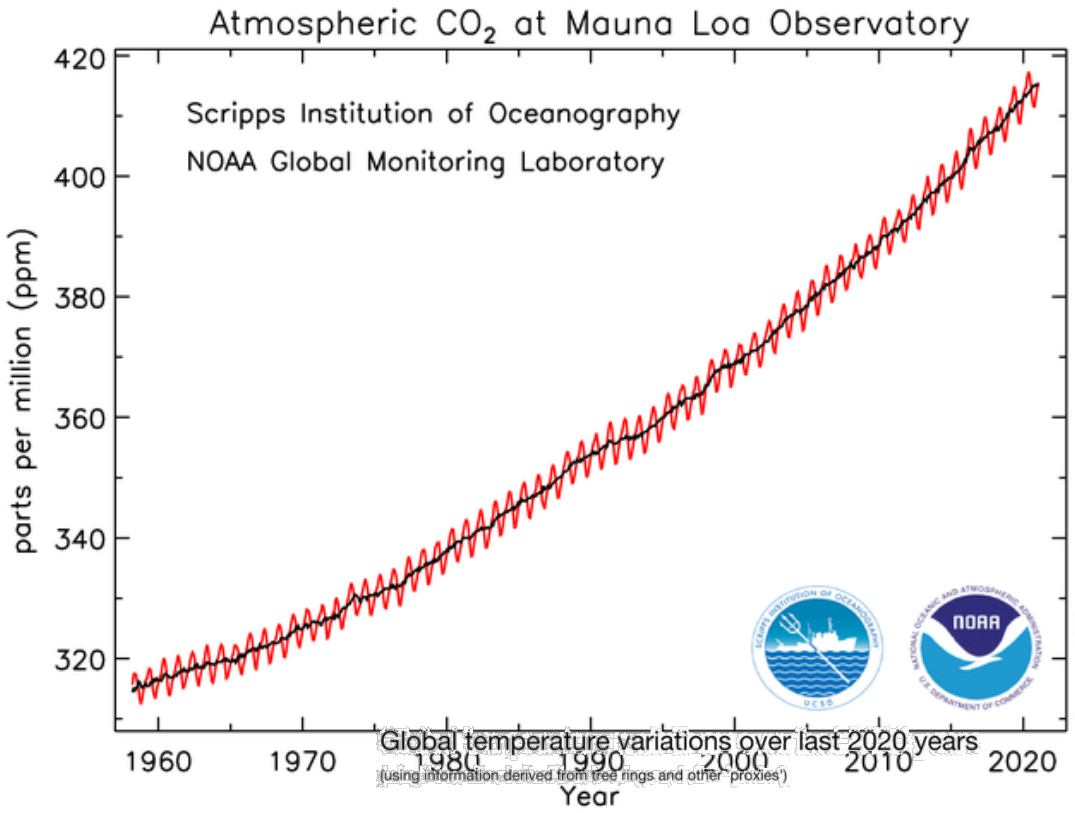
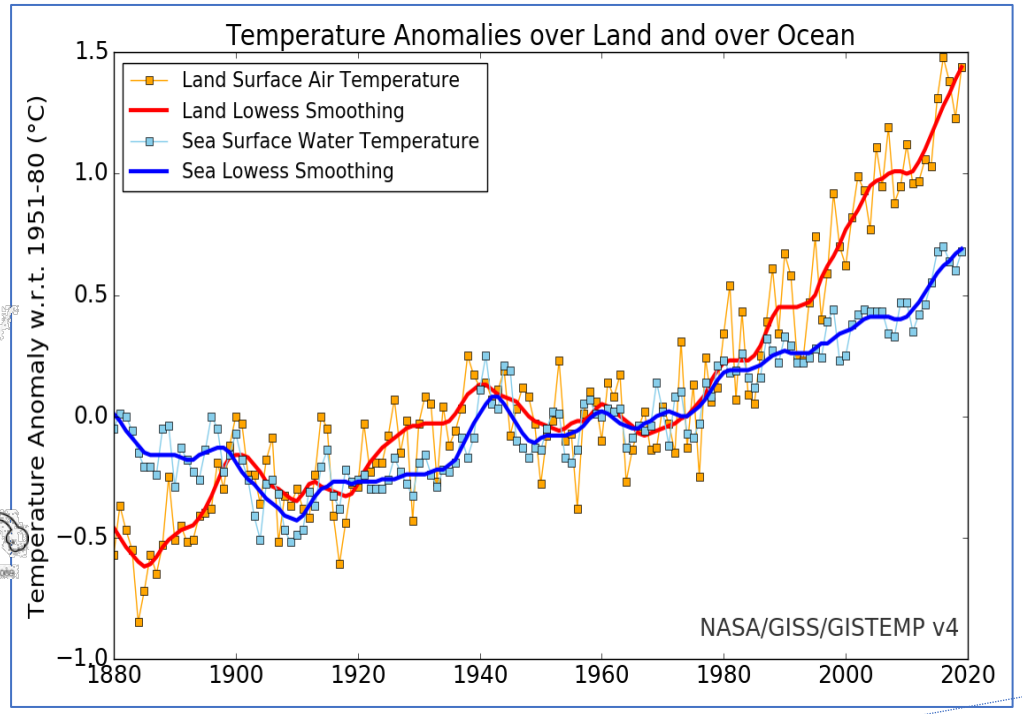
Clima, oceano e dinamica oceanica a piccola scala

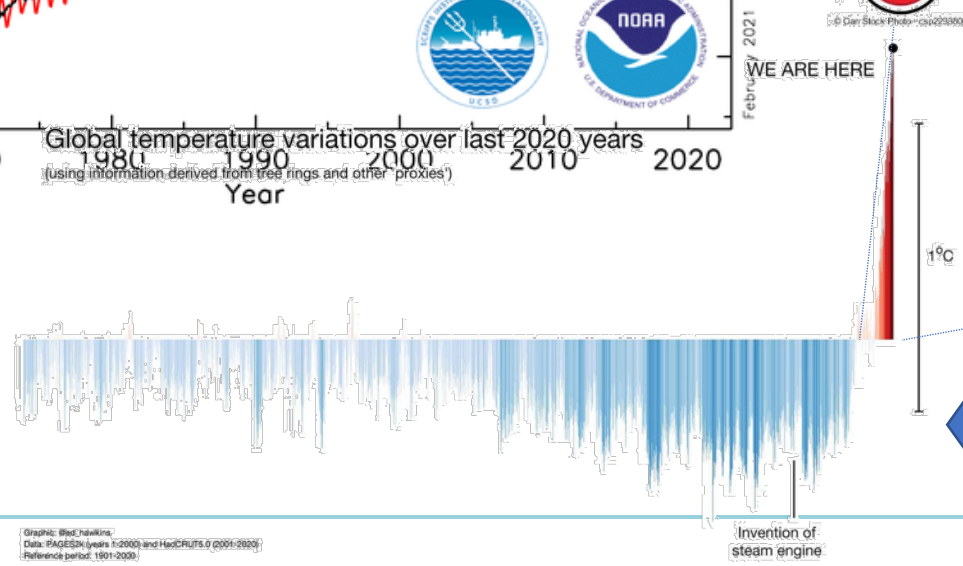
Sabrina Speich, Paris, France

23/03/2021

CLIMATE CHANGE: INCREASING GHGs LEAD TO GLOBAL WARMING

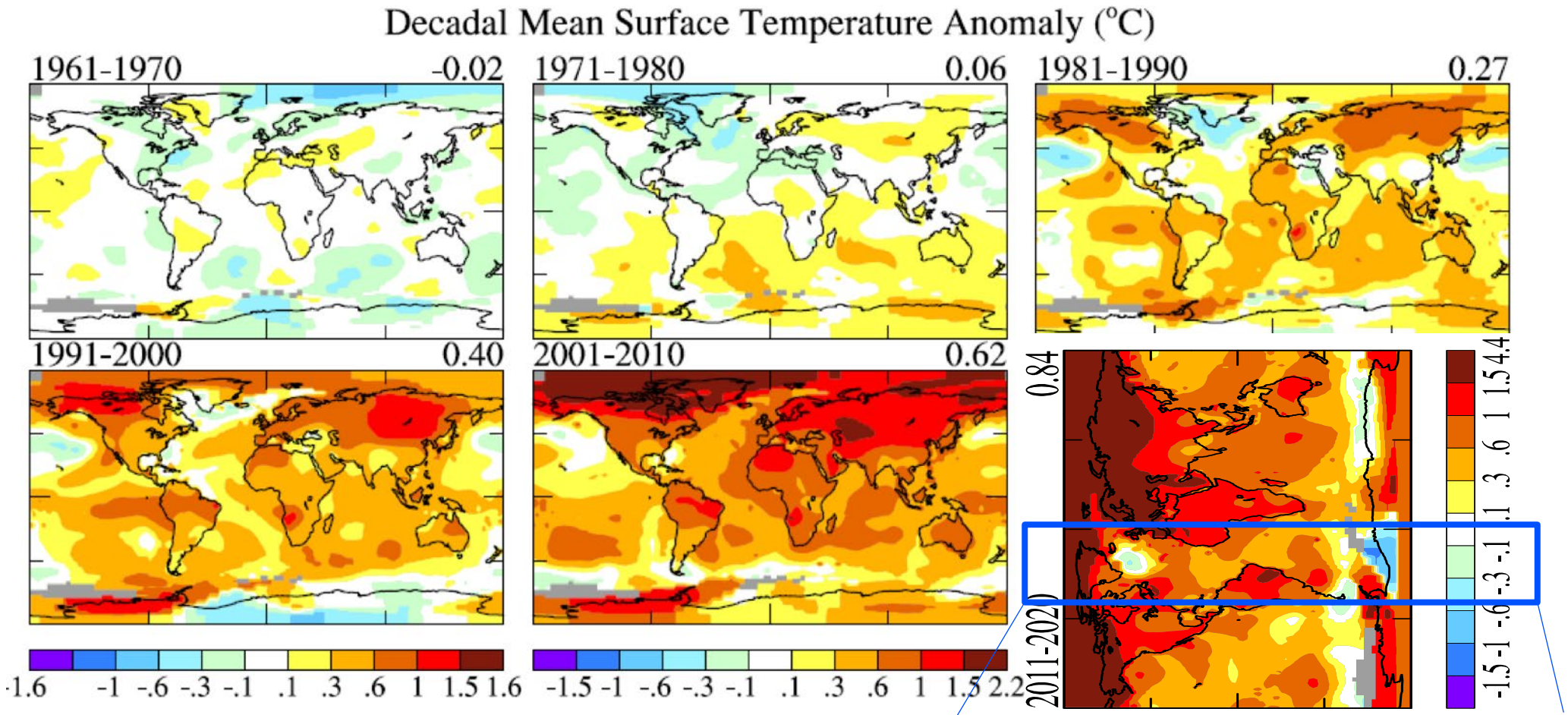






Earth surface temperature anomalies over the last 2020 years

CLIMATE CHANGE: SPATIAL INHOMOGENEITY IN TEMPERATURE INCREASE



Subtropical warming of the ocean

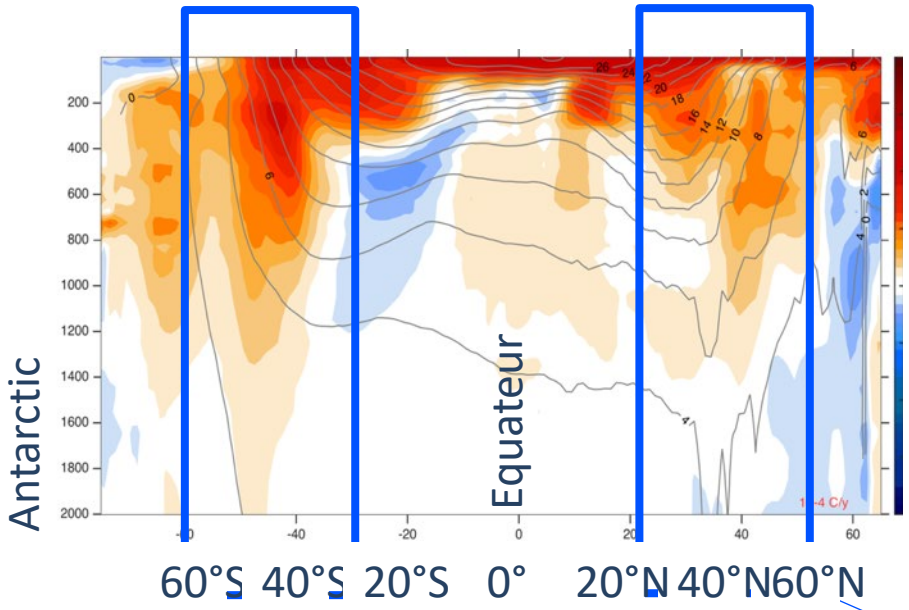
DSSTTA

CLIMATE CHANGE: INTERNAL ENERGY CHANGE, OCEAN CHANGE

WHERE DOES THE ENERGY GO?

Changes in the ocean thermal energy (Heat Content)

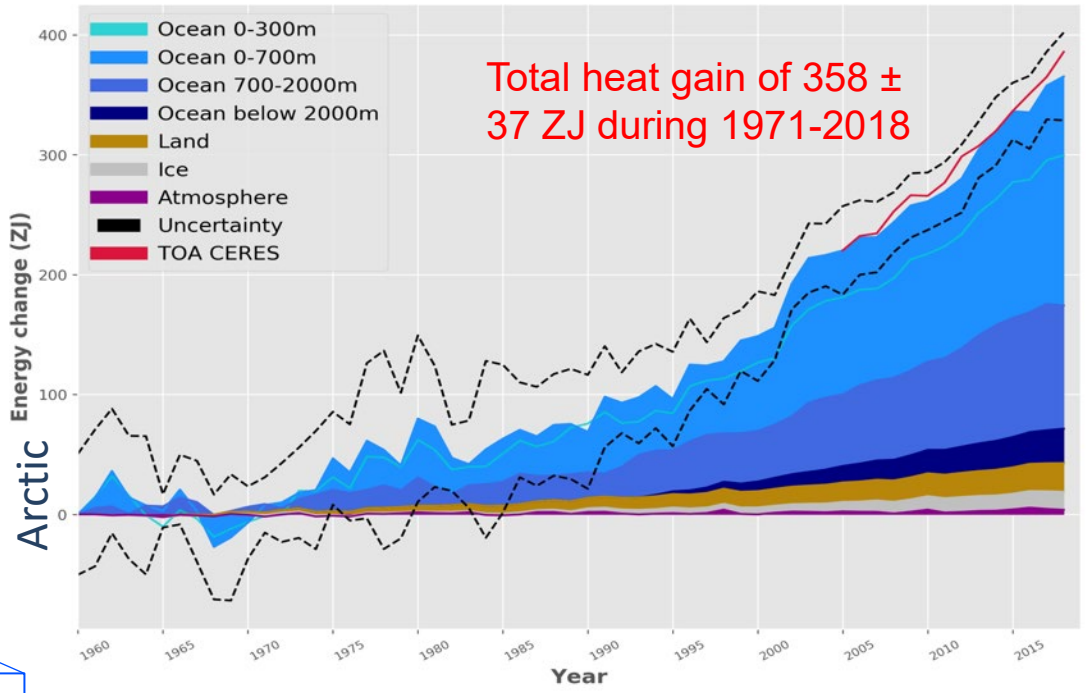
ENERGY CHANGES IN THE OCEAN



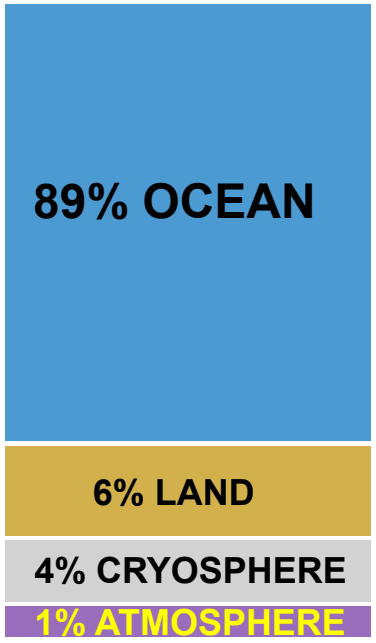
Subtropical warming of the ocean

Lijing Cheng, 2018

HOW MUCH?



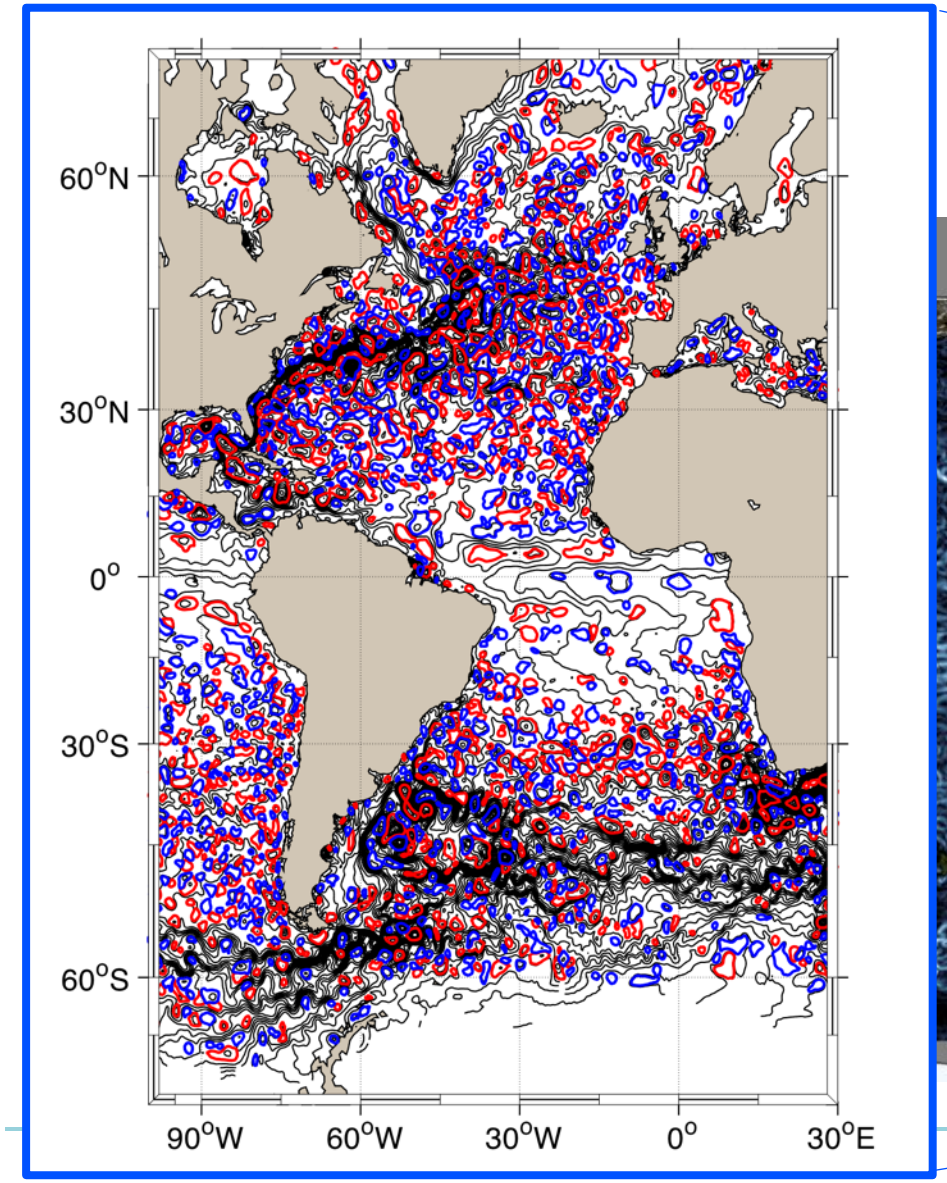
WHERE?

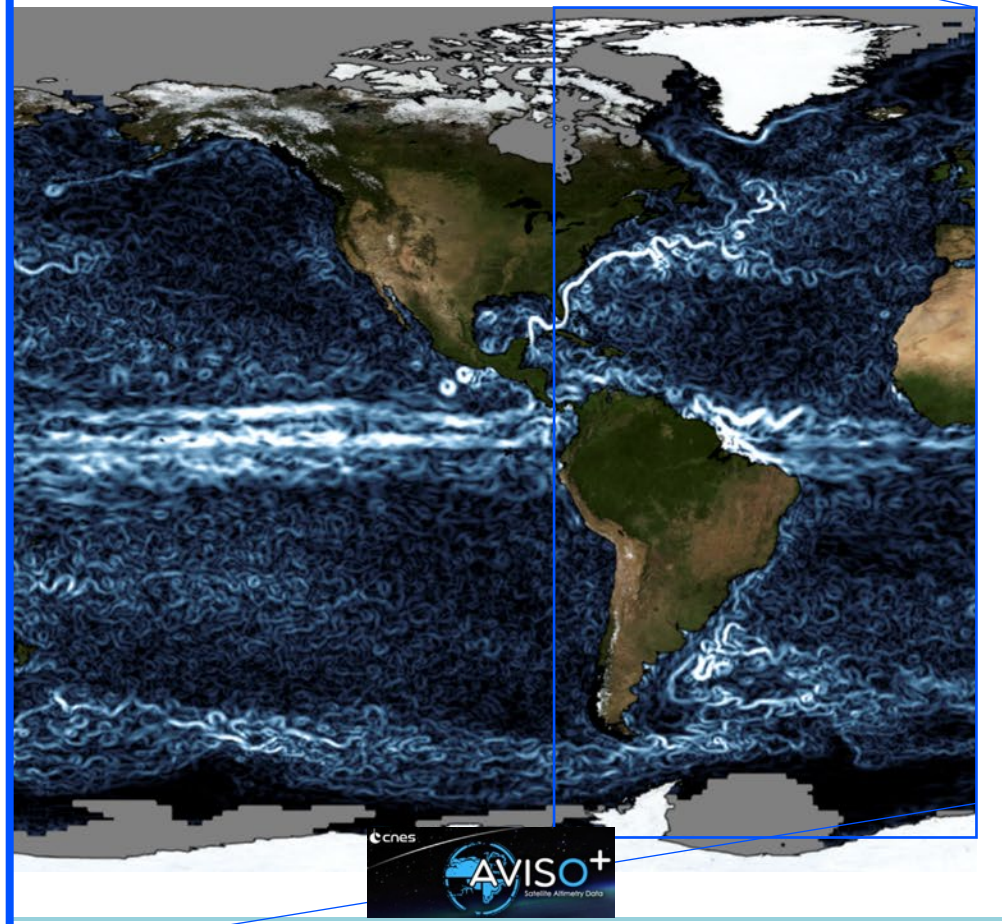


von Schuckmann et al., 2020

→ THE OCEAN IS WARMING

THE OCEAN: A TURBULENT FLUID

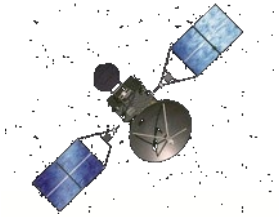


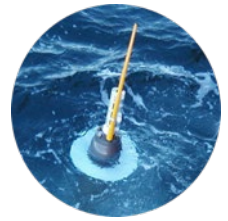


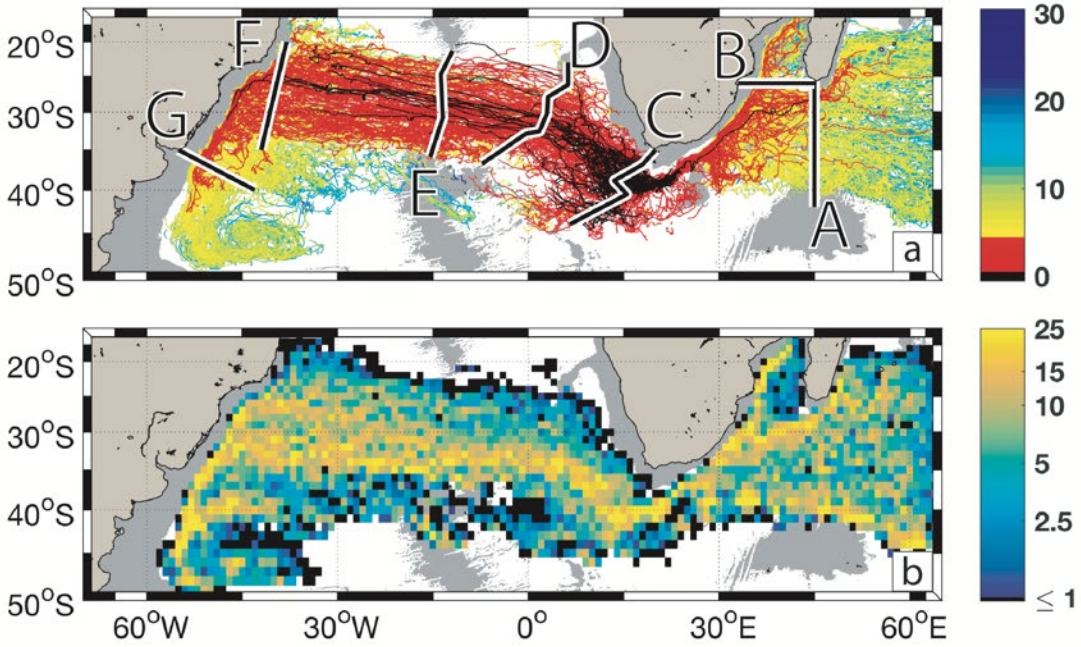
Laxenaire et al., JGR, 2018; 2019; 2020

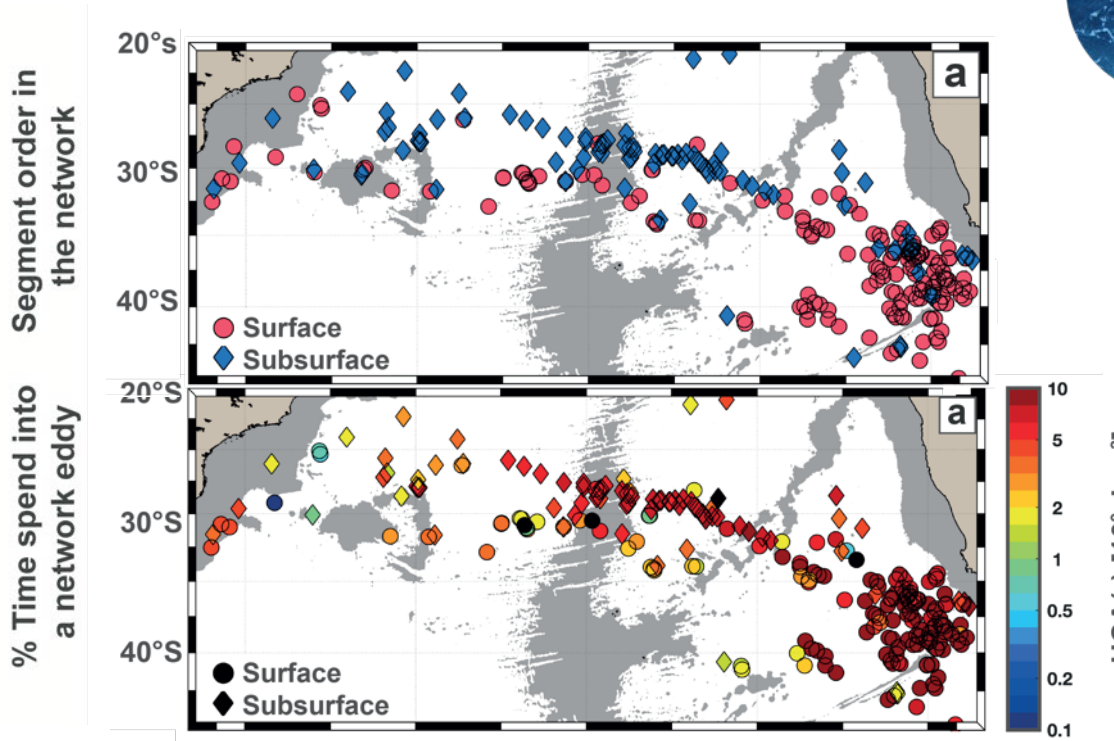
Focus on the Agulhas leakeage & eddies

Estimating eddies presence, trajectories, 3D structure









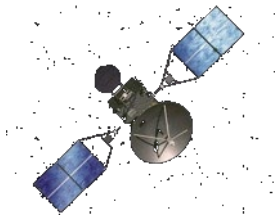
A new eddy identification and tracking method that includes eddy-merging and splitting

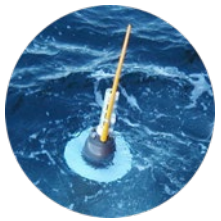
14.3 AR are shed per year; they cross the basin and interact with the Brazil Current

Laxenaire et al., JGR, 2018; 2019; 2020

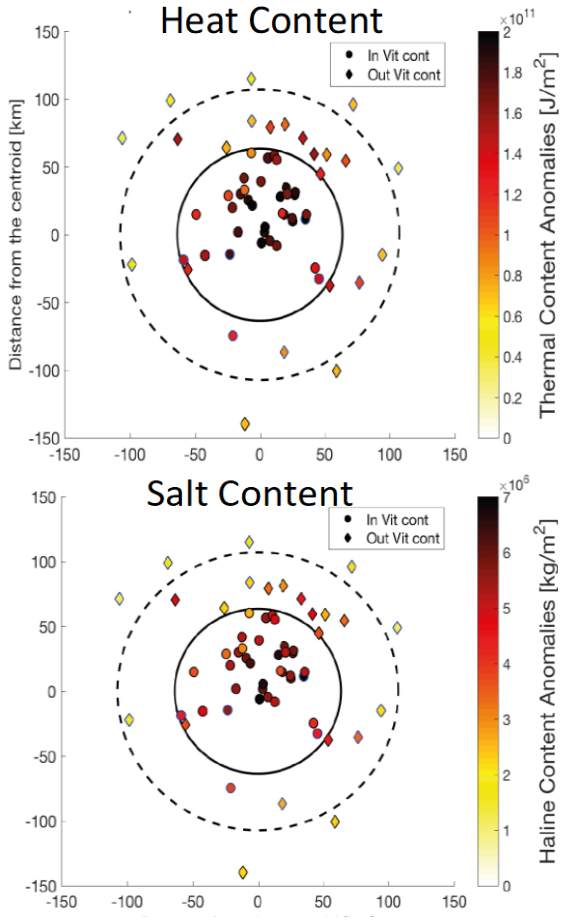
Reconstructing 3D eddy structure using Argo profiles

Agulhas Ring Mode Waters:
Indian central waters modified by Cape Basin air-sea interactions

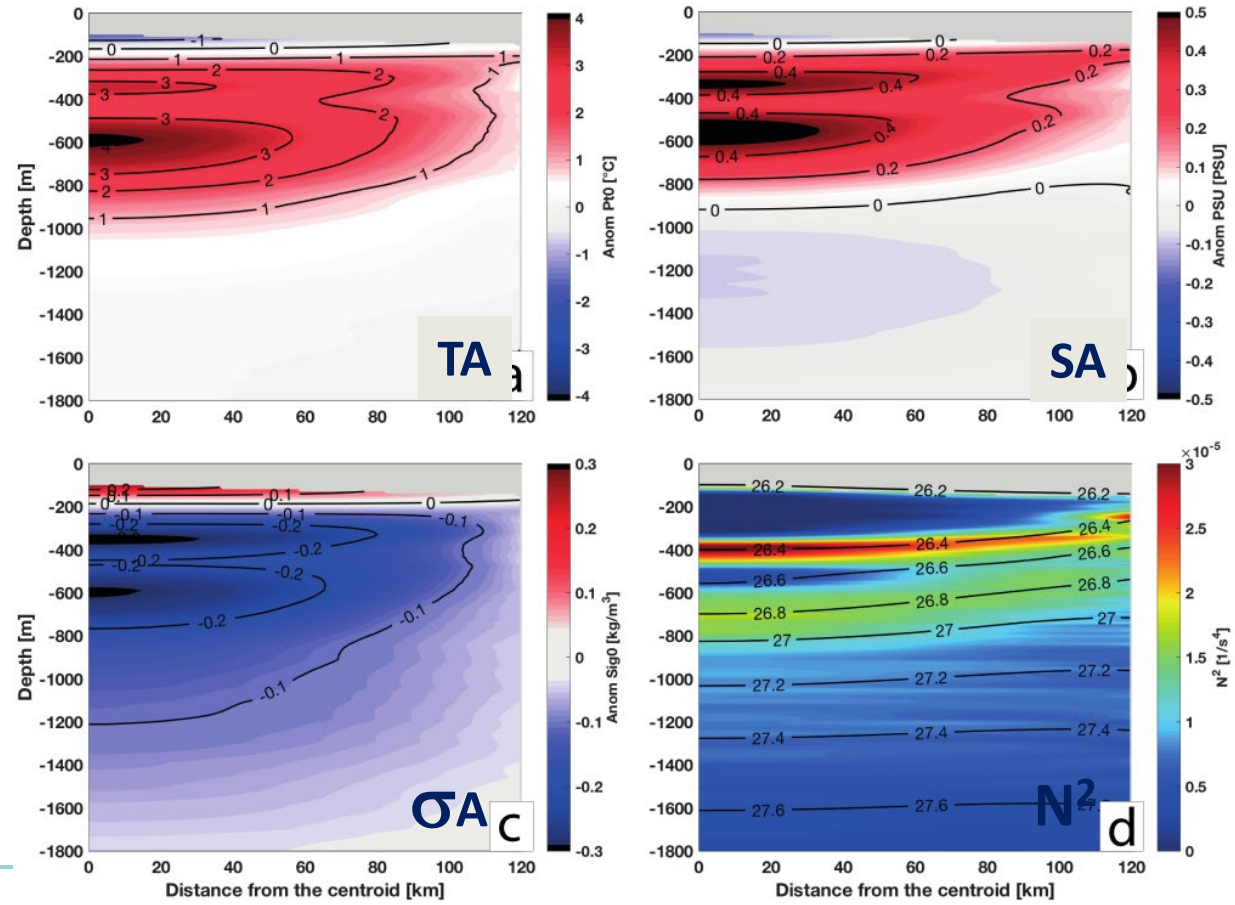




Agulhas Ring
Heat & Salt contents

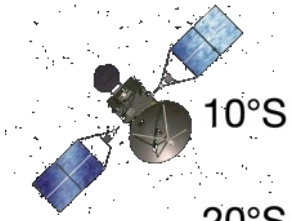


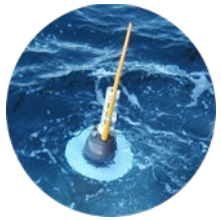
Agulhas Ring properties anomalies:
A double Mode water core ring

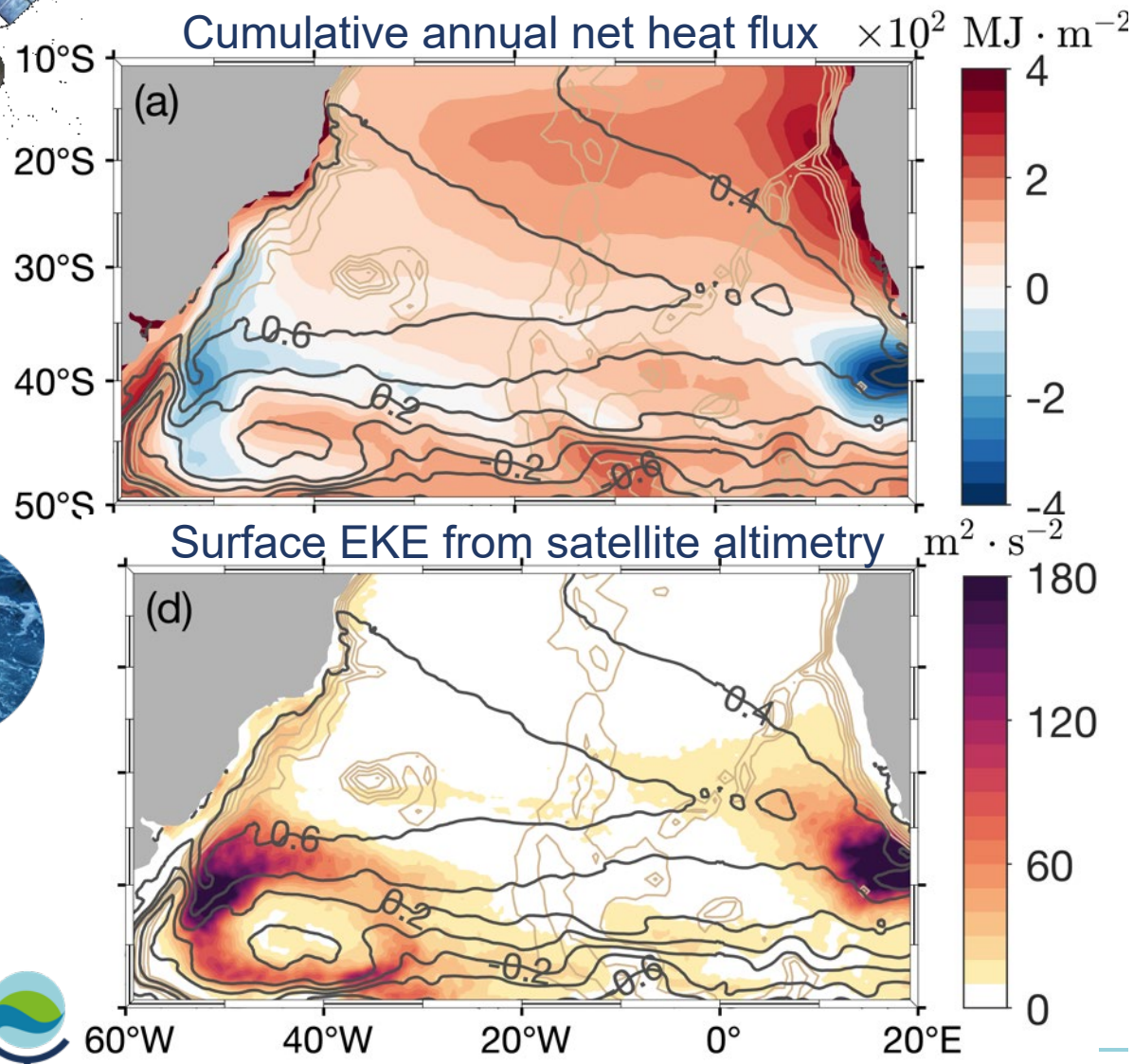


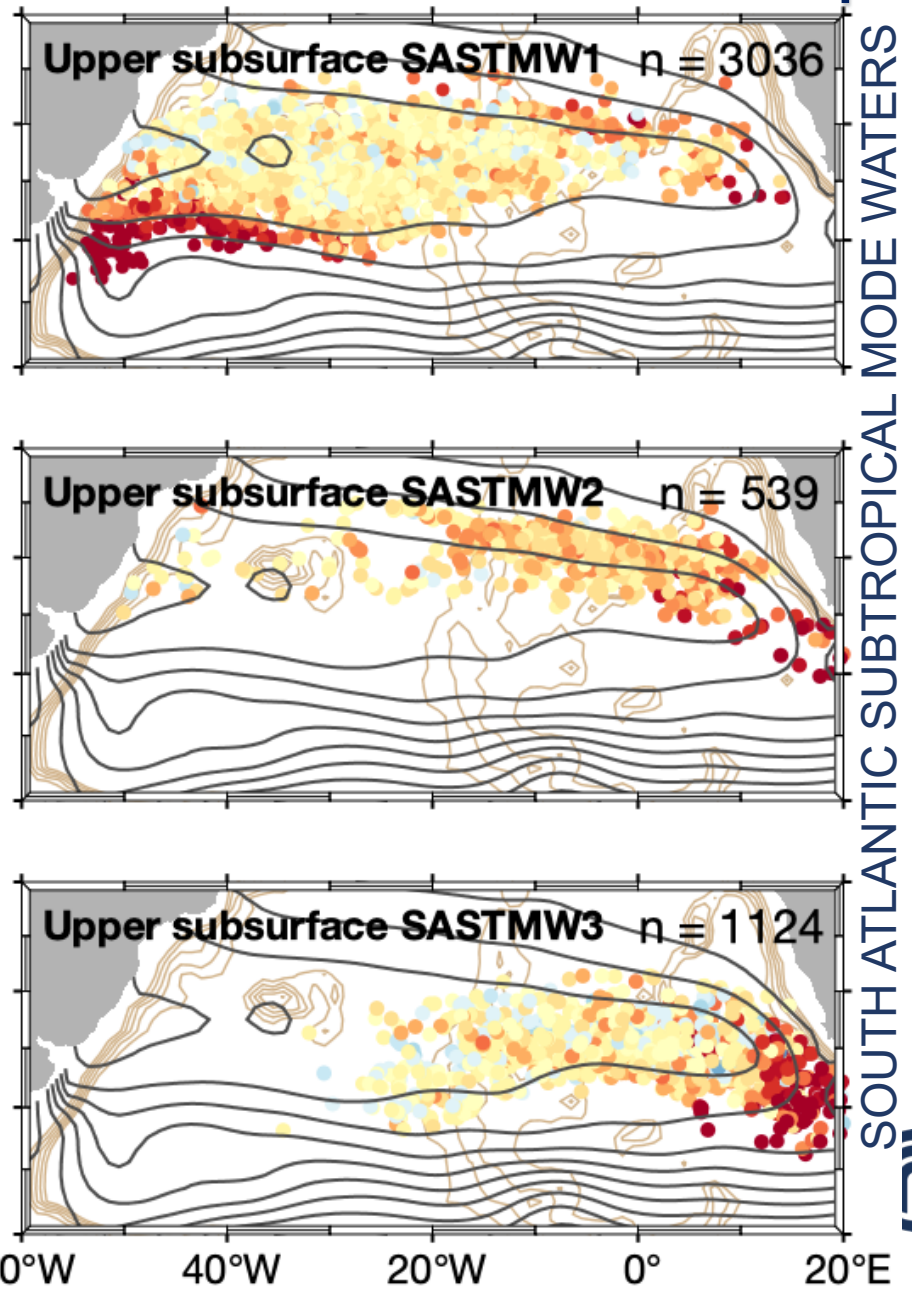
Laxenaire et al., JGR, 2019; 2020

Air-Sea interactions, eddies, Mode Waters & Heat transport



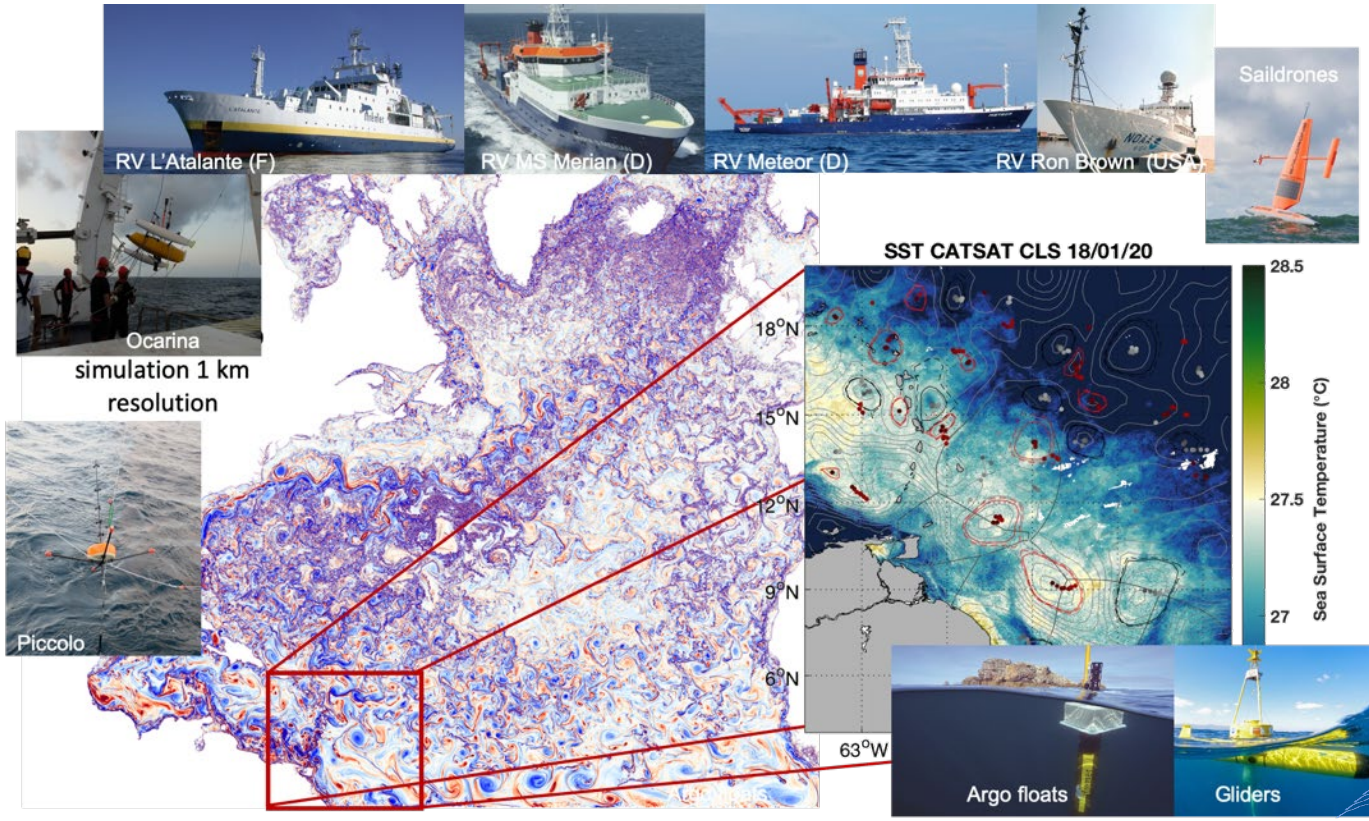


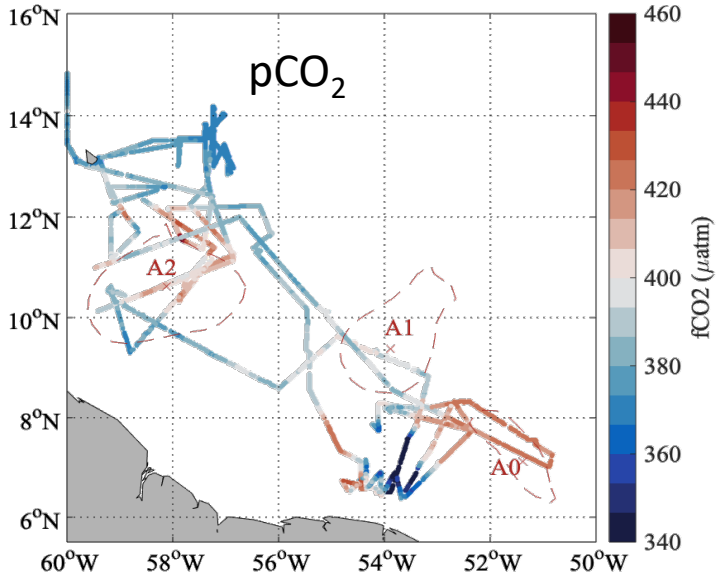


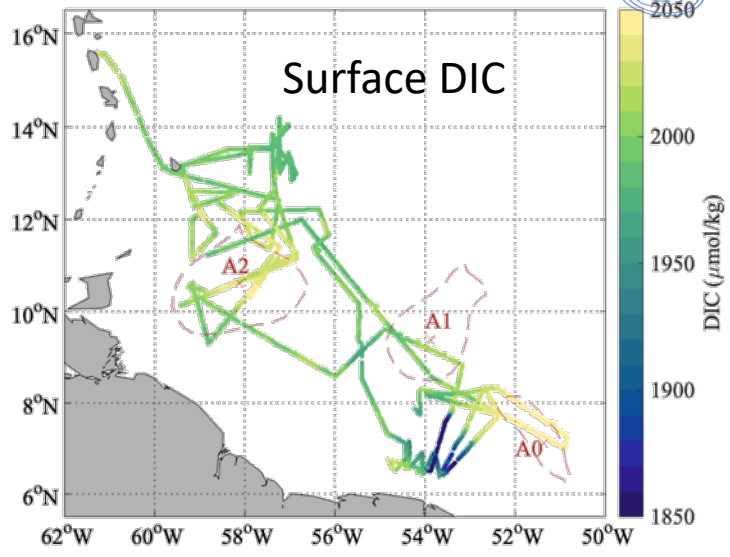


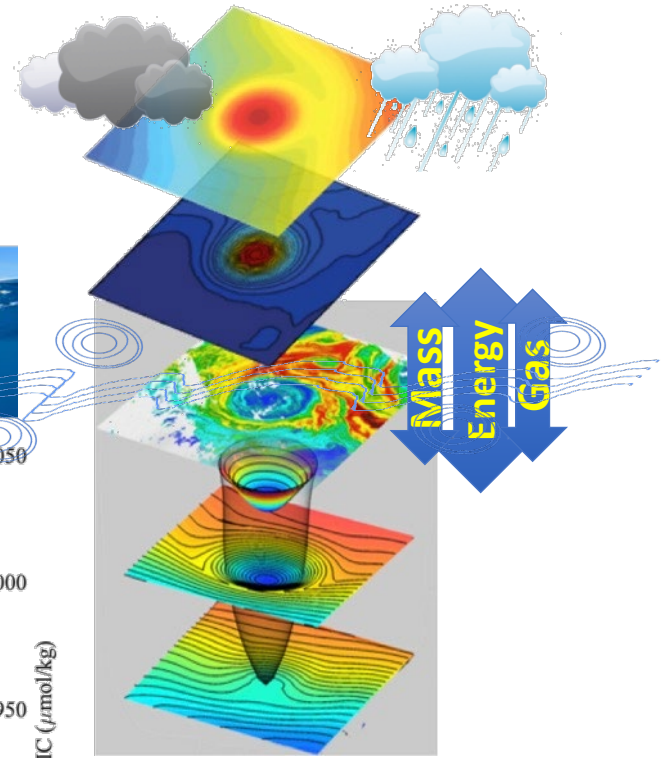
DSSTTA

Yanxu Chen PhD Thesis









EUREC4A-OA Field experiment Jan-Feb 2020

JPI OCEANS JPI Climate

To improve understanding on small-scale ocean dynamics and air-sea interactions

Small ocean scales drive air-sea exchanges of CO2, H20 & other gases

Ocean Observations for societal benefit

Global Ocean Observing System

GCOS Climate

WCRP World Climate Research Programme

Services

Ocean Health

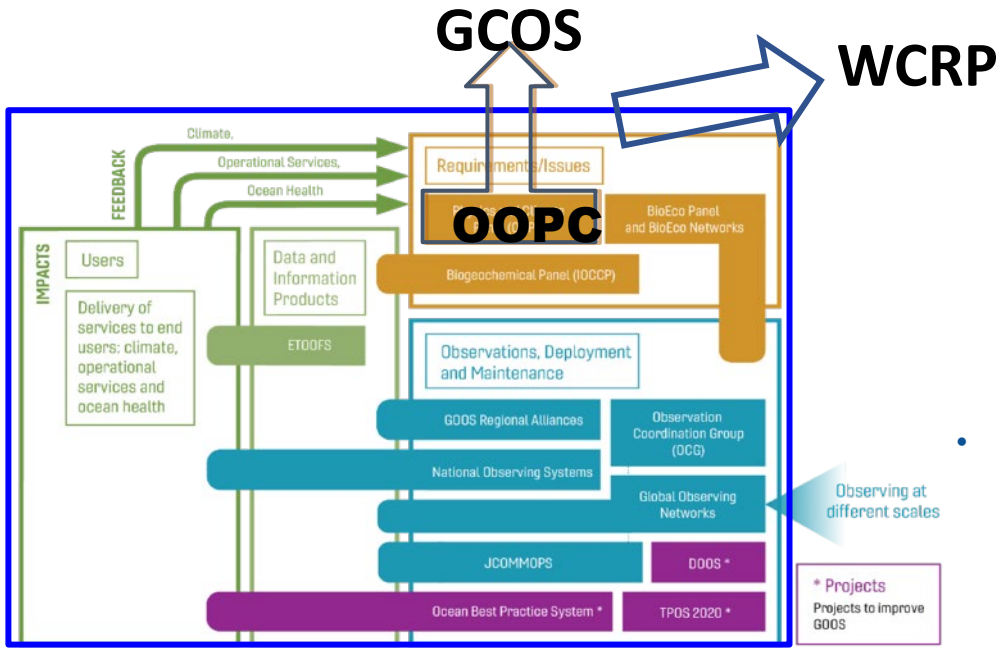
https://www.goosocean.org

https://gcos.wmo.int

GCOS • GOOS • WCRP OOPC Ocean Observations Panel for Climate

Preparing the ocean observing for society challenges

- Conduit into all of GOOS, with structures covering parallel work in requirements for biogeochemistry and bioeco observations
- Requires wide consultation and proper planning



GOOS Structure

Integrating the Ocean Observing

GCOS · GOOS · WCRP

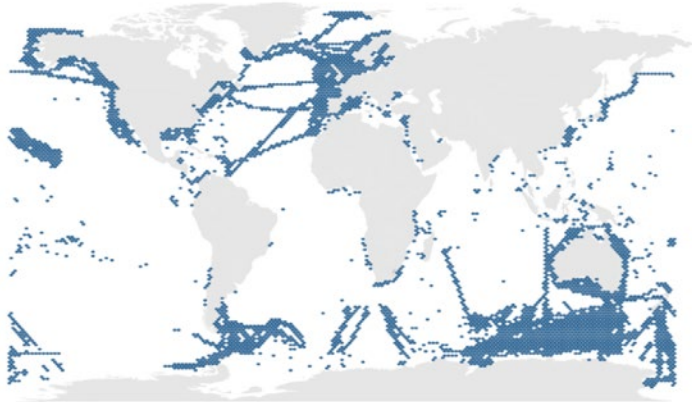
OOPC Ocean Observations Physics and Climate panel

1. **OceanOPS network status summary versus EOVs/ECVs**

www.ocean-ops.org/reportcard2020

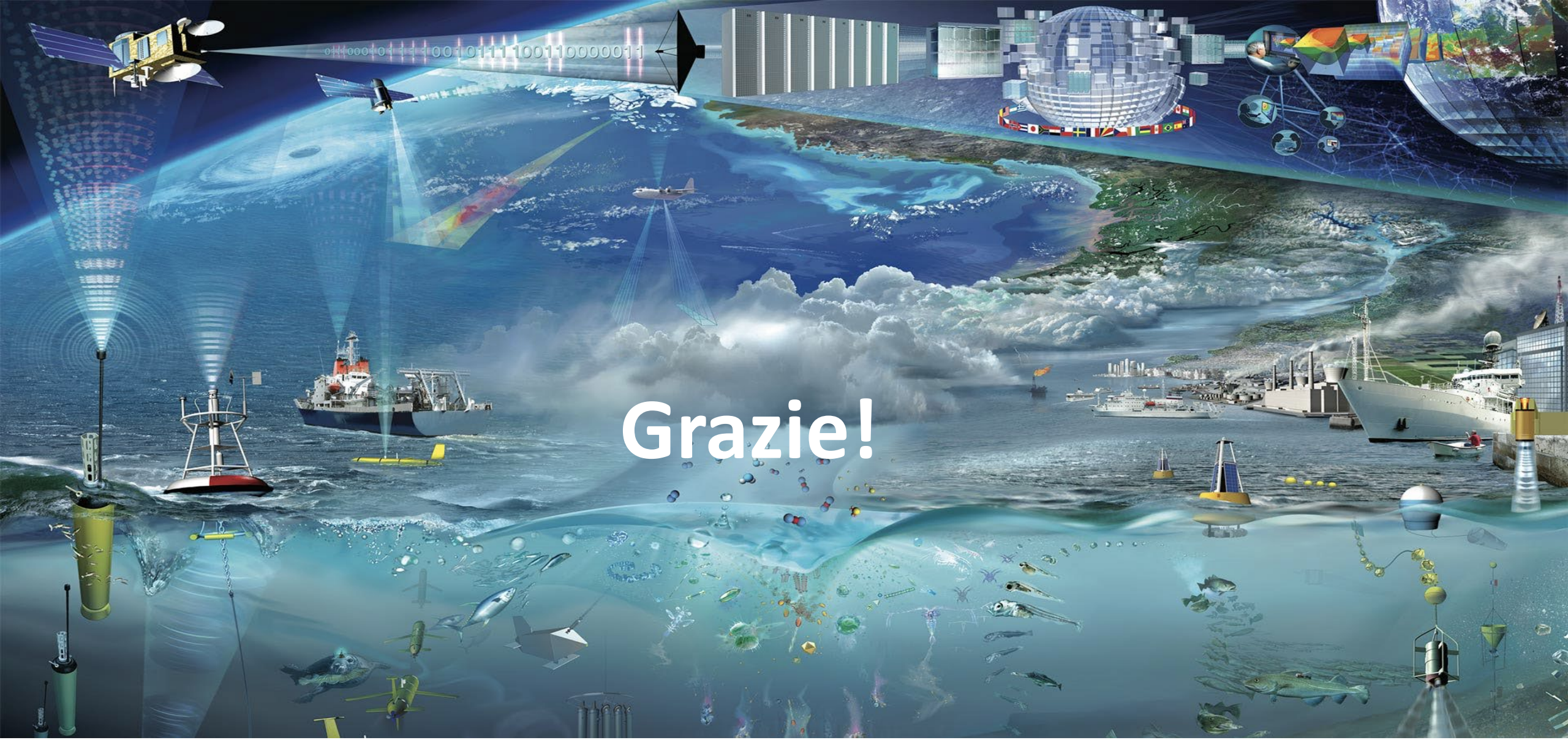
GOOS *in situ* networks[1]	Implementation Status[2]	Data & metadata: Real time[3]	Data & metadata: Archived high quality[4]	Data & metadata: Meta-data[5]	Best practices[6]	GOOS delivery areas[7]: Operational services	GOOS delivery areas[7]: Climate	GOOS delivery areas[7]: Ocean health
Ship based meteorological measurements - SOT/VOS	★★☆	★★☆	★★★	★★☆	★★☆	●	●	
Ship based aerological measurements - SOT/ASAP	★★☆	★★☆	☆☆☆	★★☆	★☆☆	●	●	
Ship based oceanographic measurements - SOT/SOOP	★★☆	★★★	★★★	★★☆	★★☆	●	●	●
Sea level gauges - GLOSS	★★★	★★☆	★★★	★☆☆	★★☆	●	●	
Drifting and polar buoys - DBCP	★★★	★★☆	★★☆	★★☆	★★☆	●	●	
Moored buoys - DBCP	★★☆	★★★	★☆☆	★★☆	★★☆	●	●	
Interdisciplinary moorings - OceanSITES	★★☆	★☆☆	★☆☆	★★☆	★☆☆		●	●
Profiling floats - Argo	★★★	★★★	★★★	★★★	★★☆	●	●	
Repeated transects - GO-SHIP	★★★	★☆☆	★★★	★★☆	★★★		●	●
OceanGliders	★☆☆ Emerging	★★☆	★☆☆	★★☆	★☆☆	●	●	●
HF radars	Emerging	★★★	★★★	★☆☆	★★★	●	●	●
Biogeochemistry & Deep floats - Argo	★☆☆ Emerging	★★★	★☆☆	★★★	★★☆	●	●	●
Animal borne ocean sensors - AniBOS	Emerging	★★★	★☆☆	★☆☆	★★☆	●	●	●

2. **First biological "sustained" ocean observations assessment**



- Biological observations - subsumed into a small number of ECVs that are important for capturing the impact of climate on the ocean;
- Sustained obs cover only 7% of surface of the ocean; only ⅓ of those are freely and openly shared;

Satterthwaite et al., in press, 2020



GCOS • GOOS • WCRP

OOPC Ocean Observations Panel for Climate

GCOS GLOBAL CLIMATE OBSERVING SYSTEM

The Global Ocean Observing System GOOS

WCRP World Climate Research Programme

UNESCO IOC WMO UN environment International Science Council