climate change initiative

OCEAN SURFACE HEAT FLUX

2026 Ocean Salinity Science and Technology Meeting

21st May 2026

CCI-OSHF: A new ESA Climate Change Initiative to enhance ocean surface heat fluxes estimates

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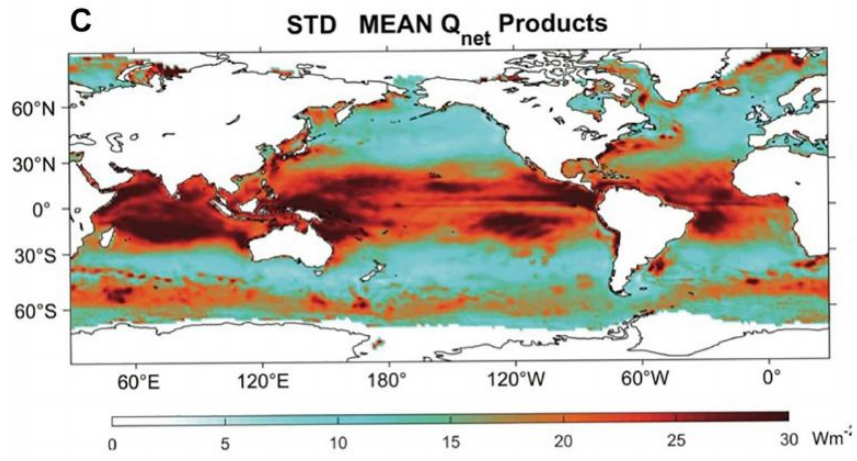
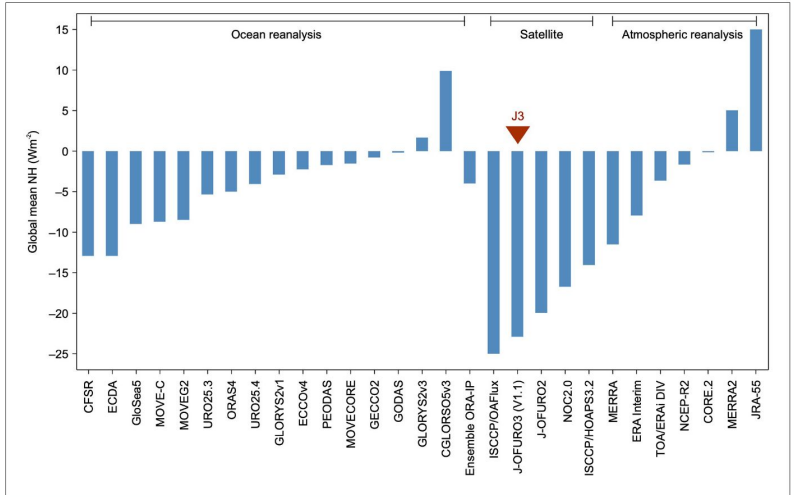
The goal

To create a new Climate Data Record (CDR) for total Ocean Surface Heat Flux (OSHF), enhancing the spatio-temporal resolutions better approaching the GCOS requirements, and complementing other existing products.



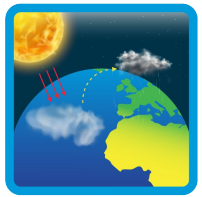
Cronin, 2019



Tomita, 2021

The team

CCI-OSHF



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ZBT

Climate Research Group: C. Yang

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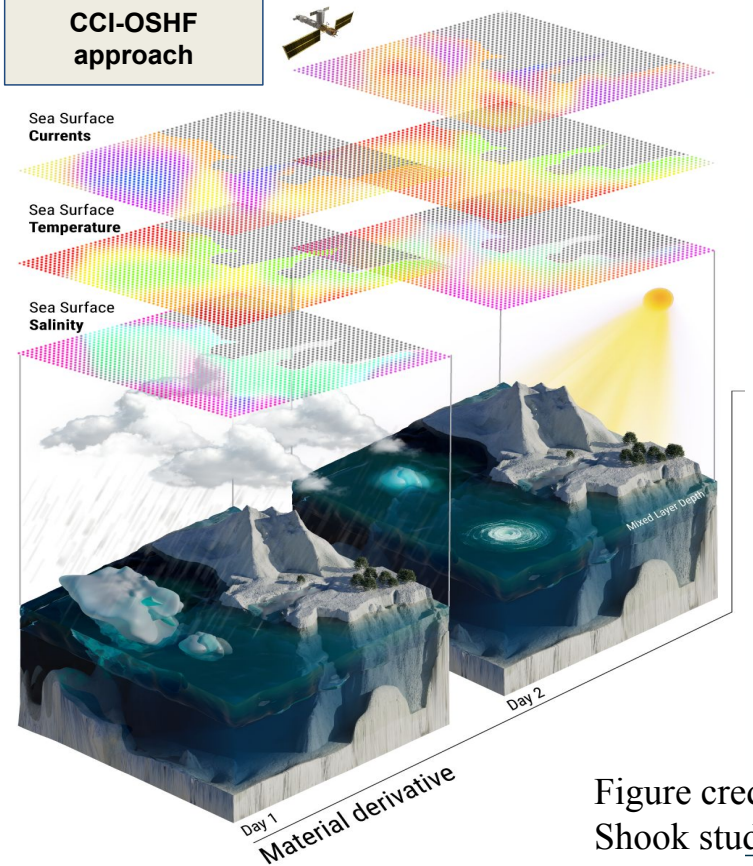
SHINY EARTH

The approach

CCI-OSHF approach



$$\frac{Dq}{Dt}h = \left\{ h\left(\frac{\partial q}{\partial t} + u \cdot \nabla q \right) \right\} = \underbrace{(Q_{SW} - Q_{SW(-h)} + Q_{LW} + Q_{sen} + Q_{lat})}_{f_q} + \underbrace{\kappa \nabla^2 q}_{d_q} + \underbrace{(q_0 - q_{-h})\left(\frac{Dh}{Dt} + w_{-h} \right)}_{h_q}$$

Satellite observations: Sea Surface Temperature, Sea Surface Salinity and Sea Surface Currents

In situ observations: Mixed Layer Depth

- Different approach from other remote sensing existing approaches
- Estimate of the net flux, not separated contributions
- Assumption that diffusivity and entrainment is small

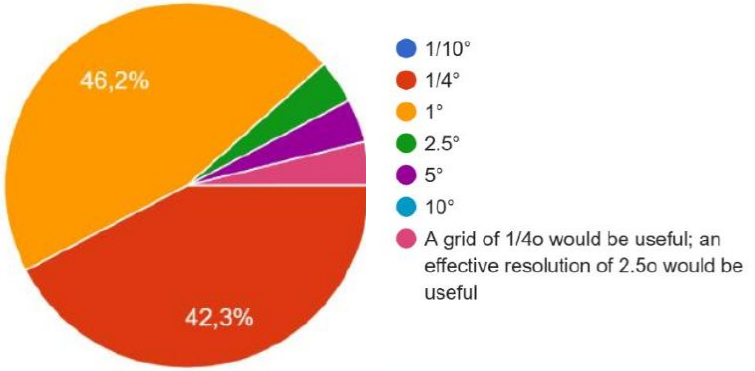
Figure credits:
Shook studio

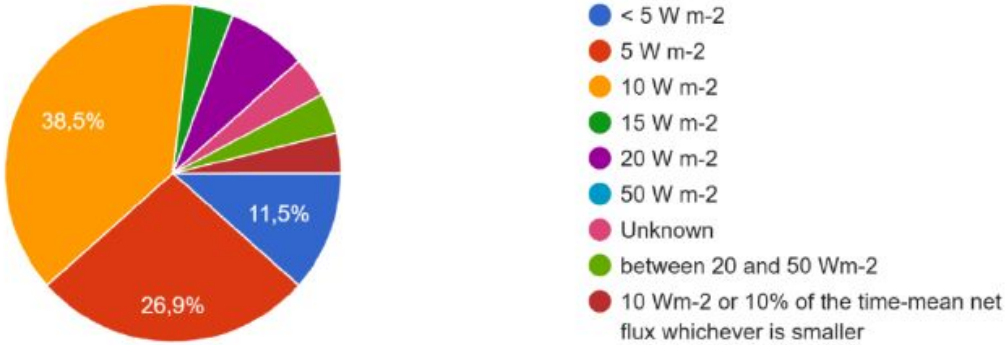
The requirements

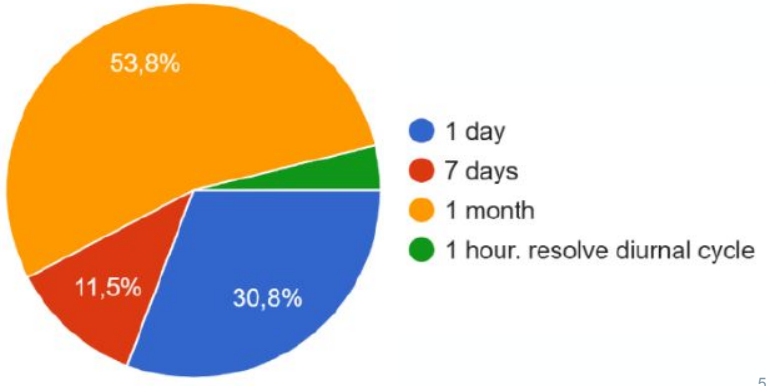
Three products will be delivered:

Global maps since 2011 till present at

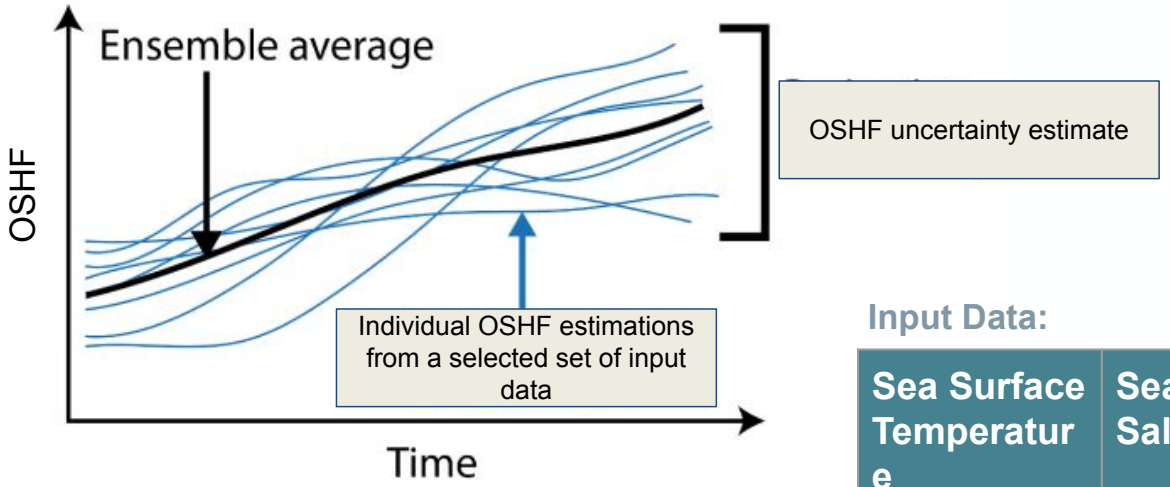
- 0.25ºx0.25º-daily resolution
- 0.25ºx0.25º-monthly resolution
- 1ºx1º-monthly resolution







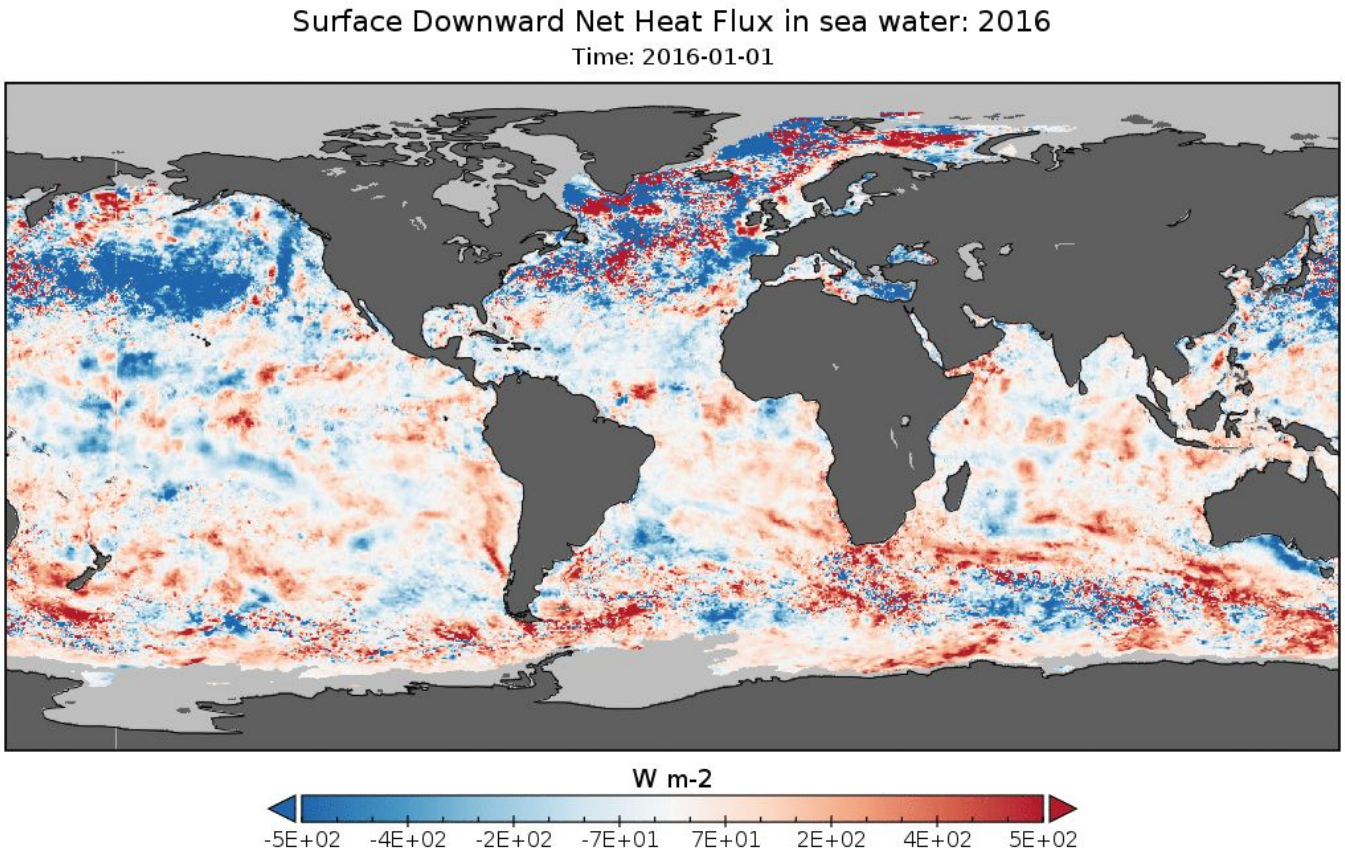
The product



Input Data:

Sea Surface Temperature	Sea Surface Salinity	Sea Surface Currents	Mixed Layer Depth
CCI-SST	CCI-SSS	NEUROST	CORA
CMC-SST	SMOS BEC SSS	CMEMS ALLSAT	ARMOR3D
		OSCAR	

Quick look



The generation of the daily product at 0.25 ºx0.25º is finished:

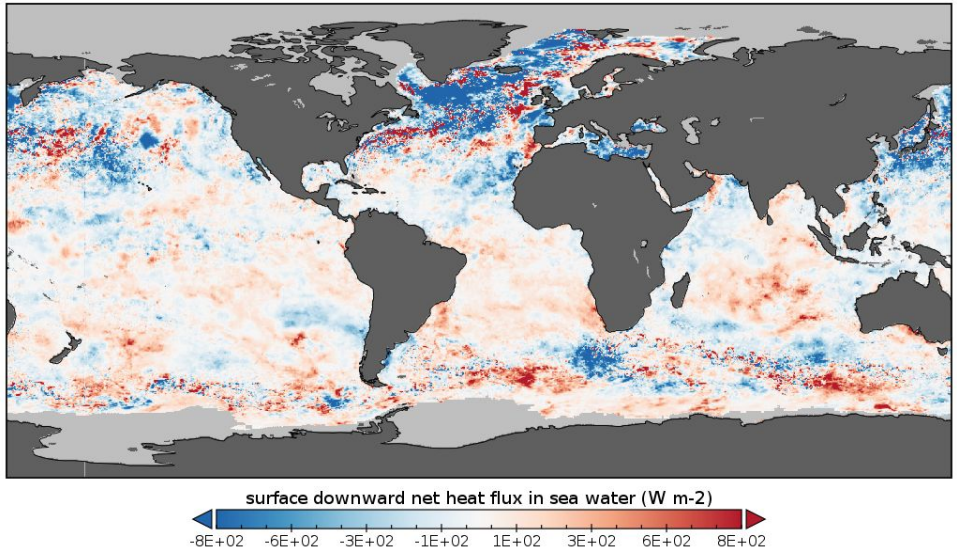
- Generation of 0.25 ºx0.25º monthly and 1ºx1º monthly on going

Validation is on-going

Consistency of the ensemble

OSHF ensemble product in 1st January 2015

surface downward net heat flux in sea water

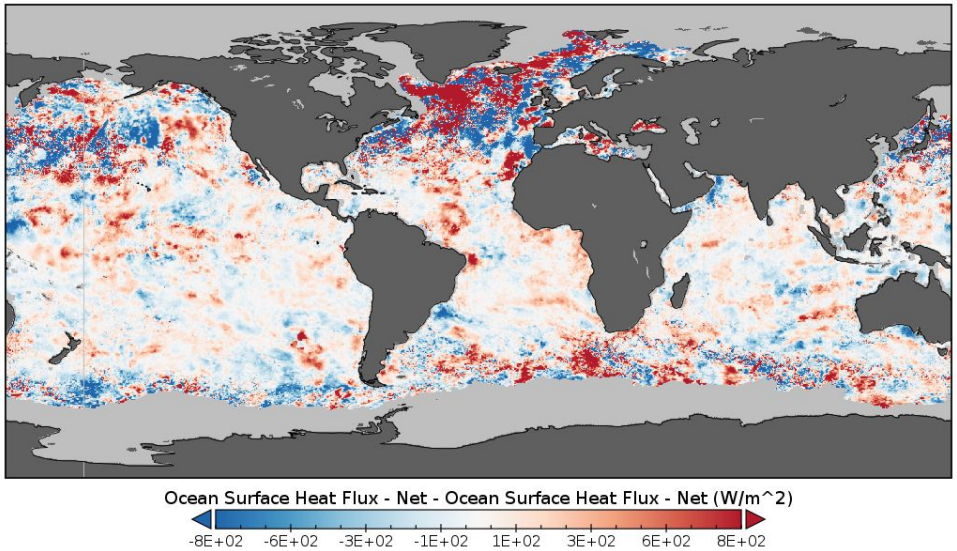


surface downward net heat flux in sea water (W m-2)

-8E+02 -6E+02 -3E+02 -1E+02 1E+02 3E+02 6E+02 8E+02

Impact of changing SST

CORA-ALSSAT-BEC: CCI-CMC



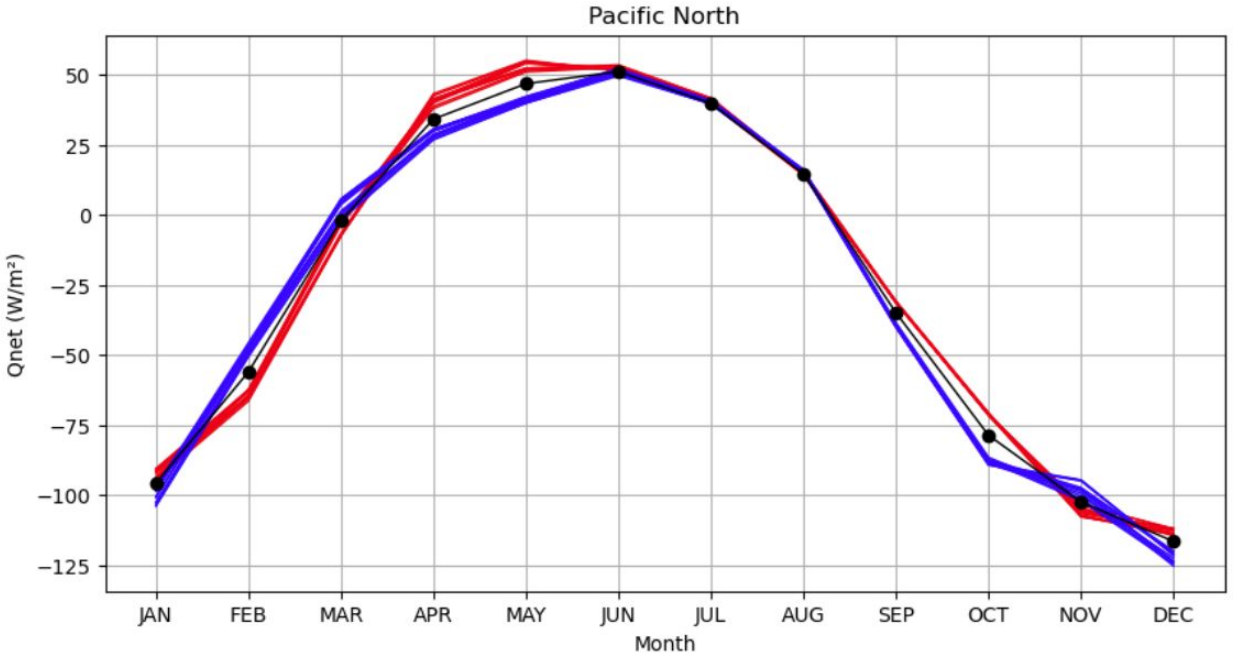
Ocean Surface Heat Flux - Net - Ocean Surface Heat Flux - Net (W/m^2)

-8E+02 -6E+02 -3E+02 -1E+02 1E+02 3E+02 6E+02 8E+02

Consistency of the ensemble

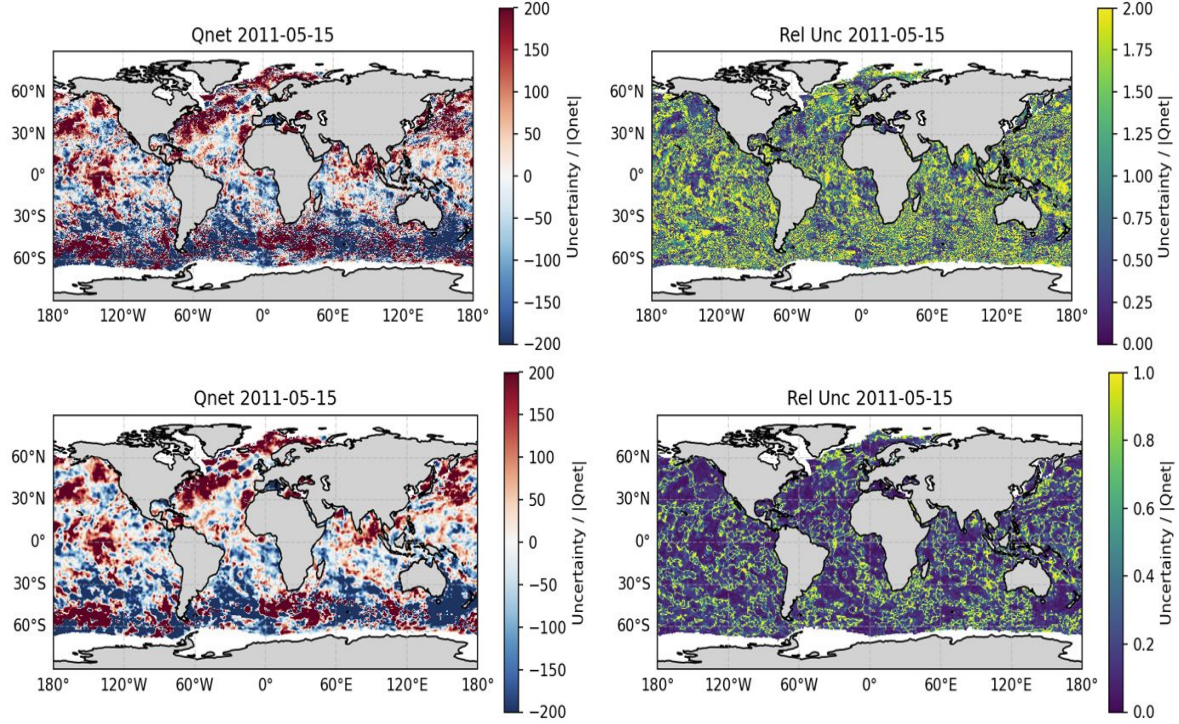
Although SST is the main driver of the day-to-day uncertainties, at seasonal timescales the primary contributor is the mixed layer depth.

ARMOR
CORA

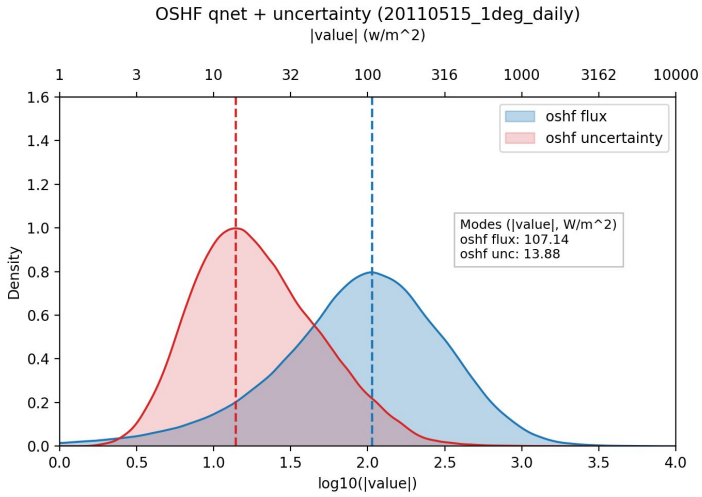


OSHF uncertainty

0.25x0.25º-daily



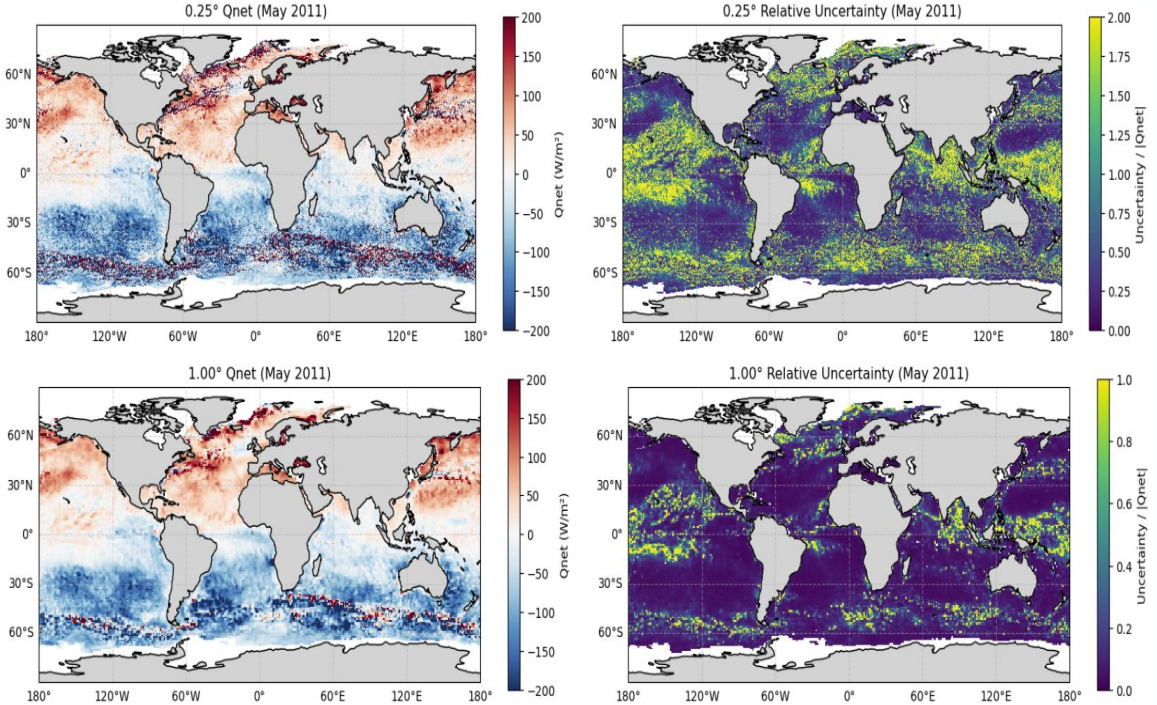
1ºx1º-daily



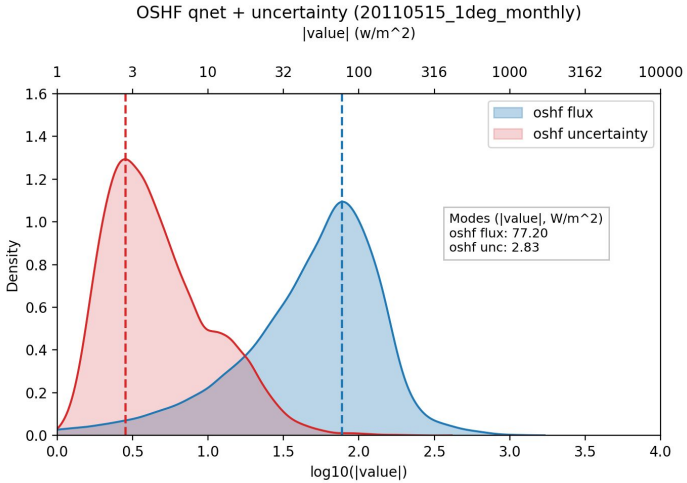
1ºx1º-daily

OSHF uncertainty

0.25x0.25º-monthly



1ºx1º-monthly



1ºx1º-monthly

Preliminary comparison with ERA5 Qnet

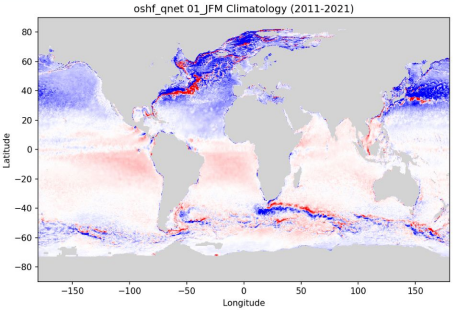
$$\frac{Dq}{Dt}h = h\left\{\frac{\partial q}{\partial t} + u \cdot \nabla q\right\} = \underbrace{\left(Q_{SW} - Q_{SW(-h)} + Q_{LW} + Q_{sen} + Q_{lat}\right)}_{f_q} + \underbrace{\kappa\nabla^2 q}_{d_q} + \underbrace{\left(q_0 - q_{-h}\right)\left(\frac{Dh}{Dt} + w_{-h}\right)}_{h_q}$$

ERA5 (https://doi.org/10.24381/cds.adbb2d47):

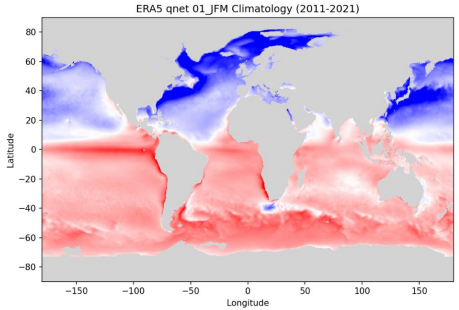
$$Q_{net} = Q_{SW} + Q_{LW} + Q_{lat} + Q_{sen}$$

Preliminary assessment: Seasonal climatology (2011-2021)

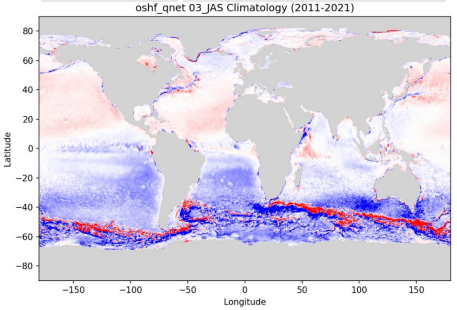
JFM CCI-OSHF



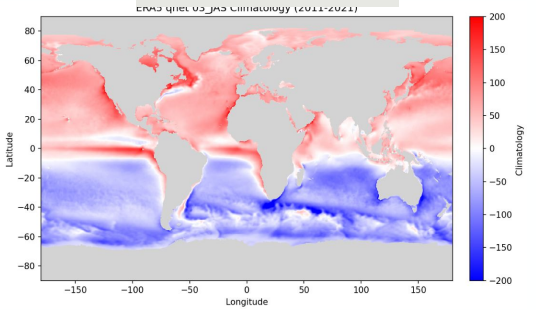
ERA5



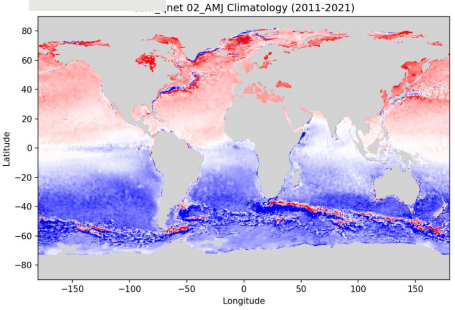
JAS CCI-OSHF



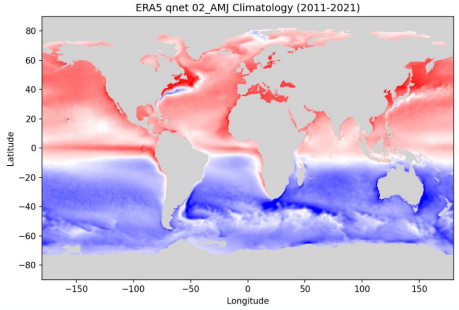
ERA5



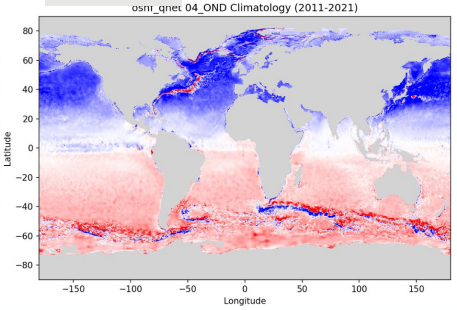
AMJ CCI-OSHF



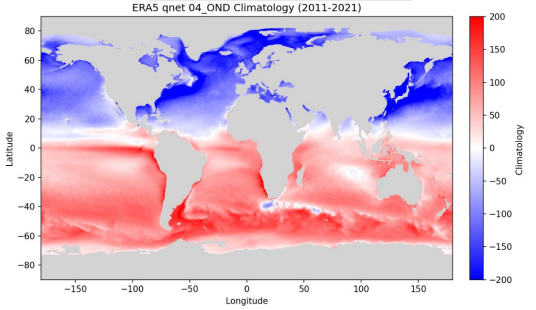
ERA5



OND CCI-OSHF



ERA5



Seasonal climatology

1. **Seasonal consistency:**
   a. During winter, spring and autumn, both CCI-OSHF and ERA5 exhibit broadly consistent spatial patterns and magnitude although ERA5 fields appear smoother than those of CCI-OSHF.
   b. During summer, the CCI-OSHF estimates show substantially lower ocean heat absorption than ERA5.

   Assessing definition of MLD

2. **Equatorial regions:** A persistent negative bias is observed in CCI-OSHF relative to ERA5 across equatorial regions throughout the year.

   Geostrophic limitations of altimetric currents

3. **Eastern boundary current systems:** CCI-OSHF also tends to exhibit lower heat flux values compared to ERA5, resulting in a negative bias in these areas.

   Assessing impact of entrainment in upwelling regions

Next steps

KO	+03M	+06M	+09M	+12M	+15M	+18M	+21M	+24M	+27M	+30M	+33M	+36M

May 2025 May 2026 May 2027 May 2028

CRDP v1

ATBD v1

E3UB v1

ADP v1

CRDP v2

USER CONSULTATION

SSD v1

PVR v1

CNR ISMAR ISTITUTO DI SCIENZE MARINE

CRDP v3

ocean surface heat flux

Thank you very much!!
And follow our developments :-)

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