A new global, combined SST and IST CDR from 1982 to 2024, for the Copernicus Climate Change Service C3S

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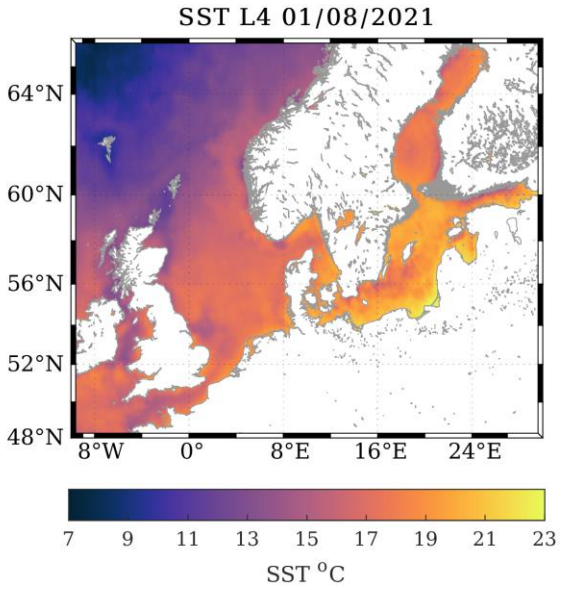
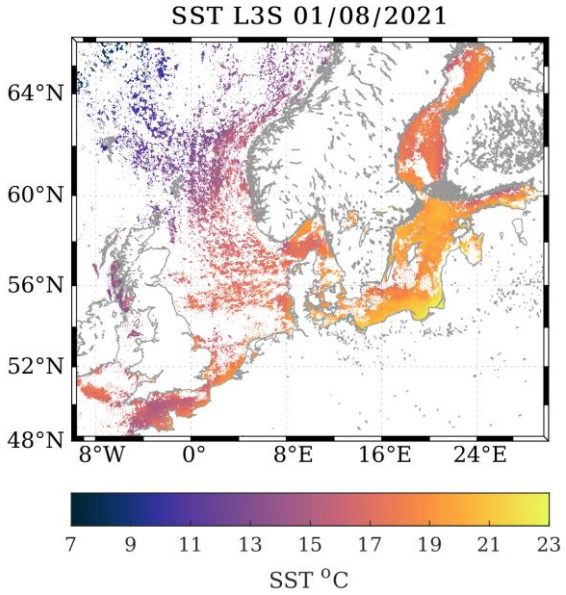
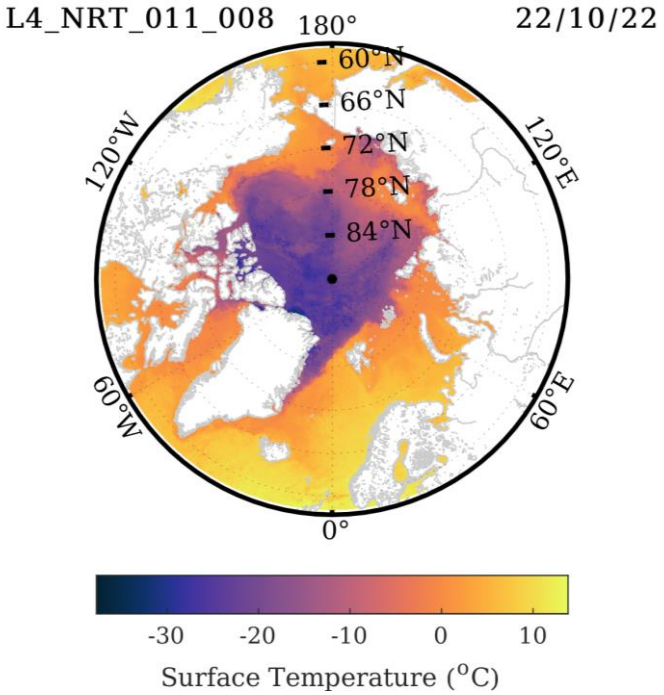
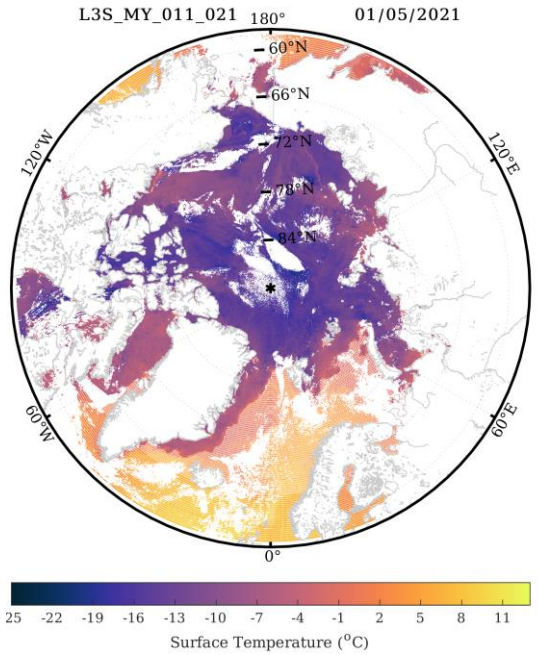








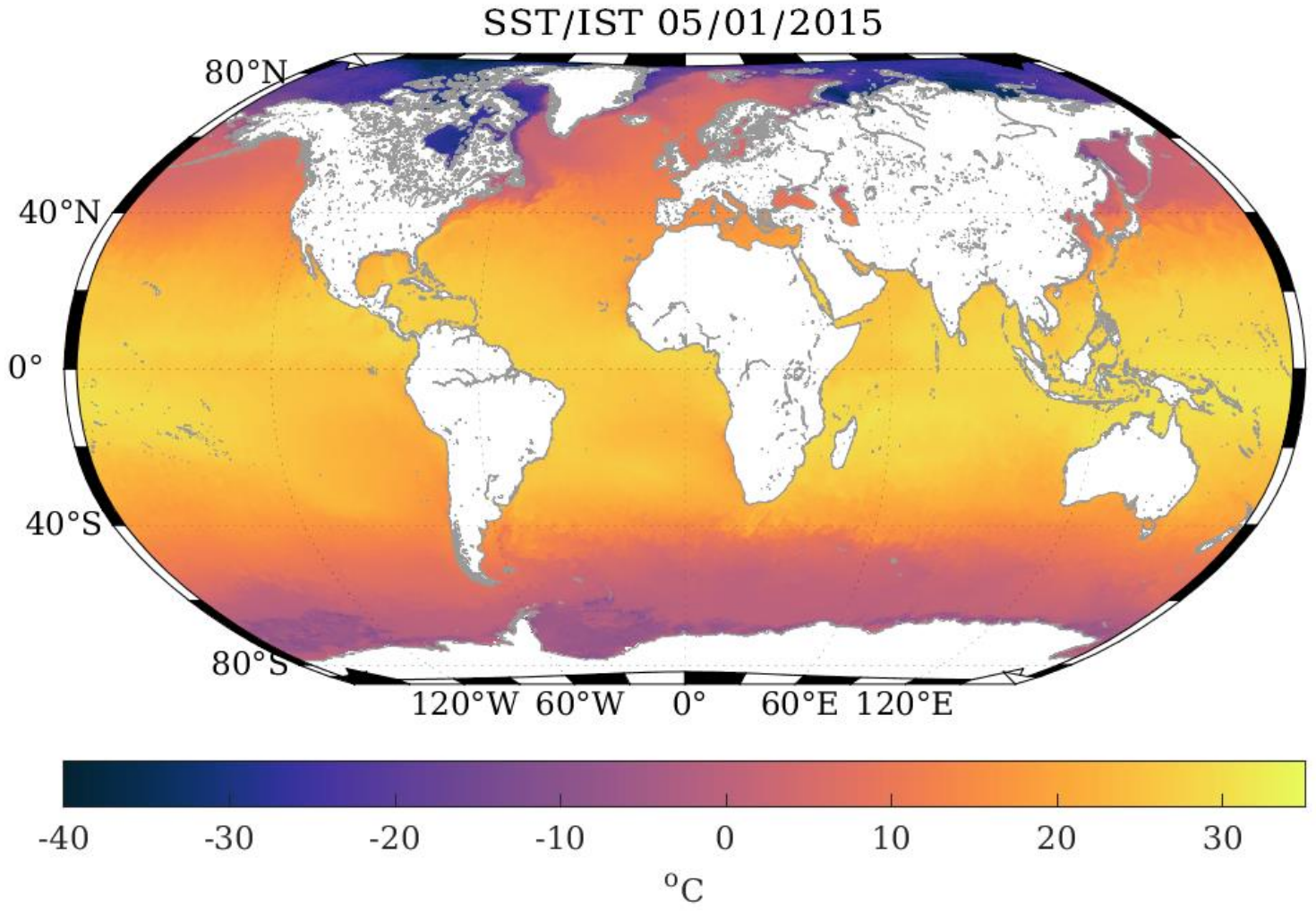
- Near-Real-Time (NRT) BAL SST L4 (010_007_b) 2016
- NRT BAL SST L3S (010_032) 2019-
- NRT BAL SST L4 DIU (010_034) 2022-
- Multi-Year (MY) BAL SST L4 (010_016) 1982-2023
- MY BAL SST L3S (010_040) 1982-2023

- NRT ARC SST/IST L4 (011_008) 2019-
- MY ARC SST/IST L4 (011_016) 1982-2023
- MY ARC SST/IST L3S (011_021) 1982-2023

https://marine.copernicus.eu

Global SST/IST

- Global L4 SST_{20cm}/IST_{skin} CDR at 0.05^0, 1982-2022 to be released in 2024.
- ICDR extensions for 2023-2024.
- Combines IR and PMW[1]



[1]Nielsen-Englyst et al., 2024, Impact of microwave observations on the estimation of Arctic sea surface temperatures, Rem. Sens. Env., 301.

Input and Auxiliary data

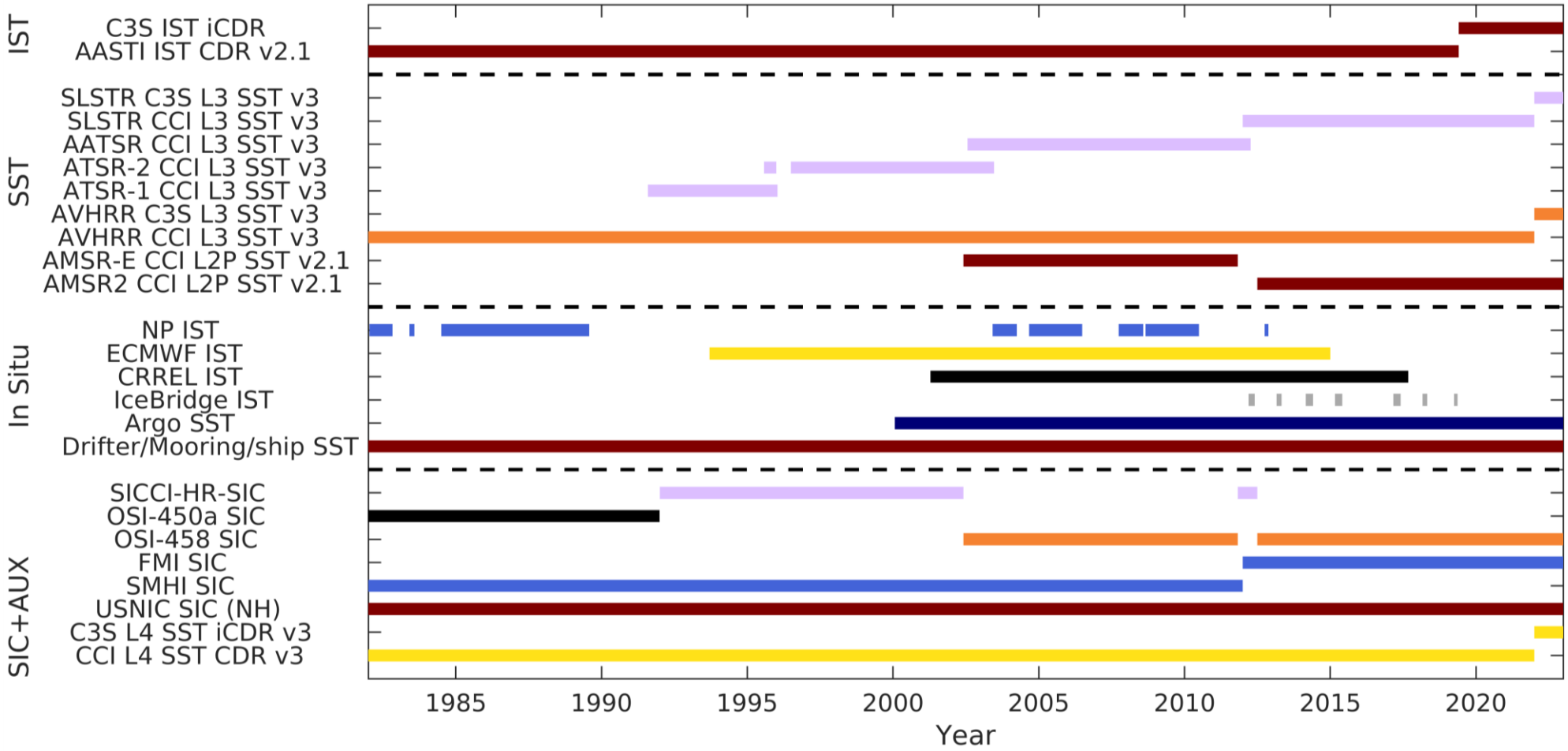


Figure: Overview of input data, auxiliary data and in situ data used for the validation along with the CDR / ICDR (dark red) datasets.

Methodology

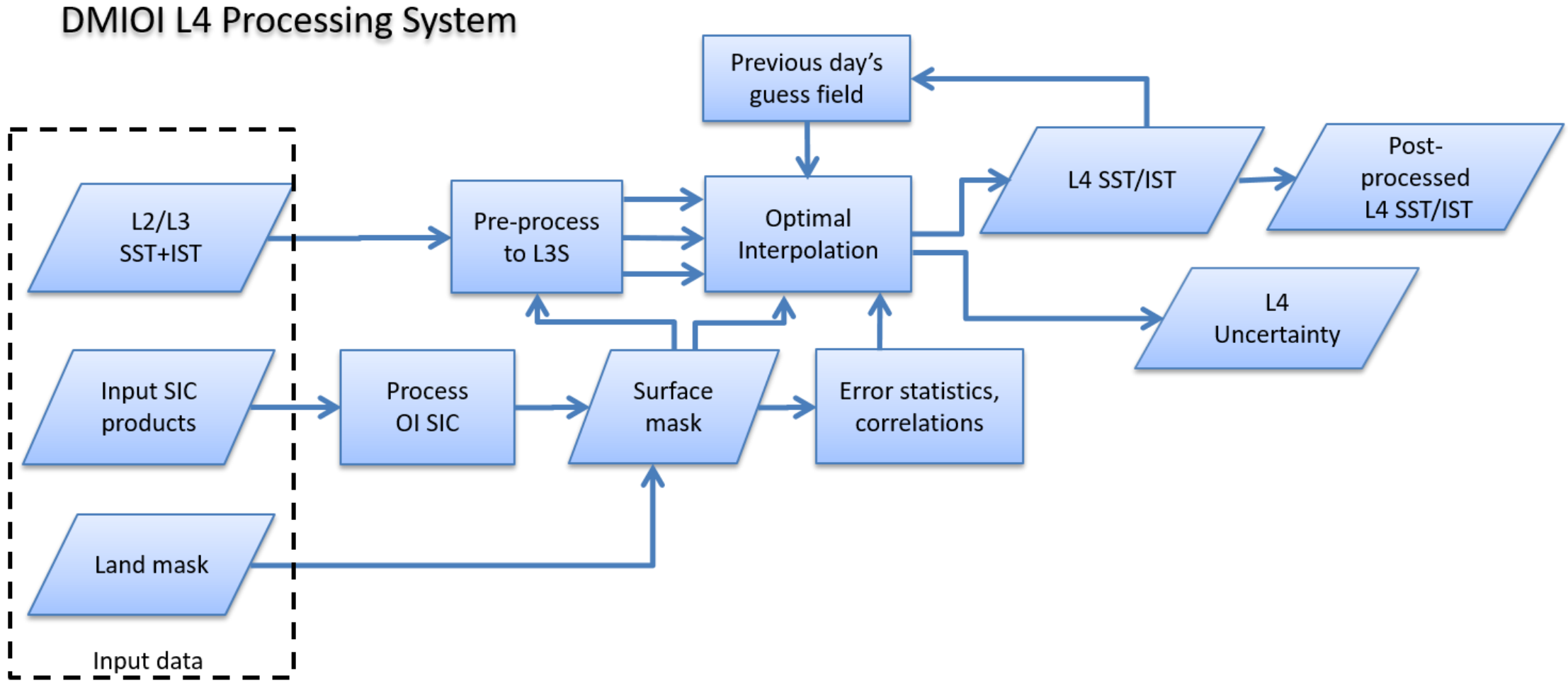


Figure: Schematic diagram of the DMIOI processing chain at DMI.

Dedicated SIC product

- Based on CARRA2 developments https://climate.copernicus.eu/copernicus-arctic-regional-reanalysis-service
- Combination of OSI-SAF/Sea Ice CCI+ AMSR2, SSMIS products
- Expanded to cover both NP and SP
- See dedicated poster 64-S3 by Ida Olsen et al.

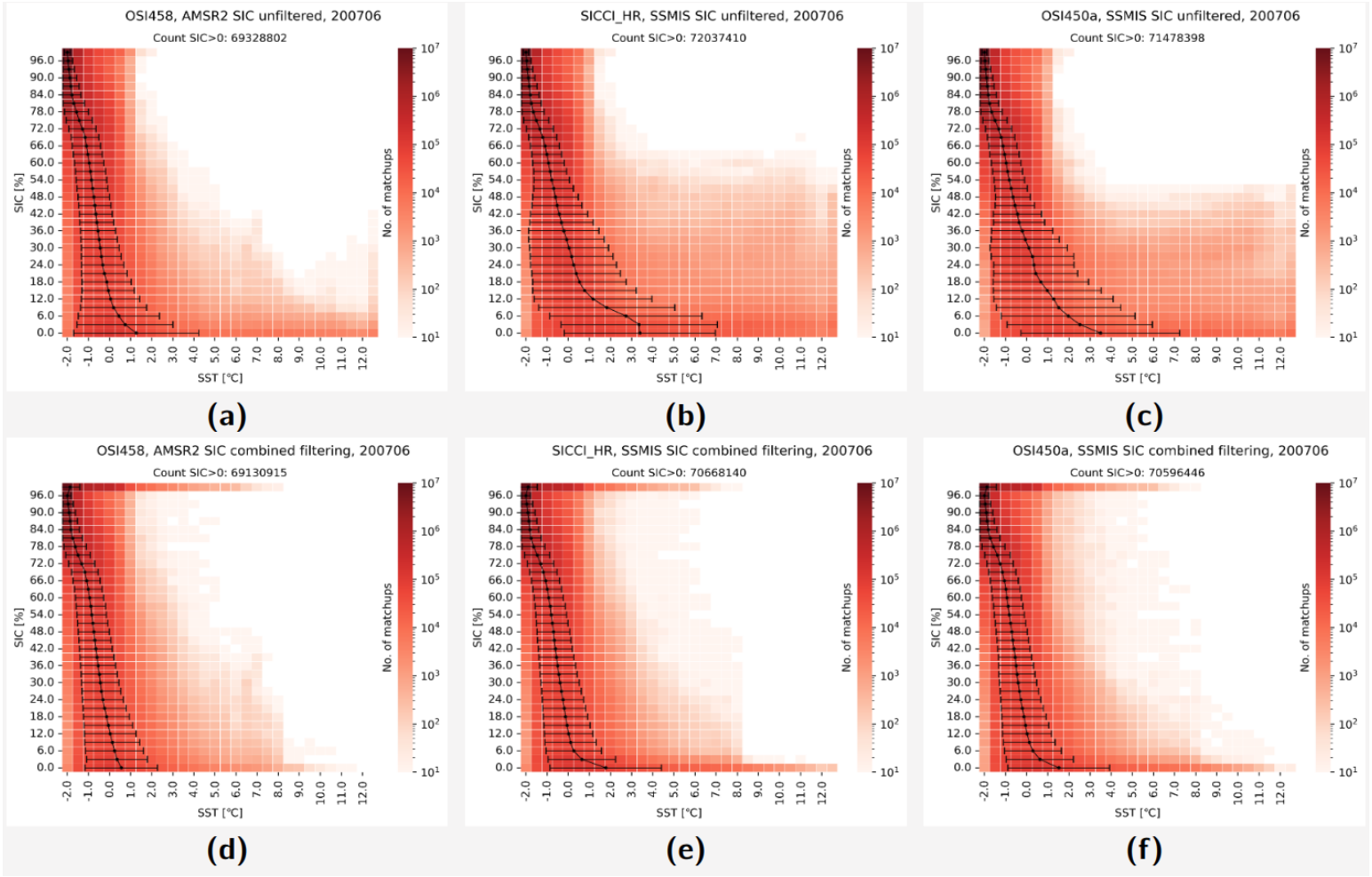
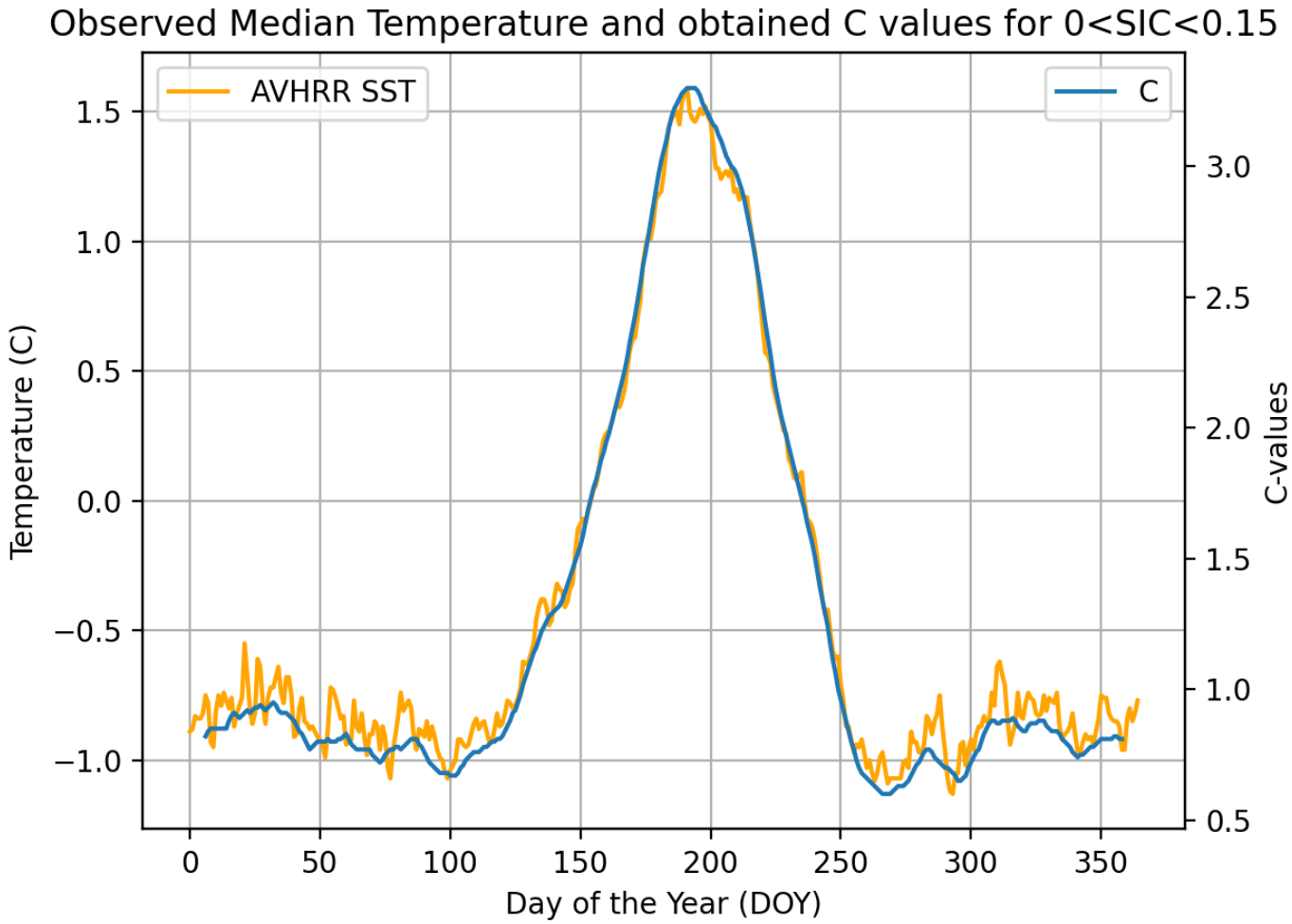


Figure: SIC data versus ESA CCI SST for June 2007 before filtering (a,b,c) and after filtering (d,e,f)

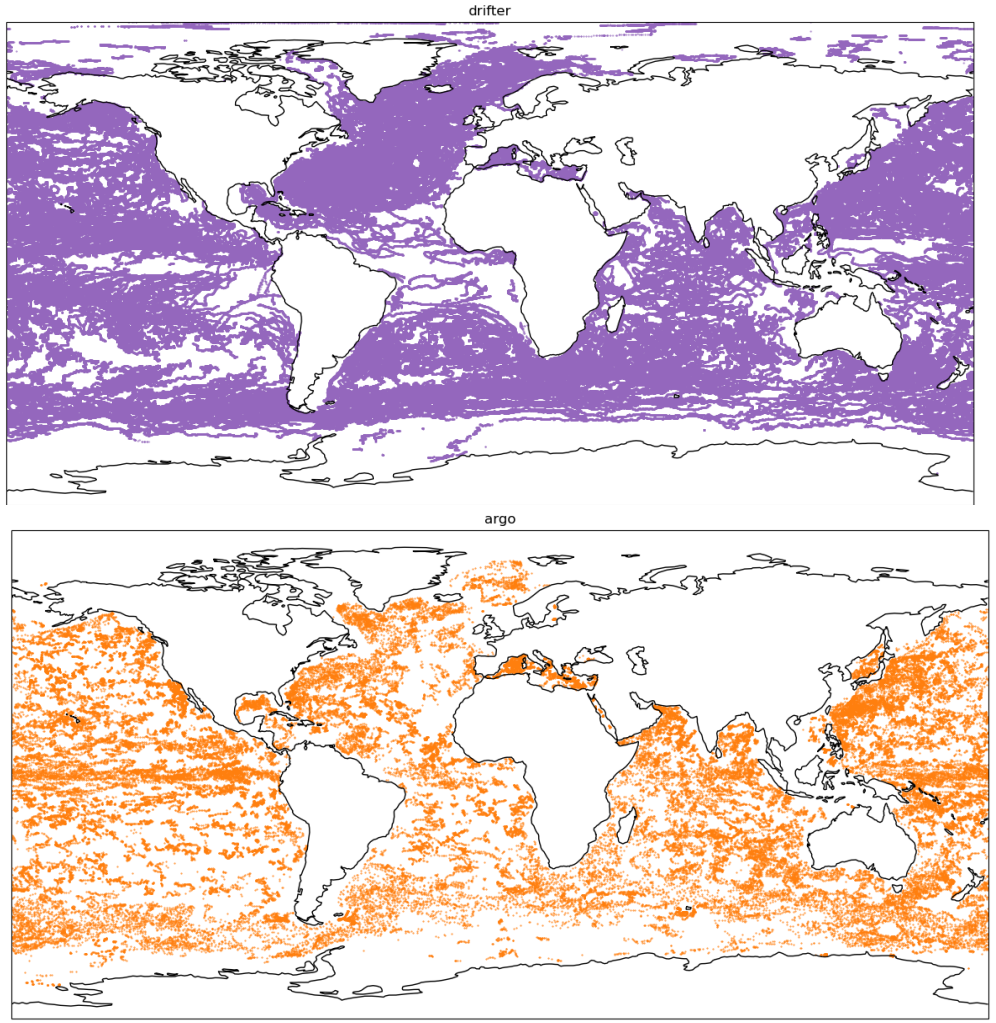
Sub-ice SST

- Adapted from Banzon et al. (2020), Improved Estimation of Proxy Sea Surface Temperature in the Arctic, https://journals.ametsoc.org/view/journals/atot/37/2/jtech-d-19-0177.1.xml
- $T_s(SIC) = T_f + C(1-SIC)$, where T_f as function of salinity follows Fofonoff & Millard (1983)
- Using daily estimates of the coefficient C
- Climatological Salinity from WOA18 and SIC to estimate sub-ice “SST”.
- Separately for NH, SH



Validation

- SST
  - Drifting buoys
  - GTMBA
  - VOS
  - ARGO floats (+surface)
  - Animals



- IST
  - ECMWF distributed ice drifting buoys
  - CRREL mass balance buoys + SIMB3
  - NP drifting ice stations
  - IceBridge Flights

Figure: Example of match-ups with drifters (top) and Argo floats (bottom) for 2015.

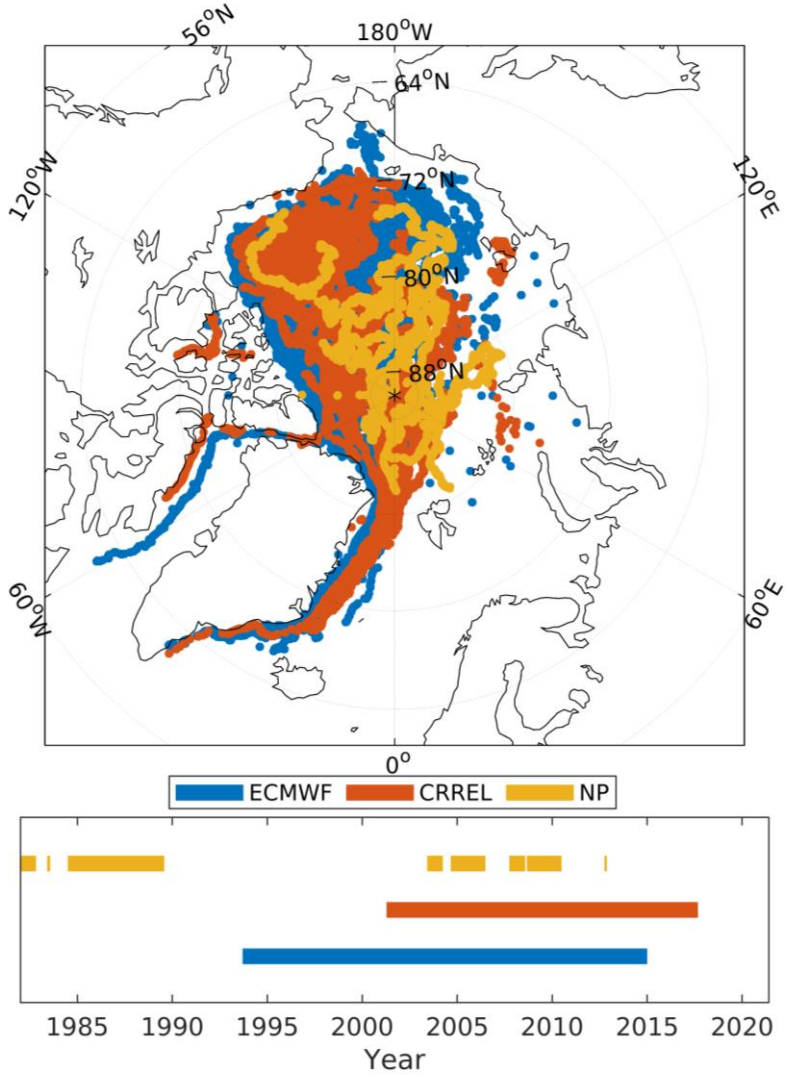
Test-Runs: SST

- More than 30...
- All for 2015
- Testing various options
  - 1st guess variances (TR7, TR14, TR31)
  - Correlation functions (TR14, TR30)
  - Uncertainties on input data (TR14)
  - Number of obs allowed (TR17)
  - Observation window (TR24)

	SST	TR1	TR7	TR14	TR17	TR24	TR30	TR31	ESA CCI
Argo	Median	-0.02	-0.03	-0.03	-0.03	-0.02	-0.03	-0.03	-0.03
	RSD	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.23
	Num	86710	86710	86710	86710	86710	86710	86710	86591
Argo surf	Median	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.05
	RSD	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.22
	Num	22168	22168	22168	22168	22168	22168	22168	22161
Drifter	Median	-0.06	-0.07	-0.07	-0.06	-0.06	-0.06	-0.06	-0.07
	RSD	0.28	0.28	0.28	0.27	0.28	0.28	0.31	0.27
	Num	3483745	3483745	3483745	3483745	3483745	3483745	3483745	3479828
GTMBA	Median	0	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.05
	RSD	0.19	0.18	0.18	0.18	0.19	0.18	0.18	0.17
	Num	29346	29346	29346	29346	29346	29346	29346	29346
Ship	Median	-0.19	-0.19	-0.19	-0.19	-0.18	-0.19	-0.19	-0.18
	RSD	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.71
	Num	636394	636394	636394	636394	636394	636394	636394	631531

Test-Runs: IST

- Only CRREL buoys available for 2015
- No benchmark against other Global MY/CDR products
- CMEMS Arctic MY SST/IST[2]: MD −2.87, StD 3.36, Num 22979 for 2001-2017.
- T_{2m} vs T_{skin}

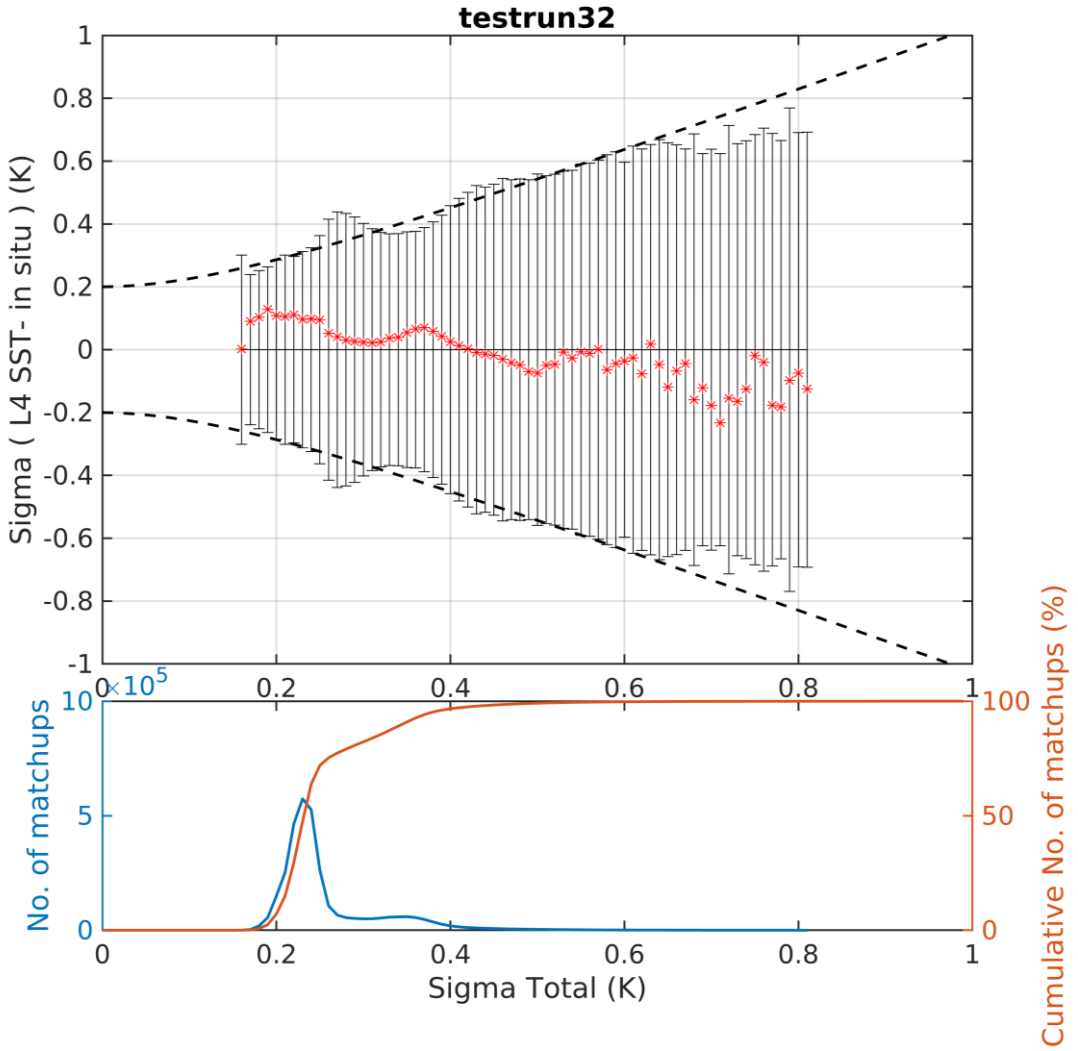


	IST	TR1	TR7	TR14	TR17
CRREL	Median	-3.19	-3.18	-3.03	-3.77
	RSD	3.79	3.72	3.40	3.67
	Num	2038	2038	2038	2038

[2]Nielsen-Englyst et al., 2023, A combined se and sea-ice surface temperature climate dataset of the Arctic, 1982-2021, Rem. Sens Env., 284.

SST Uncertainties

- L4 uncertainties included in the product for SST, IST and MIZ
- TR32: 1st-guess variances, error covariances, controlling input to surface types, temporally varying AASTI uncertainty
- Only SST uncertainties validated during test-runs



Conclusions

- First global combined SST and IST CDR using IR and PMW observations.
- Grid resolution 0.05º from 1982-2022 with extensions for 2023-2024.
- Using dedicated SIC product for sea ice and marginal ice zone classification.
- Metrics so far indicate SST performance comparable to previous C3S Global SST product.
- IST validation performance similar to that of the CMEMS Arctic SST/IST Multi-Year product.
- To be released by end of September 2024 for the1982-2022 CDR and 2023 to mid-2024 iCDR.