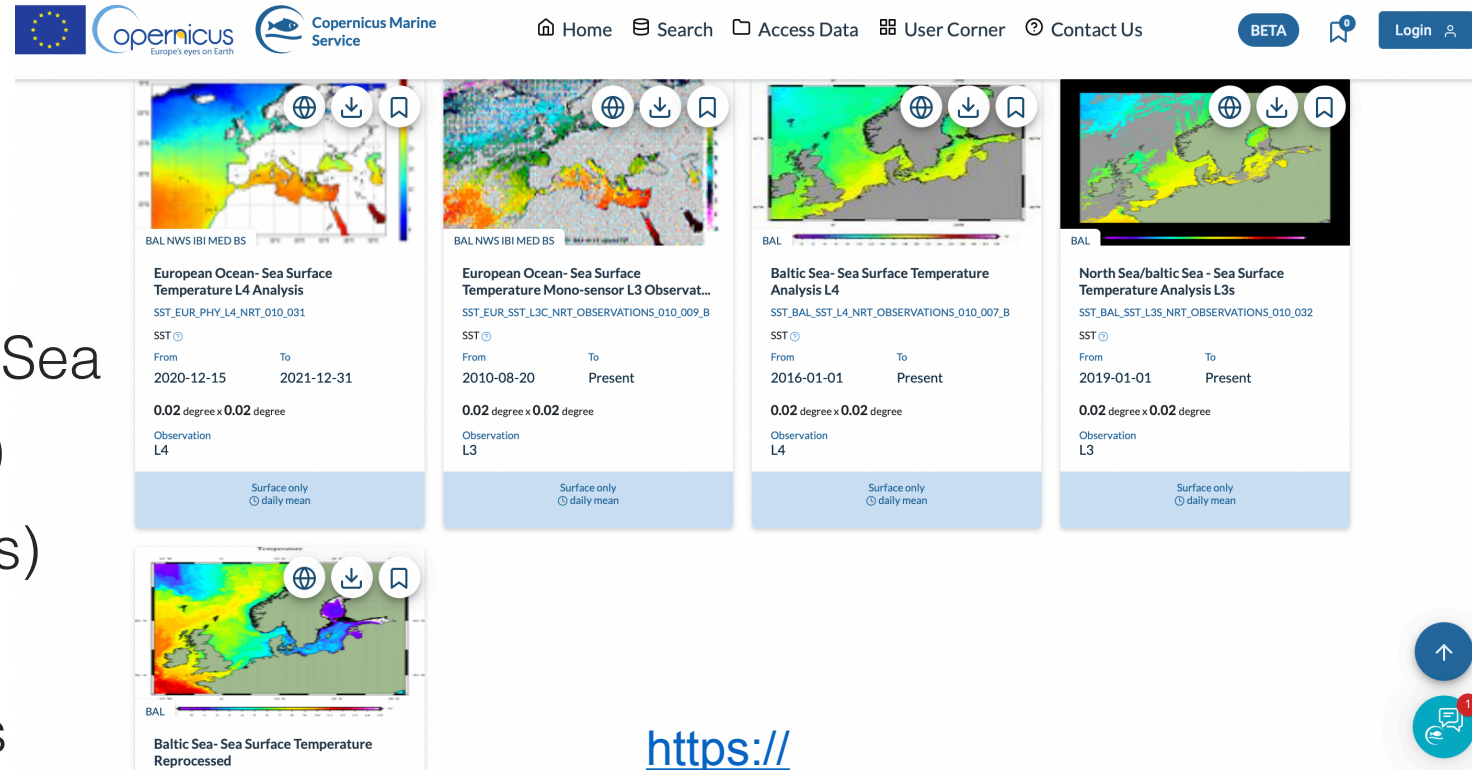


# Overview of the North Sea & Baltic Sea SST activities for the Copernicus Marine Service

Ioanna Karagali, Jacob L. Høyer, Wiebke Margitta Kolbe, Pia Nielsen-Englyst, Magnus Barford Suhr, Sotirios Skarpalezos

# Overview

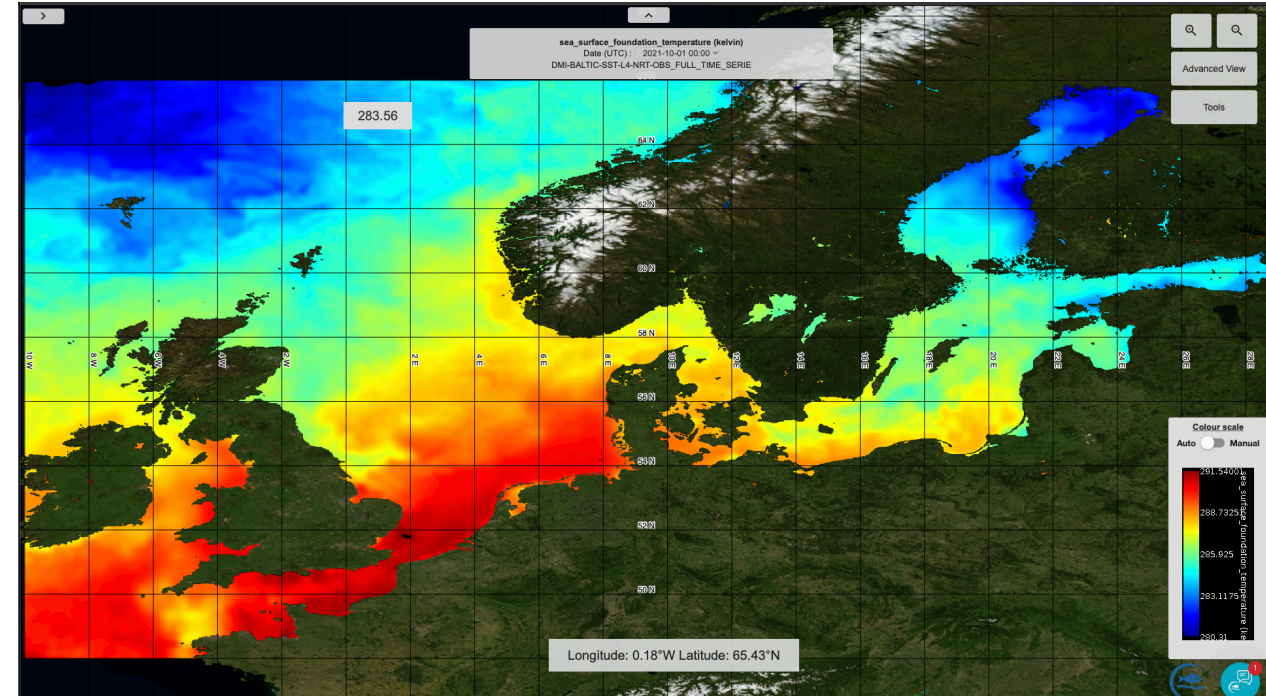
- Copernicus Phase 2 2022-2024
- SST TAC Production Unit
- Products for the North Sea/Baltic Sea
  - NRT SST L4 (2016-onwards)
  - NRT SST L3S (2016-onwards)
  - REAN SST L4 (1982-2021)
  - Ocean Monitoring Indicators
- 2 new products released in November 2022
  - NRT SST L4 diurnal sub-skin
  - REAN SST L3S (1982-2021)



[https://  
marine.copernicus.eu](https://marine.copernicus.eu)

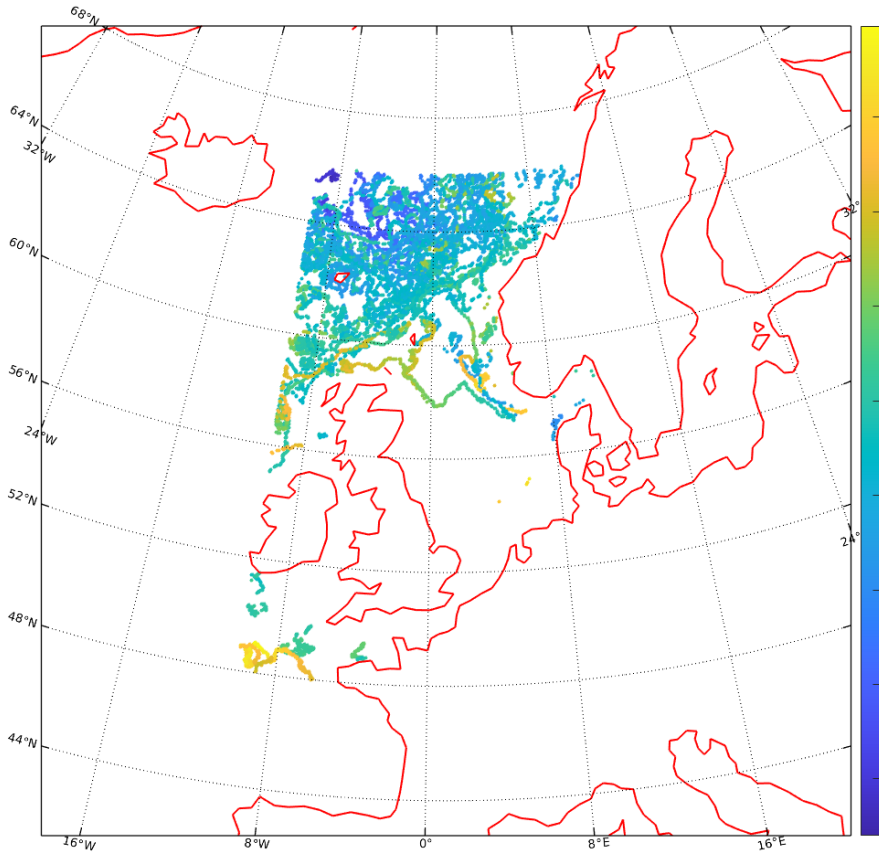
## L4 NRT SST

- Daily 06:30, 0.02 degrees, 2016 -
- Night-time observations
- DMI OI scheme
- Validation stats with moored buoys
  - Bias: -0.02, StDev: 0.53, N: 1320.
- Evolution 2022: Uncertainty analysis
- Foreseen evolutions 2023-2024
  - 2023: Assess & improve effective spatial resolution. Improve sea ice consistency through salinity-updated freezing point temperature. Integration of MTG-I data.
  - 2024: Routine validation with moored buoy network. Improvements in land mask for coastal areas and inland water bodies.

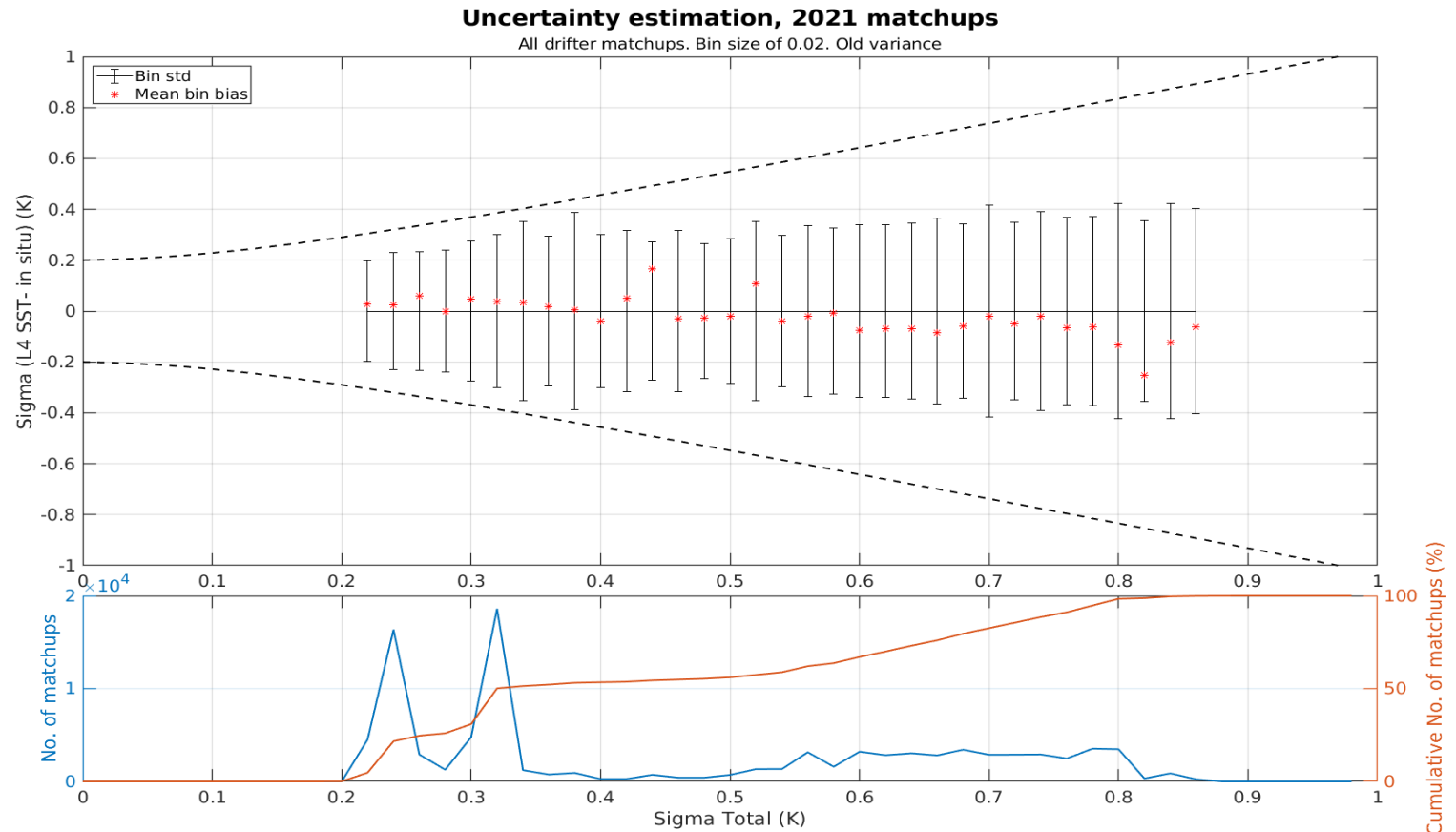


Example of the daily L4 SST on the CMEMS catalogue.

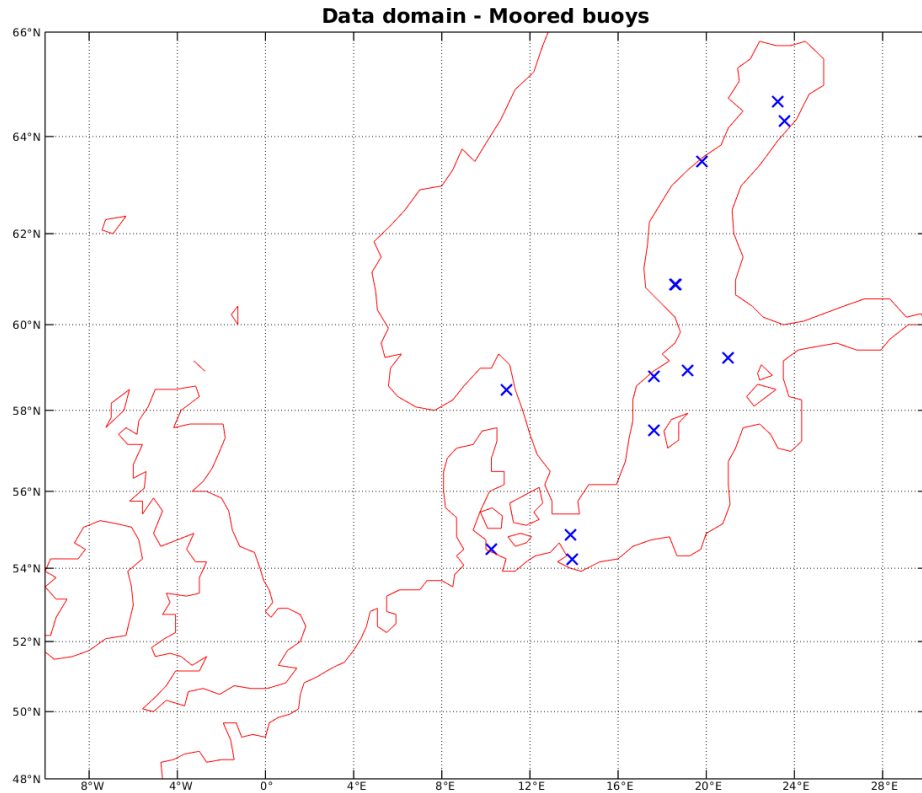
# L4 NRT SST Uncertainties vs Drifters



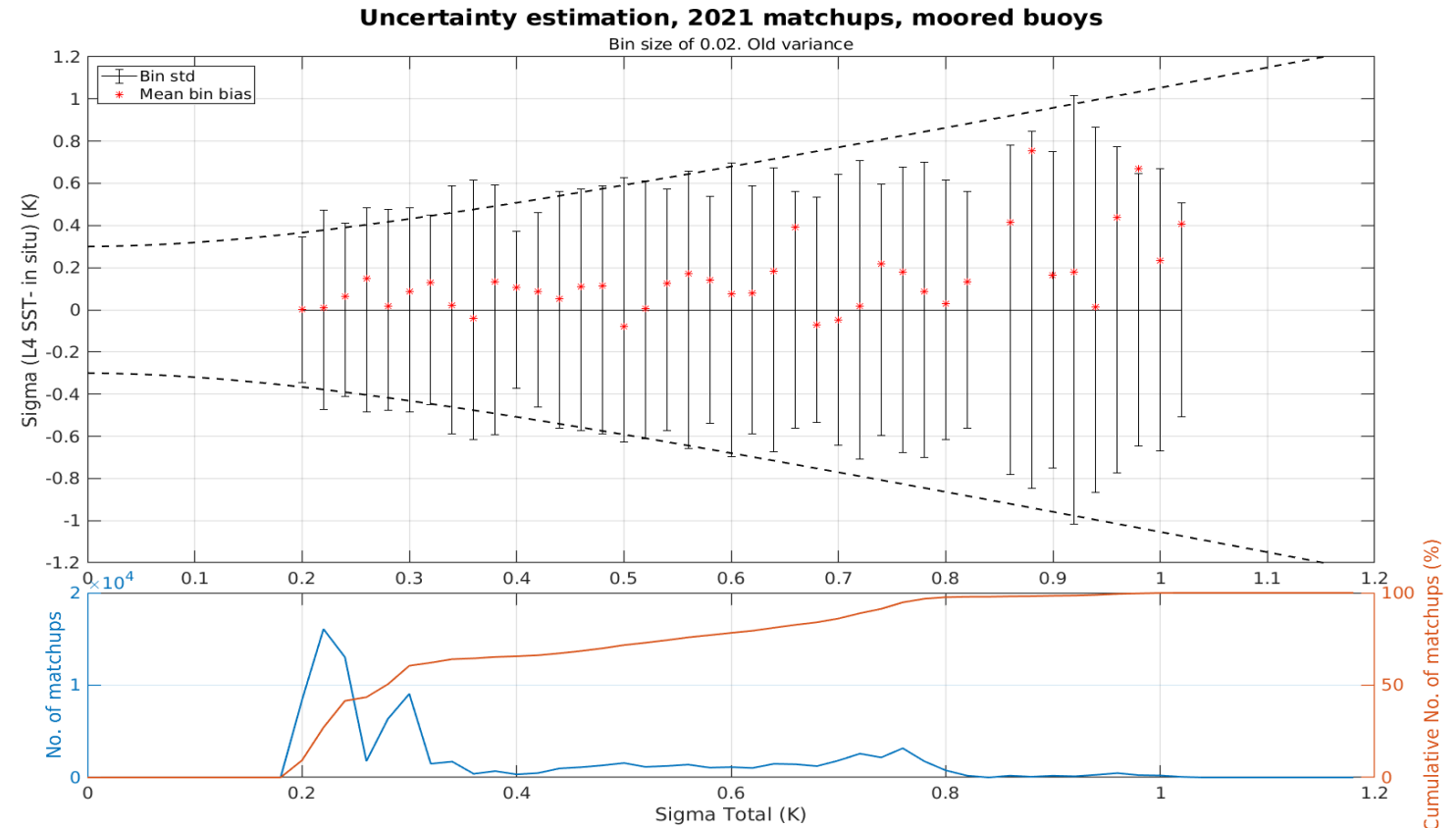
Map of drifters for 2021.



# L4 NRT SST Uncertainties vs Moored Buoys

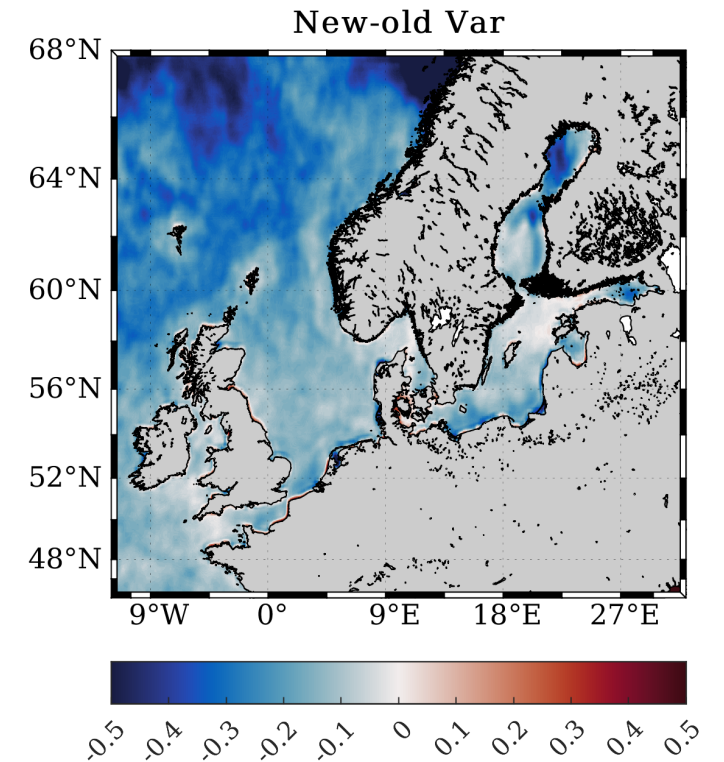
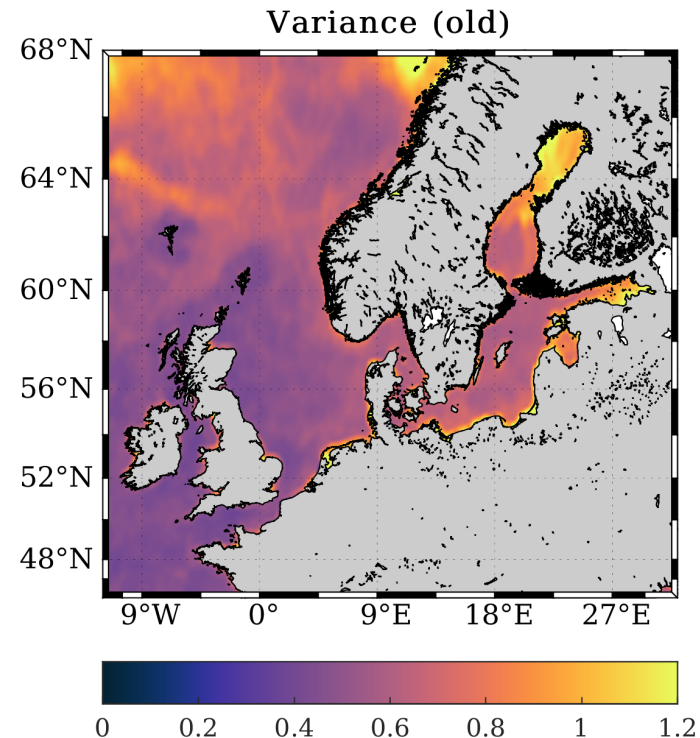
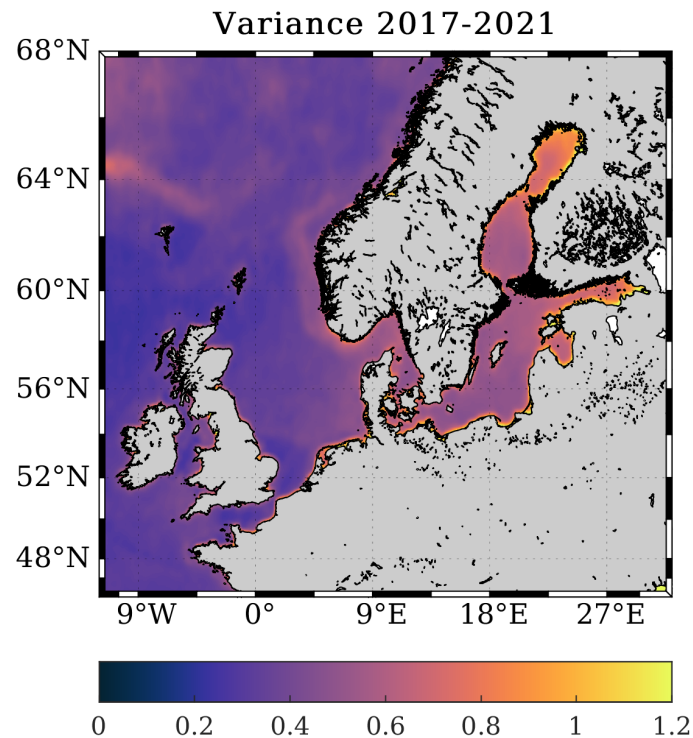


Map of moored buoys for 2021.



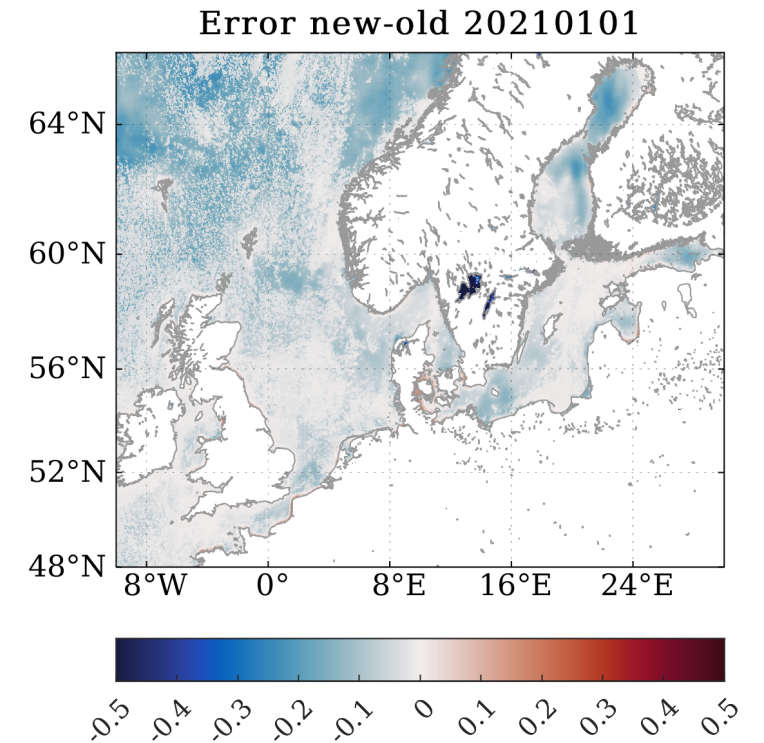
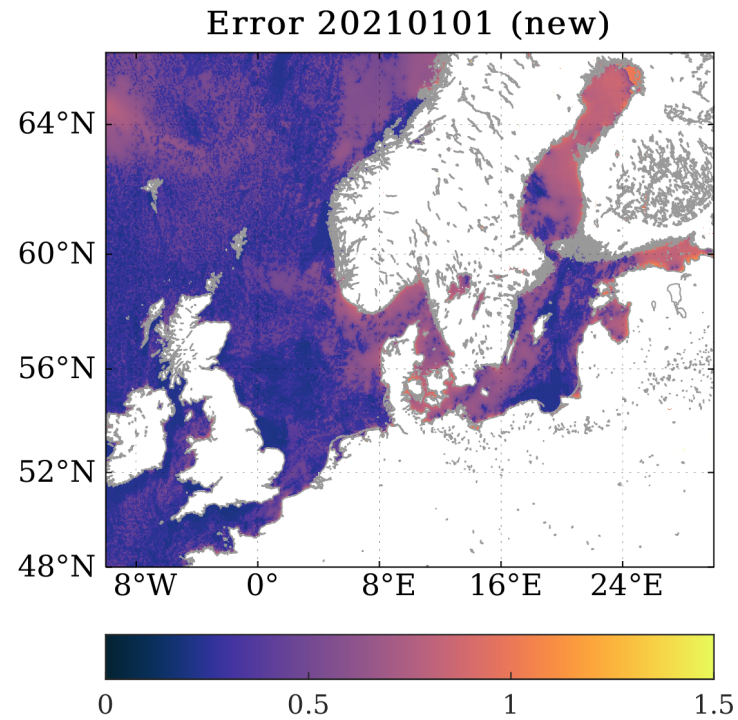
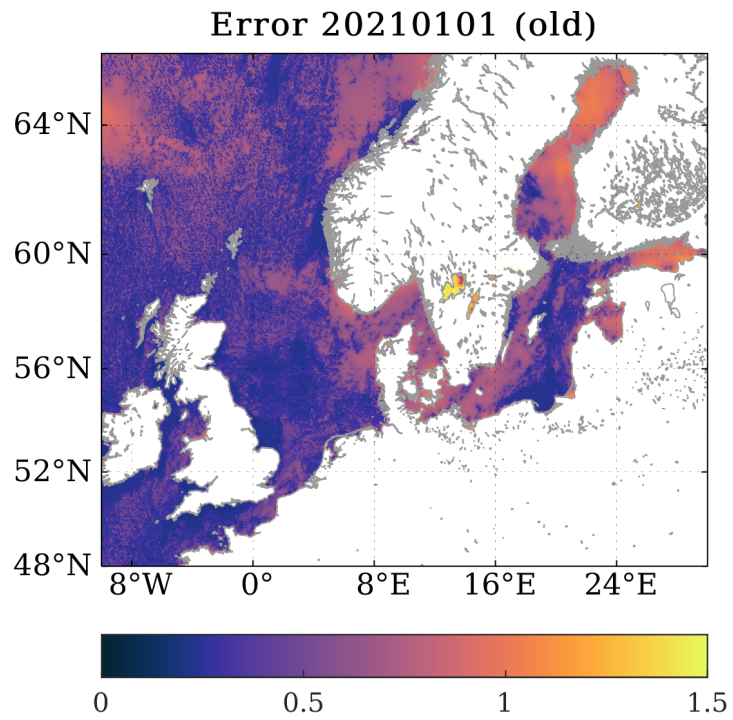
# Understanding uncertainties

- No clear seasonal or spatial patterns for uncertainties  $> 0.4$
- Higher uncertainty estimates for grid points with last obs at least 1 day prior to analysis
- Derive new 1st-guess variance field based on 2017-2021 analyses.



# Reducing uncertainties

- Impact of new 1st-guess variance on error field.
- Error estimates reduced

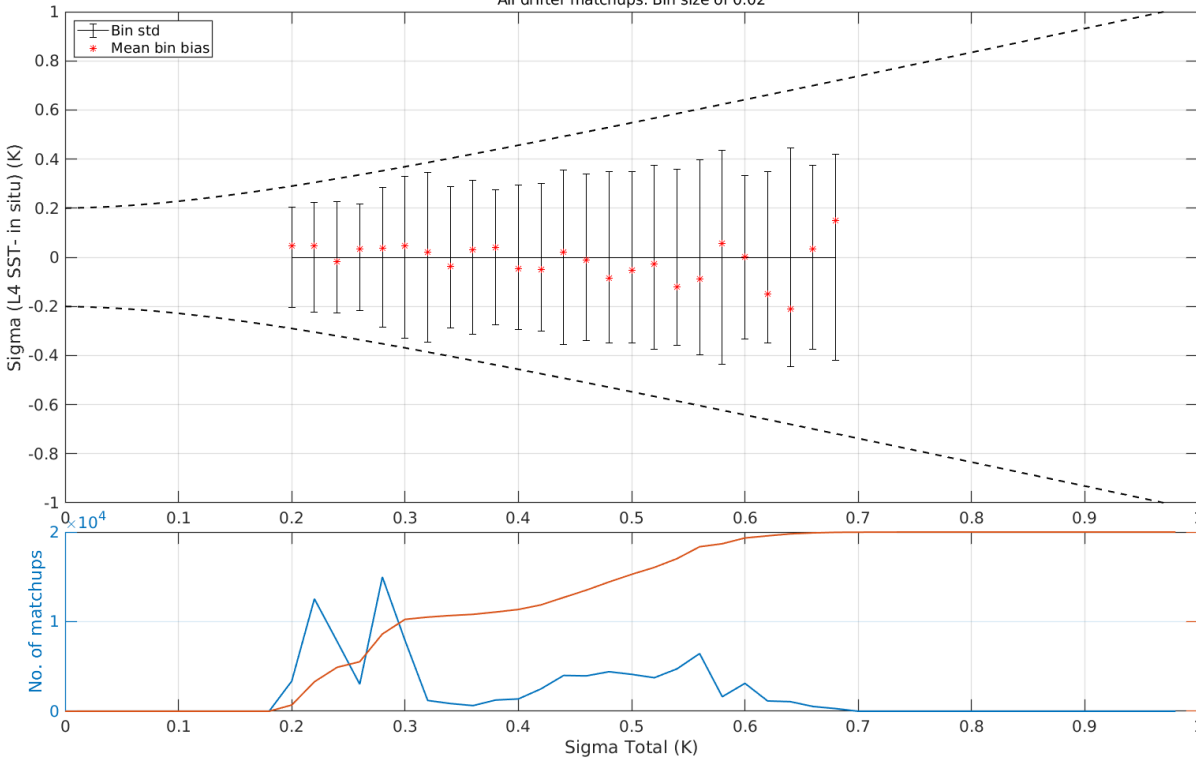


# New uncertainty analysis

- Using new 1st-guess variance, new uncertainty estimates for 2021
- Repeat analysis with drifters and moored buoys → Reduced error estimates.

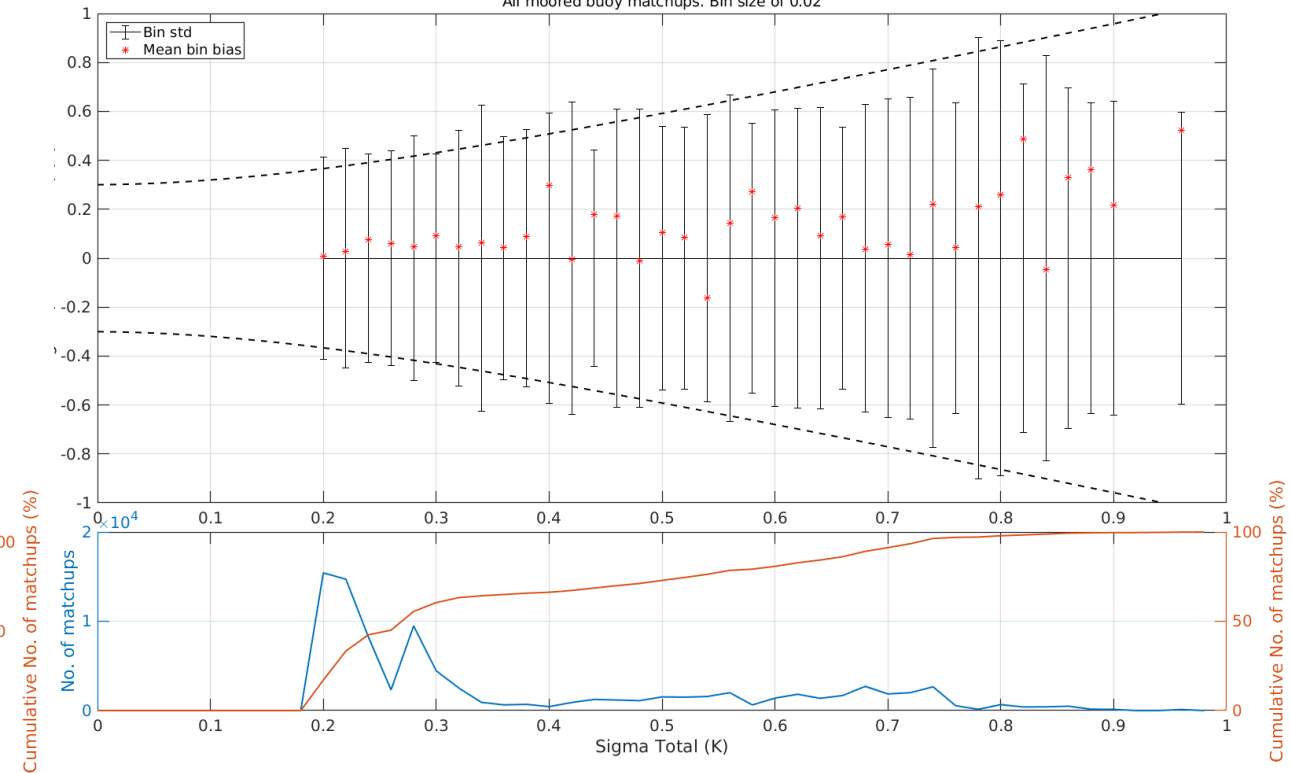
**Uncertainty estimation, 2021 matchups**

All drifter matchups. Bin size of 0.02



**Uncertainty estimation, 2021 matchups**

All moored buoy matchups. Bin size of 0.02

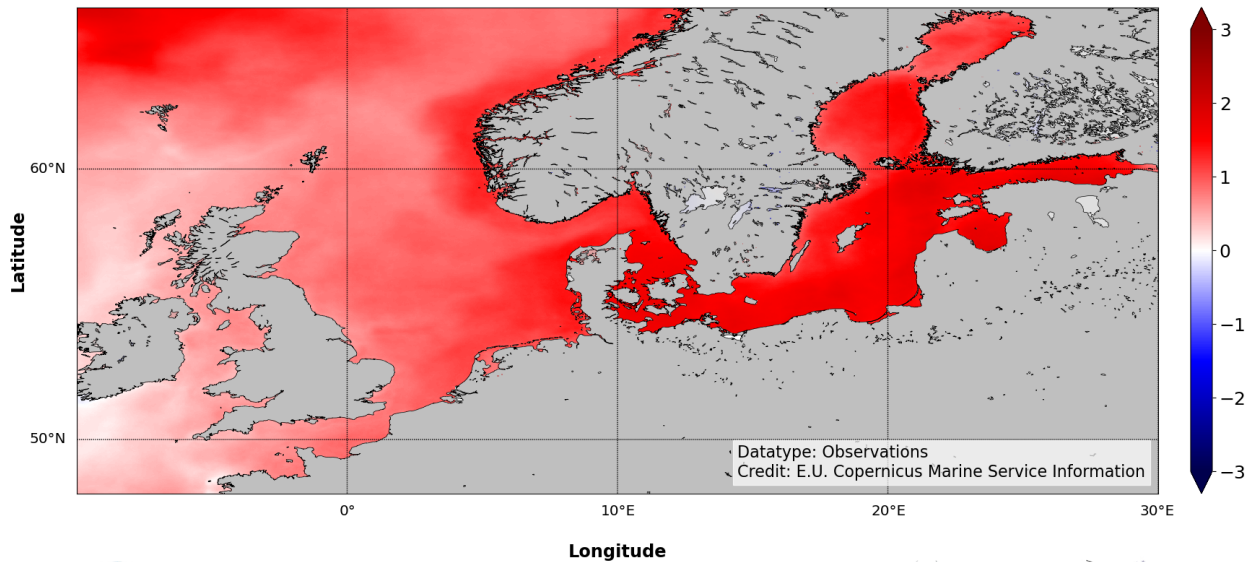




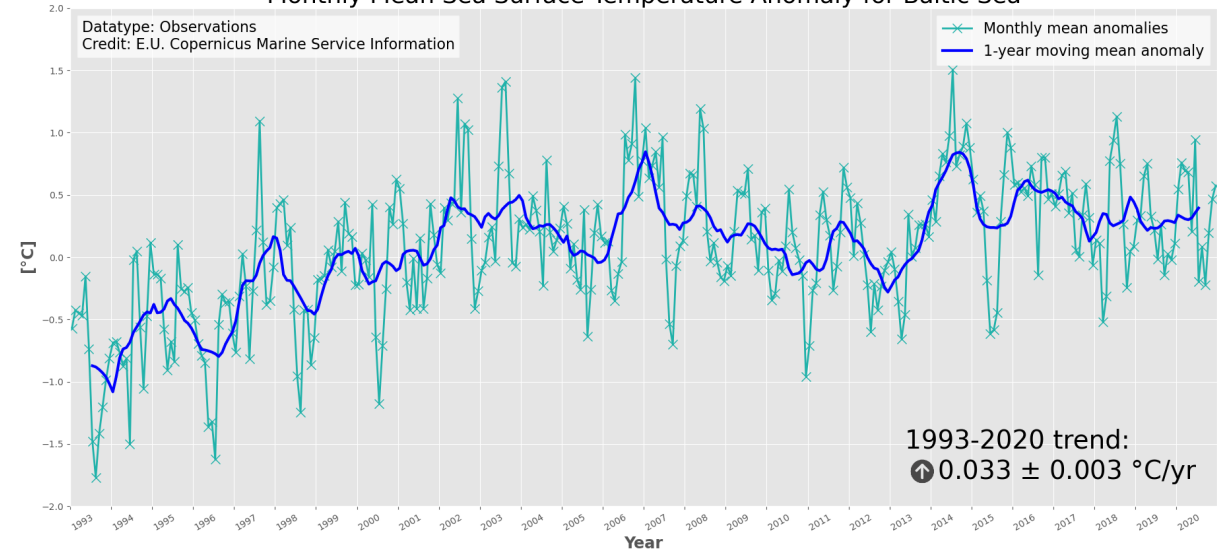
# REAN L4 SST

- Release of corresponding L3S.
- Extended to 12/2021 for OMI for 2021 (to be released)
  - Cumulative trend in SST anomalies 1993-2021
  - Monthly mean anomalies from 1993-2014 climatology.

Sea Surface Temperature Trends for North Sea and Baltic Sea



Monthly Mean Sea Surface Temperature Anomaly for Baltic Sea



# NRT SST L4 diurnal sub-skin

## **L3**<sub>*Tsens*</sub>

- Per sensor
- L2 aggregation
- Hourly at :00±??

## **L3S**<sub>*T*</sub>

- From  $L3_{Tsens}$
- Bias correction
- Result: 24  $L3S_T$
- With gaps

## **L3S**<sub>*DT*</sub>

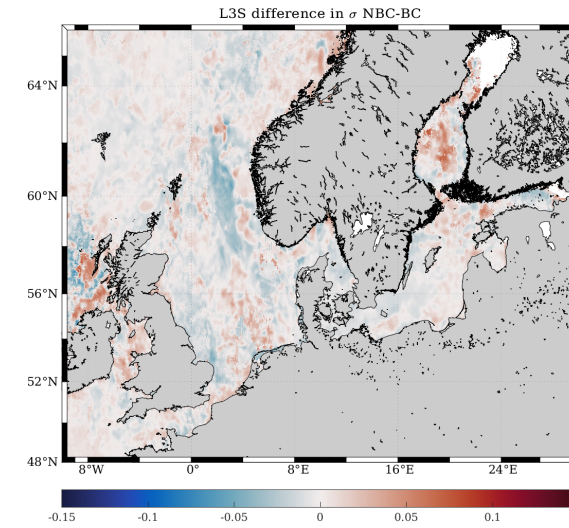
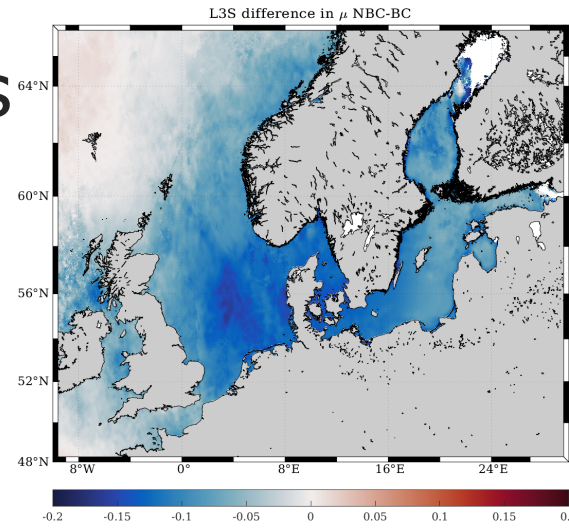
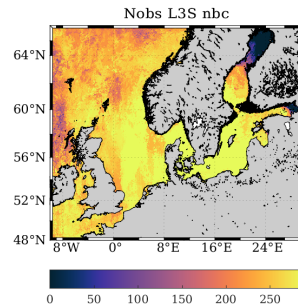
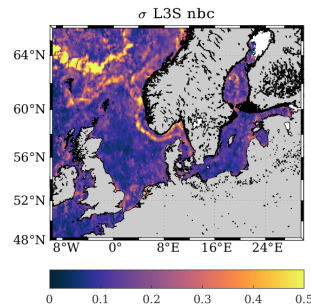
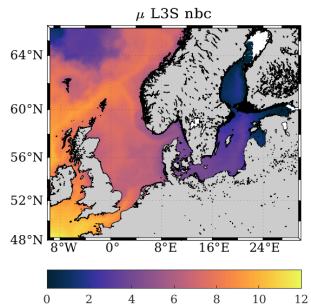
- $L3S_{DT} = L3S_T - L4_{found}$
- If  $L3S_{Ts}$  empty:
- Time interp?
- Use  $L4_{found}$ ?

## **L4**<sub>*diurnal*</sub>

- OI on  $L3S_{DT}$
- +  $L4_{found}$

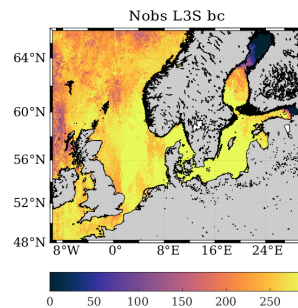
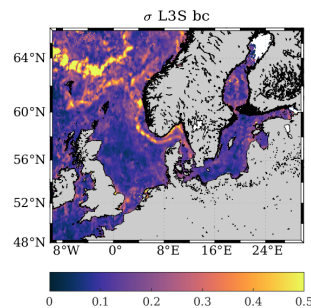
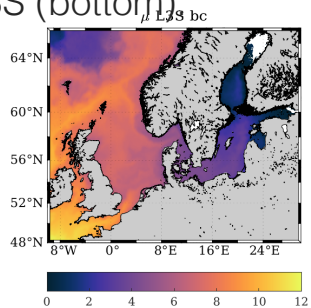
# Bias correction sensitivity tests

- Test period 03 -14 March 2022
- Very high % of cloud-free conditions
- Assess differences of bias correcting the single-sensor SST fields.



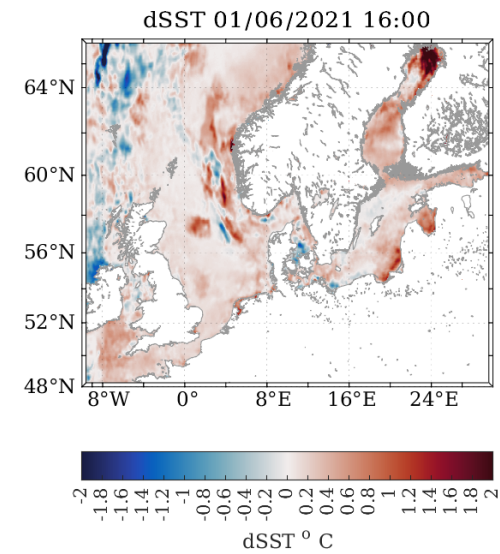
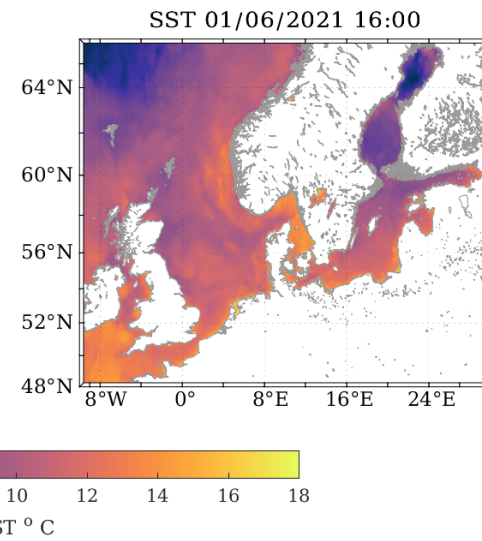
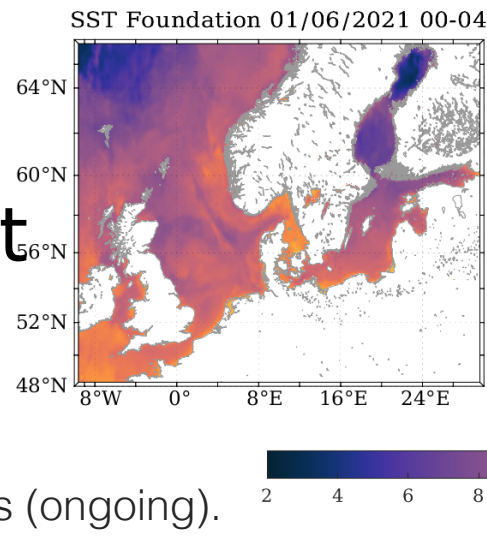
Differences in mean SST and standard deviation of SST for not bias-corrected and bias-corrected L3S.

Mean SST, StDev of SST and N. obs for not bias-corrected (top) & bias-corrected L3S (bottom).

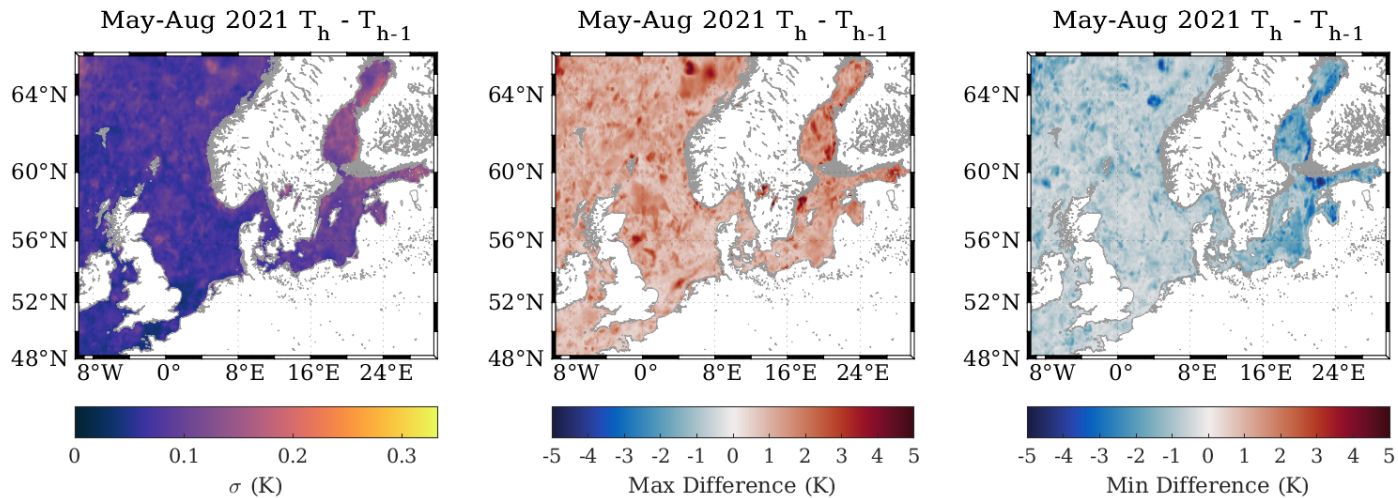


# Analysis of DV product

- Test period May - August 2021
- Assess diurnal variability (ongoing).
- Validation with moored buoys and drifters (ongoing).



Example of night-time foundation (left), SST at 16:00 and dSST ( $SST_{16:00} - SST_{foundation}$ ) for June 01, 2021.



Variability as standard deviation of differences in  $SST_h - SST_{h-1}$ , maximum and minimum difference for the period May to August 2021.

# Conclusions and Outlook

- 3 Near-Real-Time and 2 Multi-Year products for the North Sea/Baltic Sea
- Continuous assessment & evolution of the products through annual release cycles.
- Major developments for the next years include ingestion of new sensors, improvements in spatial resolution and coastal areas.
- Multi-Year product useful for analysis of SST variability.
- New Diurnal product useful for analysis of MHW.
  
- **Bonus:** Global daily L4 SST at 0.05 degrees also available
  - [https://podaac.jpl.nasa.gov/dataset/DMI\\_OI-DMI-L4-GLOB-v1.0](https://podaac.jpl.nasa.gov/dataset/DMI_OI-DMI-L4-GLOB-v1.0)

Thank you for your attention.  
Questions welcome through Moodle or  
email [ika@dmi.dk](mailto:ika@dmi.dk)  
ORCID:0000-0002-8695-7190