

A decade of observations and achievements of the MOOSE observatory

A. Bosse, L. Coppola, L. Mortier, P. Raimbault, P. Testor and the MOOSE consortium

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Introduction

Conclusion

The Mediterranean Ocean Observing System for the Environment (MOOSE) integrates a range of platforms to detect and identify long-term environmental anomalies :

➤ Fixed observatories :

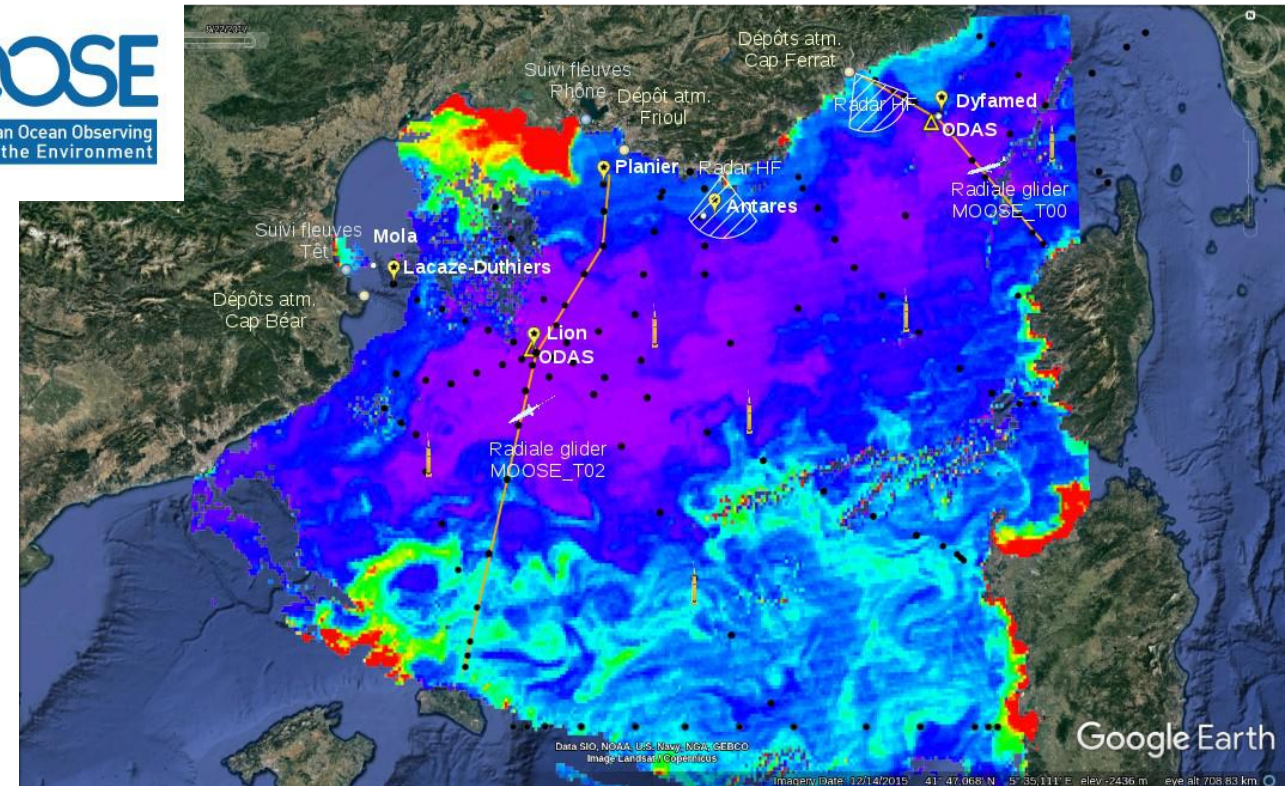
- Canyons moorings : PLANIER, LACAZE
- Meteorological buoys : LION, AZUR
- Deep moorings from EMSO-France :
- LION, DYFAMED, ALBATROSS

➤ Repeated oceanographic cruises :

- monthly : DYFAMED, ANTARES, MOLA
- yearly : MOOSE-GE

➤ Autonomous platforms :

- Gliders (two endurance lines)
- Argo profiling floats from EURO-ARGO



The network of observations of the MOOSE part of the **French ILICO Research Infrastructure**



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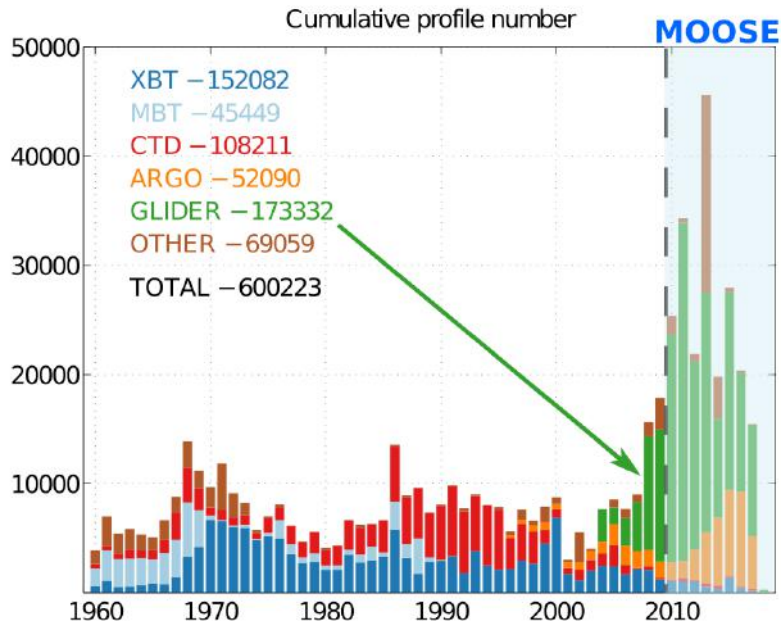
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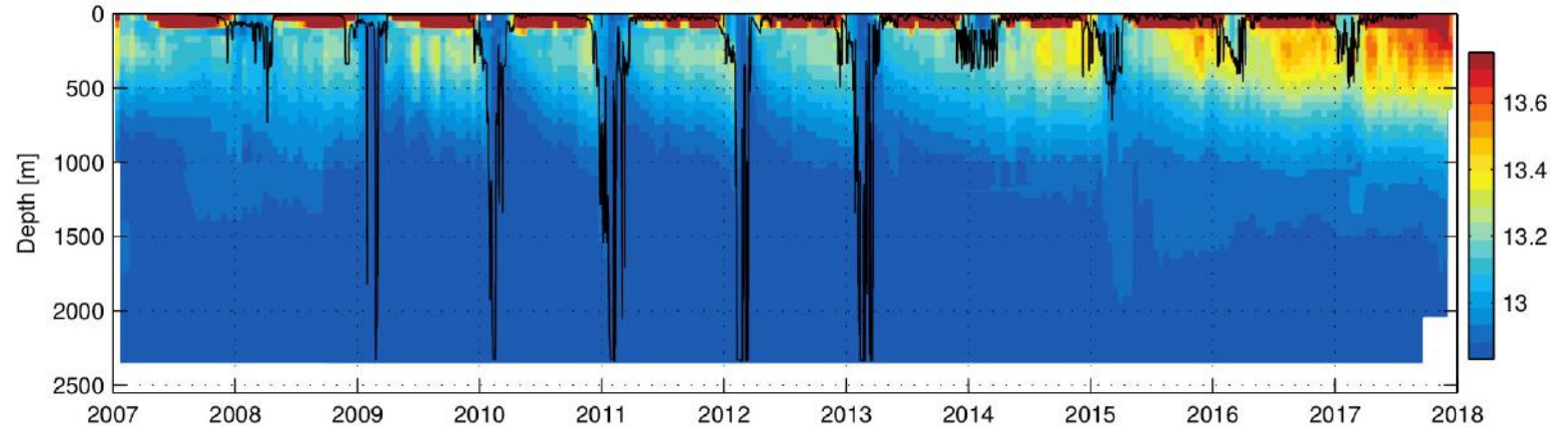
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WP1 : Water mass properties and regional circulation



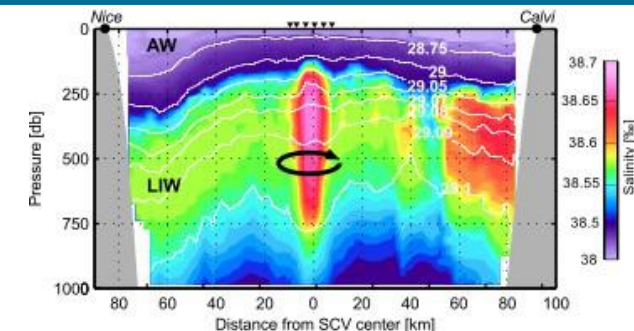
MOOSE gliders = major data provider in the NW Mediterranean



Temperature measurement at the LION mooring site. (Margirier et al, in press)

- **Abrupt warming** of the water masses at intermediate levels.
- **Regime shift** in deep convection in the Gulf of Lion.

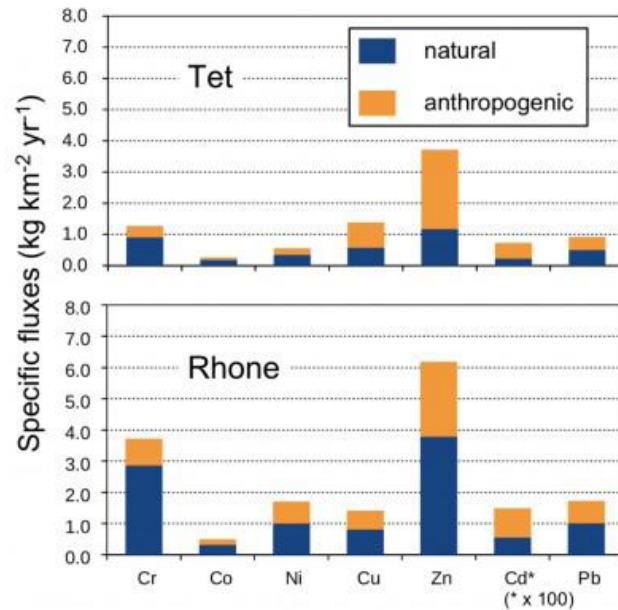
Major breakthroughs concerning **coherent eddies** (Bosse et al 2015, 2016, 2017) → **deep convection and shelf water cascading** (Durrieu de Madron et al 2013, 2017; Houpert et al 2016; Margirier et al 2017; Testor et al 2018).



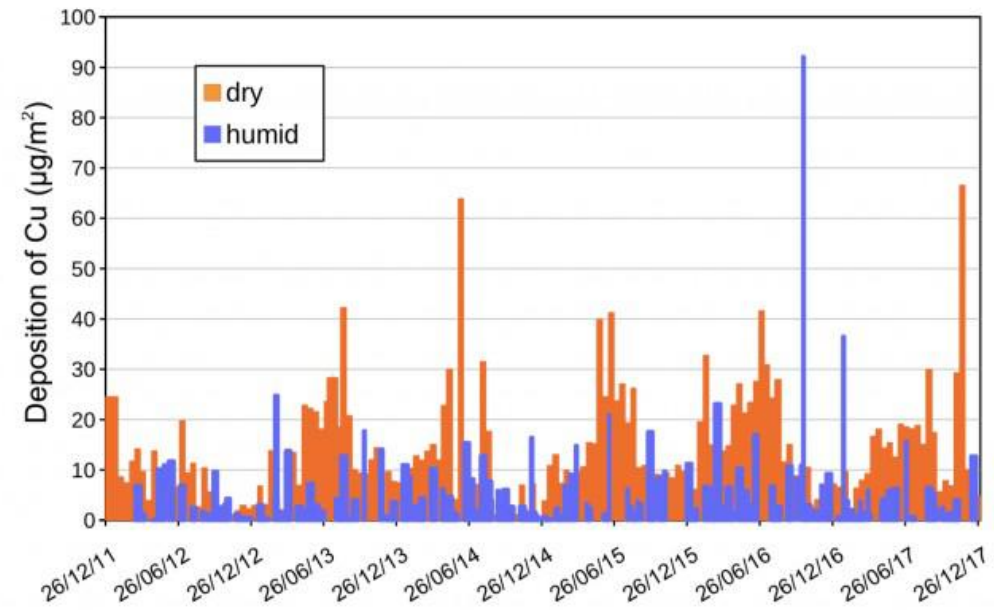
WP2 : Climate and anthropogenic impacts from river inputs and atmospheric depositions



Satellite image of the **Rhone river plume** during a flooding event.

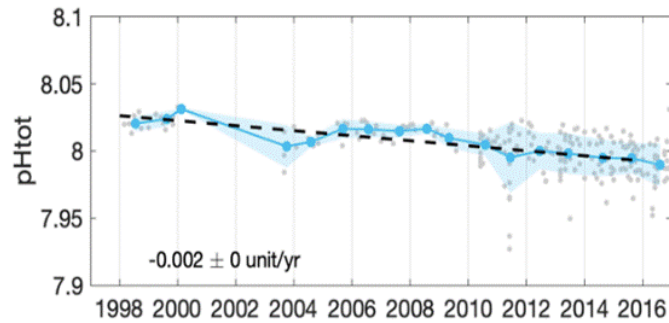


First quantification of the **long-term evolution of nutrient inputs** from Têt and Rhône river water discharges of natural and anthropogenic origin. (Dumas et al 2015)



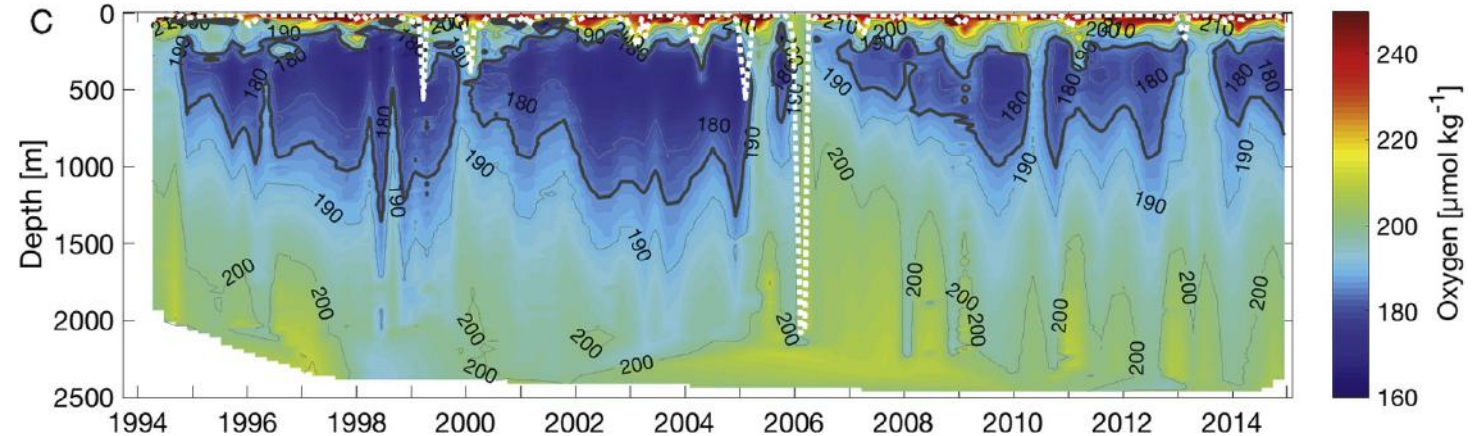
Atmospheric **copper deposition rates** at Cap Béar (eastern Gulf of Lion).

WP3 : Marine biogeochemical cycles and acidification



Evolution of **pH** in the Mediterranean Waters. (Coppola et al, 2020)

Quantification of the **acidification trend** of the NW Mediterranean, the increase of the associated **carbon sink** and set up a formal **carbon audit** of the NW Mediterranean (WP7, EuroSea H2020 project).



Monthly CTD stations at DYFAMED monitoring dissolved oxygen site since 1994. (Coppola et al 2018)

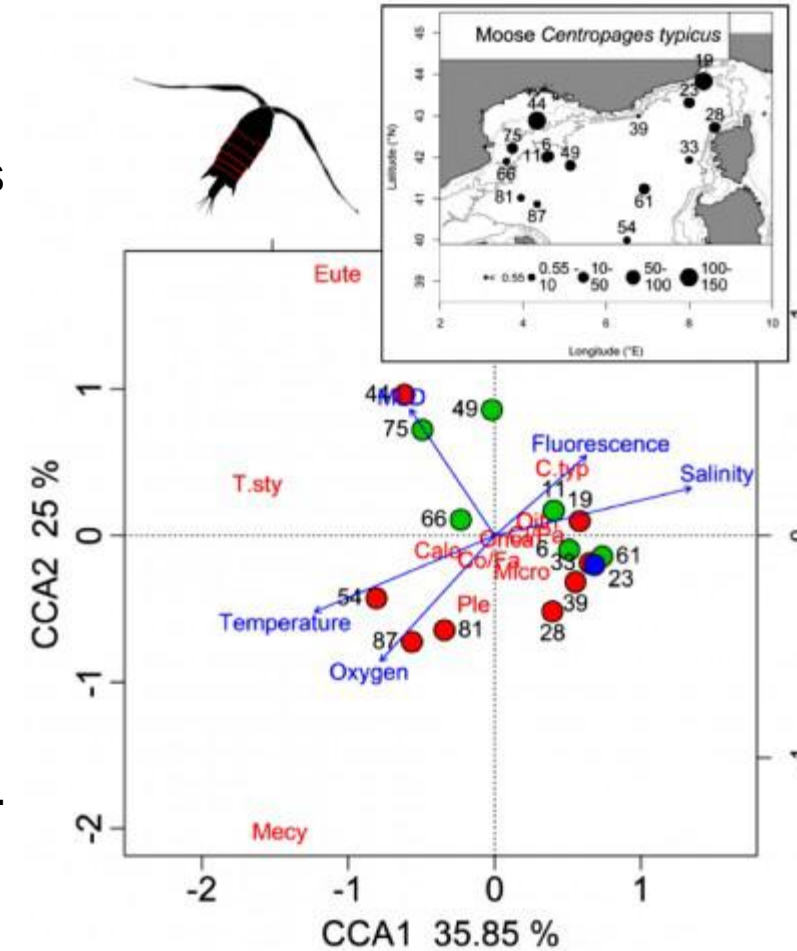
- ✓ Observation of **long term oxygen minimum variability** at intermediate depth sensitive to vertical mixing and biological activity
- ✓ Development of a method to **infer biogeochemical variables** based on temperature, salinity, and oxygen using new **deep learning** techniques (e.g. CANYON-MED; Fourrier et al., 2020).

WP4 : Biological communities and biodiversity



Crew members preparing the deployment of plankton nets during the MOOSE-GE research cruise.

- ✓ Long-term monitoring of **zoo and phytoplankton communities** (nets and DNA metabarcoding).
- ✓ Deep convection region is an area of both **enhanced energy transfer to higher trophic levels and organic matter export** in the NW Mediterranean Sea. (Donoso et al, 2017)
- ✓ **Marine mammals** monitoring during MOOSE-GE cruises and by autonomous platforms (Cauchy et al, 2020).



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- ✓ Once the data are qualified, they are **distributed to the public** through Coriolis (<http://www.coriolis.eu.org>) in near real time when possible, and in delayed mode on the Sea Scientific Open Data Edition (SEANOE) repository (<https://www.moose-network.fr/fr/doi-moose-2/>).
- ✓ The MOOSE data have led to **many scientific results** directly and also through **numerical modelling** studies.

- MOOSE is now a model of **integrated regional observing system** within the Global Ocean Observing System (GOOS <https://www.goosocean.org/>) and contributes to its components (Go-Ship, OceanGliders, OceanSites, Argo).
- MOOSE aims also contributes to **coordination of observational activities at the European level** (EuroGOOS, MONGOOS, MSFD) and is supported by **National/European Research Infrastructures and projects** (Flotte Océanographique Française, IR-ILICO, IR-OHIS, EMSO ERIC, EuroArgo ERIC, H2020 EuroSea, H2020 GROOMII, H2020 JERICO-RI).

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