Observations in the Mediterranean: Overcoming Challenges and Seizing Opportunities through Coordination

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THE CRITICAL IMPORTANCE OF OCEAN OBSERVATIONS AND COORDINATION

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  - Supports the livelihoods of three billion people worldwide
  - Shapes our culture
  - A home to a rich and fascinating marine life
  - Essential for climate and weather
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Everywhere the ocean is under threat from climate change, pollution, overfishing and more

- Even truer for the Mediterranean
  - A key component for the culture, development and economy
  - Warms at a rate of 20% faster than the rest of the globe
  - …

Climate and weather

Flash floods in Nabeul

Ocean health

Grouper fish in Tabarka

Coastal communities

Beach pollution in Bizerte

THE CRITICAL IMPORTANCE OF OCEAN OBSERVATIONS AND COORDINATION

- Awareness about the ocean is just beginning

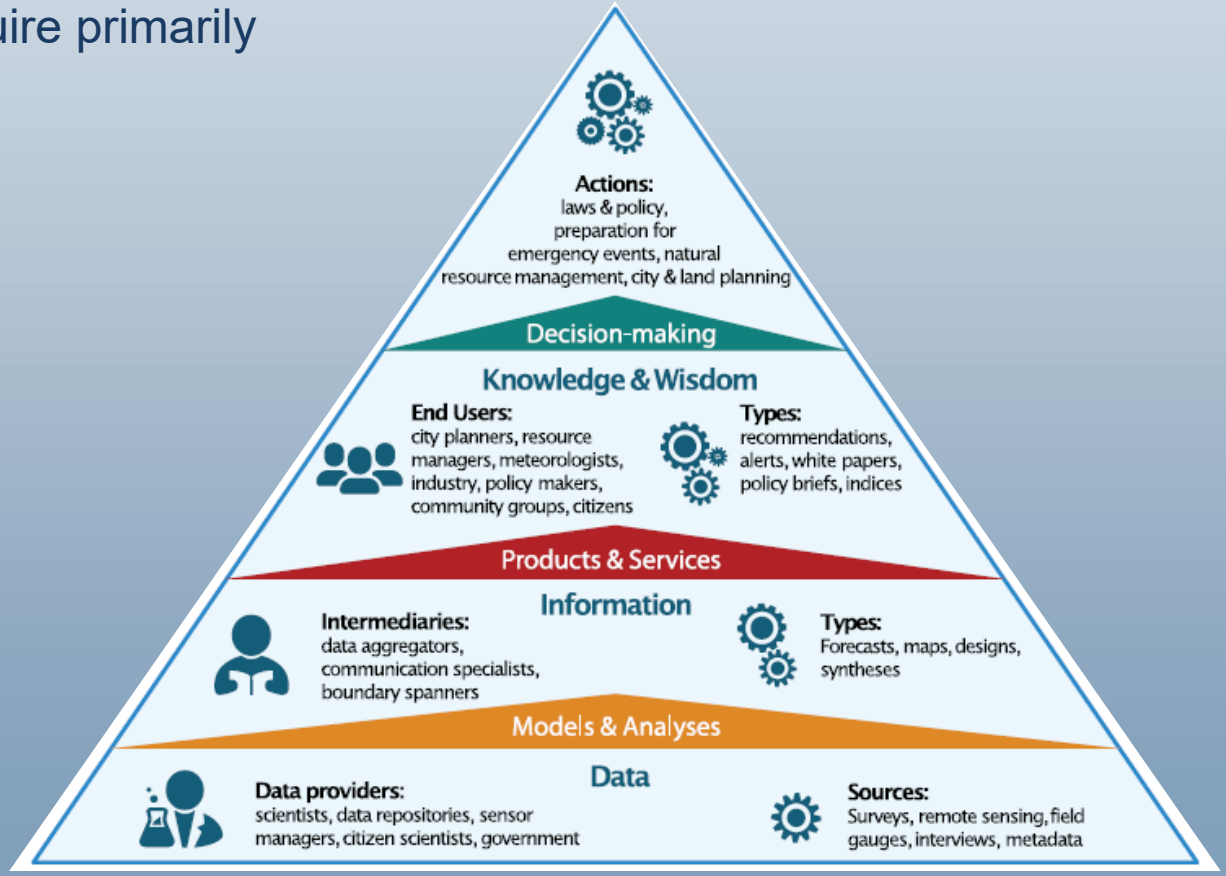
Underwater Earth / XL Catlin Seaview Survey / Aaron Spence

"*Out of sight, out of Money*" phenomenon that ocean suffer

THE CRITICAL IMPORTANCE OF OCEAN OBSERVATIONS AND COORDINATION

- To tackle societal and climate challenges it is essential to better understand the ocean, create knowledge and solutions

- Data are at the basis of this “value chain”, what we require primarily



Virapongse et al., 2020, *Earth Science Informatics*

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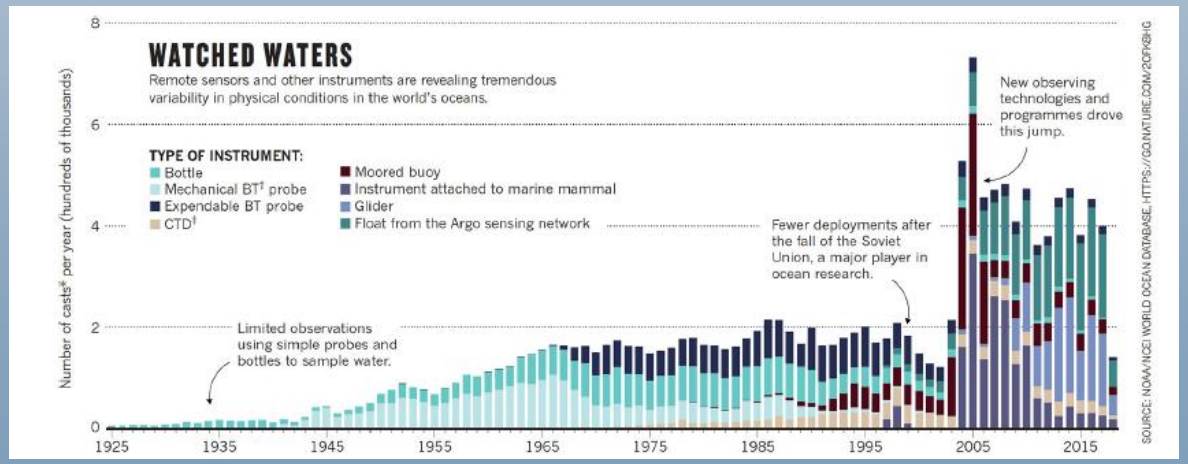
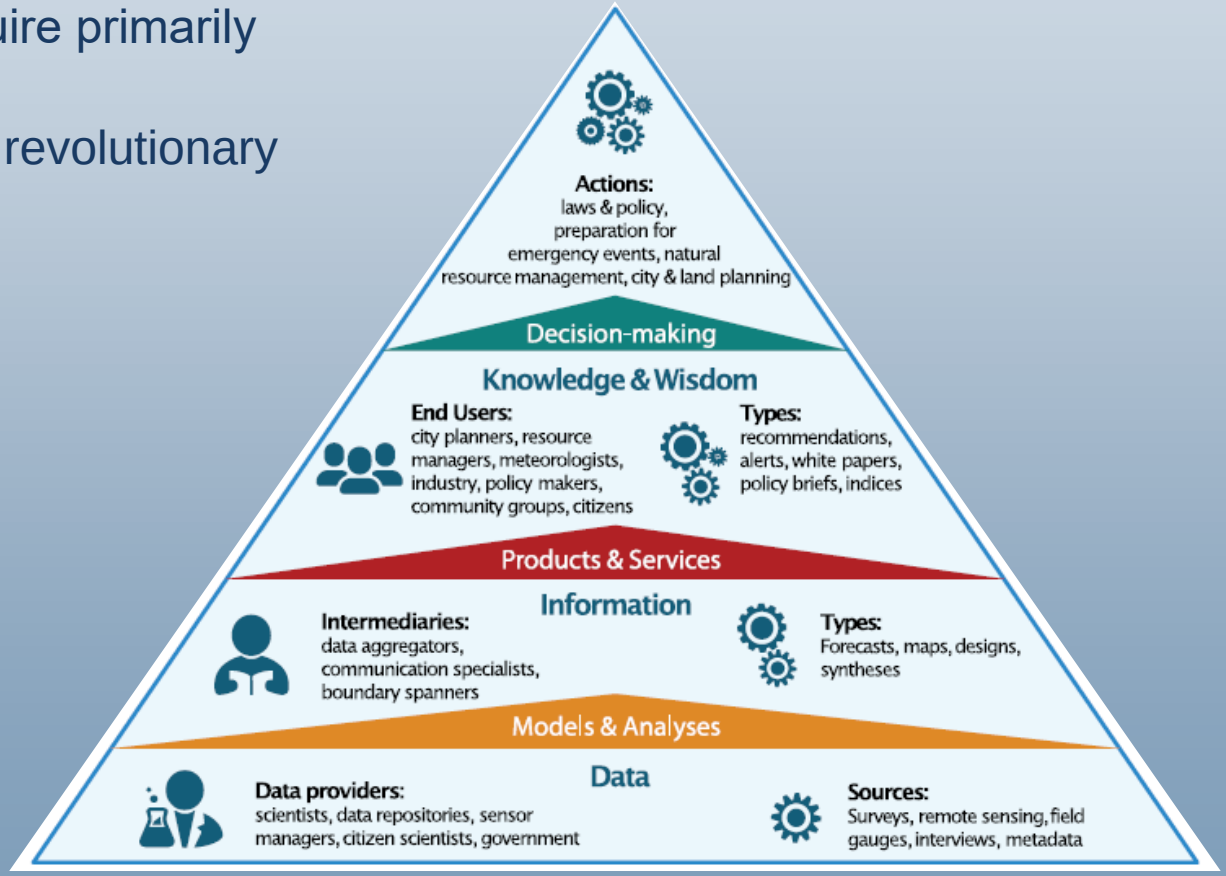
- To tackle societal and climate challenges it is essential to better understand the ocean, create knowledge and solutions
- Data are at the basis of this “value chain”, what we require primarily
- There is still a significant gap in ocean data despite the revolutionary impact of autonomous platforms
  - Only 7% of the ocean has sustained observations
  - ~ 1/10 000 smaller than for the atmospheric observations



Bates et al., 2018. Nature



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- We also need FAIR data
  - Findable (easy to find, unique identifier, rich metadata …)
  - Accessible (open, free, standardized communication protocol …)
  - Interoperable (Integrated with other data, standardized vocabulary …)
  - Reusable (released with standard, licenses, …)

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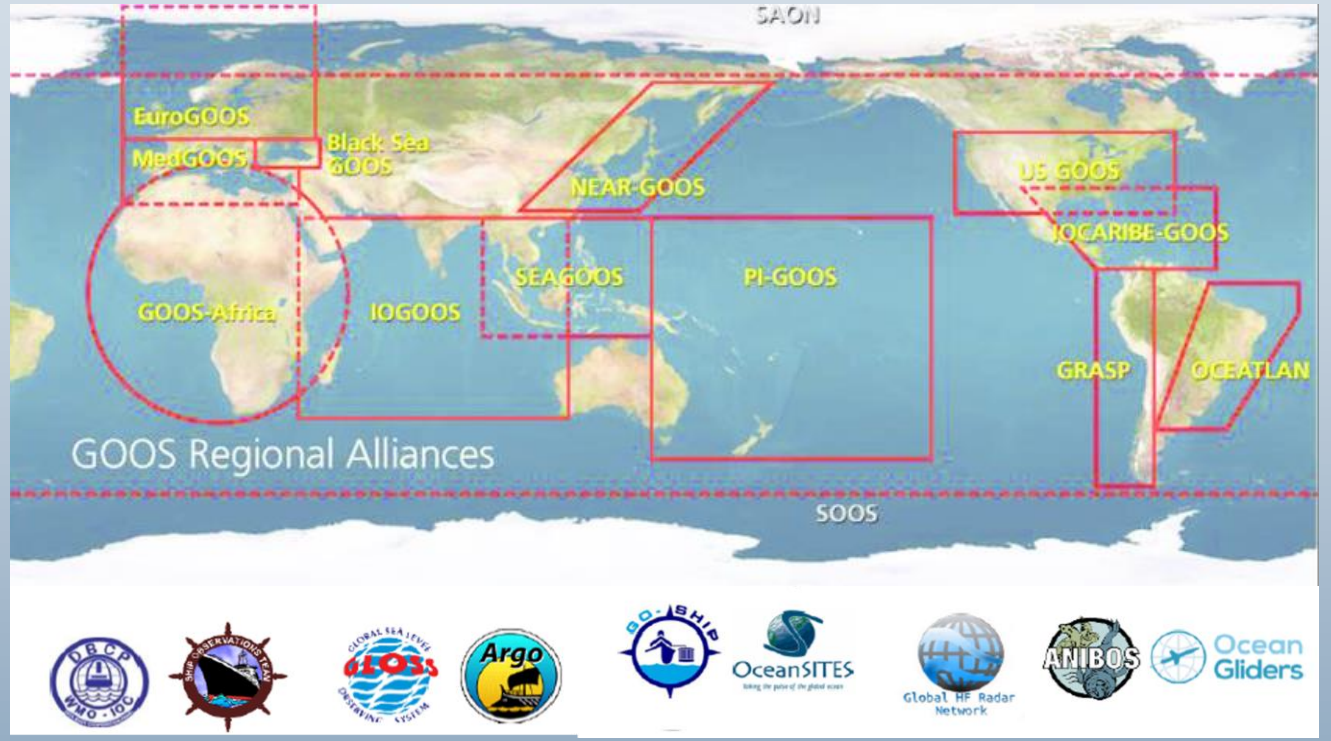
The GOOS (Global Ocean Observing System) seeks to address all of this

The Global Ocean Observing System

THE CRITICAL IMPORTANCE OF OCEAN OBSERVATIONS AND COORDINATION

- The GOOS today
  - 84 countries
  - 12 global observing networks
  - 13 regional alliances
  - ~ 9000 platforms
  - 100,000 daily observations

- Coordination is essential for maximizing the advantages of collecting and sharing data



Tanhua et al., 2019. *Frontiers in Marine Science*

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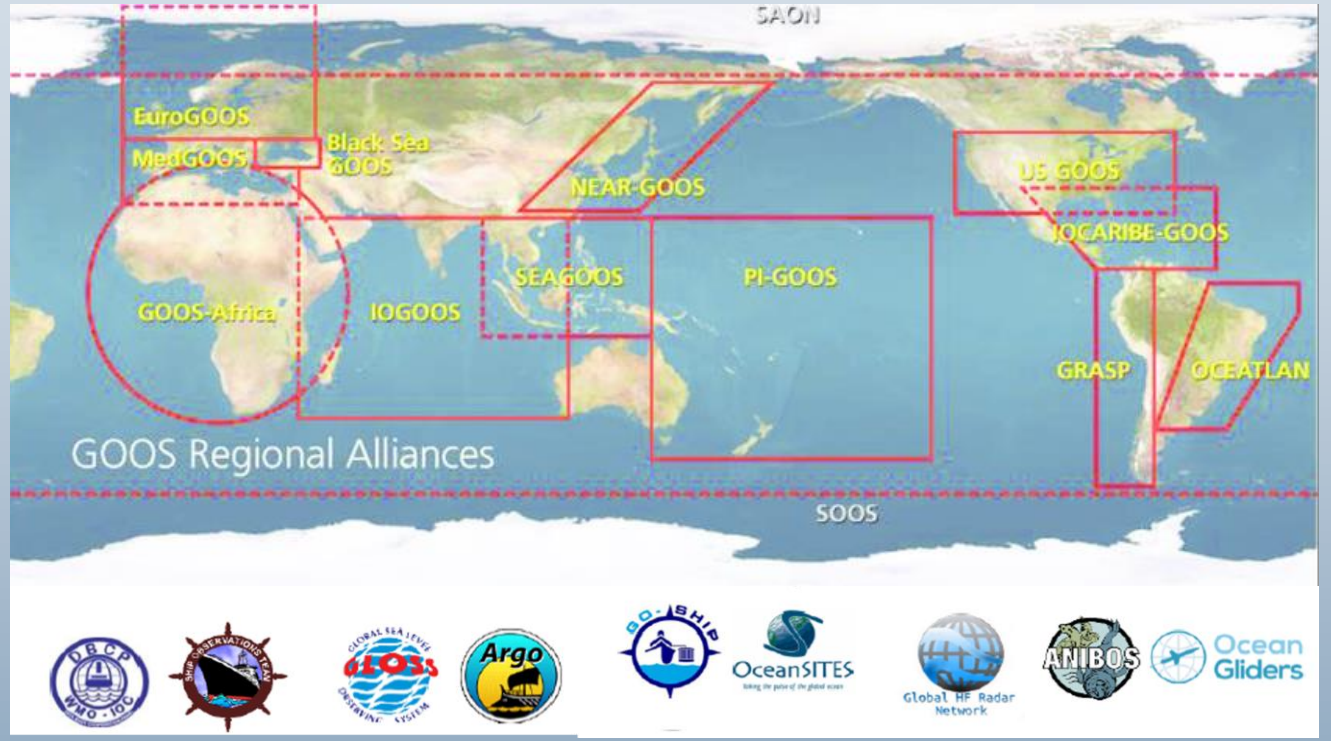

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OceanOPS (joint IOC-UNESCO/WMO center)
is at the heart of the GOOS coordination strategy

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- International hub for metadata and monitoring body
  - Manage metadata
  - Monitoring web-based tools and services (network performances and projections, data sharing, …)
  - On demand reporting tools, statistics, and maps

GOOS *in situ* networks [1]	Implementation STATUS [2]	Data & metadata REAL TIME [3]	Data & metadata ARCHIVED DELAYED MODE [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 - SOT	★★☆	★★☆	★★☆	★★☆	★★☆	✓	✓	
Ship based oceanographic - SOT	★★☆	★★½	★★★	★½☆	★★☆	✓	✓	
Repeated transects - GO-SHIP	★★½	Not applicable	★★★	½☆☆	★★★		✓	✓
Sea level gauges - GLOSS	★★½	★★☆	★★★	★☆☆	★★☆	✓	✓	
Time series sites - OceanSITES	★★☆	Not applicable	★★½	★★☆	★★☆		✓	✓
Moored buoys - DBCP	★★½	★★★	★★★	★★☆	★★½	✓	✓	✓
Tsunami buoys - DBCP	★★☆	★★★	★★★	½☆☆	★★★	✓		
HF radars	★½☆ Emerging	★½☆	½☆☆	★☆☆	★★★	✓	✓	
Drifting buoys - DBCP	★★★	★★½	★★½	★½☆	★★★	✓	✓	
Profiling floats - Argo	★★★	★★★	★★★	★★★	★★☆	✓	✓	
Deep & biogeochemistry floats - Argo	★☆☆ Emerging	★★½	★★½	★★★	★★☆	✓	✓	✓
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  - International coordination (global and basin scale)
  - Mediation (civil society, private sector, stakeholders, bilateral collaboration, …)
  - Deployment and retrieval opportunities

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- Data policy
  - Allocating unique WMO identifiers
  - IOC/UNESCO warning and notification system
  - Guidance on intergovernmental issues (e.g. EEZ)

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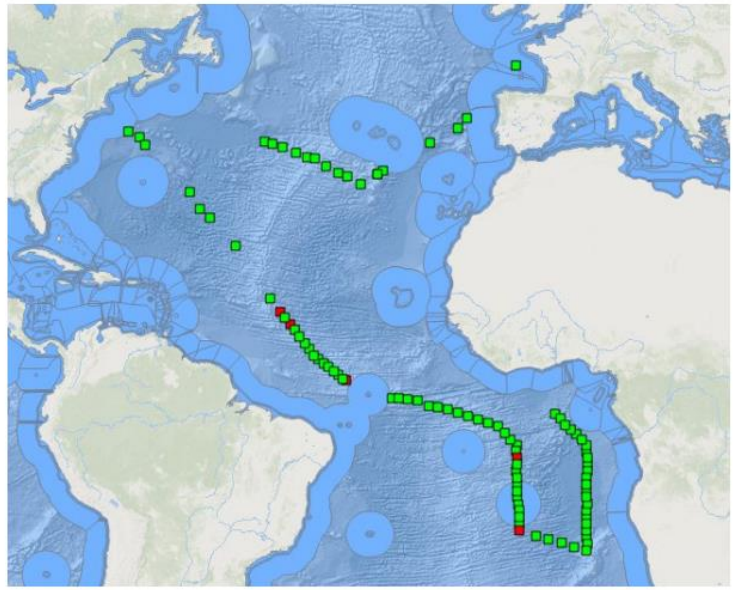

2021-22 BlueObserver IRIS cruise, chartered by USA, Canada and EuroArgo
About 100 units were deployed in the Atlantic Ocean. This cruise could have filled up the persistent gaps in the Azores, Brazilian or west African coast EEZs, but the lack of time and pathway for MSR clearance resulted in deployment in high seas only, except for UK/St Helena EEZ which provided a global concurrence.

OCEAN OBSERVATIONS AND COORDINATION IN THE MEDITERRANEAN

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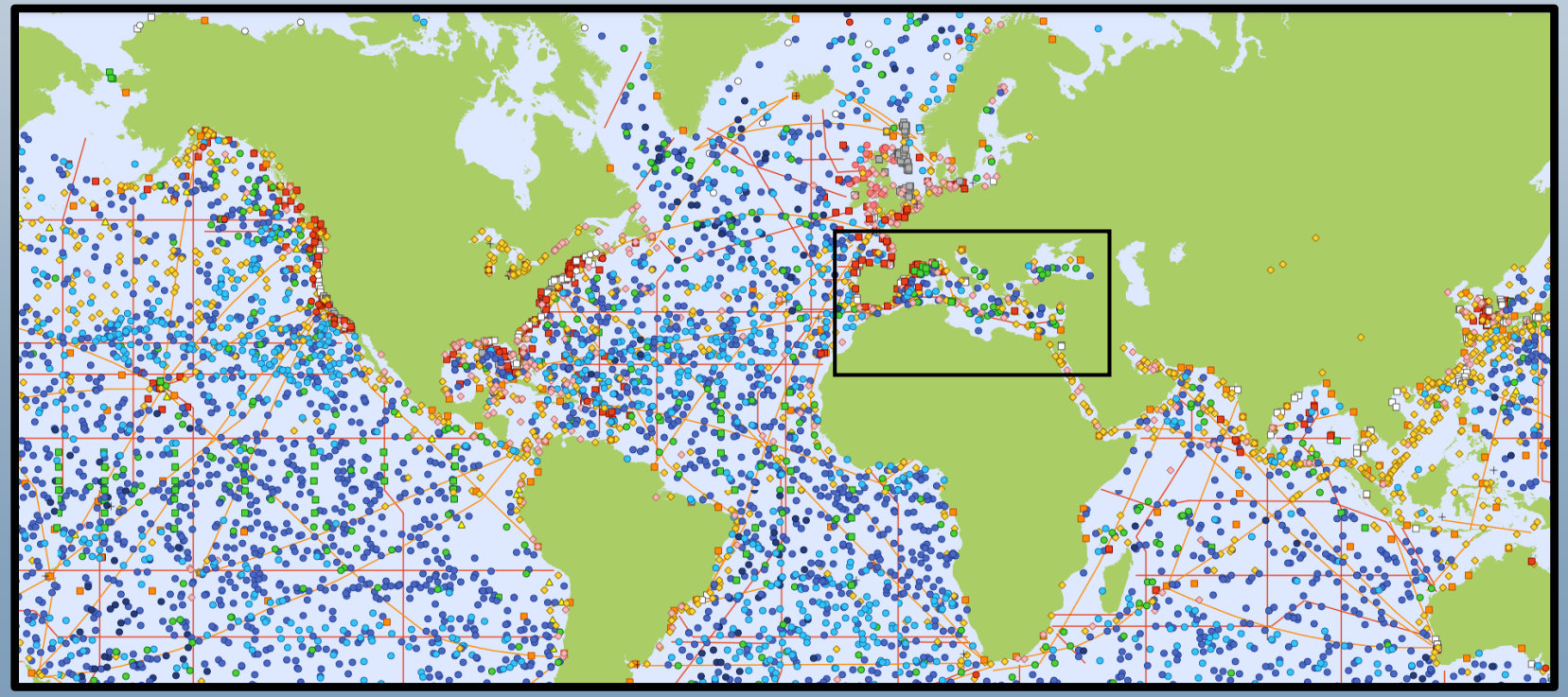
- Status
  - One of the most studied area in the world
  - Well established regional observing and forecasting systems (MOOSE, SOCIB, JERICO, EMODnet, SeaDatNet, ...)
  - Several GOOS regional alliances (MONGOOS, EuroGOOS, GOOS-Africa, …)



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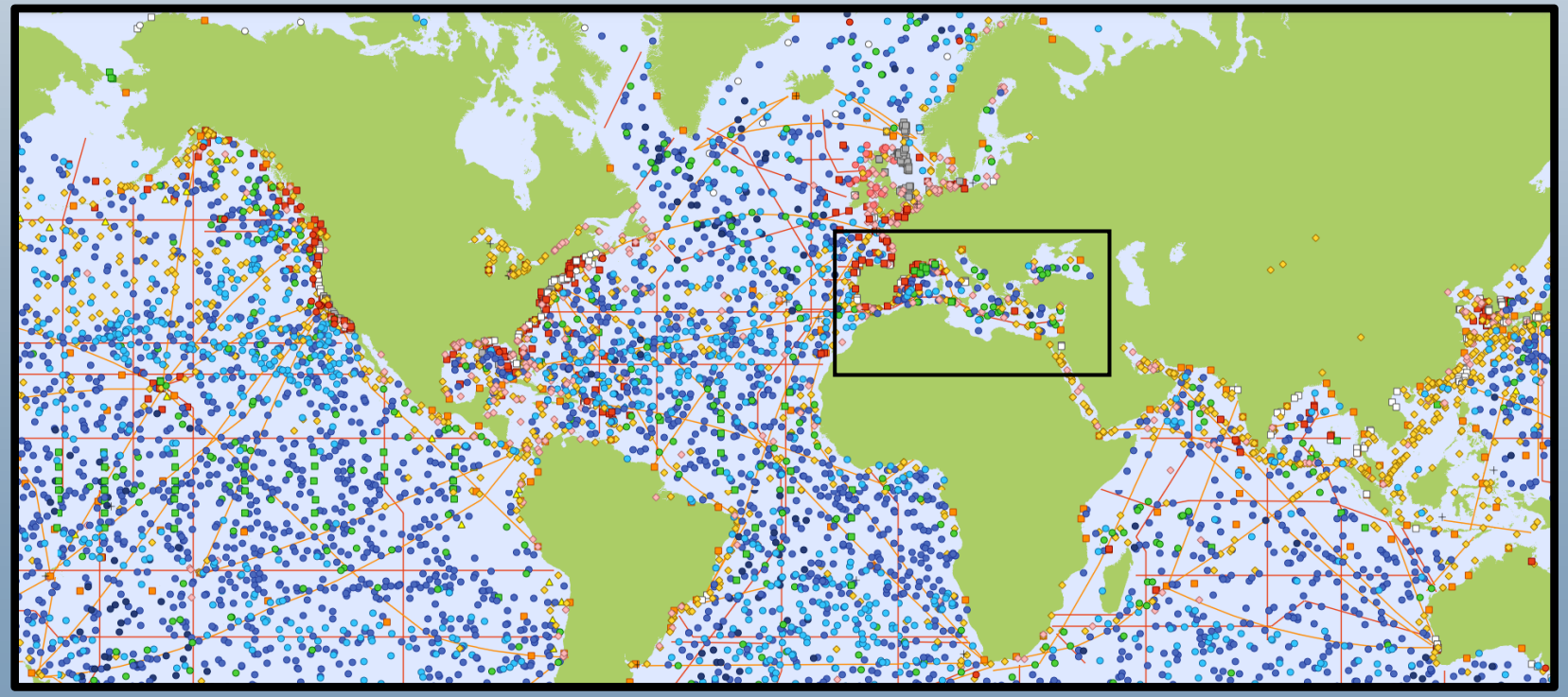

Still inadequately observed nor fully understood

OCEAN OBSERVATIONS AND COORDINATION IN THE MEDITERRANEAN

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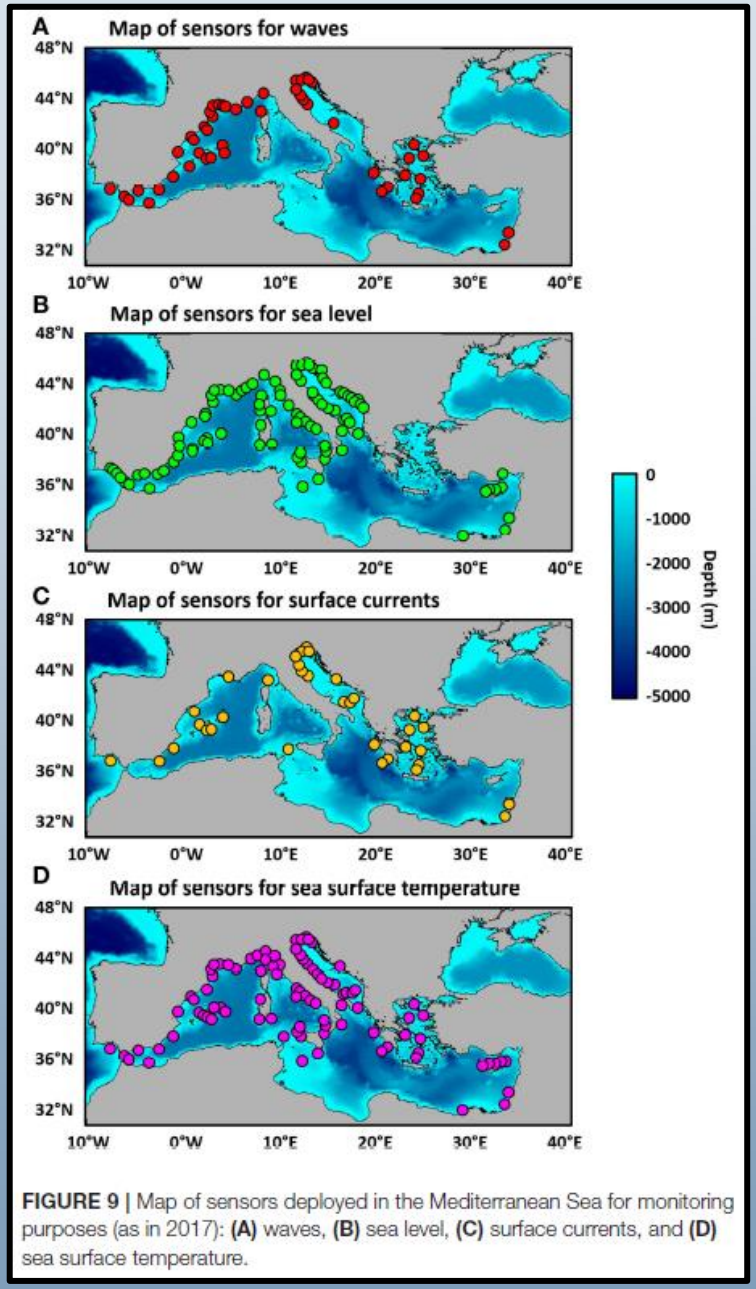

FIGURE 9 | Map of sensors deployed in the Mediterranean Sea for monitoring purposes (as in 2017): **(A)** waves, **(B)** sea level, **(C)** surface currents, and **(D)** sea surface temperature.

Tintoré et al., 2019

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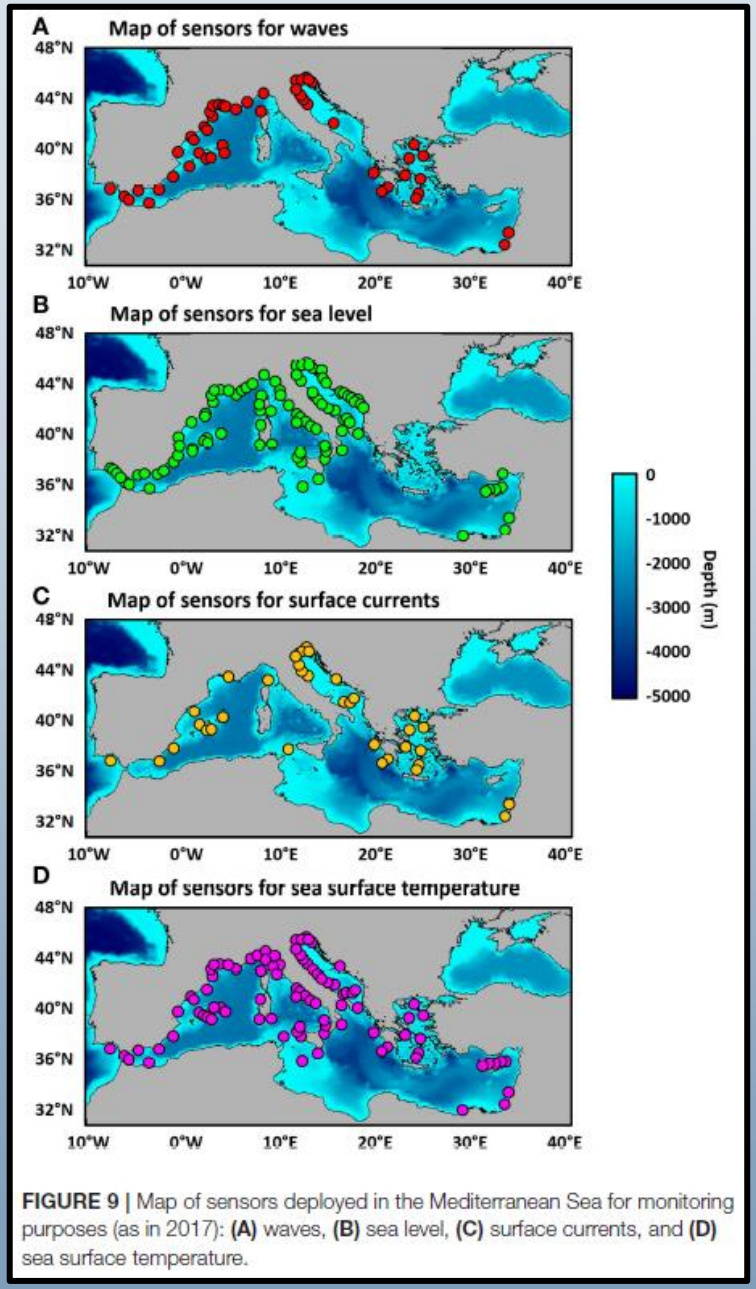

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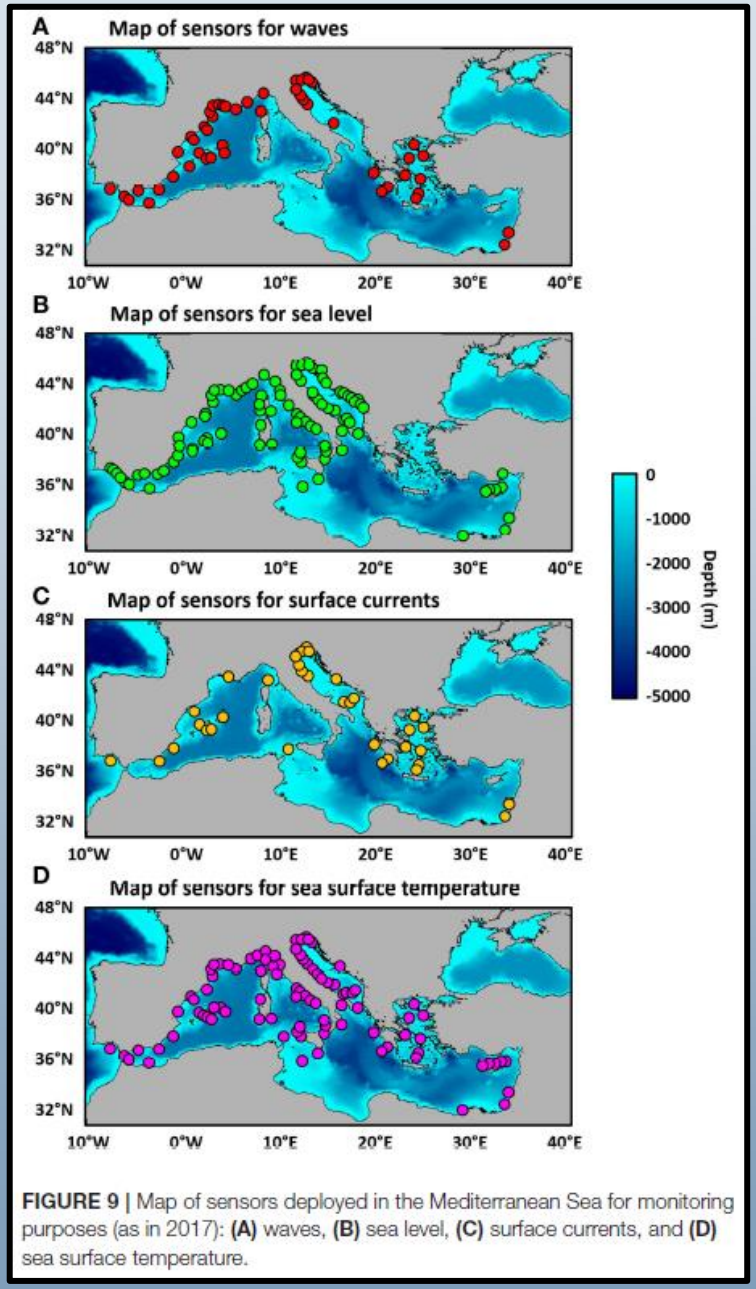

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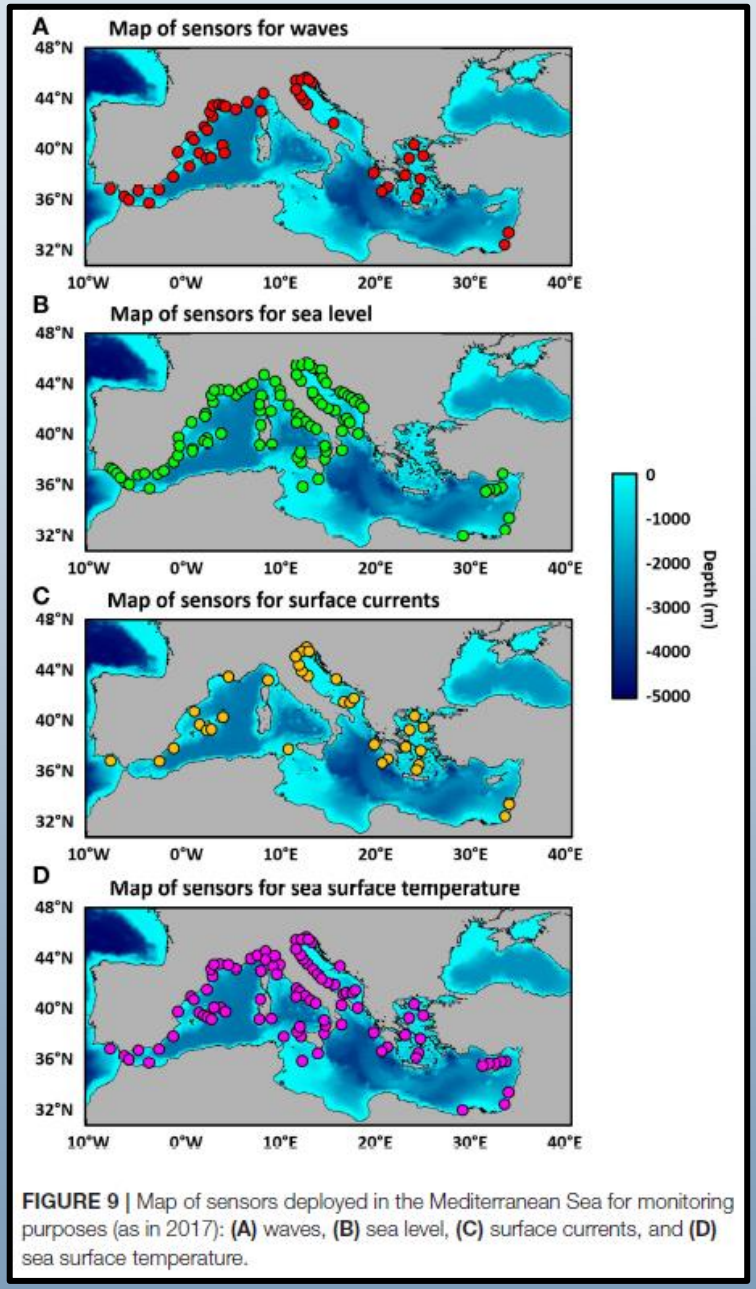

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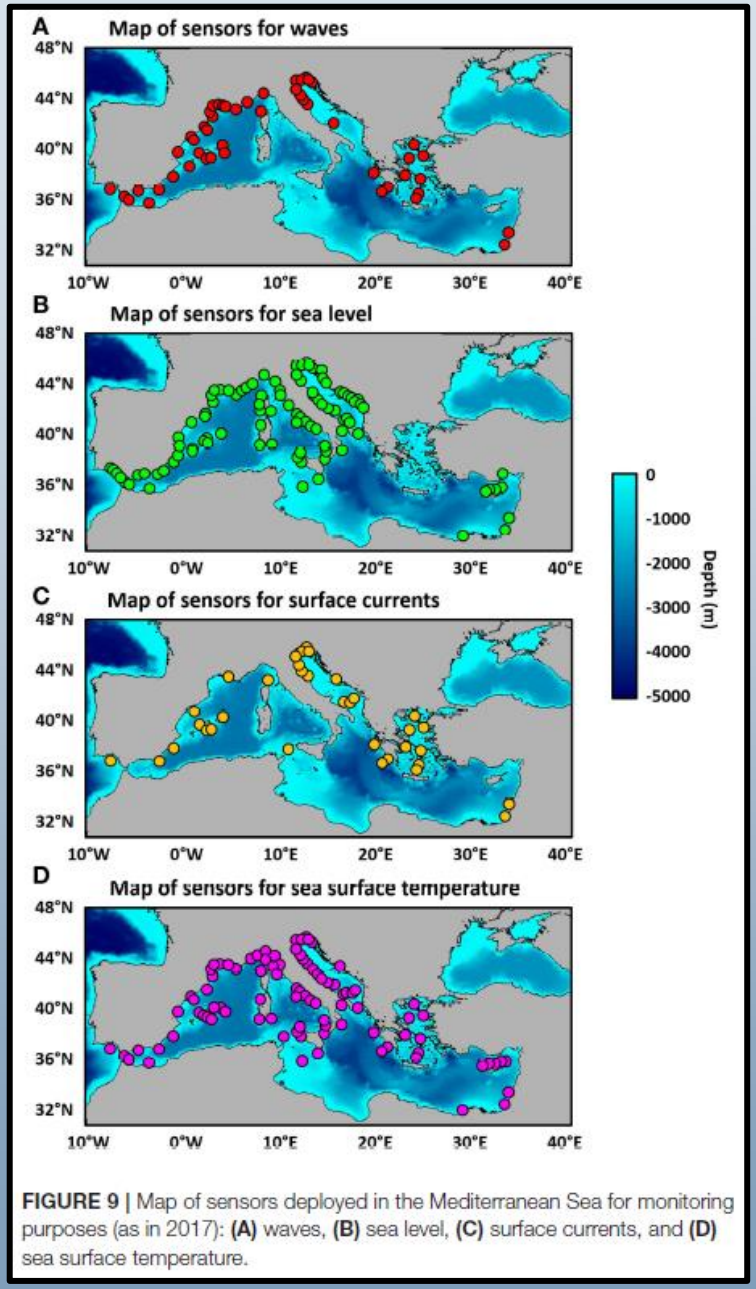

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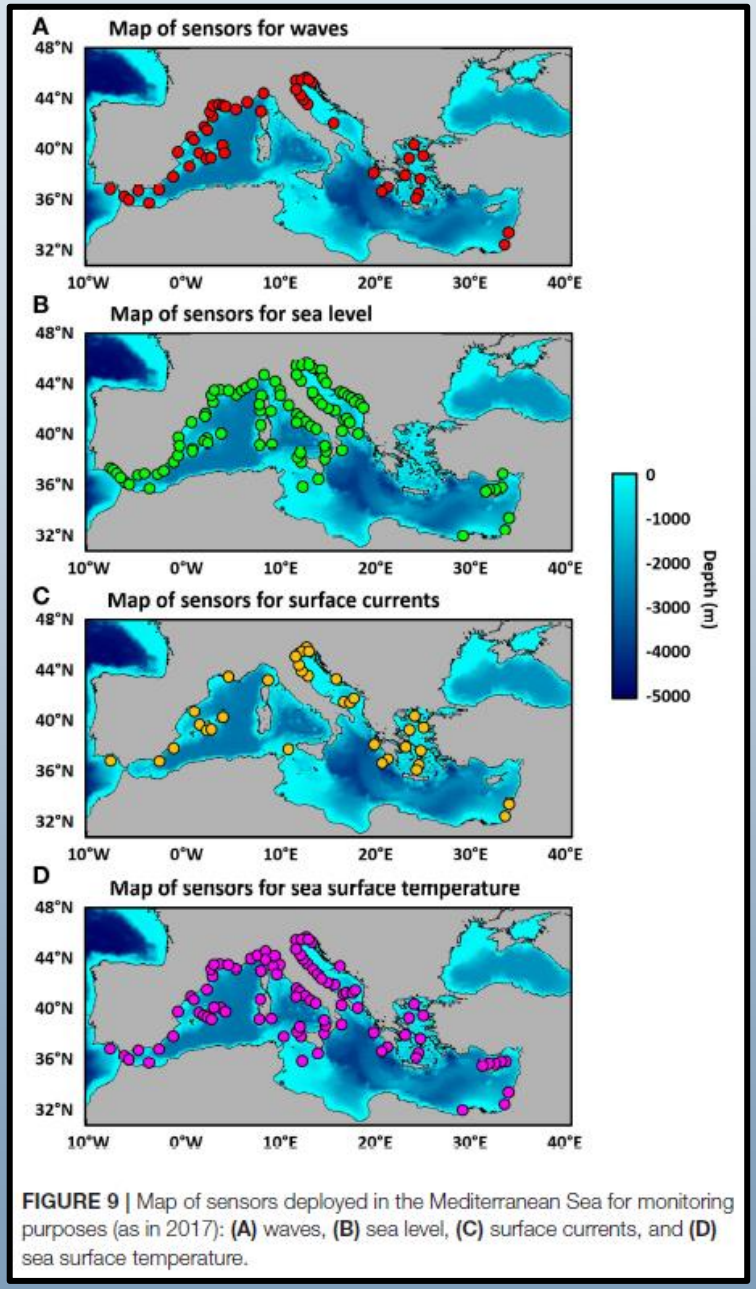
  - Communication with stakeholders is generally lacking
  - International collaborative framework exists but coordination and synergies must be strengthened



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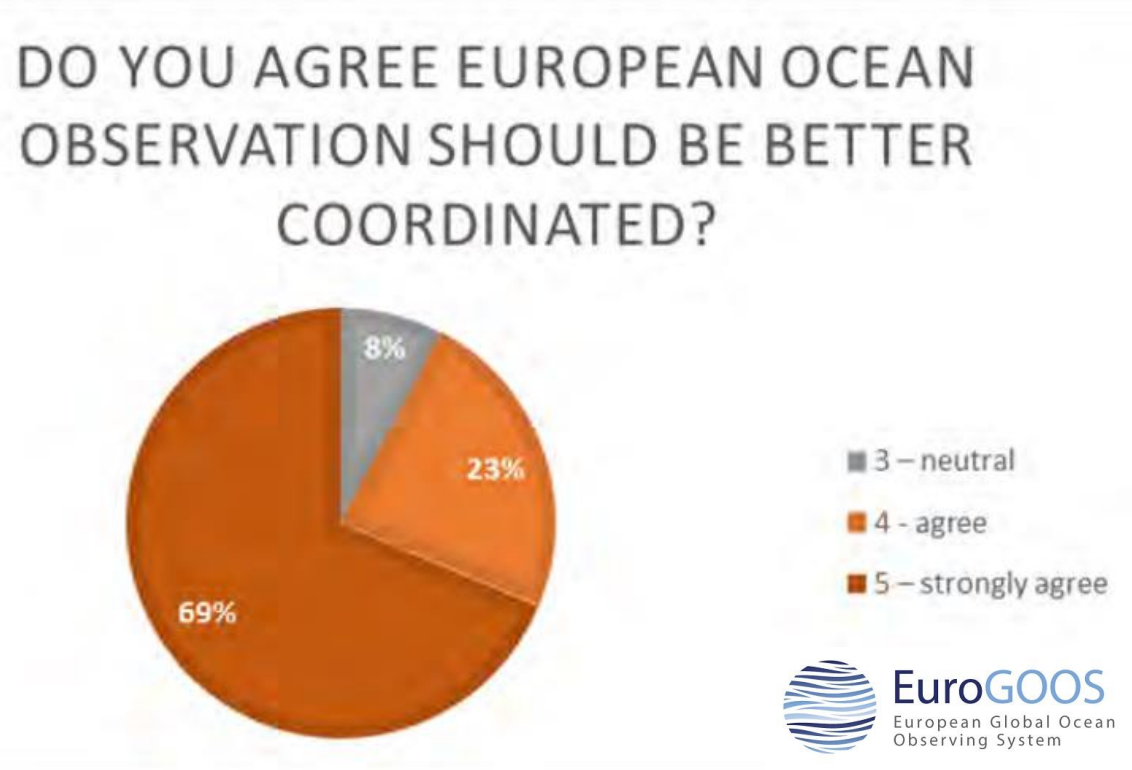
- A lack of coordination



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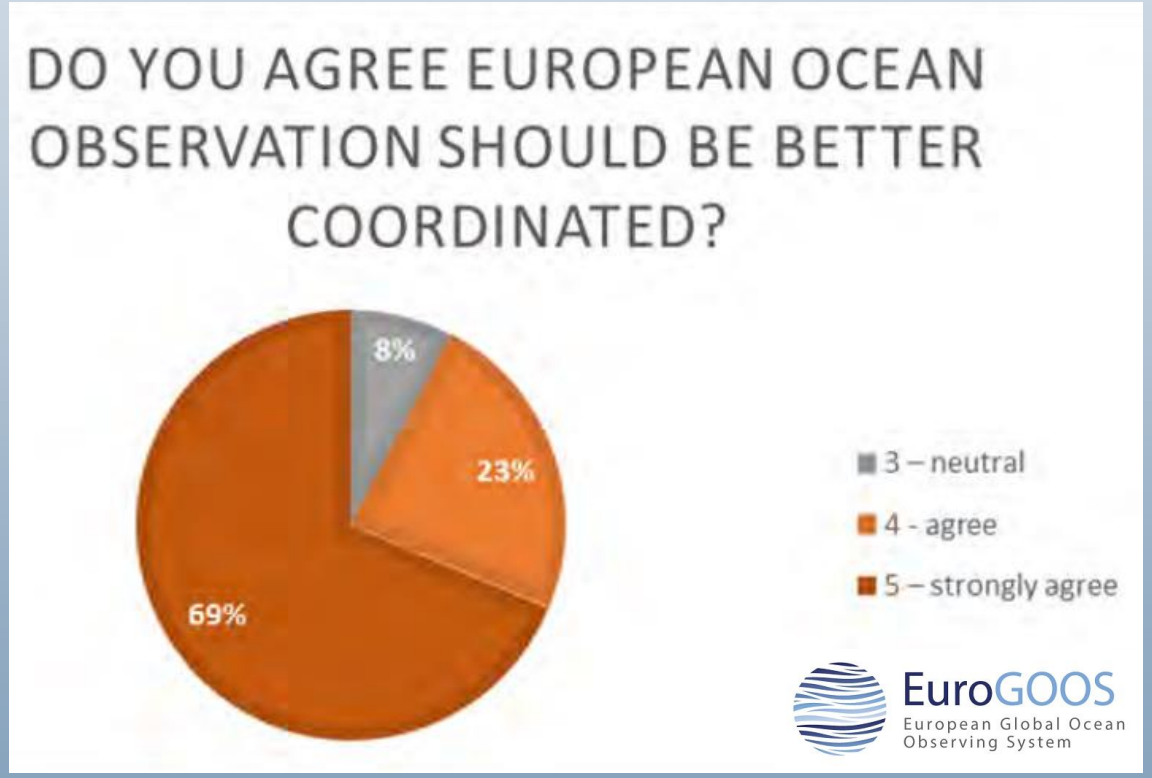

Monaco / China supported the position of Mediterranean Focal point + technical coordinator for BGC-Argo at OceanOPS

- Few words on Monaco initiatives in the Mediterranean
  - The Mediterranean Science commission (CIESM)
  - RAMOGE agreement
  - PELAGOS sanctuary
  - MedFund
  - Monaco Explorations project of the Ocean Decade will be dedicated to the Mediterranean from 2024

BGC-ARGO IN THE MEDITERRANEAN

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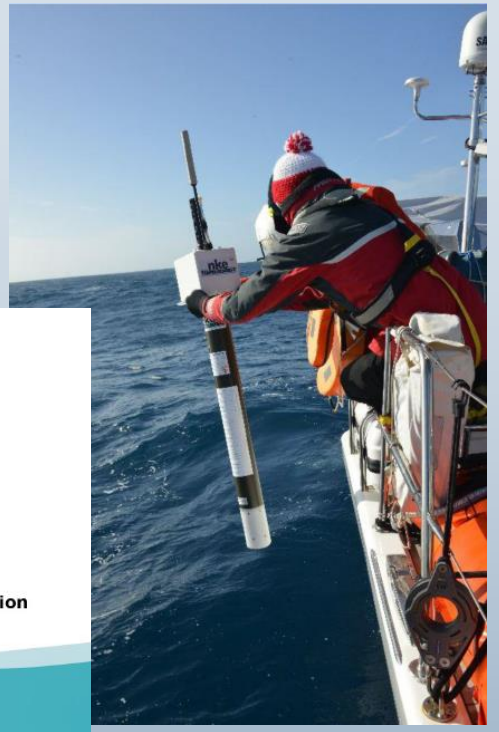
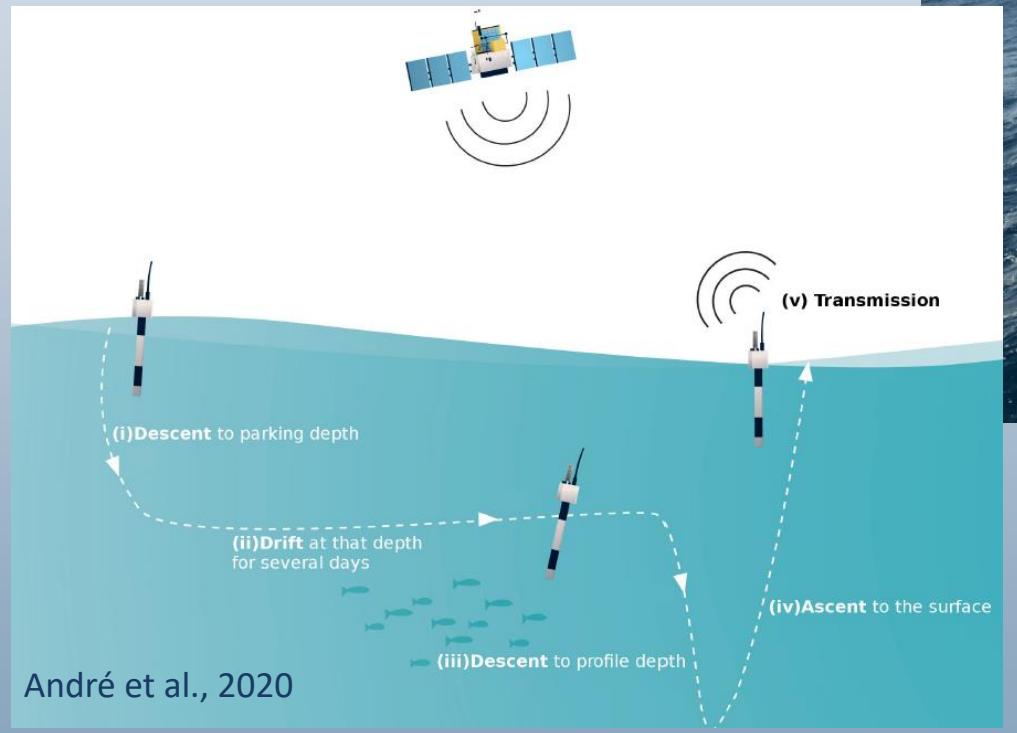
- ARGO is a major network of the GOOS
  - Measures T/S over the upper 2 km
  - 10-days interval
  - Array of ~ 4000 floats
  - 1 float / 300 km2
- BGC-ARGO is an extension of ARGO
  - 6 additional BGC parameters
  - ~ 500 active profiling floats
  - 16 nations



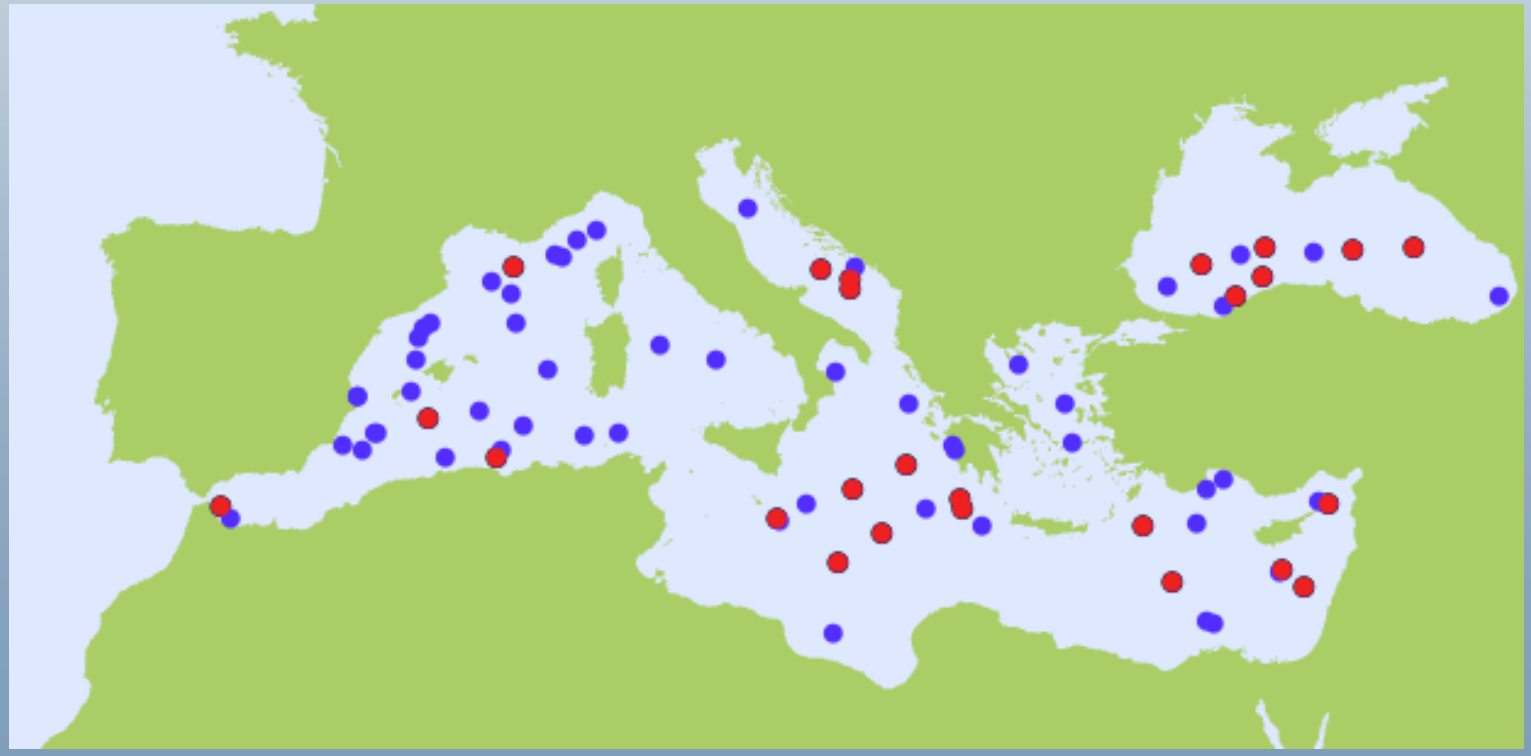


The Mediterranean was a pilot area for BGC-Argo

BGC-ARGO IN THE MEDITERRANEAN

- A success story
  - A total of ~180 BGC-Argo floats were deployed in the Mediterranean (~ 560 Argo)
  - 25 BGC-Argo float actives (~ 80 Argo)
  - ~ 175 BGC-Argo profiles / month in 2022

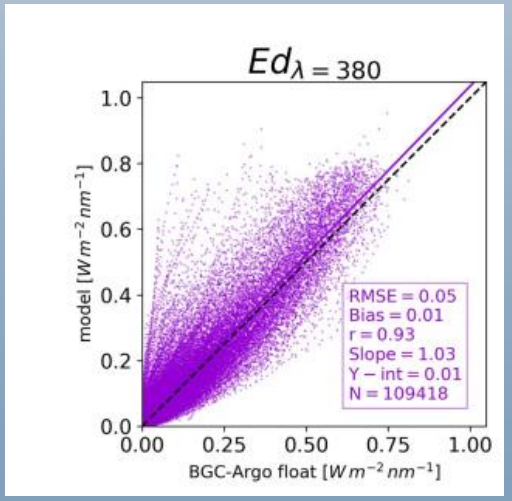
In 2022, coverage and activity indicators meet BGC-Argo's targets



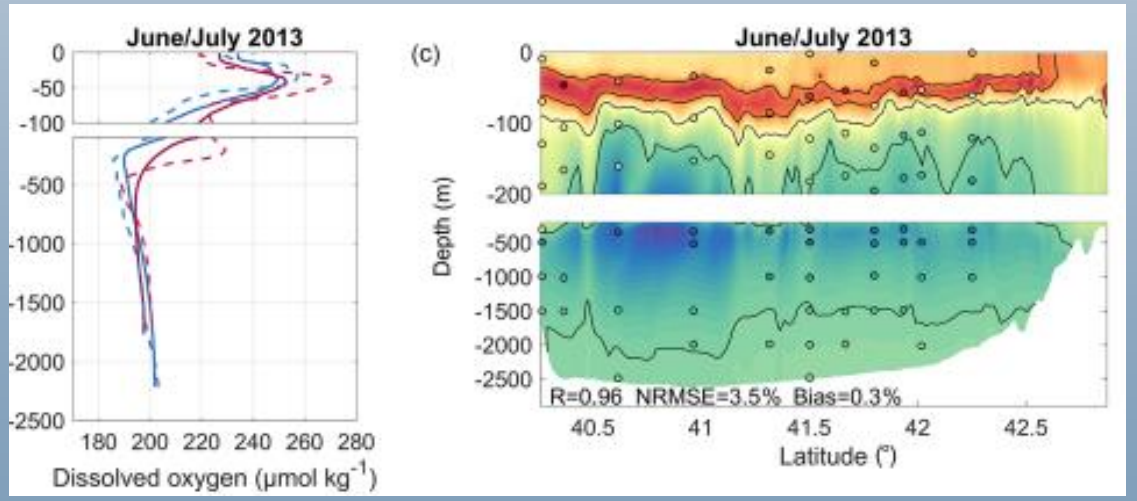
BGC-ARGO IN THE MEDITERRANEAN

- A revolution in the way biogeochemistry is observed in the Mediterranean Sea
  - Primary production, Nutrient dynamics, ecosystem
  - Episodic events , seasonal variability, annual budget,
  - Models validation, initialization and assimilation
  - Marine optics …

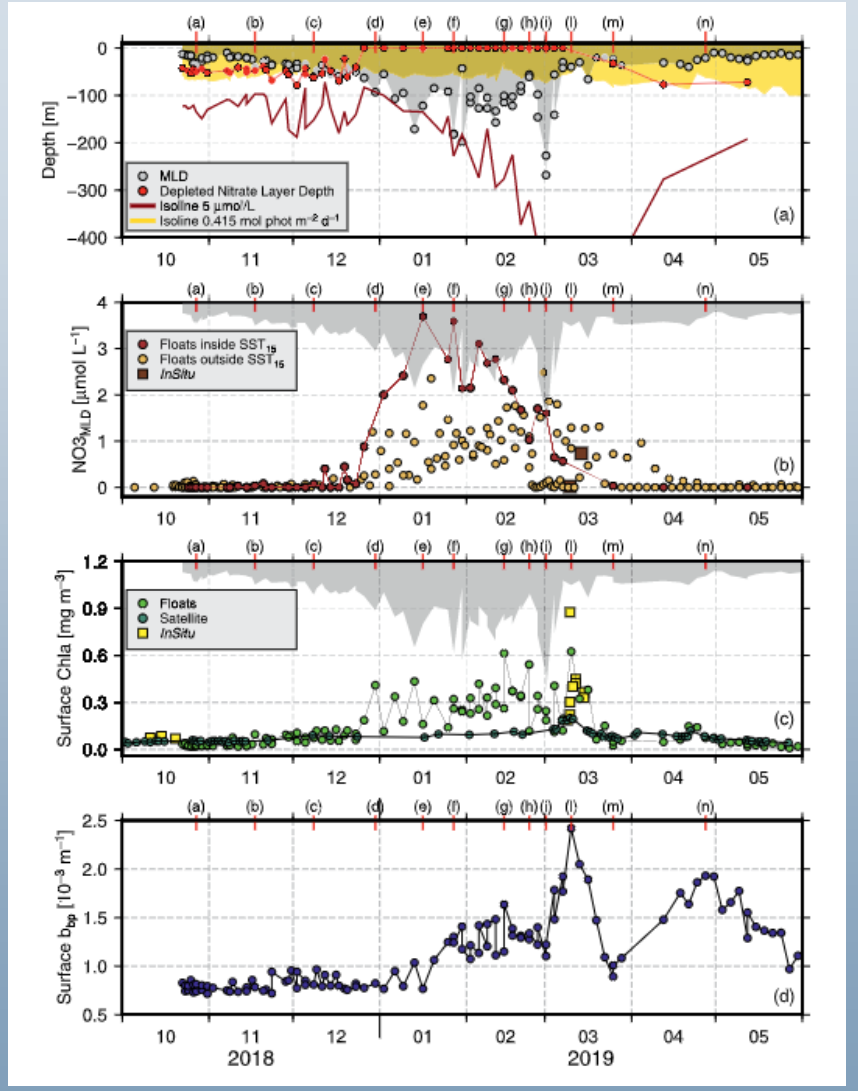
https://biogeochemical-argo.org/peer-review-articles.php



Terzic et al., 2020



Ulses et al., 2021



D'ortenzio et al., 2021

BGC-ARGO IN THE MEDITERRANEAN

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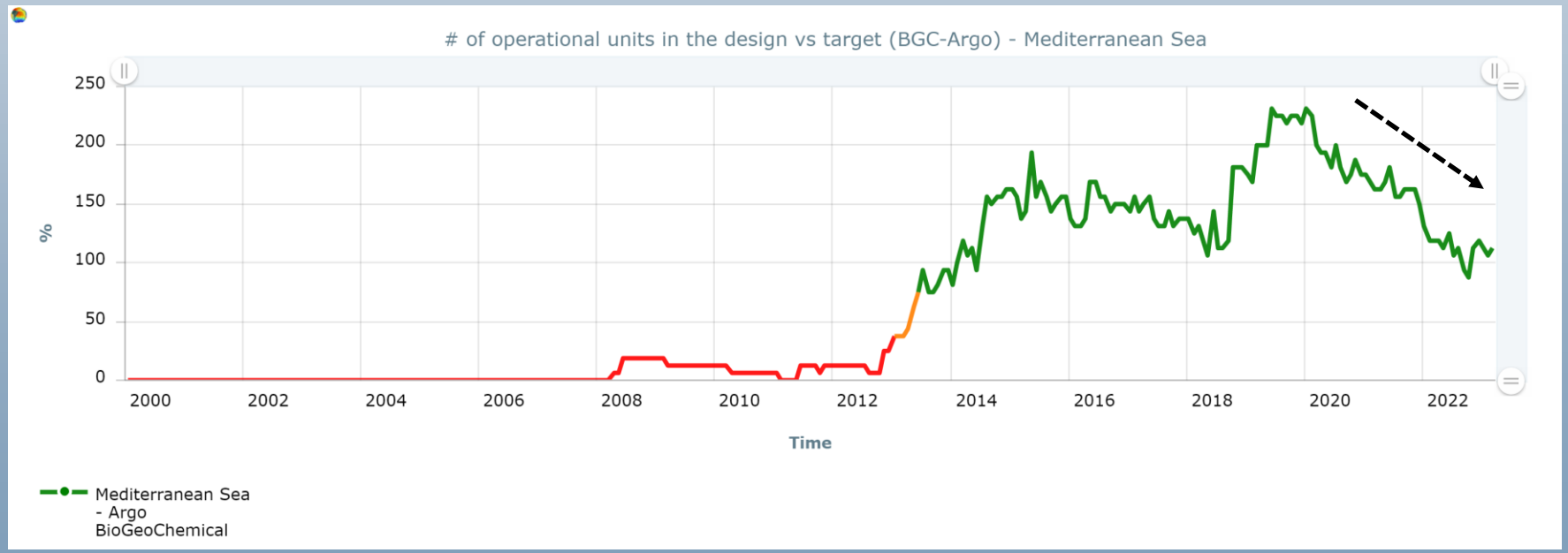
  - Intensity of deployments very variable from one year to another (not enough sustainable funds)
  - The number of operational units decrease since 2020 (can become critical in the coming years)



BGC-ARGO IN THE MEDITERRANEAN

- An uncertain future ?
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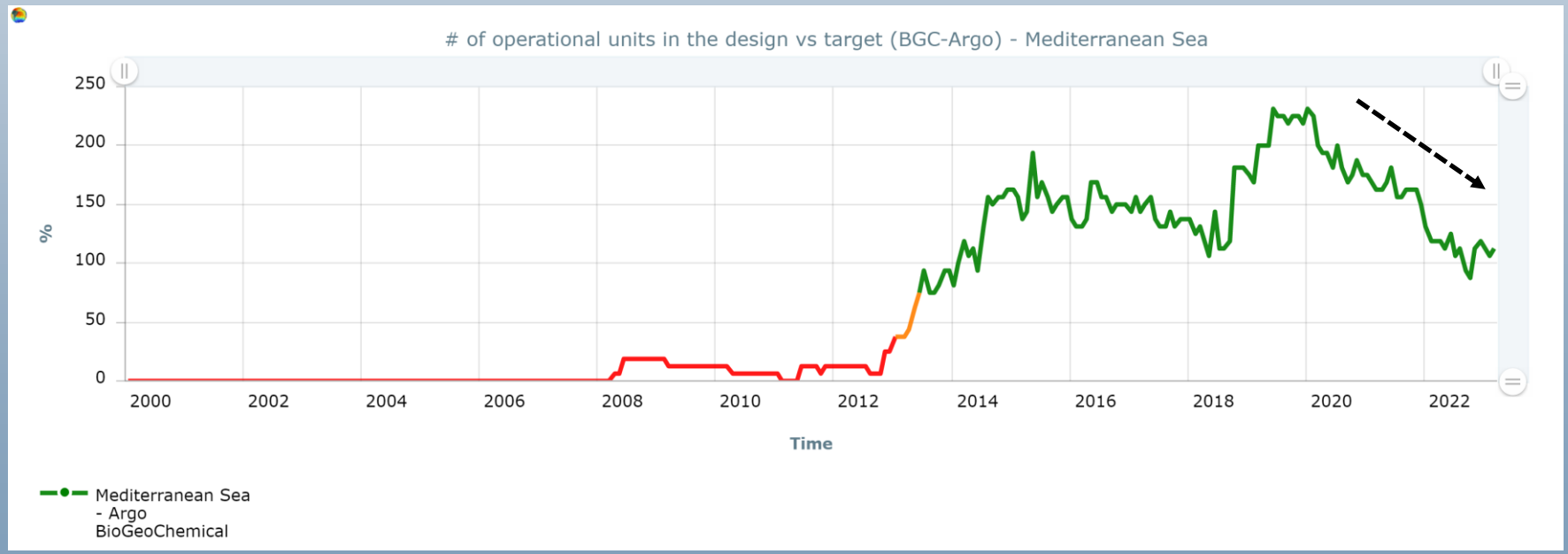
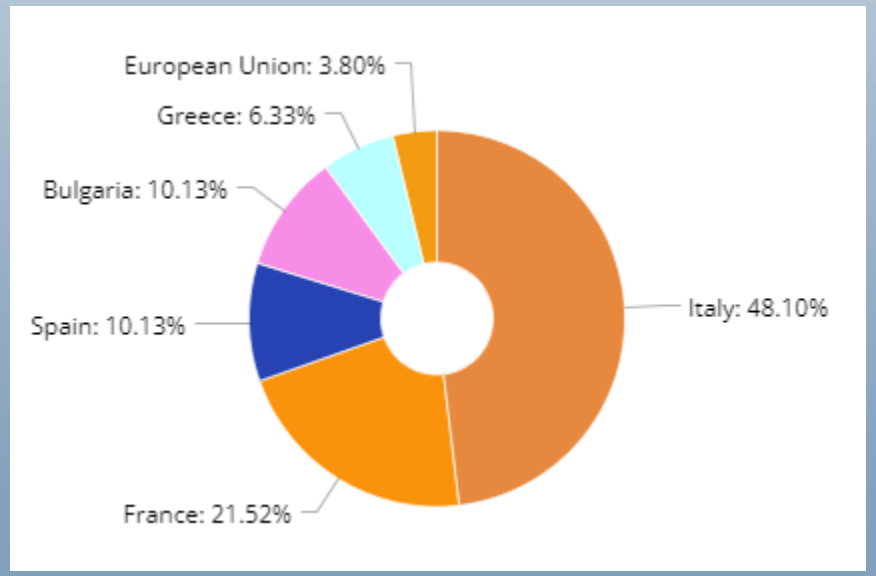


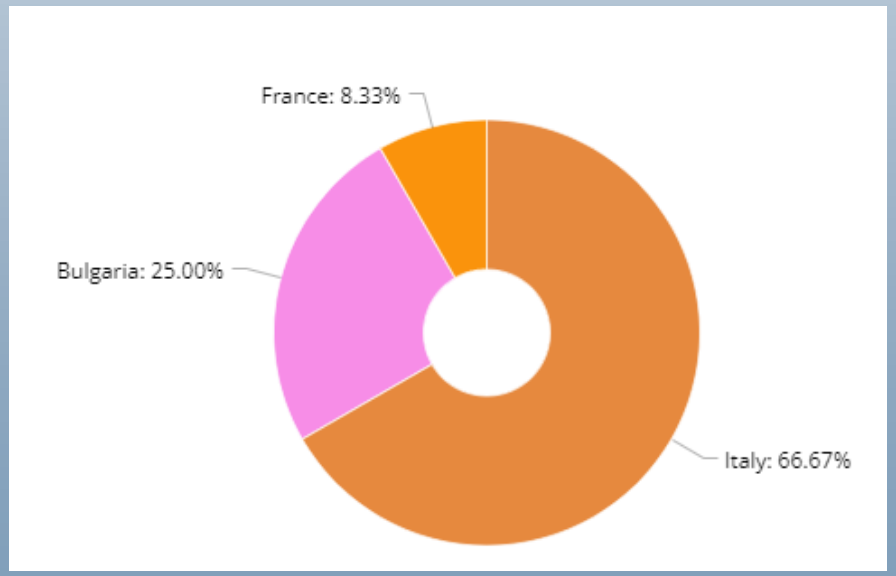
BGC-ARGO IN THE MEDITERRANEAN

- An uncertain future ?
  - Intensity of deployments very variable from one year to another (not enough sustainable funds)
  - The number of operational units decrease since 2020 (can become critical in the coming years)
  - 80% of BGC floats carry only oxygen as additional sensor (not compliant with the objectives of 5 / 6 sensors)
  - Insufficient national diversity (almost exclusively countries from EU)

Active floats Argo



Active floats BGC-Argo



Спасибо

Thank you

Gracias

Merci

谢谢

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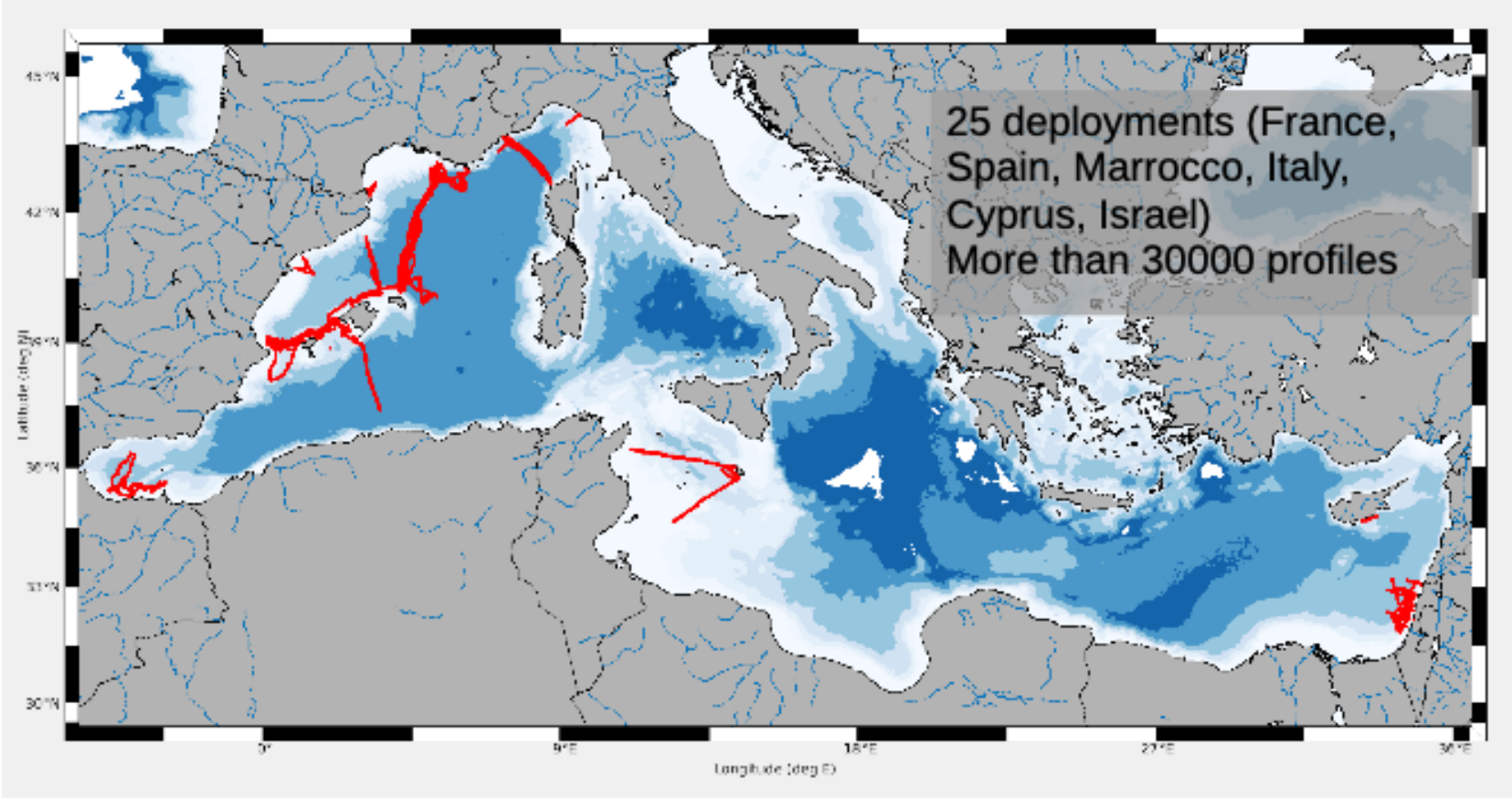
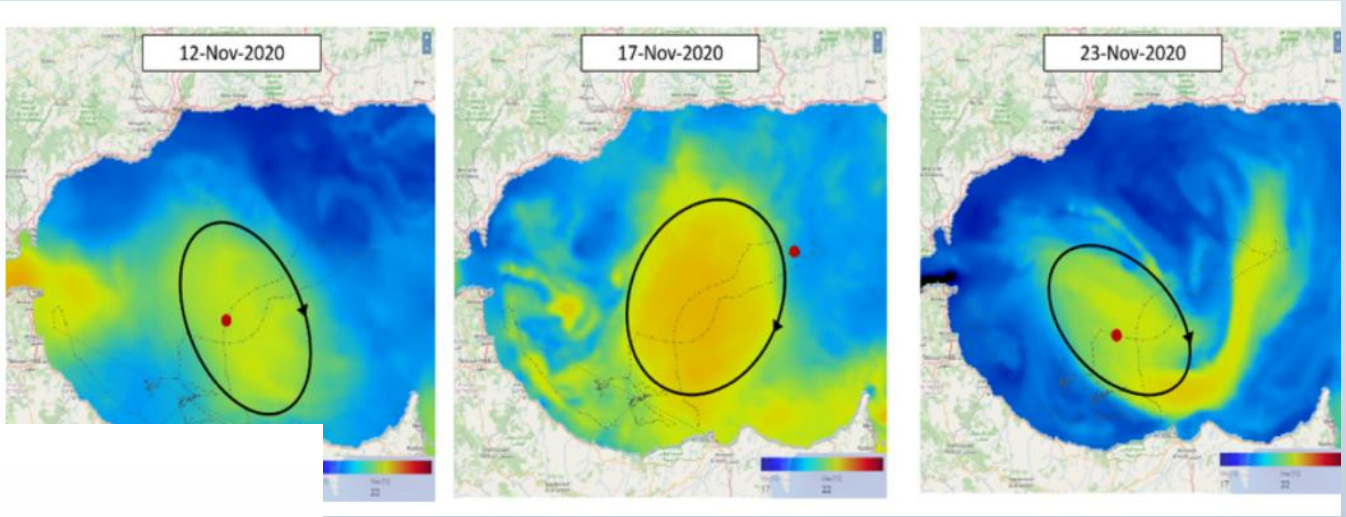
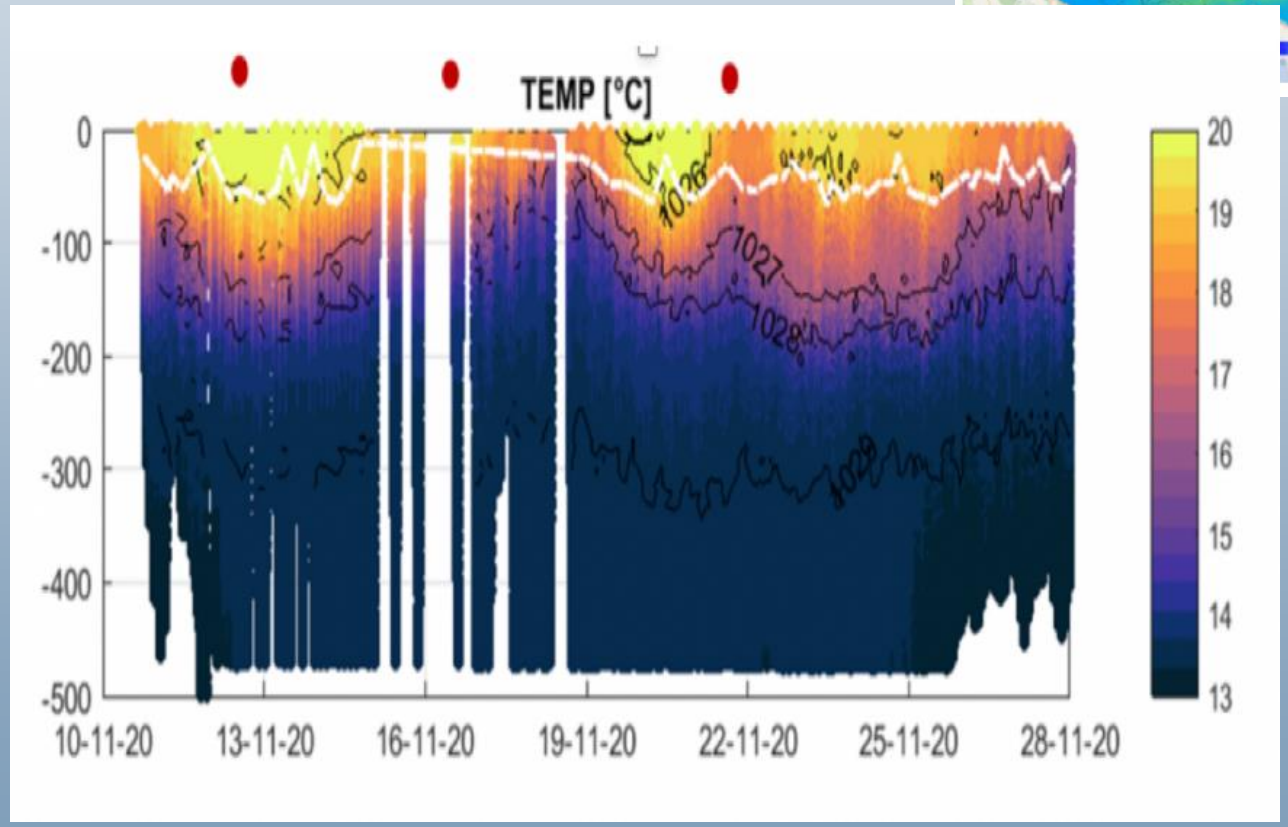
SUPPORTING SLIDES

Glider deployments in the MedSea 2021-2022



SUPPORTING SLIDES





SUPPORTING SLIDES

Metadata provider
OceanOPS

Ocean observing systems

Data Providers
Observing technologies / observing networks

Dashbord

Marine Data Center (DAC)

Data Aggregators Service Providers

End User