

# SST Climatology and Analysis Inter-Comparison Task Team Report

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# SST Climatology and L4 IC Task Team Members

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**WHOI (USA):** Robert Schlegel

# Tasks

**Task 1:** Inter-comparison of SST analyses for climate studies (led by Chunxue Yang, CNR/ISMAR) *(Completed)*

**1.1:** Peer-reviewed paper published comparing various long-term SST analyses for climate applications. *(Completed. Published April 2021 in J. Climate)*

**Task 2:** Understand differences among the SST analysis products and find ways to improve these products (led by Xu Li, NOAA/NCEP) *(Ongoing)*

**Task 3:** Feature inter-comparison of SST analyses (led by Jorge Vazquez, NASA/JPL) *(Ongoing)*

# Task 1

**Aims:** Perform various diagnostics on a range of publicly available, global SST analyses, in order to provide guidance for users on the application of long-term SST analyses for climate studies and climate applications.

- A contribution to the **Independent Assessment of Essential Climate Variables (C3S\_511) Project** for the Copernicus Climate Change Service (C3S) – *Project closing 30 June 2021. Plans for intercomparison activities under next phase of C3S TBD.*

## Progress since GHRSSST-XXI:

- Switched to using Multi-Product **Median** (was previously **Mean**) SST
- NOAA/NCEI Daily OISSTv2.0 (1981-2015) and Daily OISSTv2.1 (2016-present) replaced NOAA/NCEP Monthly OISSTv2 in study (<https://www.ncdc.noaa.gov/oisst>) – *See Boyin Huang's poster S3-ID-004*
- CMEMS OSTIA-based Reprocessed SST Analysis (1981-2018) added to study (<https://resources.marine.copernicus.eu>) - *See Mark Worsfold's poster S5-ID-002*
- Yang et al. (2021) Sea Surface Temperature intercomparison in the framework of the Copernicus Climate Change Service (C3S), *J. Climate* (<https://doi.org/10.1175/JCLI-D-20-0793.1>)



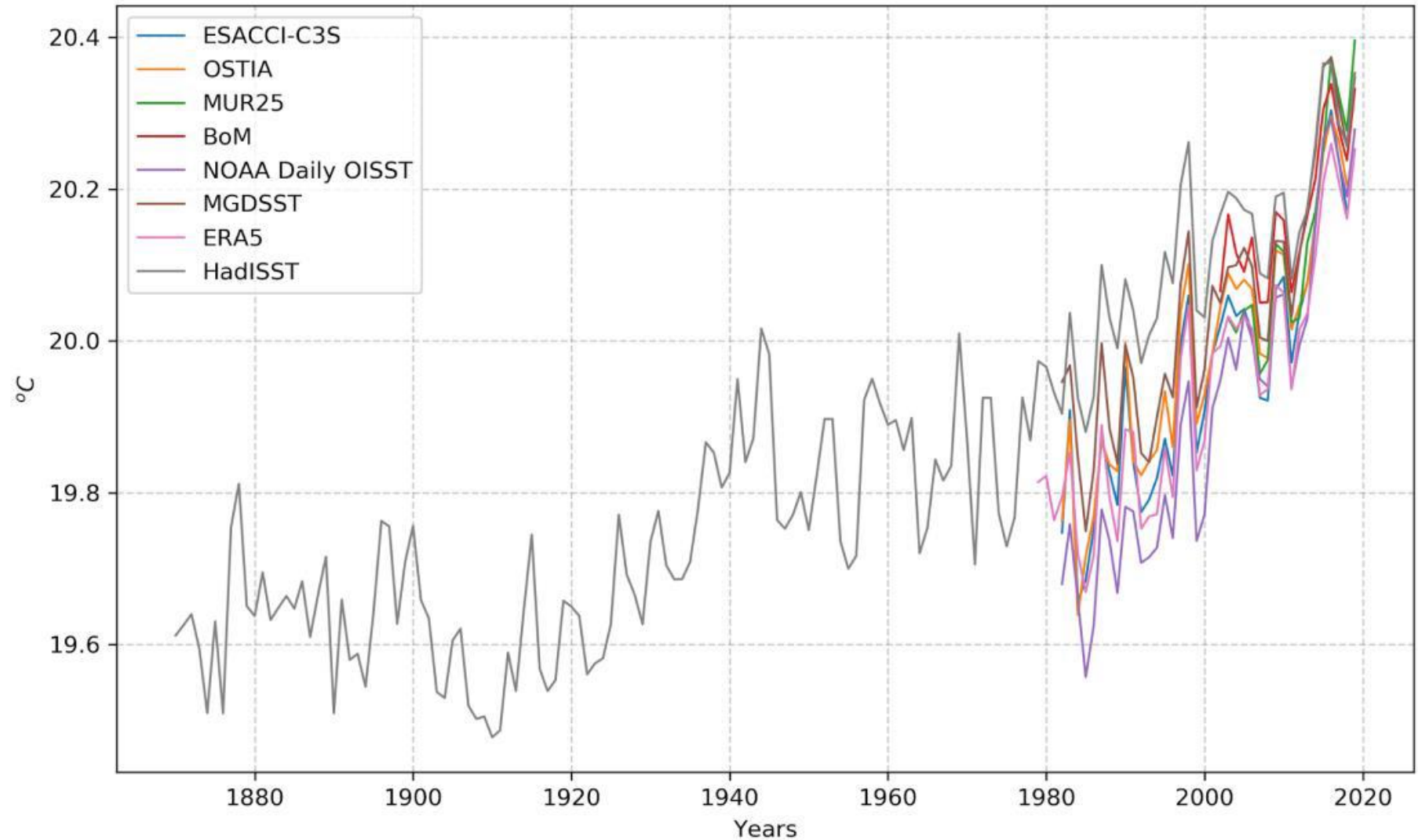
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# Global monthly mean SST



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Yang et al. (2021) *J. Climate* (<https://doi.org/10.1175/JCLI-D-20-0793.1>)

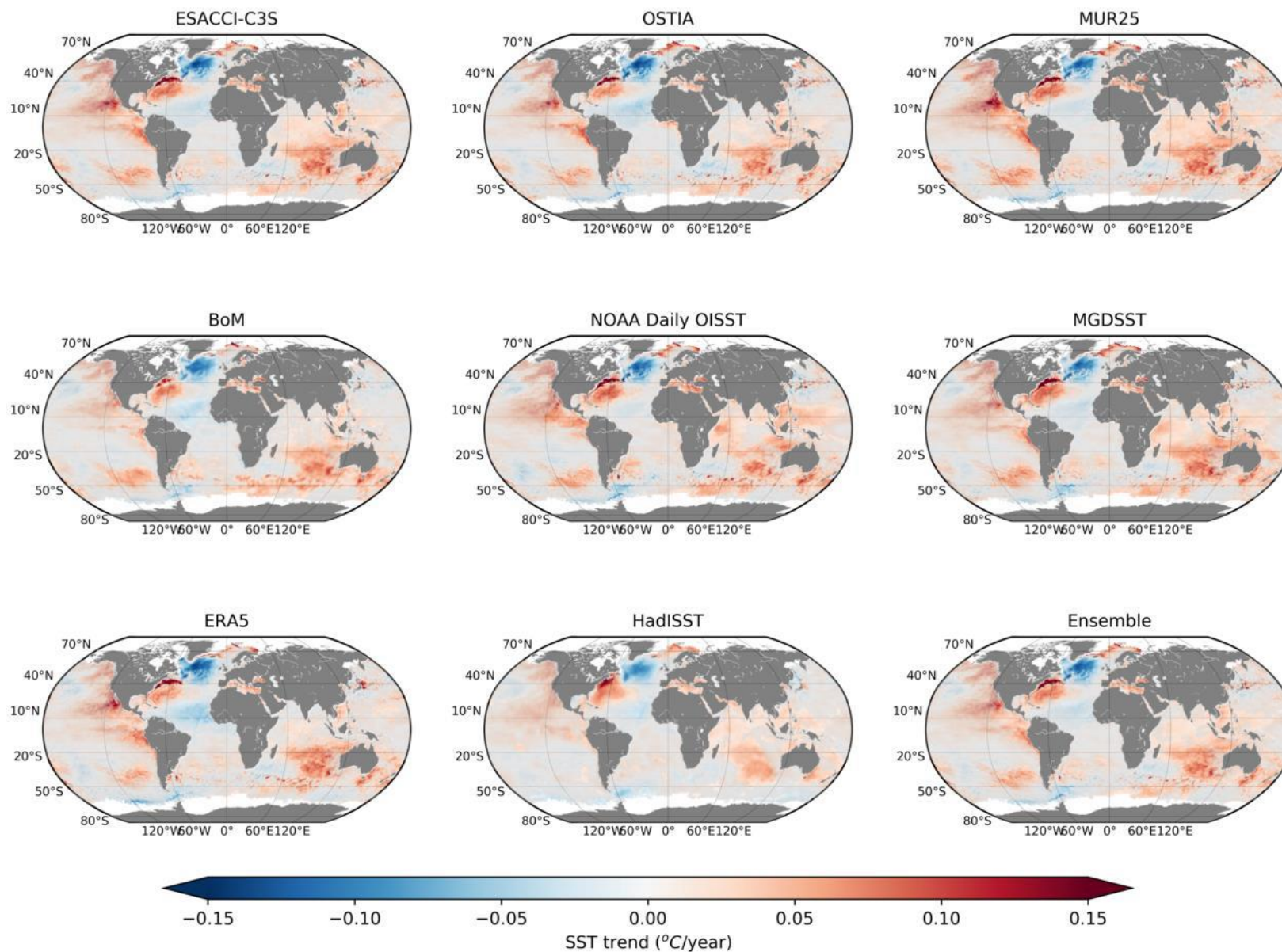






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# Linear trends of global SST for the period 2003-2018



# Task 2

**Aims:** Understand differences among the L4 products and then find out the possible ways to improve L4 products.

**Contact:** [Xu.Li@noaa.gov](mailto:Xu.Li@noaa.gov) if you would like to join this task.

**2.1:** For 1 – 10 May 2020, for various operational SST analyses (NCEP NSST, GAMSSA, OSTIA, CMC) compare the total number of available drifting buoy SST observations with the number that pass the pre-processing tests before the analysis and the number that pass the tests after the analysis. *(Completed. Reported at G-XXI)*

**2.2:** Understand the contribution of all types of in-situ SST data (drifting and moored buoys, ships, Argo floats, etc) used in operational SST analyses. Investigate the way in-situ data are used (directly assimilated, quality control or bias correction of satellite data, etc). *(No progress since G-XXI)*

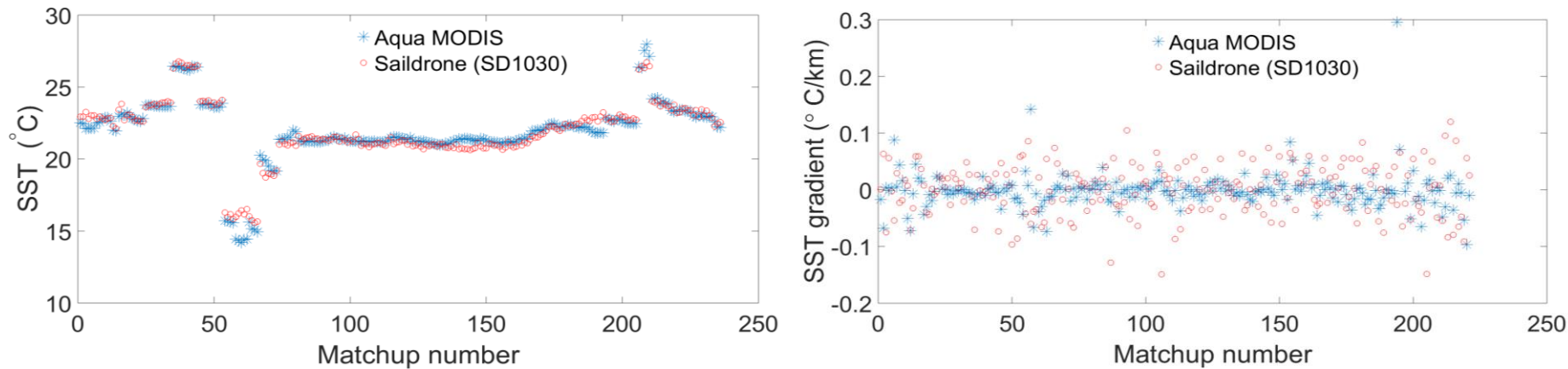
# Task 3.1

**Aim:** Validate L2, L3 and L4 SST gradients in highly variable regions using SailDrone SST data

## Ongoing:

- Following a similar methodology to that used for Level 4 datasets ([see Jorge Vazquez' poster S1-ID-006](#)), a new approach was developed for Level 2 SST products
- Preliminary results compare SST gradients from Terra/Aqua MODIS and SNPP VIIRS with those derived from Saildrone campaigns (SD1030 and SD1053) from the Atlantic to Mediterranean (October 18, 2019 to July 17, 2020). ([See Marouan Bouali's poster S3-ID-032](#))
- Future work will use similar approach with additional Saildrone campaigns over regions with low cloud coverage

### Saildrone SD1030 Atlantic-Mediterranean mission (Oct 18, 2019- Jul 17, 2020)



	Bias	Correlation	RMSE
SST	-0.019	0.976	0.48
$\nabla$ SST	--	0.079	0.05

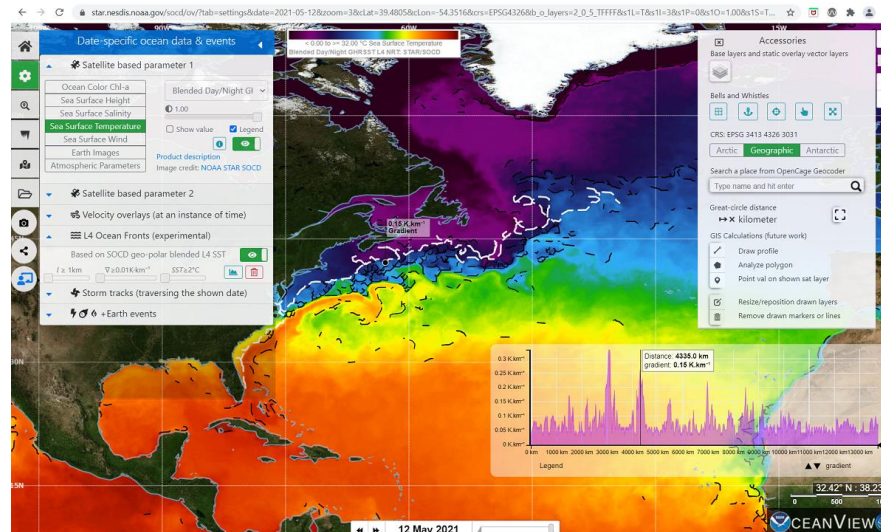


# Task 3.2

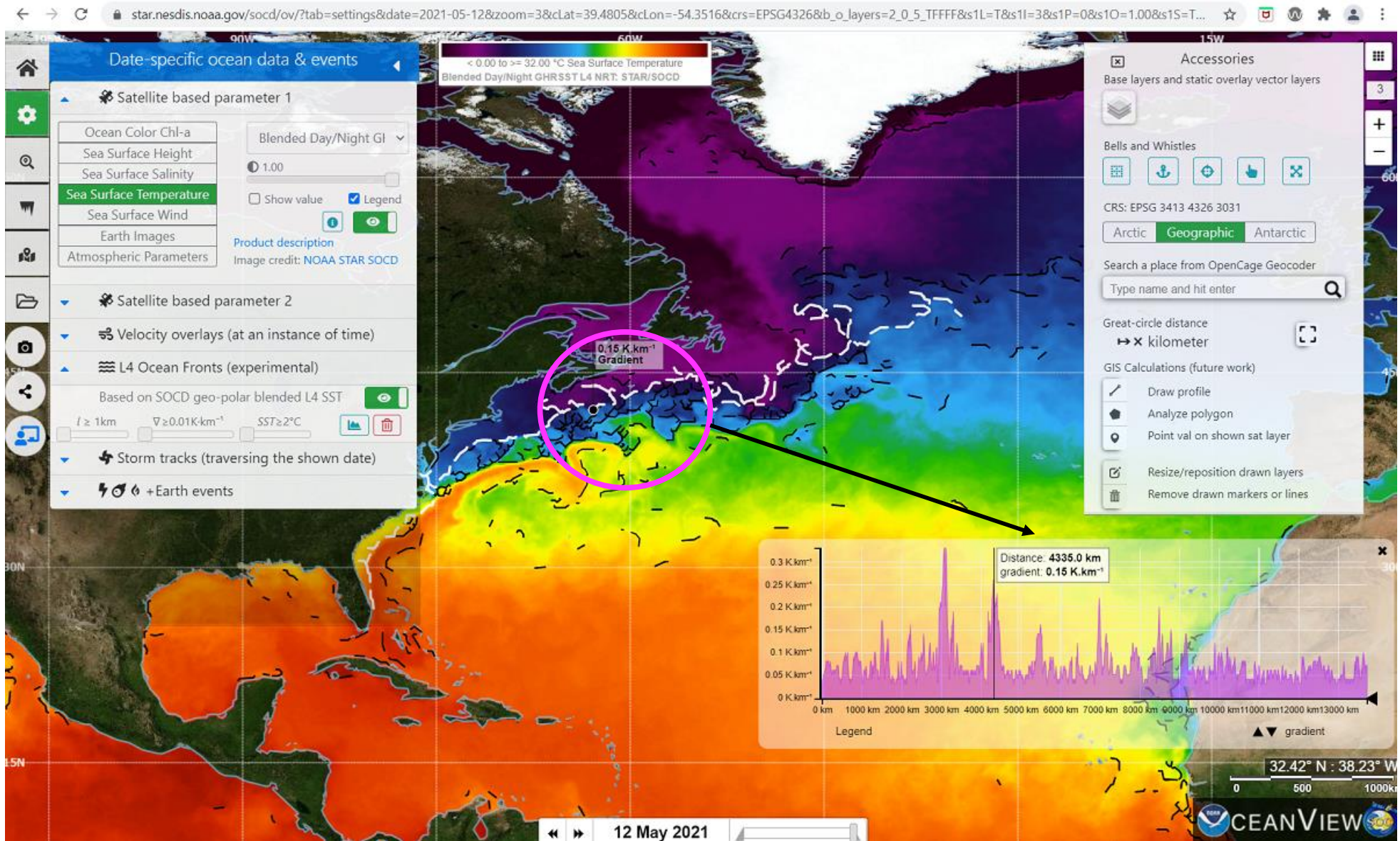
**Aim:** Produce an online visualisation tool for L4 SST gradients

## Ongoing:

- First version of NOAA STAR SOCD's OceanView (OV) completed and public: <https://www.star.nesdis.noaa.gov/socd/ov/> (See Prasanjit Dash's poster S2-ID-041)
- OV displays the location of SST fronts derived from SOCD Geo-Polar blended Level 4 SST, according to user specifications
- Characteristics of detected fronts such as average SST gradient magnitude and length are available and can be used to filter the displayed fronts.
- OV also includes a profiler to see the value of SST gradients along a given front



# Task 3.2





# Task 3.3

**Aim:** Develop the science to calculate SST fronts and intercompare

## Ongoing:

- Currently, OceanView includes NOAA's SOCD Geo-Polar Blended L4 SST with a module that displays corresponding SST fronts and their characteristics
- In the current version of OV, the detection of fronts is based on a Sobel filter
- Include other L4 datasets in OV (CMC, OSTIA and others) to allow visual comparison of SST fronts
- Improve the detection of SST fronts by exploring other techniques
- Continue the comparison of SST gradients from several GHRSSST L4 products with each other and with those derived from Sairdrone campaigns (see Vazquez et al. 2020\*)

**Validation statistics of SST and derived gradients for several GHRSSST Level 4 products using the Sairdrone campaigns of Baja California (left) and the North Atlantic Gulf Stream (right)**

		Bias	RMSE	Correlation			Bias	RMSE	Correlation
CMC	SST	-0.074	0.417	0.975	CMC	SST	-0.350	1.310	0.962
	∇SST	-0.009	0.022	0.315		∇SST	-0.012	0.054	0.374
K10	SST	0.137	0.475	0.969	K10	SST	-0.688	1.928	0.917
	∇SST	-0.007	0.022	0.293		∇SST	-0.009	0.062	0.072
REMSS	SST	0.075	0.401	0.977	REMSS	SST	-0.085	0.962	0.977
	∇SST	-0.007	0.023	0.243		∇SST	-0.016	0.055	0.342
OSTIA	SST	0.022	0.365	0.980	OSTIA	SST	-0.209	1.185	0.968
	∇SST	-0.008	0.022	0.306		∇SST	-0.012	0.053	0.371
DMI	SST	0.040	0.489	0.966	DMI	SST	0.002	1.401	0.951
	∇SST	-0.008	0.023	0.255		∇SST	-0.017	0.058	0.210
MUR	SST	0.285	0.500	0.975	MUR	SST	-0.051	1.057	0.975
	∇SST	-0.003	0.021	0.395		∇SST	-0.010	0.054	0.321

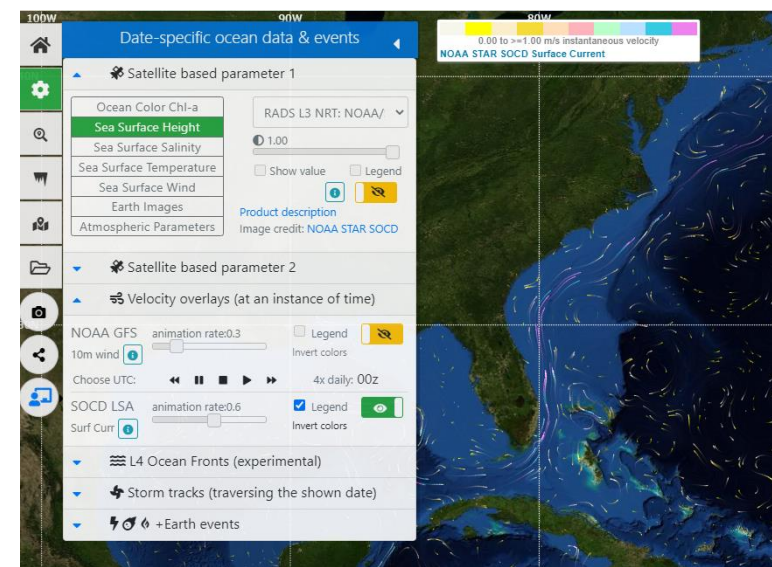
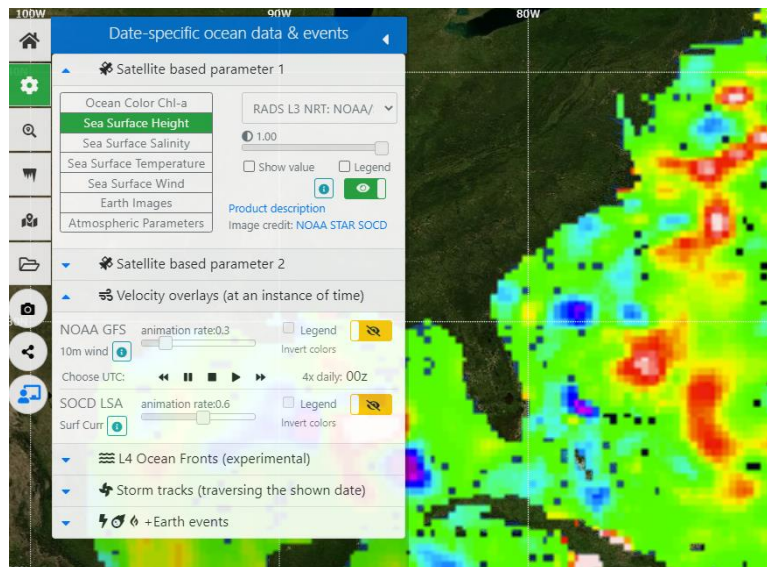
\* Vazquez-Cuervo, J.; Gomez-Valdes, J.; Bouali, M. Comparison of Satellite-Derived Sea Surface Temperature and Sea Surface Salinity Gradients Using the Sairdrone California/Baja and North Atlantic Gulf Stream Deployments. *Remote Sens.* 2020, 12, 1839. <https://doi.org/10.3390/rs12111839>

# Task 3.4

**Aim:** Validate SST gradients/fronts with other independent but related data, e.g., sea surface salinity gradients or altimeter derived currents

## Ongoing:

- OceanView currently includes visualisation of other ocean parameters such as
  - Sea Surface Salinity: L3 SMAP/SMOS
  - Ocean Color Chl-a: DINEOF NRT, N20/SNPP blended, CMEMS L4
  - Sea Surface Height: NOAA SOCD RADS LSA
  - Ocean Surface currents: NOAA SOCD RADS LSA
- The methodology to compare the properties of SST fronts with other ocean variables will evolve depending on available literature and new ideas from the ocean community



# Task 3.5

**Aim:** Compare feature resolution of various SST analyses

**Ongoing:**

- Explore methodologies other than spectral analysis to define a “resolution” metric in the spatial domain

**Future work:**

- Test the metric on several GHRSSST L4 products over a limited dataset manually/visually selected to contain small scale ocean features (meanders, eddies, vortex...)
- Assess the ability of such a metric to determine automatically which L4 product is better at preserving the resolution of ocean features observed at Level 2



# Questions for discussion

**Task 1:** Under Phase 2 of C3S, how could we contribute to the further inter-comparison of SST analyses for climate studies?

Would it be possible to compare SST gradients over the interannual time scales for the different L4 products?

**Task 2:** Who can commit time to contributing to T2.2: "Understand the contribution of all types of in-situ SST data (drifting and moored buoys, ships, Argo floats, etc) used in operational SST analyses"?

Proposed new tasks:

T2.3: Impact of COVID on number of in-situ data ingested into operational L4 over past 12 months.

T2.4: Decrease in number of ship data due to TAC to BUFR format transition.

T2.5: Compare different methods for generating L4 background fields, important in data poor areas?

**Task 3:** Would it be possible to incorporate Sairdrone into iQuam?

***Please put comments in IC-TT Moodle Forums: <https://training.eumetsat.int/enrol/index.php?id=368>***

If interested in contributing to the IC-TT, please contact:

[helen.beggs@bom.gov.au](mailto:helen.beggs@bom.gov.au) and [chunxue.yang@artov.ismar.cnr.it](mailto:chunxue.yang@artov.ismar.cnr.it)

# **Additional Slides for Discussion**

# New OSTIA-based SST Reanalyses

(Simon Good, Mark Worsfold, UK Met Office)

- CMEMS reprocessed SST analysis based on Met Office OSTIA configuration: provides foundation SST and uses the latest OSTIA configuration, covering 1 Oct 1981 to June 2020, updated every 6 months  
[https://resources.marine.copernicus.eu/?option=com\\_csw&task=results?option=com\\_csw&view=details&product\\_id=SST\\_GLO\\_SST\\_L4\\_REP\\_OBSERVATIONS\\_010\\_011](https://resources.marine.copernicus.eu/?option=com_csw&task=results?option=com_csw&view=details&product_id=SST_GLO_SST_L4_REP_OBSERVATIONS_010_011)
- ESA SST CCI and C3S reprocessed analysis: provides SST at 20 cm depth, covering 1 Sep 1981 to Feb 2021, updated daily to be 28 days behind present  
<https://cds.climate.copernicus.eu/cdsapp#!/dataset/satellite-sea-surface-temperature?tab=form>
- Both products used reprocessed satellite observations from the ESA SST CCI project.
- See Mark Worsfold's poster S5-ID-002



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# SST Analysis Datasets Description



Dataset	Institution	Time Range	Observation input	Type of SST	Horizontal Grid spacing	Temporal resolution	Main Reference
ESA CCI SST (v2.0)	UK Met Office	1981-2018	IR	SST at 0.2 m	global 0.05°x0.05°	daily	Merchant et al. (2019)
ERA5	ECMWF	1979-2018	IR + MW + in situ	SSTdepth	global 0.25°x0.25°	hourly	Hirahara et al. (2016)
HadISST1	UK Met Office	1870-2018	IR + in situ	SSTdepth	global 1°x1°	monthly	Rayner et al. (2003)
NOAA Daily OISST (v2.1)	NOAA	1981-2018	IR + in situ	SST at 0.2 m	global 0.25°x0.25°	daily	Huang et al. (2020)
MUR25 (v4.2)	JPL PO.DAAC	2003-2018	IR + MW + in situ	Foundation SST	global 0.25°x0.25°	daily	Chin et al. (2017)
MGDSST	Japanese Met. Agency (JMA)	1982-2018	IR + MW + in situ	Foundation SST	global 0.25°x0.25°	daily	Sakurai et al. (2005)
BoM Monthly SST	Australian Bureau of Met. (BoM)	2001-2018	IR + in situ	SST at 0.2 m	global 1°x1° (weekly/monthly)	weekly and monthly	Smith et al. (1999)
CMEMS OSTIA	UK Met Office	1981-2018	IR + MW + in situ	Foundation SST	0.05°x0.05°	daily	Good et al. (2020)

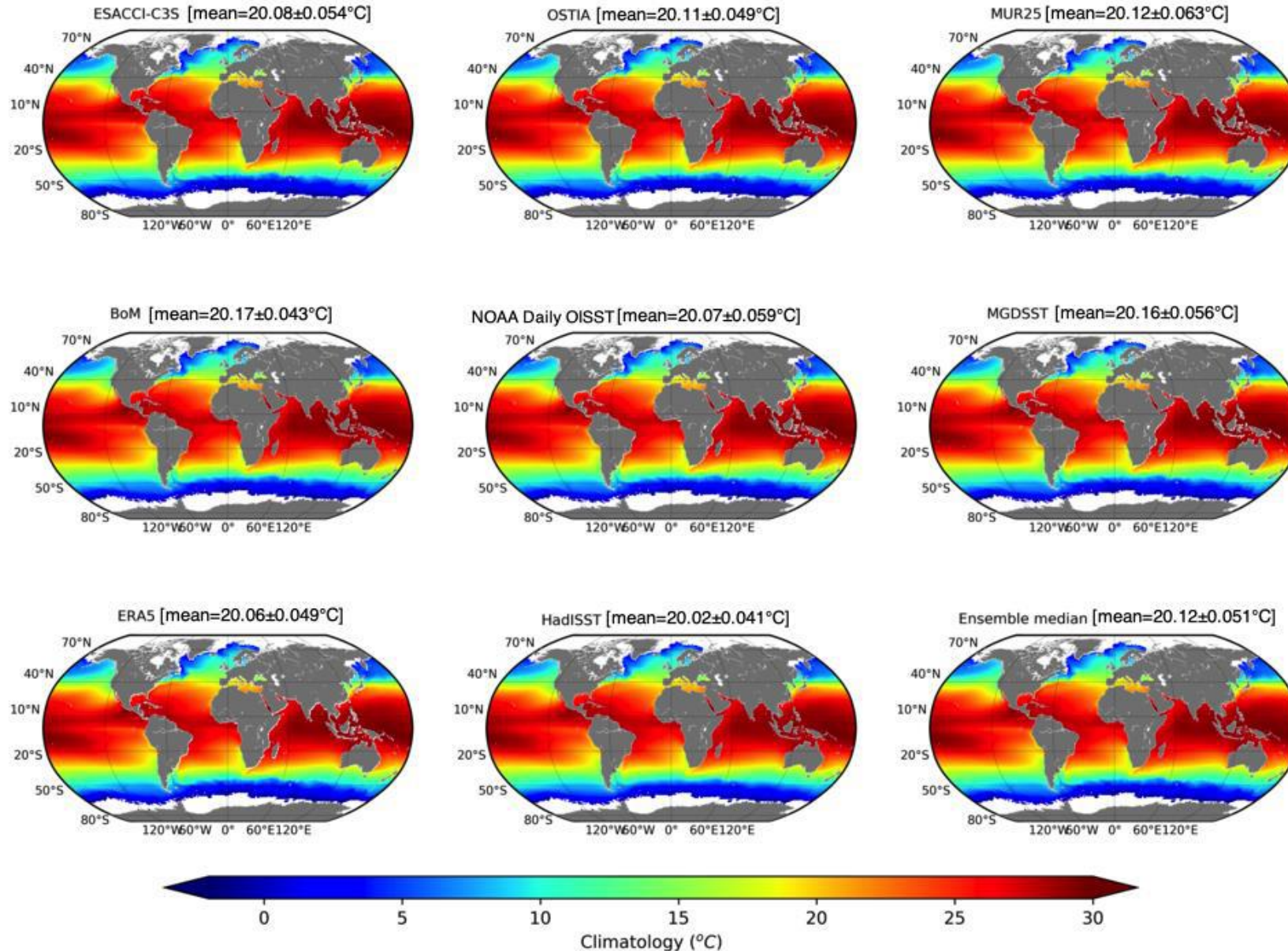


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# Global SST climatology from 2003-2018



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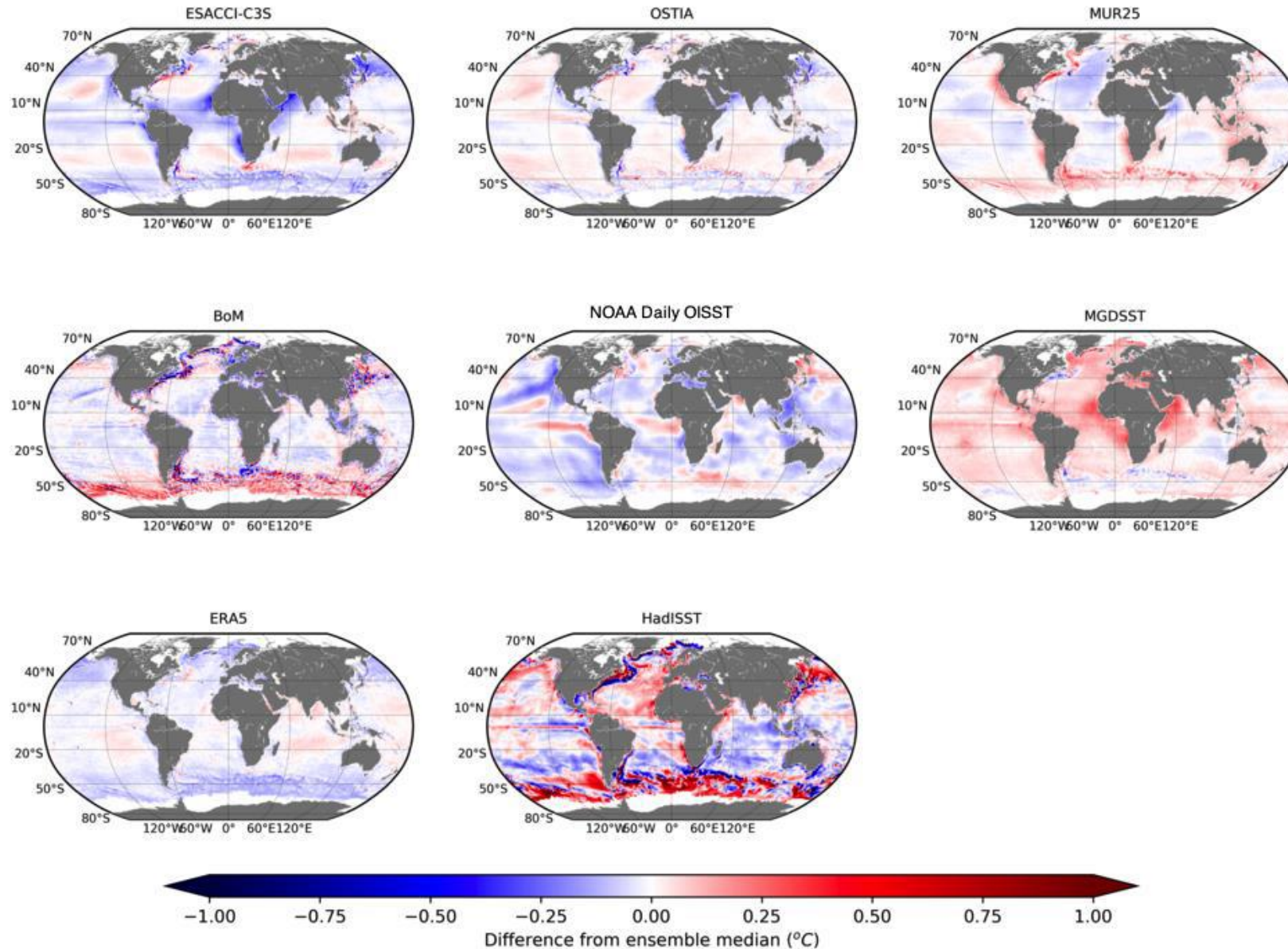
JS  
iEarth



European Commission



# The difference between each SST data and the ensemble **median** for the period of 2003-2018





# RMSD between each SST data and the ensemble **median** for the period of 2003-2018

