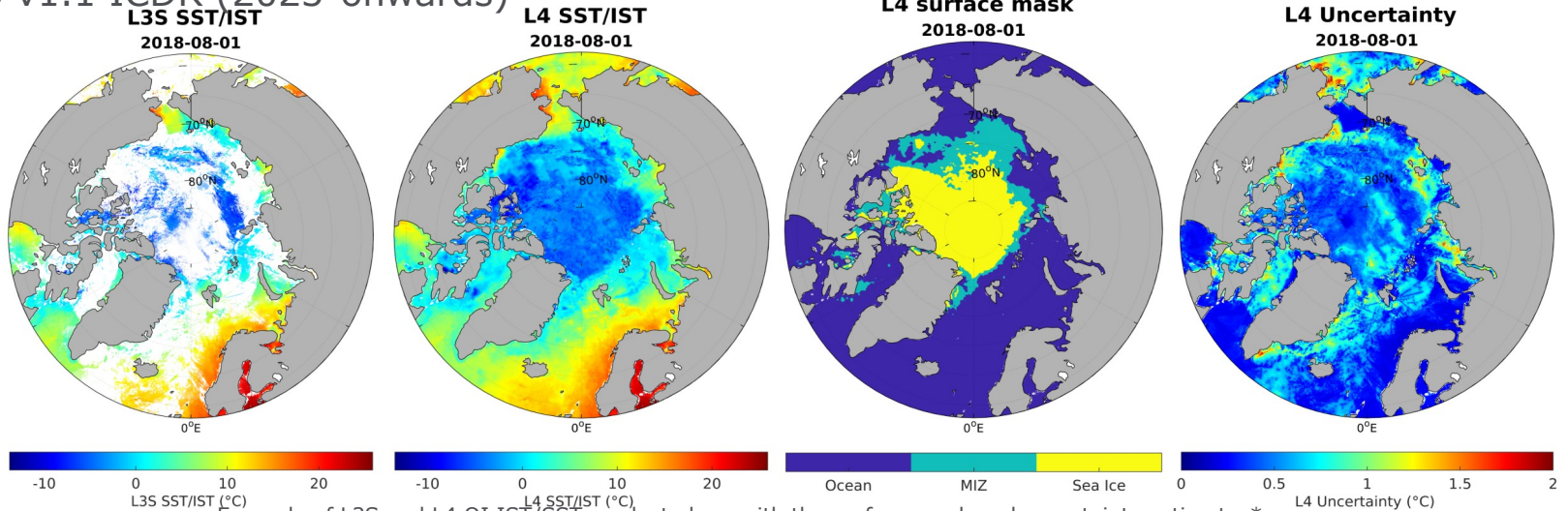




# CMEMS L4 SST/IST REAN Overview



- ESA SST\_cci L3U SST (1982-2023)
- AASTI v2.1 IST (1982-Jul 2019)
- C3S v1.0 IST CDR (July 2019-2022)
- C3S v1.1 ICDR (2023-onwards)
- OSI SAF Sea Ice Concentration to identify sea ice.
- Input data processed using an IST, SST or MIZ algorithm.



Example of L3S and L4 OI IST/SST product along with the surface mask and uncertainty estimates\*.  
 Observed stability:  $-0.0001$  °C/yr and  $0.0047$  °C/yr against drifters (SST) and NP (IST) observations\*.



# Aims and approach



- Use ESA LST\_cci IST Level: **SLSTR** on S3-A/B and **MODIS** on Aqua/Terra
- Produce Level 3 collated (L3C) single-sensor products (SSP) for each sensor/platform
- Assess L3C SSP using
  - In situ observations from the Seasonal Ice Mass Balance Buoys 3 (SIMB3) over sea ice
  - In situ observations from the Qaanaaq Automatic Weather Station on the sea ice (-69.133°E, 77.427°N in 2021)
  - AASTI v2.1 IST Climate Data Record (CDR) and Interim CDR (ICDR), available through C3S from 1982 onward.
- Ingest ESA LST\_cci L3C SSP in Copernicus Marine Service Arctic L4 SST/IST Multi-Year Product [https://data.marine.copernicus.eu/product/SEAICE\\_ARC\\_PHY\\_CLIMATE\\_L4\\_MY\\_011\\_016/description](https://data.marine.copernicus.eu/product/SEAICE_ARC_PHY_CLIMATE_L4_MY_011_016/description)

Product String and version	Sensor type	Resolution
AQUA MODIS L2P v4.aa	IR	1 km at nadir
TERRA MODIS L2P v4.aa	IR	1 km at nadir
Sentinel 3A SLSTR L2P v4.aa	IR	1 km at nadir
Sentinel 3B SLSTR L2P v4.aa	IR	1 km at nadir





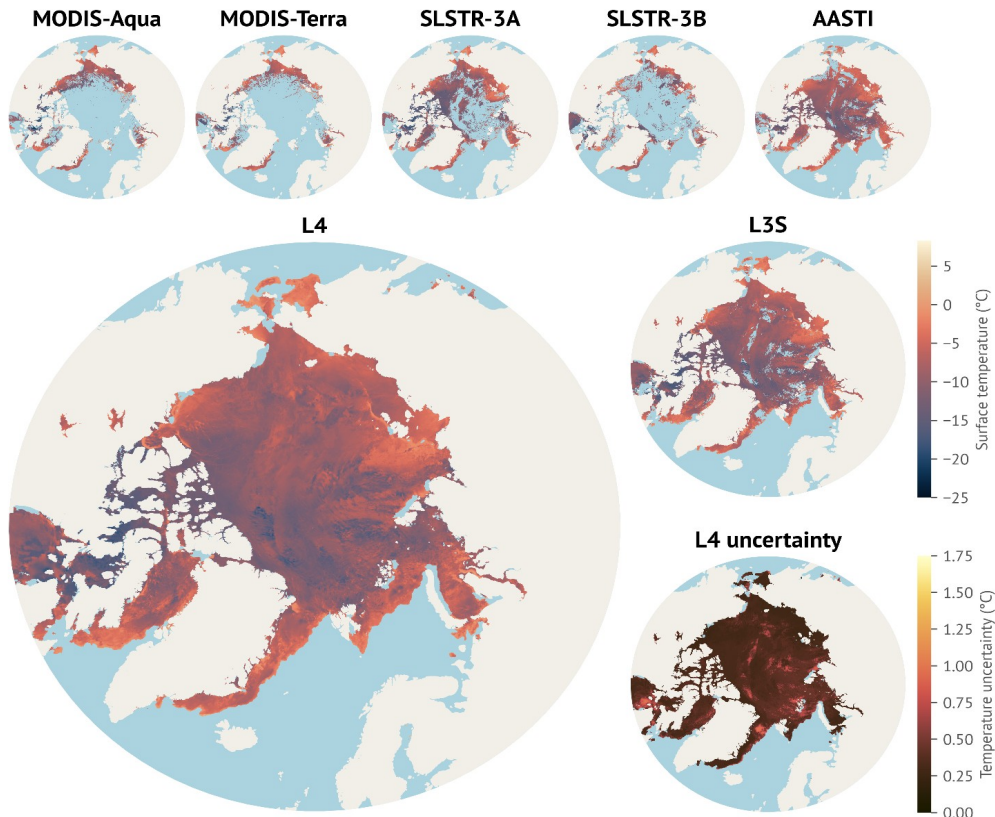
# Example May 16<sup>th</sup> 2021



- Input SSP from:

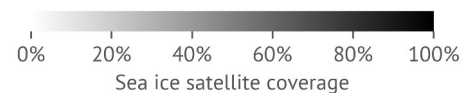
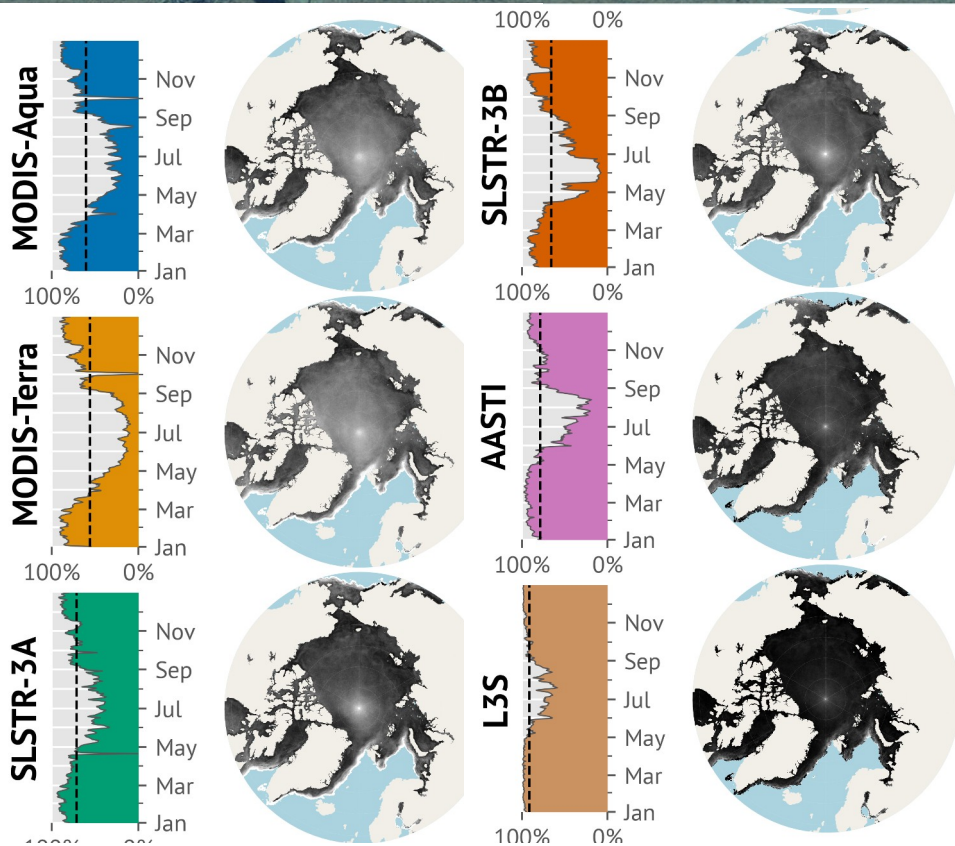
- MODIS
- SLSTR
- AASTI

- L3S and L4 product





# Data availability





# Validation with In Situ



- Validation with in situ Seasonal Ice Mass Balance Buoy 3 (SIMB3)
- Limited coverage of in situ observations
- Reporting Tair rather than skin temperature.

In situ data for 2021



Product	Mean Bias	Standard Deviation	RMS	Match-ups
MODIS/Aqua	-1.39	2.57	2.92	734
MODIS/Terra	-1.07	2.42	2.64	604
SLSTR/S3-A	-1.90	2.31	2.99	847
SLSTR/S3-B	-2.18	2.52	3.33	725
AASTI v2.1	-2.12	2.88	3.57	808
L3S MY SST/IST	-1.98	2.20	2.96	1022





# Impact on the L4 SST/IST Validation



- Reference L4 SST/IST only uses AASTI v2.1
- Updated L4 SST/IST ingests LST\_cci IST data (MODIS and SLSTR)
- Validation with SIMB3 and Qaanaaq In situ observations (T2air, IST)

L4 SST/IST version	Mean Bias			Standard Deviation			RMS			Match-ups		
	SIMB3	Q <sub>AIR</sub>	Q <sub>IST</sub>	SIMB3	Q <sub>AIR</sub>	Q <sub>IST</sub>	SIMB3	Q <sub>AIR</sub>	Q <sub>IST</sub>	SIMB3	Q <sub>AIR</sub>	Q <sub>IST</sub>
<b>Reference</b>	-2.66	-3.18	-2.01	2.84	3.31	3.45	3.89	4.58	3.98	1091	156	156
<b>Updated</b>	<b>-2.06</b>	<b>-2.91</b>	<b>-1.73</b>	<b>2.16</b>	<b>2.53</b>	<b>2.77</b>	<b>2.98</b>	<b>3.85</b>	<b>3.26</b>	1092	156	156



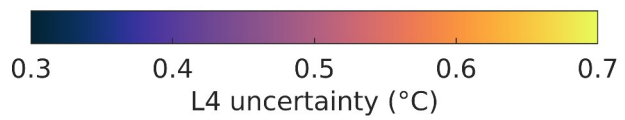
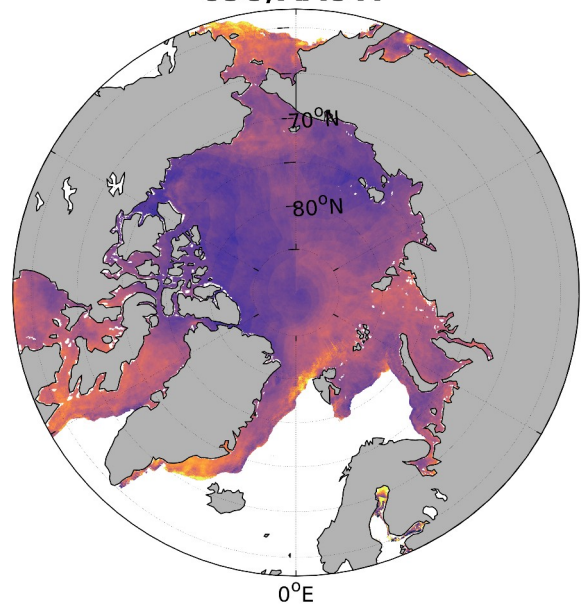




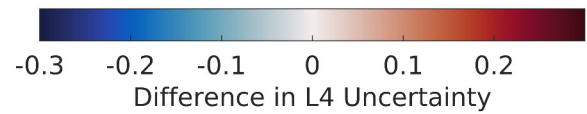
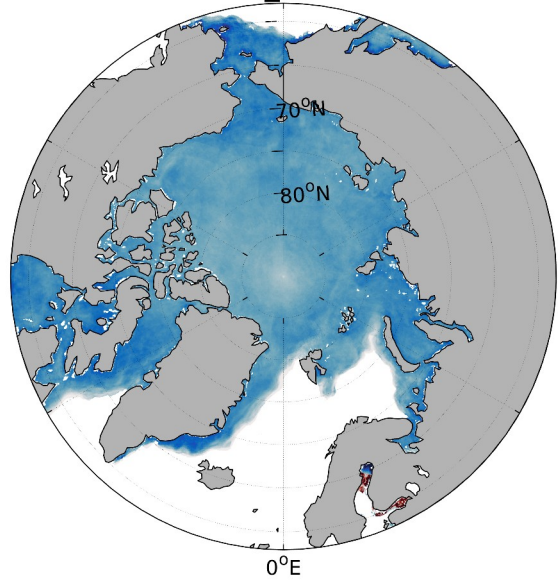
# Impact on the L4 SST/IST Uncertainties



**C3S/AASTI**



**(C3S/AASTI + cci\_1st) - (C3S/AASTI)**



Left: L4 IST uncertainty from reference data set.

Right: Difference between combined C3S/AASTI/LST\_cci L4 IST and the reference.





# Summary and Conclusions



- Used ESA LST\_cci IST Level: **SLSTR** on S3-A/B and **MODIS** on Aqua/Terra
- Produce Level 3 collated (L3C) single-sensor products (SSP) for each sensor/platform
- Assessed L3C SSP with in situ observations from SIMB3 and Qaanaaq, showing very good results!
- Added advantage of the LST\_cci data is their contribution to increased data availability
- Overall positive impact of the LST\_cci data on the L4 SST/IST product was identified as bias and standard deviation values with respect to in situ observations were reduced.
- Future ingestion of ESA LST\_cci IST CMEMS Arctic L4 SST/IST Reanalysis & potentially in next version of C3S Global L4 SST/IST CDR/ICDR.