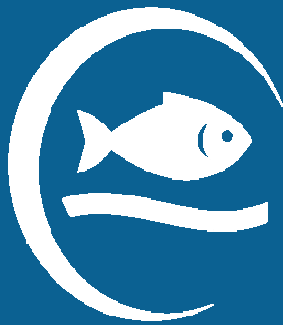


COPERNICUS MARINE SERVICE OCEAN MONITORING AND REPORTING



Marine Monitoring

Karina von Schuckmann
Mercator Océan



Implemented by

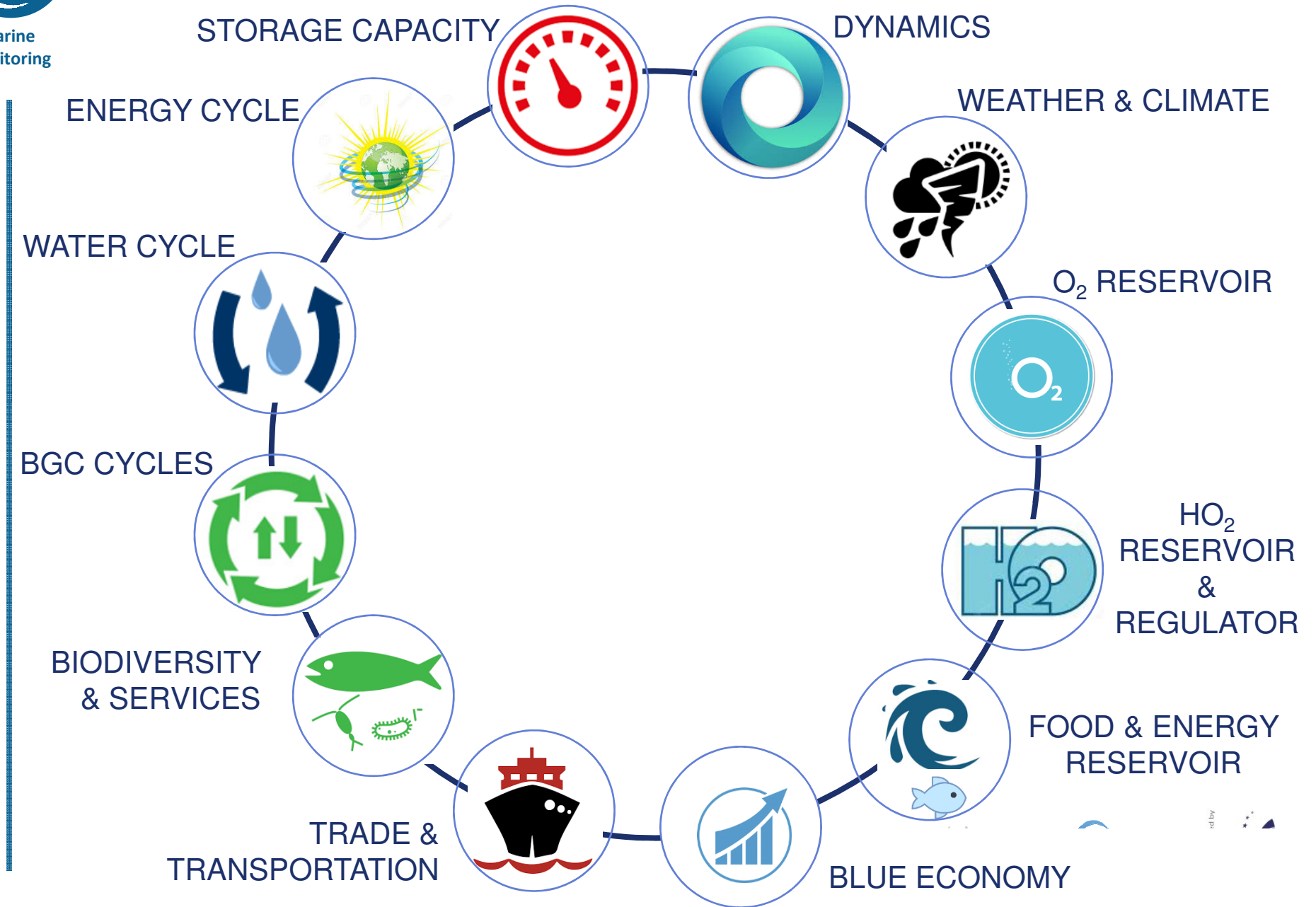


*CALYPSO SOUTH
Malta, 18. April 2018*



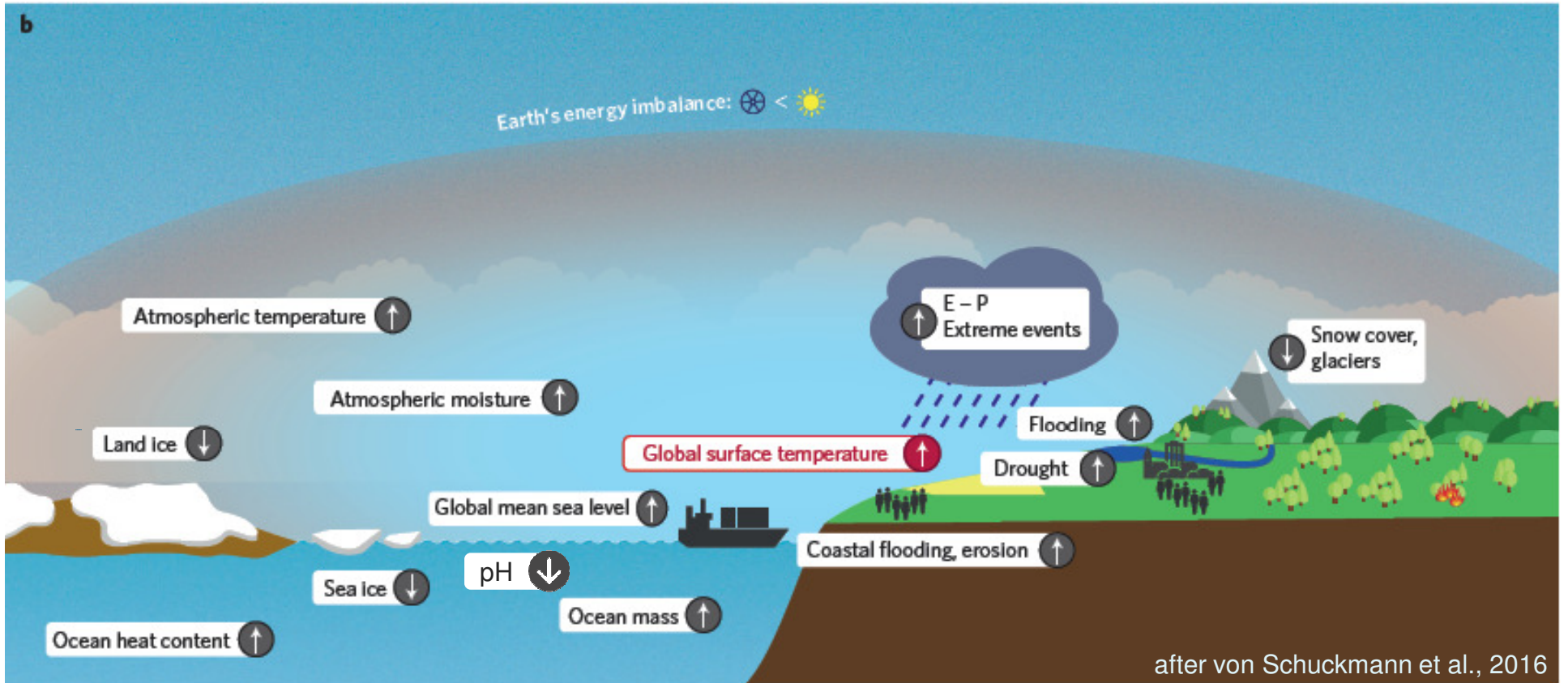
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The world's oceans drive global systems





SYMPTOMS OF EARTH SYSTEM REGULATION



WARMING OF THE OCEANS



ACIDIFICATION OF THE OCEANS



CHANGES OF OCEAN CIRCULATION





Marine
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ESSENTIAL ROLE OF OCEAN MONITORING

Increasing & pressing ocean monitoring needs



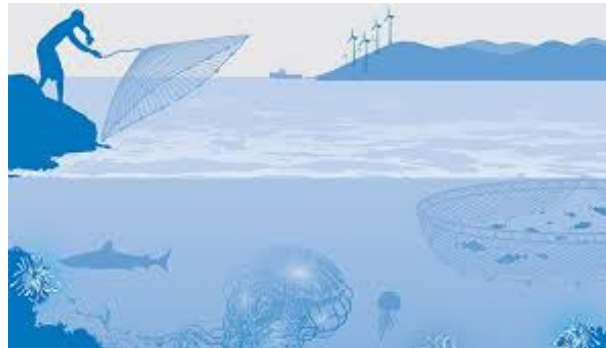
Recognized at the highest levels

(e.g. UN/Agenda 2030/SDG, IPCC/Ocean&Cryosphere, OECD/the future of ocean economy, G7/future of the oceans and seas)

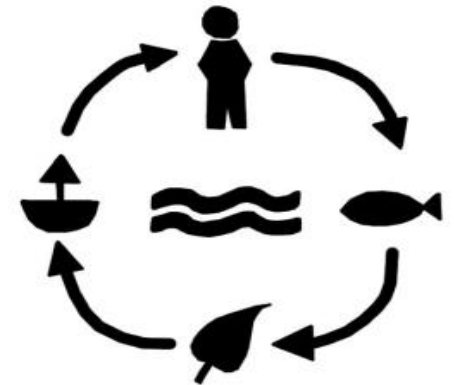
Blue Growth and Societal Challenges



To understand and predict the evolution of our weather and climate



For an increasing number of ocean services and the development of the blue economy



Better and sustainable management of the oceans and its resources.



Marine Monitoring

marine.copernicus.eu

COPERNICUS MARINE ENVIRONMENT MONITORING SERVICE
Providing PRODUCTS and SERVICES for all marine applications

European Commission

ABOUT US | MARKETS & BENEFITS | NEWS | SCIENCE & MONITORING | TRAINING & EDUCATION | SERVICES PORTFOLIO

SEARCH terms **OK**

ACCESS YOUR OCEAN INFORMATION

GETTING STARTED →

OCEAN PRODUCTS

Ocean product catalogue, to download or visualize data across more than 10 variables, including historic, current and forecasted data.

DATA →

OCEAN MONITORING INDICATORS

Essential variables monitoring the health of the ocean

TRENDS →

OCEAN STATE REPORT

Extensive annual analysis on the state of the ocean over nearly 20 years and severe/notable annual events

EXPERTISE →

SHORT-CUT TO SERVICES

- REGISTER NOW!
- SCIENTIFIC QUALITY
- ONLINE TUTORIALS
- COLLABORATIVE FORUM

LATEST NEWS FLASH

2018 22 MAR. CMEMS:7324-A
New Service Release on 22 March 2018 - Status on updates **INFORMATION**

OUR OCEAN STATE REPORT AWARDED THE DENNY MEDAL

We are delighted to announce that the Ocean State Report produced by the Copernicus Marine Service has been awarded the Institute of Marine Engineering, Science and Technology (IMarEST) Denny Medal, an annual award for the most worthy paper published with the Journal of Operational Oceanography (JOO).

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152 products matching your criteria.

GLOBAL_ANALYSIS_FORECAST_PHY_001_024

GLOBAL OCEAN 1/12° PHYSICS ANALYSIS AND FORECAST UPDATED DAILY

● ● ● ● ● X X X X

GLO

2006-12-27 to Present

hourly-mean

ADD TO CART WMS Sub-setting

GLOBAL_ANALYSIS_FORECAST_BIO_001_014

GLOBAL OCEAN BIOGEOCHEMISTRY ANALYSIS AND WEEKLY FORECAST

● ● ● ● ● X X X X

GLO

2012-01-01 to Present

mean

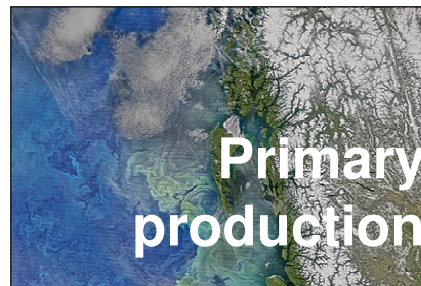
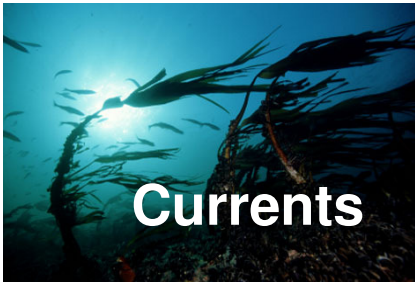
ADD TO CART WMS Sub-setting



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Essential Ocean Variables

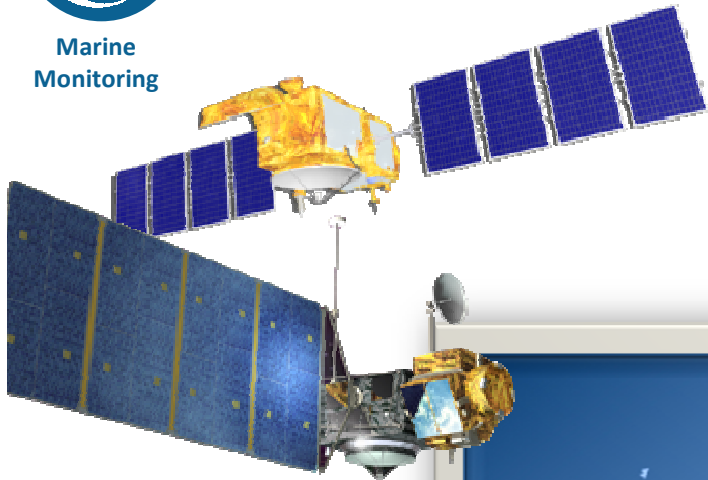
UNIQUE OCEAN INFORMATION IN REAL TIME & OVER THE LAST DECADES





Marine
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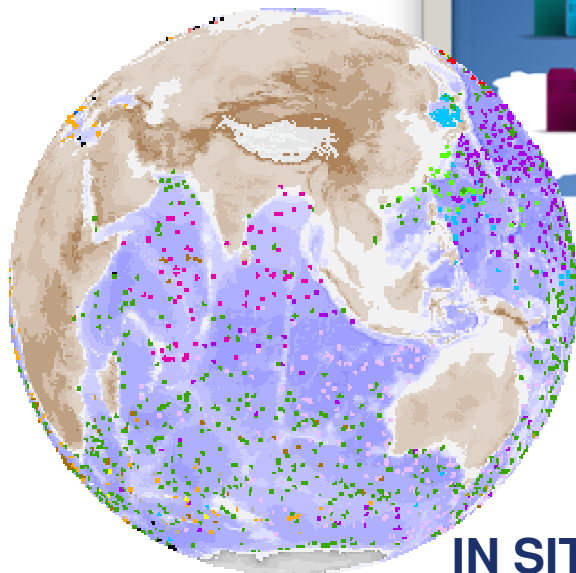
COMBINATION OF SKILLS & DATA



SPACE DATA



COMPUTING



IN SITU DATA



EXPERTS

European experts gathered by
Mercator Ocean for delivery to
Copernicus Marine





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THE OCEAN STATE REPORT ...

... provides a state-of-the-art assessment of the state of the global ocean and European regional seas



- | | |
|----------|-------------|
| 1 Global | 5 IBI |
| 2 Arctic | 6 Med Sea |
| 3 Baltic | 7 Black Sea |
| 4 NWS | |

... draws on expert analysis



... provides

- ❖ a 4-D view
- ❖ a view from above
- ❖ a view directly from the interior

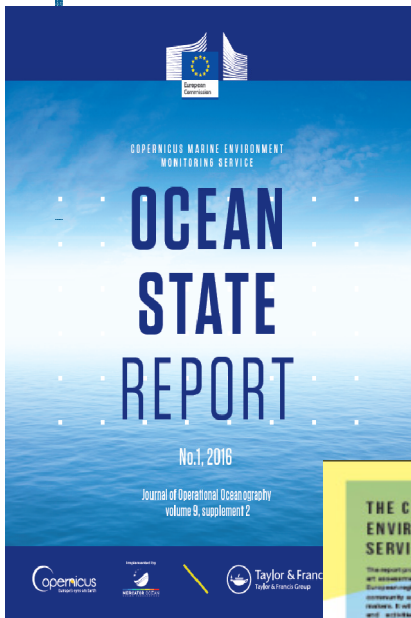




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THE OCEAN STATE REPORT

- ❖ Currently more than 100 scientific experts
- ❖ Collaboration of more than 25 European institutions
- ❖ Fundamental step forward into the development of regular Copernicus Marine Service regular reporting



ISSUE #1:

- ❖ Published in the Journal of Operational Oceanography: Open access
- ❖ Summary for policy makers
- ❖ Medal award
- ❖ **More than 7100 views since publication**

ISSUE #2:

- ❖ Accepted, and in progress for publication

ISSUE #3:

- ❖ Preparation started since FEB 2018



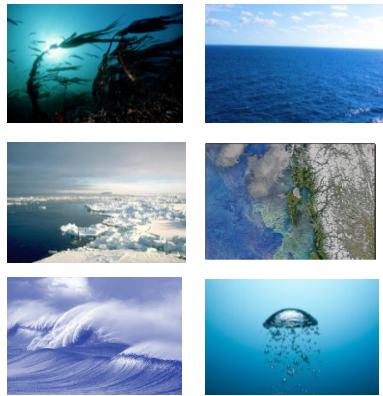


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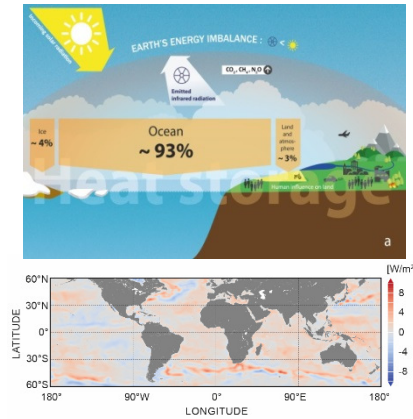
THE OCEAN STATE REPORT

Content and expected audience

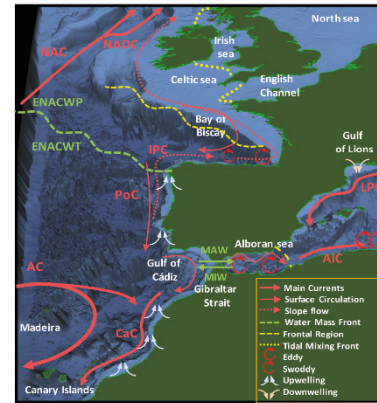
Essential Variables



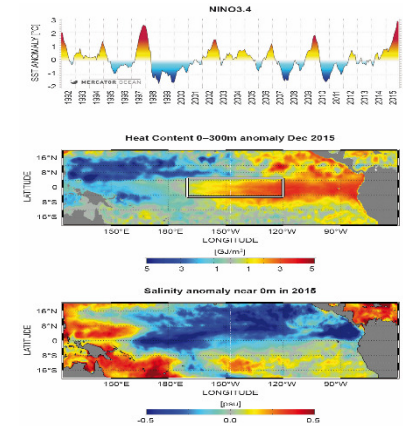
Ocean climate



European Seas



Remarkable events



Scientific
community

Policy and
decision
makers,
Blue
Economy

14 LIFE BELOW
WATER
European and
international
agencies and
organisations,
Regional Sea
Conventions

General
public
awareness

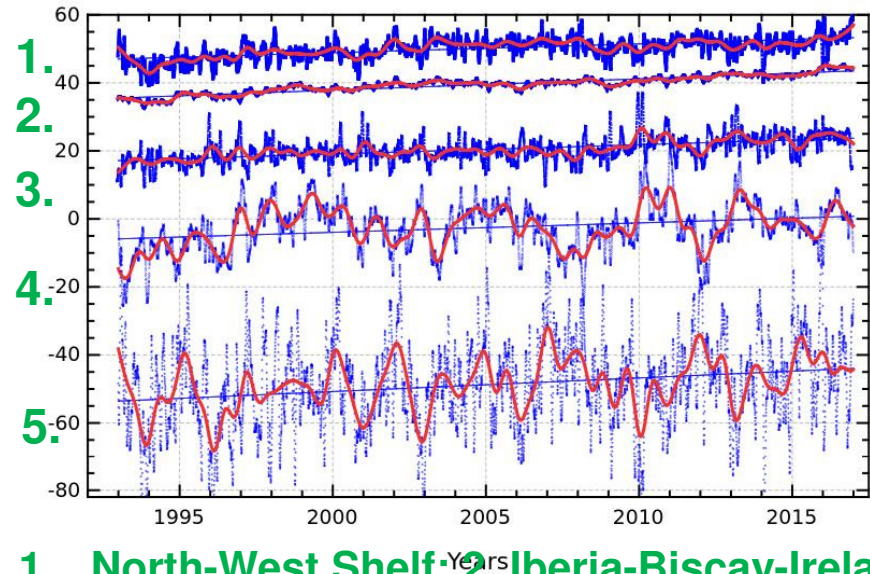
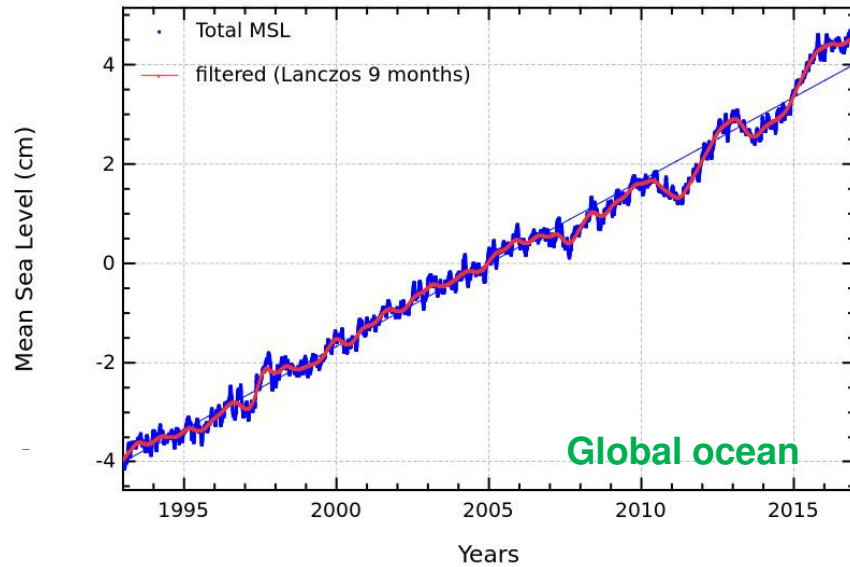




Marine
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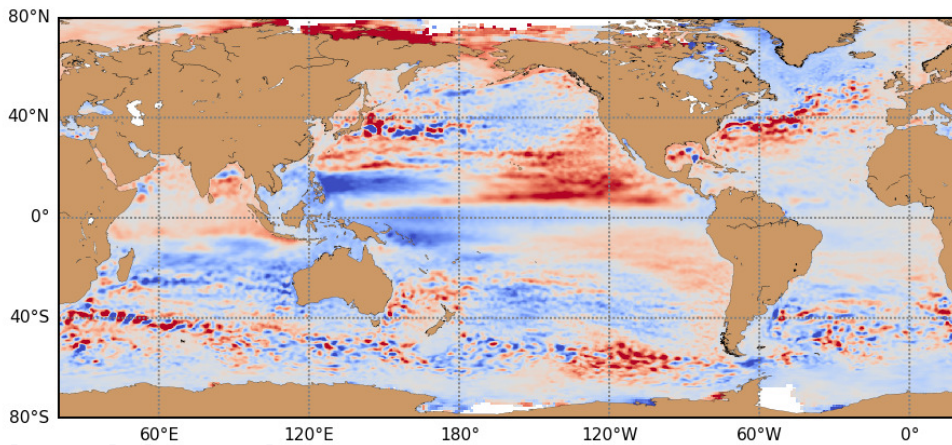
OSR2 results: Sea Level

Area averaged total sea level for the global ocean and the European regional seas

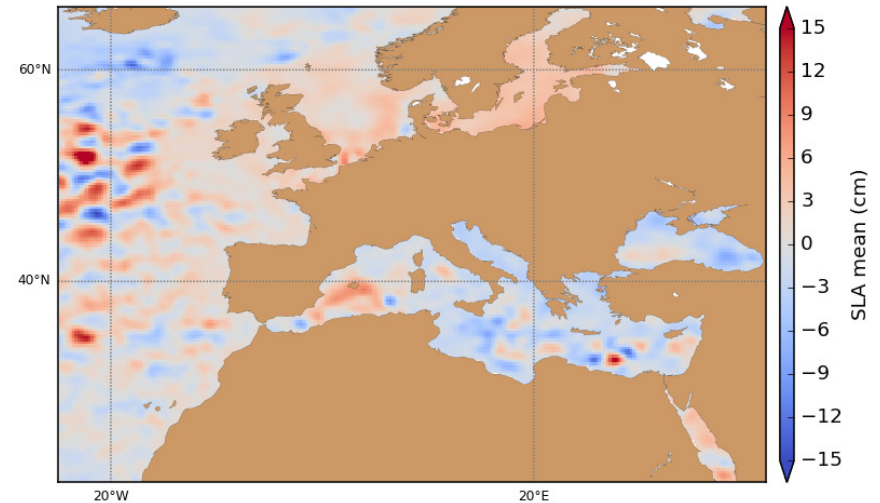


1. North-West Shelf; 2. Iberia-Biscay-Ireland,
3. Mediterranean Sea; 4. Black Sea; 5. Baltic Sea

Sea level anomalies in 2016



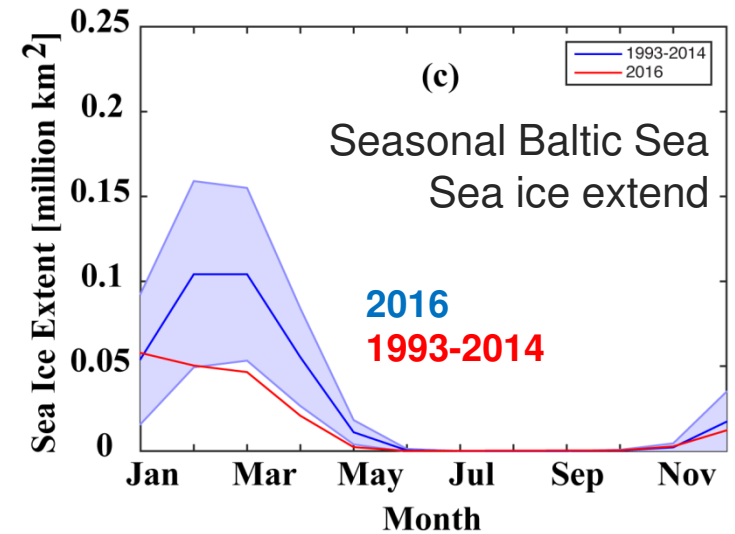
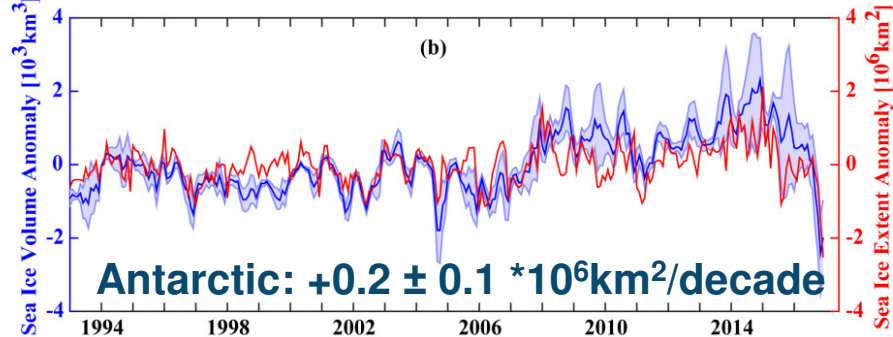
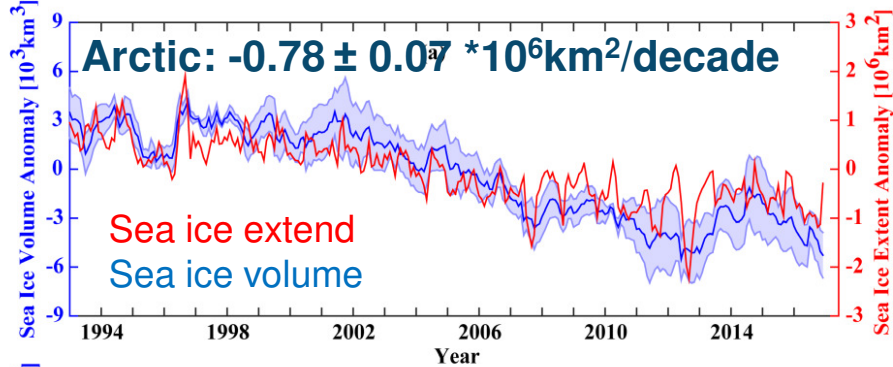
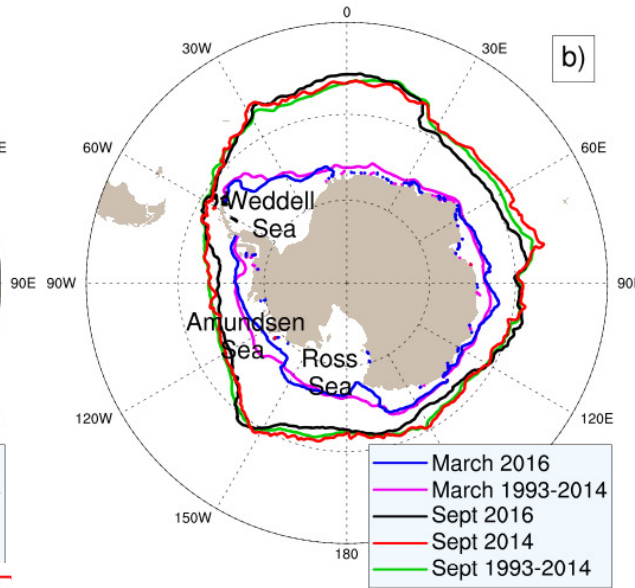
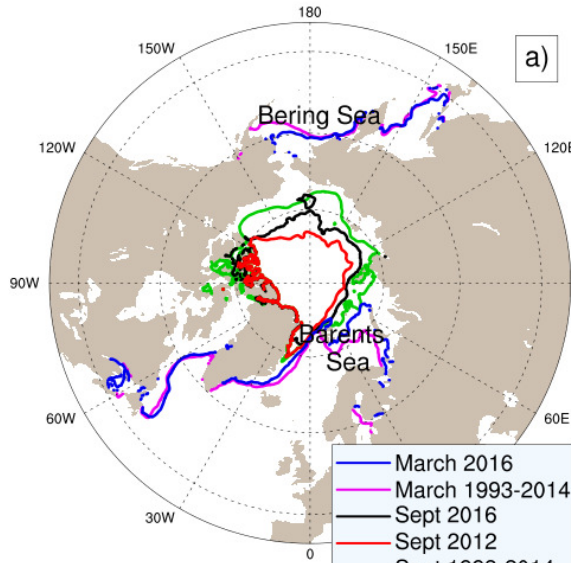
Legelais et al., 2018





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OSR2 results: Sea Ice Extent



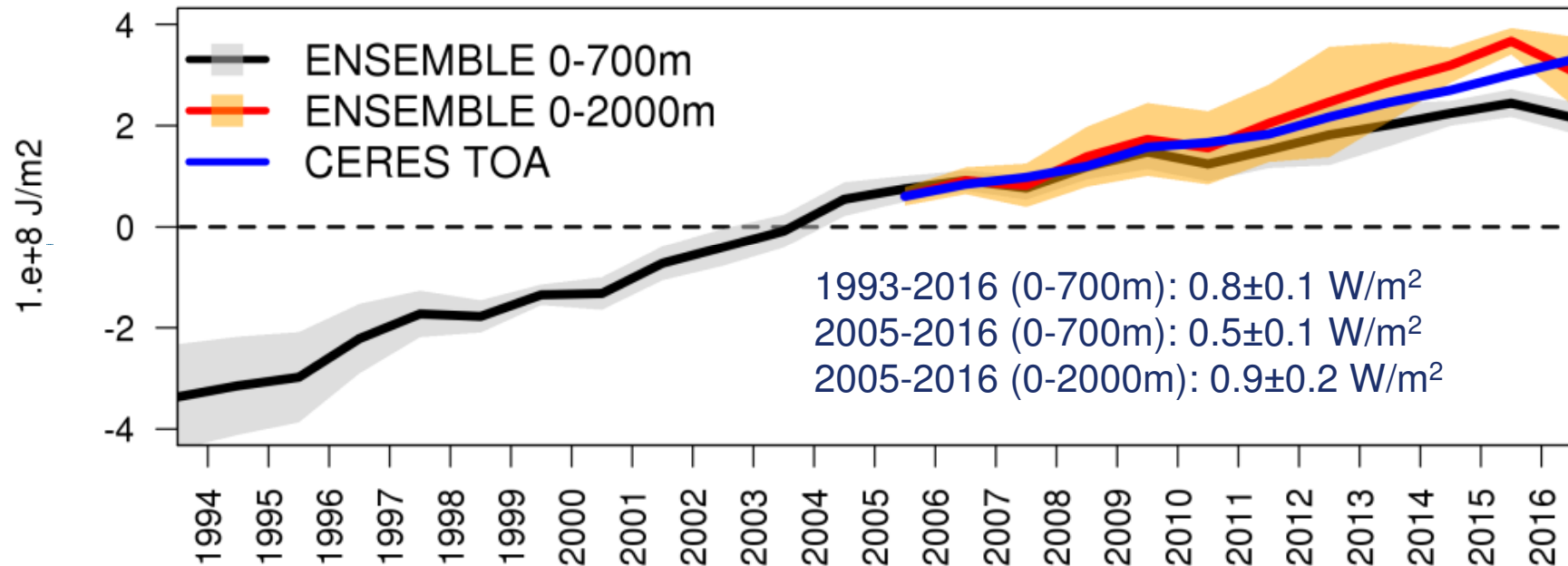


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OSR2 results: Ocean Heat Content

Increase in global ocean heat content since 1993

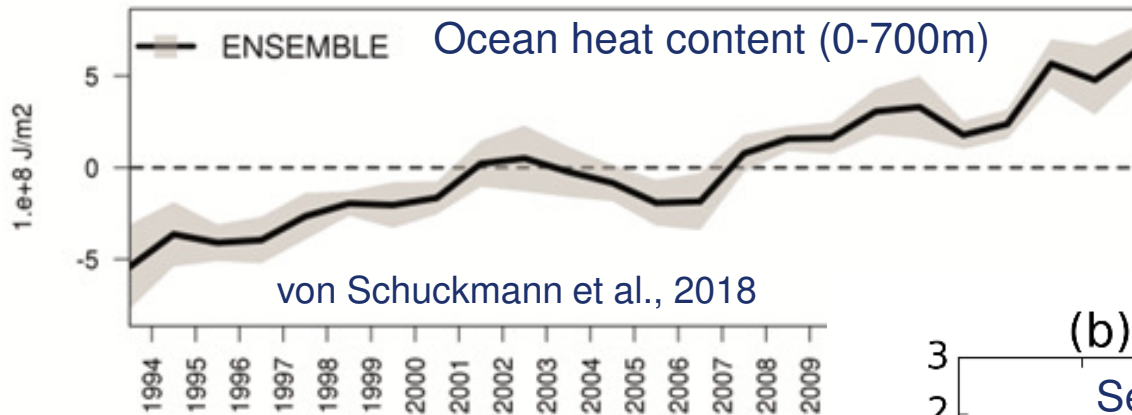
GLOBAL OCEAN (60S-60N) HEAT CONTENT (0-700m)



From 2005 onwards, about 40% of upper ocean warming can be attributed to the 700-2000m depth layer

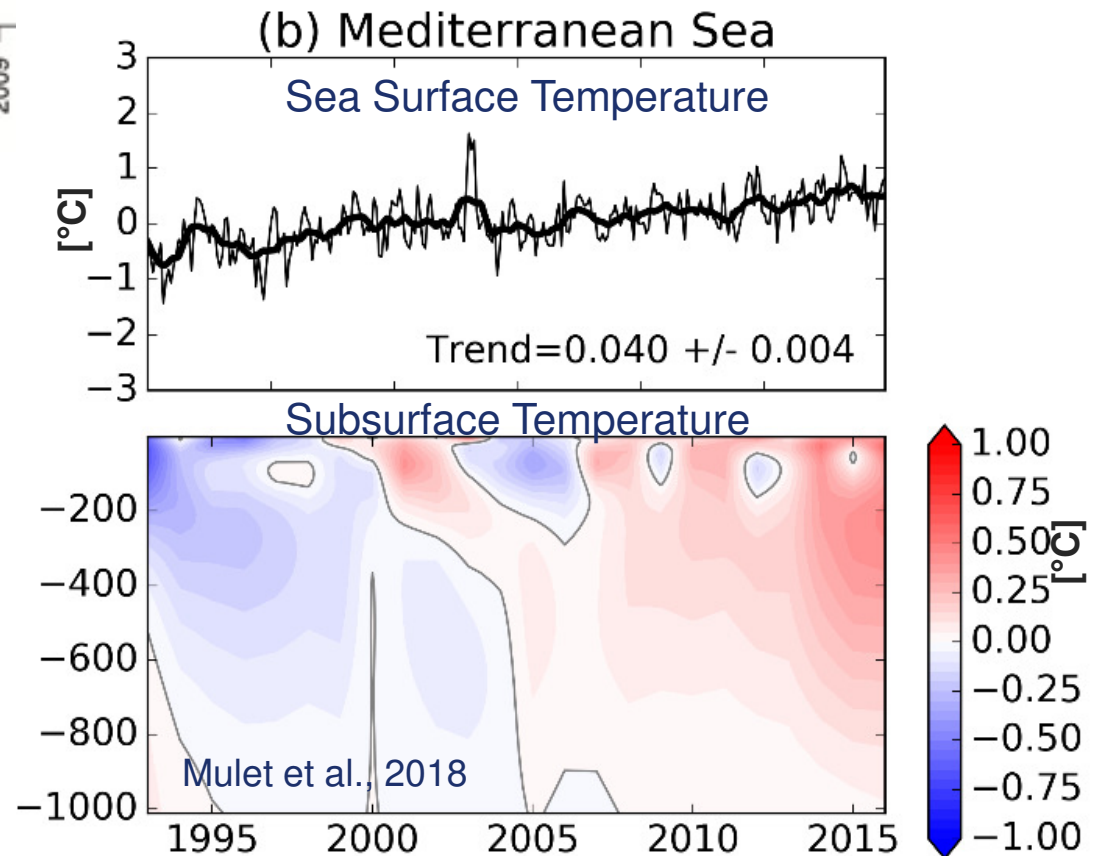


Warming in the Mediterranean Sea



1993-2016 trend for
Mediterranean Sea ocean
heat content:
 $1.3 \pm 0.2 \text{ W/m}^2$

Warming over the past two
decades is observed at the
surface and subsurface layers
of the Mediterranean Sea



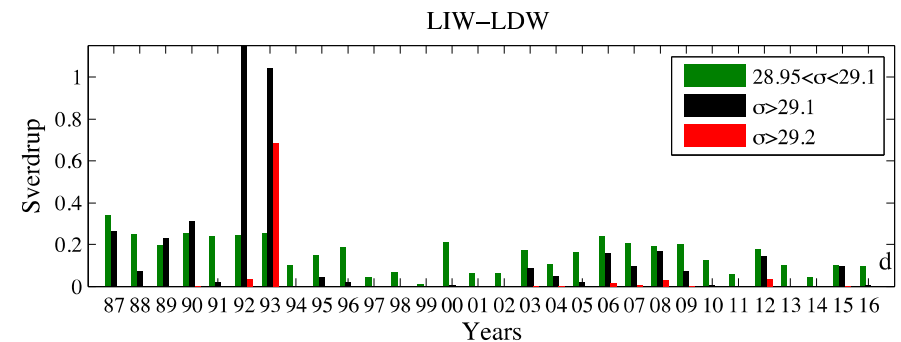
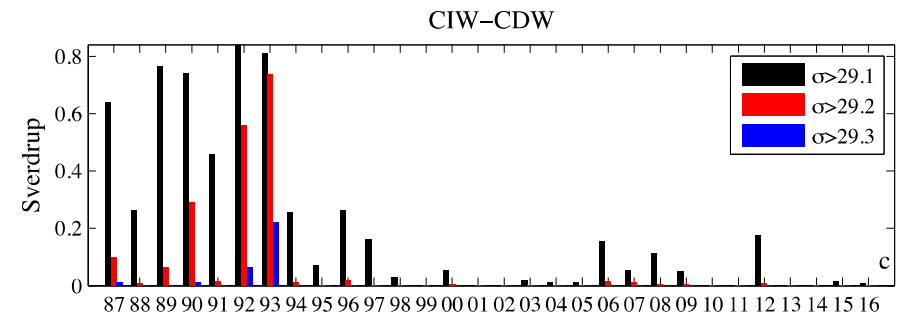
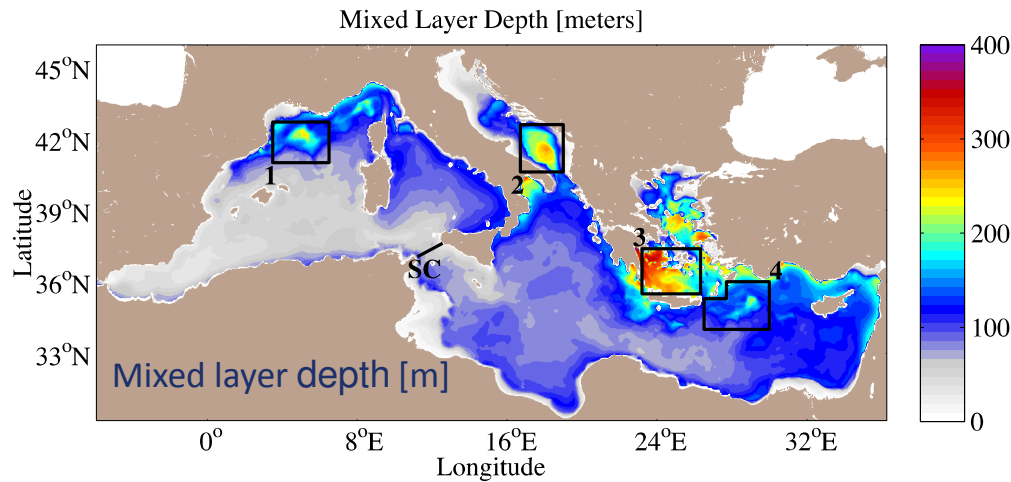


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DEEP CONVECTION

CMEMS monitoring of the open ocean deep convection process in the Mediterranean Sea:

The formation of intermediate and deep water masses is one of the most important processes occurring in the Mediterranean Sea as part of the general overturning circulation:



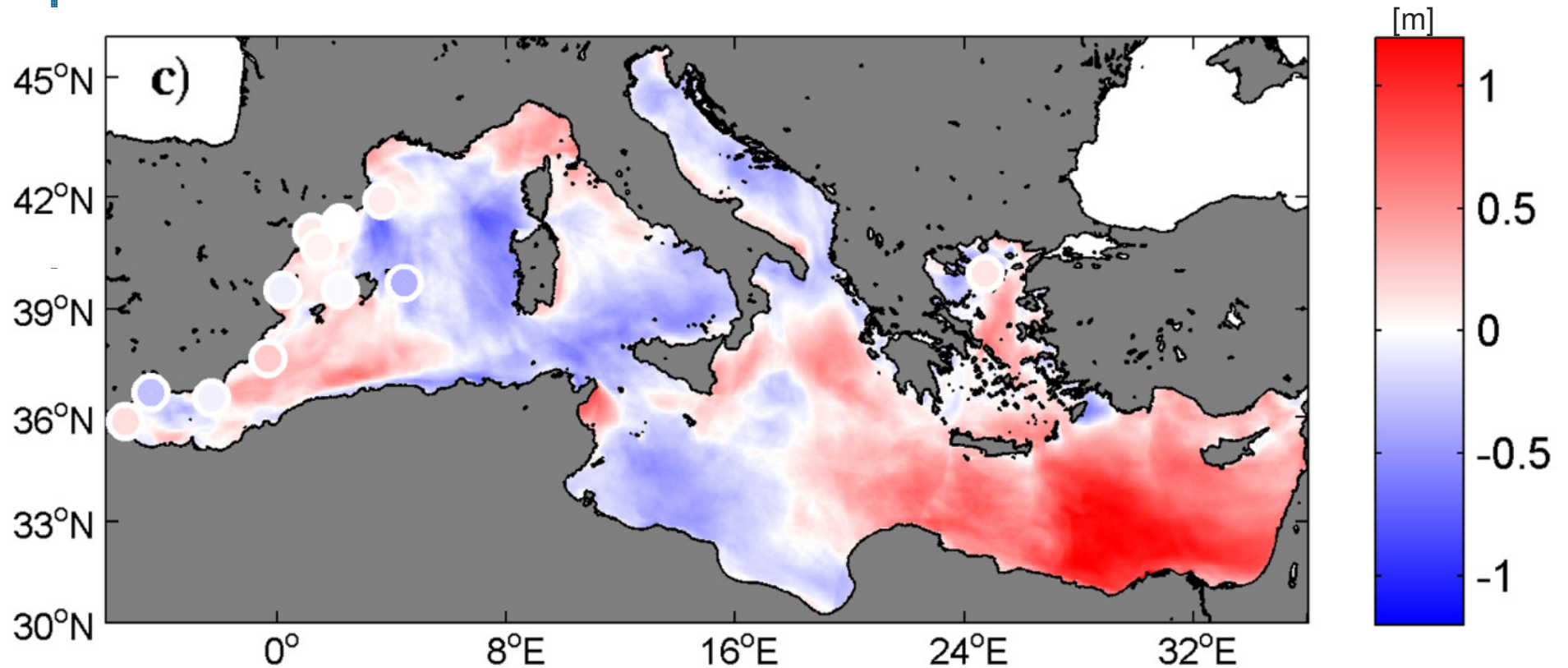
Simoncelli et al., 2018



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Extreme variability

99th percentile of significant wave height during the year 2016



Pérez Gómez et al., 2016

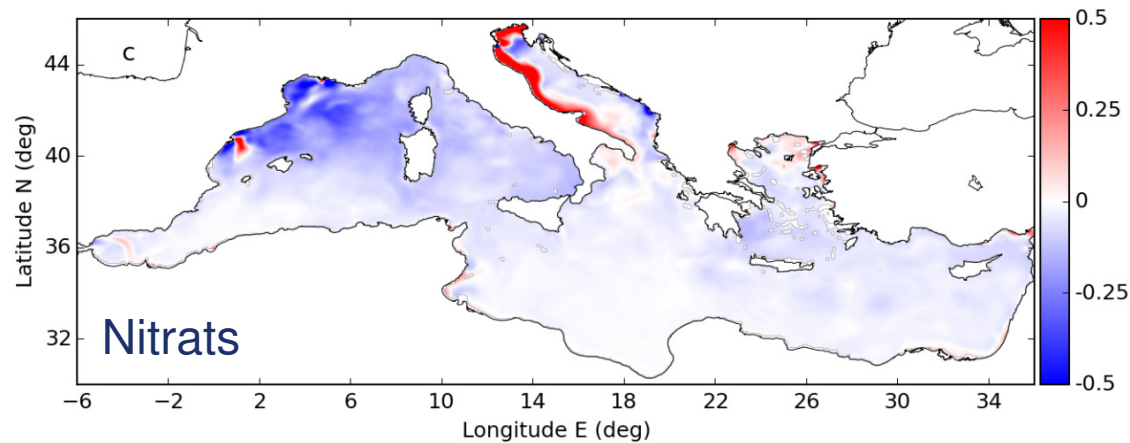
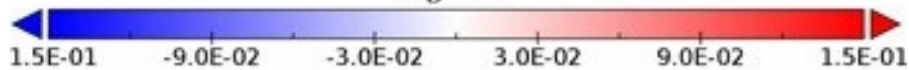
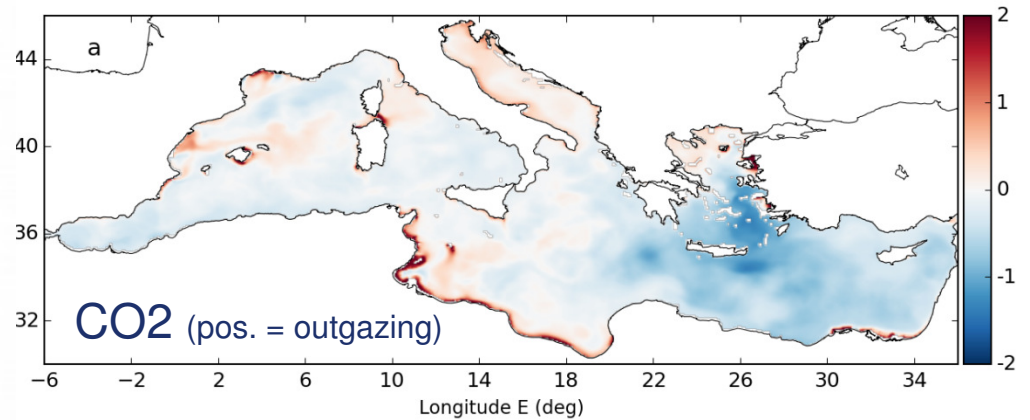
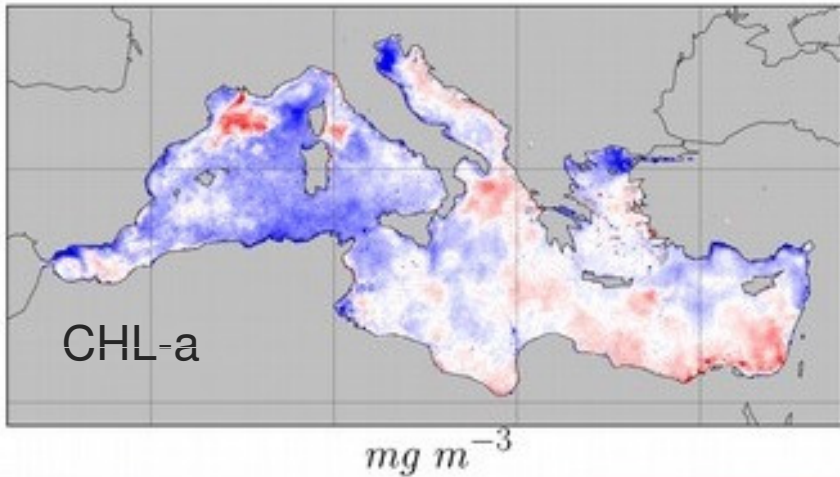




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BGC changes in the Mediterranean Sea

Anomalies during the year 2016: changes in key components of the key components of the oceanic biogeochemical cycles

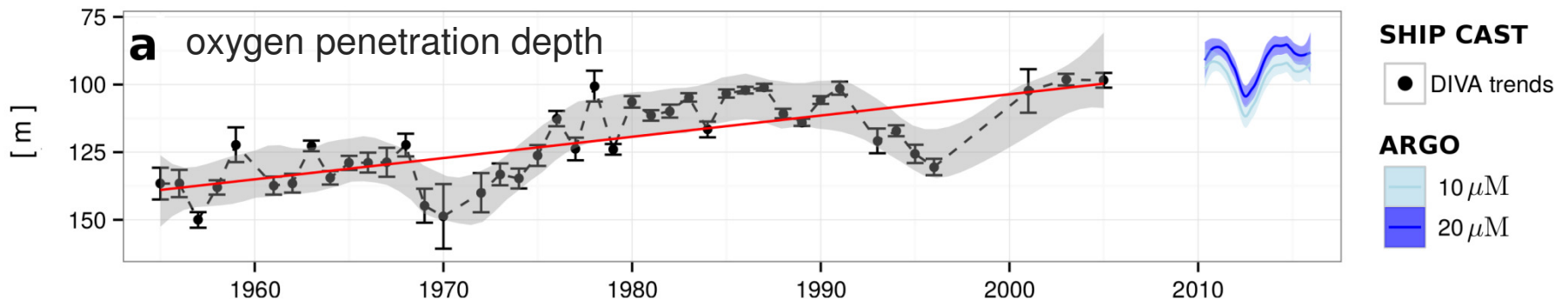




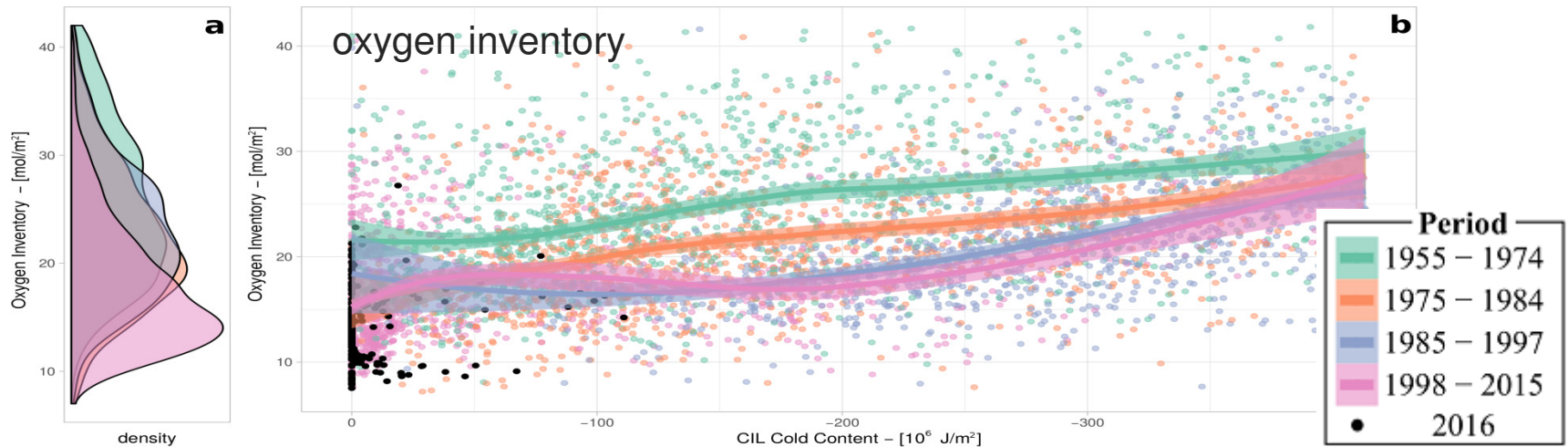
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OSR2 results: Black Sea oxygen inventory

The Black Sea is entirely anoxic except for a thin ventilated surface layer, about 10 % of its volume.



During the past 60 years, the vertical extent of this oxygenated layer has narrowed from 140m to ~80m...



... which is linked to reduced deep winter ventilation as a consequence of global warming.

Capet et al., 2018



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Ocean Monitoring Indicators

COPERNICUS MARINE SERVICE OCEAN MONITORING INDICATORS

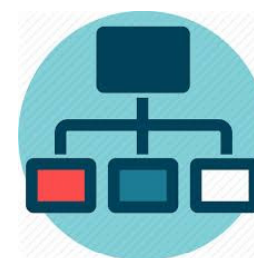
VISUALISATION



DOCUMENTATION



DATA DISTRIBUTION



OCEAN HEAT CONTENT

Global OHC
1993-2016

Reg. OHC
1993-2016

Reg. OHC
2016

SEA LEVEL

Global SL
1993-2017

Reg. SL
1993-2017

SEA ICE

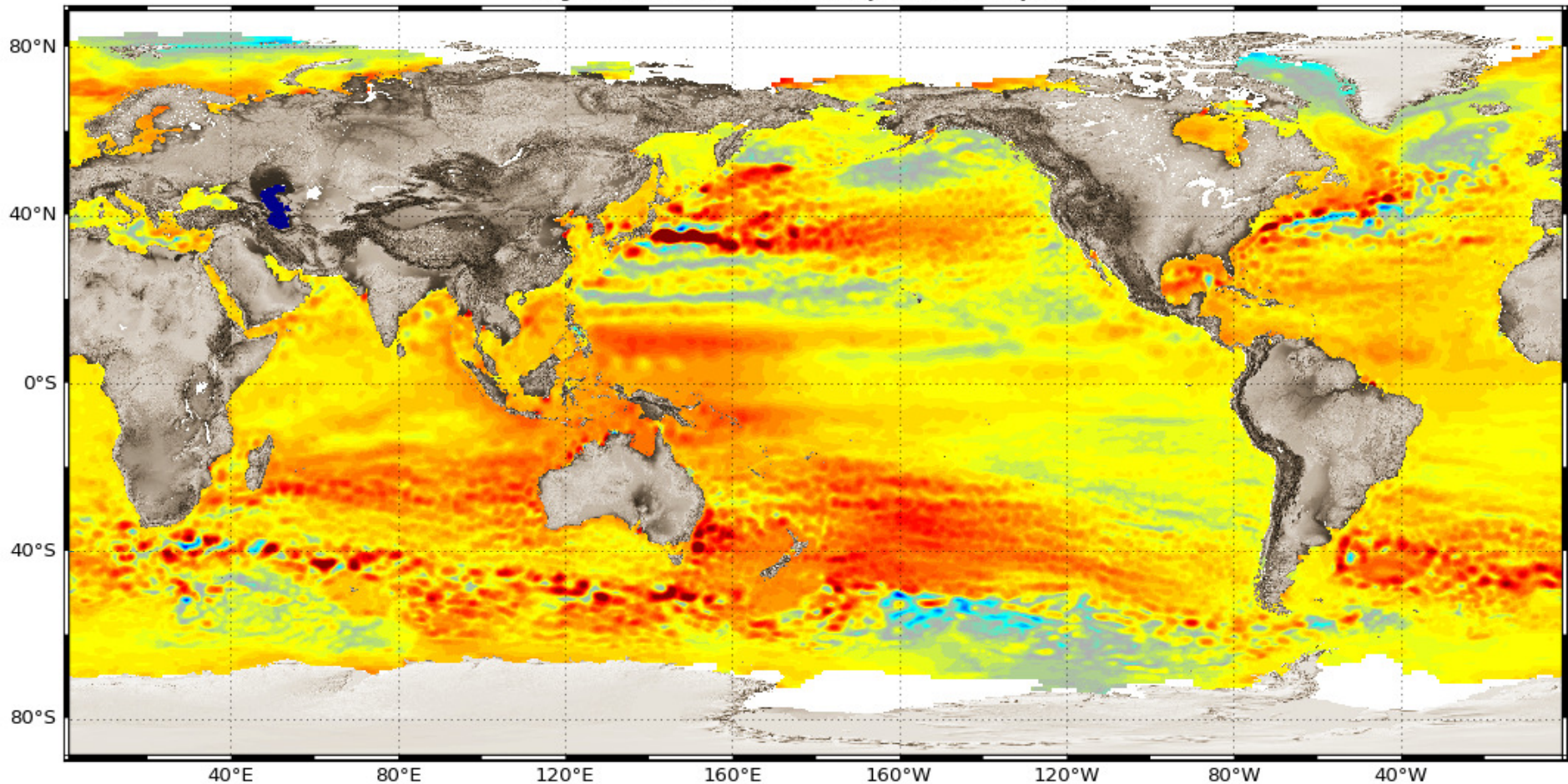
SIE Arctic
1993-2016

SIE Antarctic
1993-2016

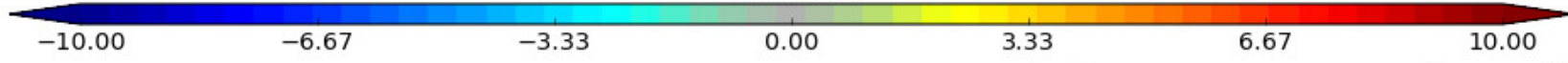
SIE Arctic
1979-2016



Regional Mean Sea Level Trends (Jan-1993 to May-2017)



Data Type: Observations
Credit: E.U. Copernicus Marine Service information / Copernicus Climate Change Service
(mm/year)



<http://marine.copernicus.eu>



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THANK YOU

Knowing more about :

*the program
the service
the entrusted entity*

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