

MASSILIA PROJECT Modelling of the Bay of Marseille:

Impact of the Anthropogenic Supply on the marine coastal ecosystem



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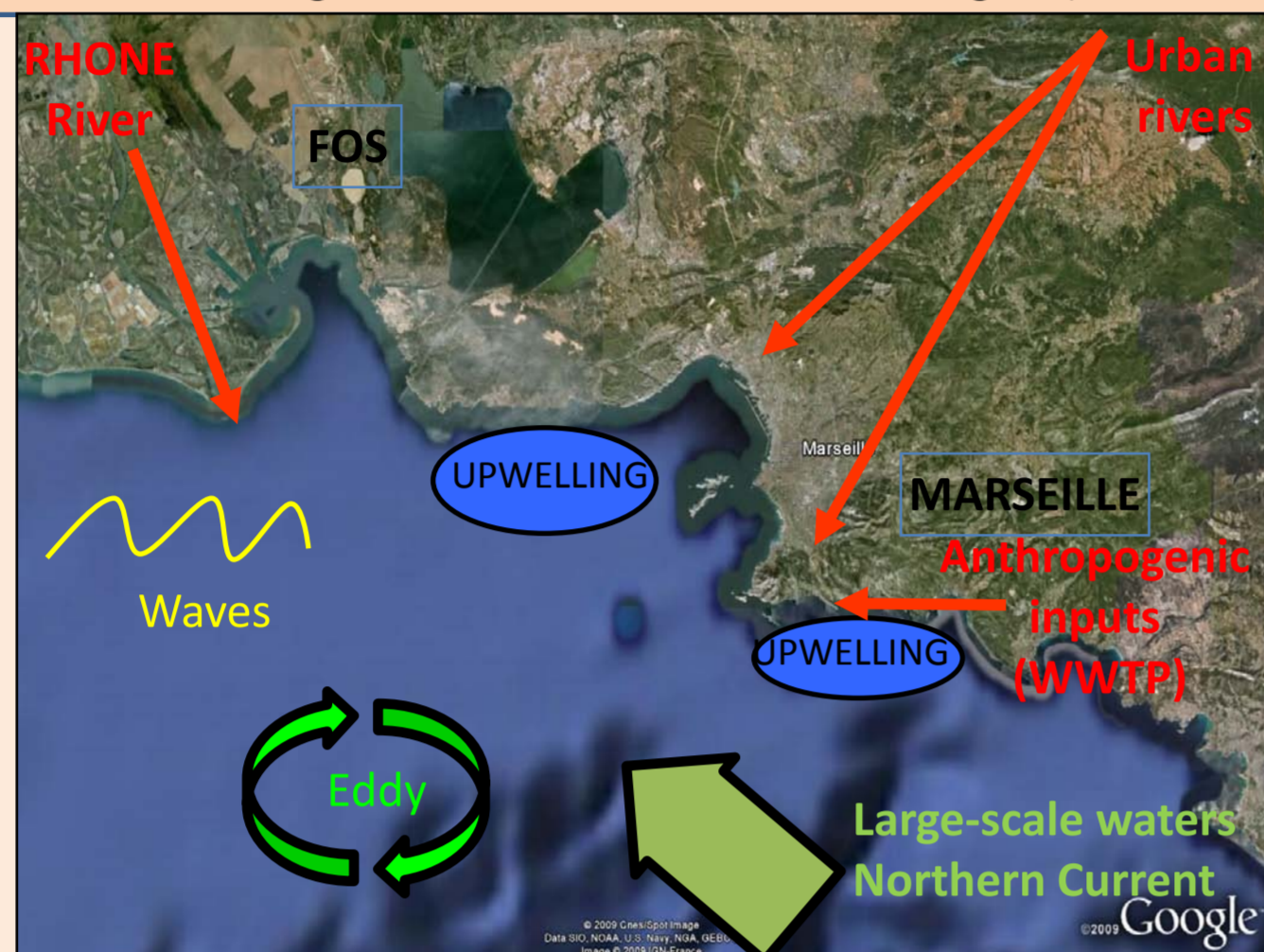
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INTRODUCTION

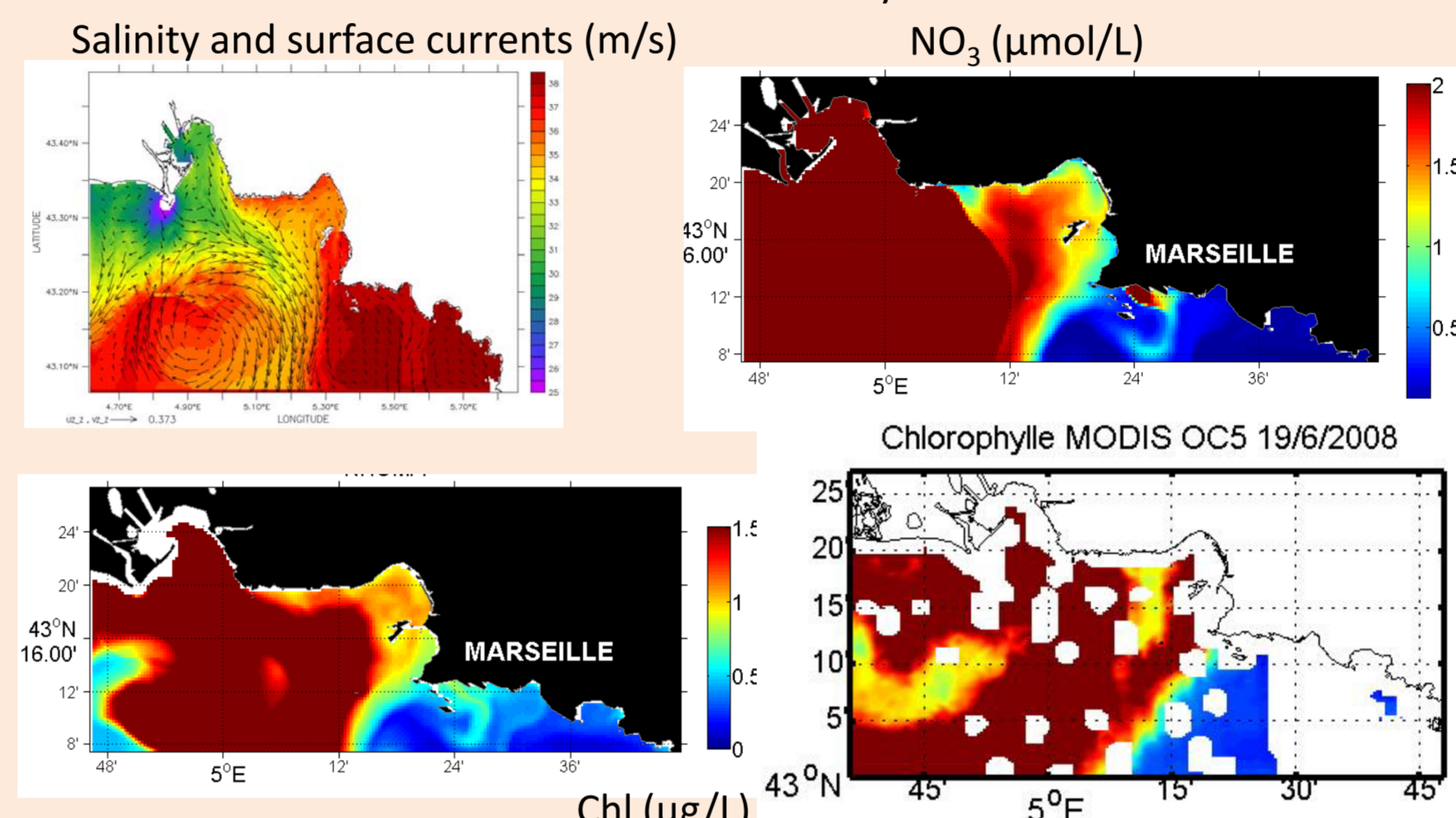
Numerical tools and in-situ observations were used in the area off Marseille to answer the following questions:

- What are the respective contributions of the physical forcing in the modulation of the oligotrophic level of this coastal ecosystem submitted to strong anthropogenic inputs?
- What is the influence of extreme events, which frequency increases with global warming (floods, storms, heat events), on the changes in the first trophic level (phytoplankton) in the Bay of Marseille?
- Are the chemical contaminant (PCB) inputs from the city to the sea off Marseille, stocked inside the coastal marine area or exported to the open sea?



Rhone River diluted water intrusion

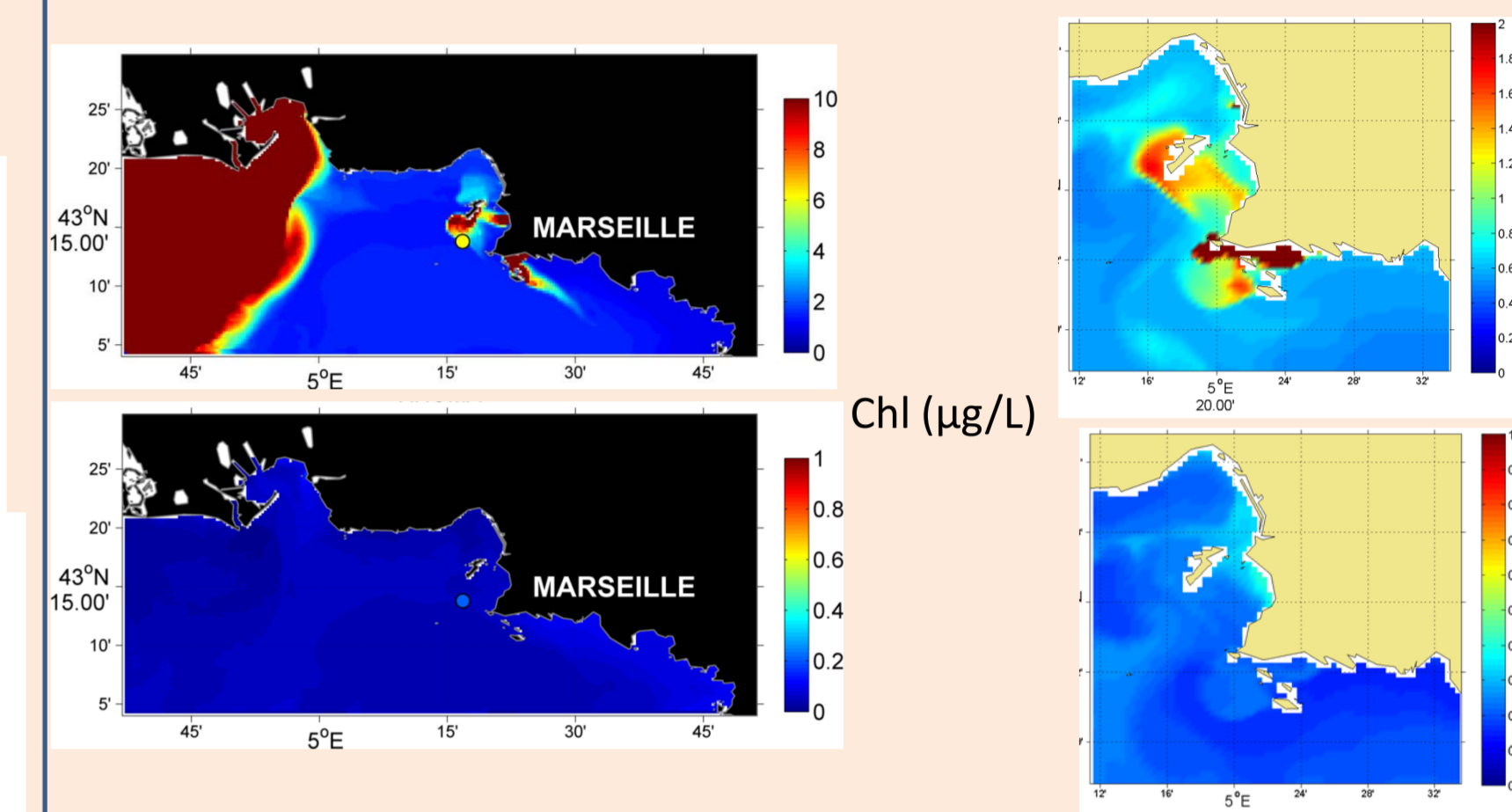
Decrease of salinity and anticyclonic eddy (Schaeffer et al, 2011) pushing Rhone River diluted water in the Bay of Marseille



Extrem event

Autumn Rainfall

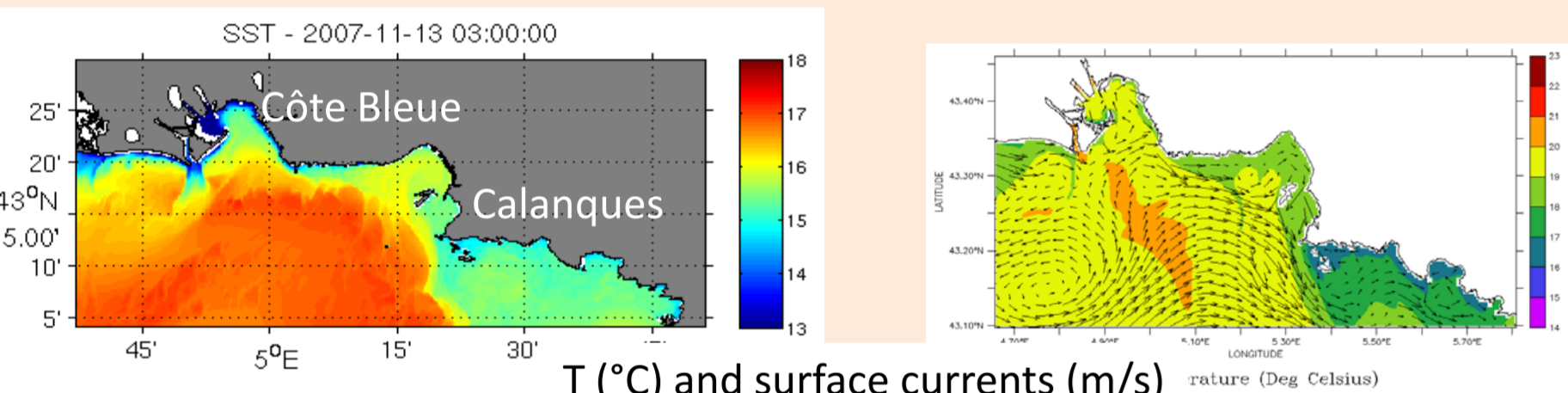
Typical event



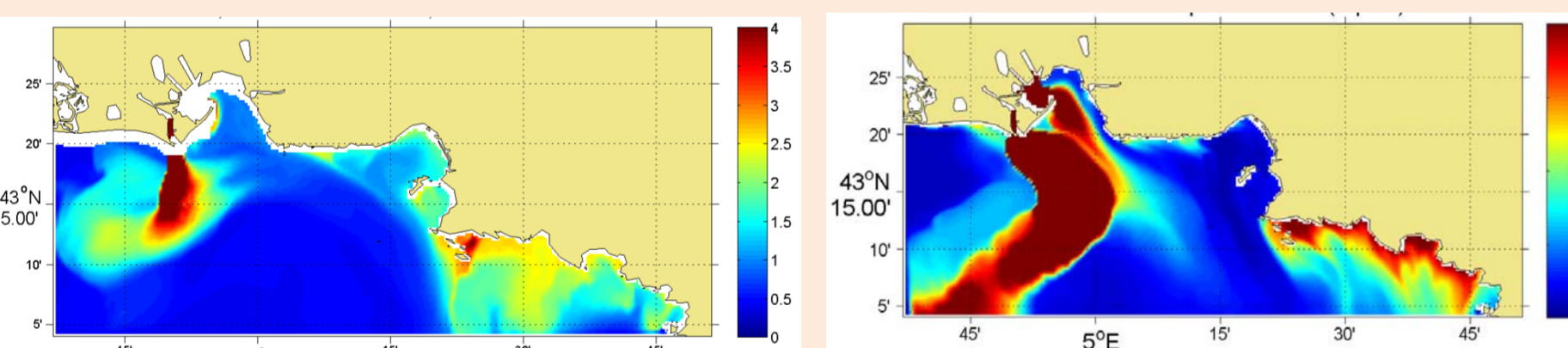
Strong OM and nutrients localized inputs inducing strong variations these concentrations locally but having weak impact on phytoplankton at this season

Mistral

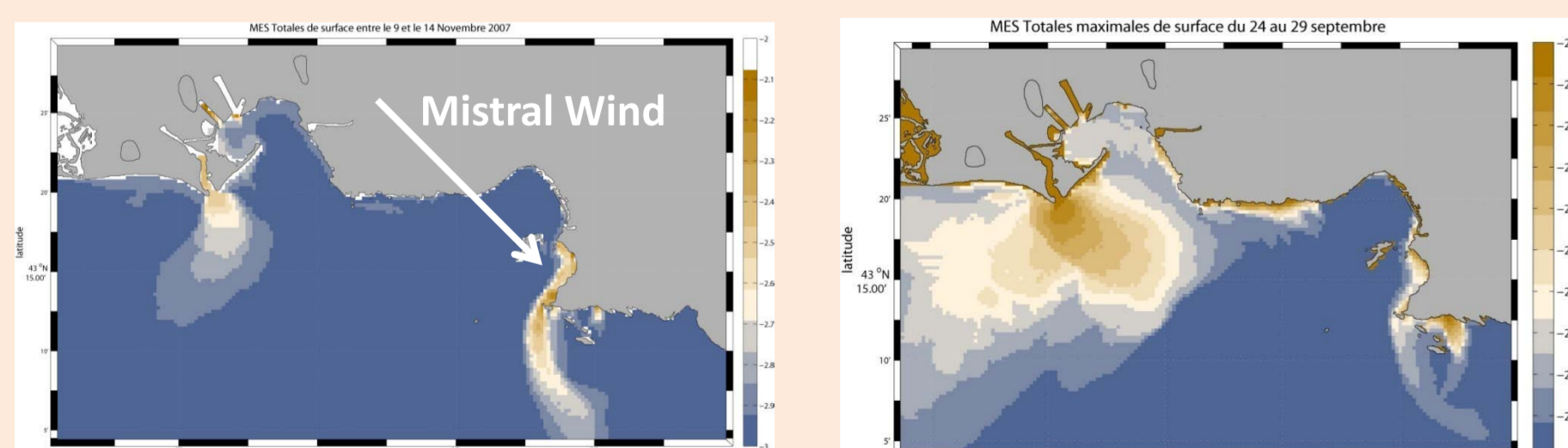
Typical event



Decrease of T° of 2 - 4 °C in Calanques and Côte Bleue areas

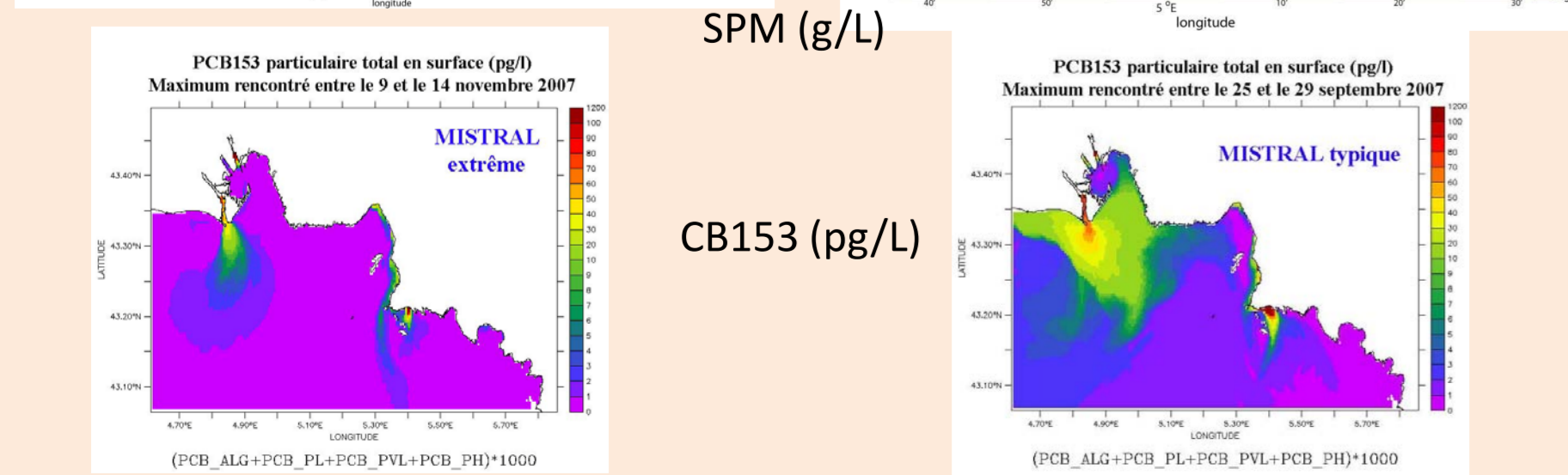


NO₃ reach the sea surface and are exported offshore



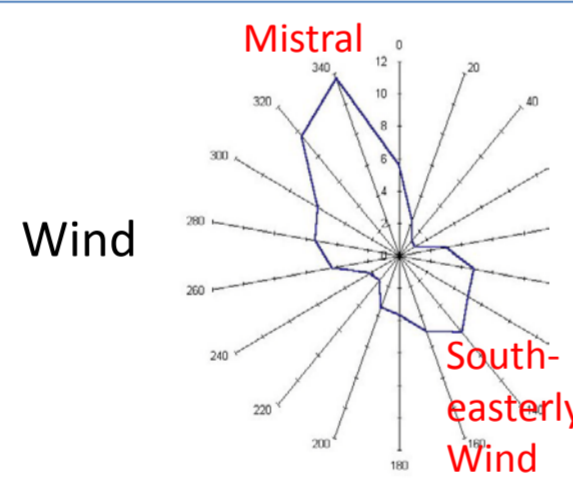
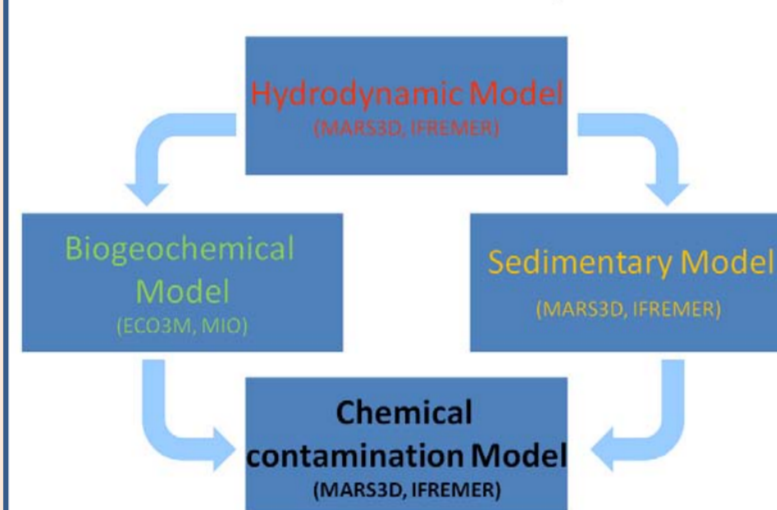
SPM (g/L)

CB153 (pg/L)

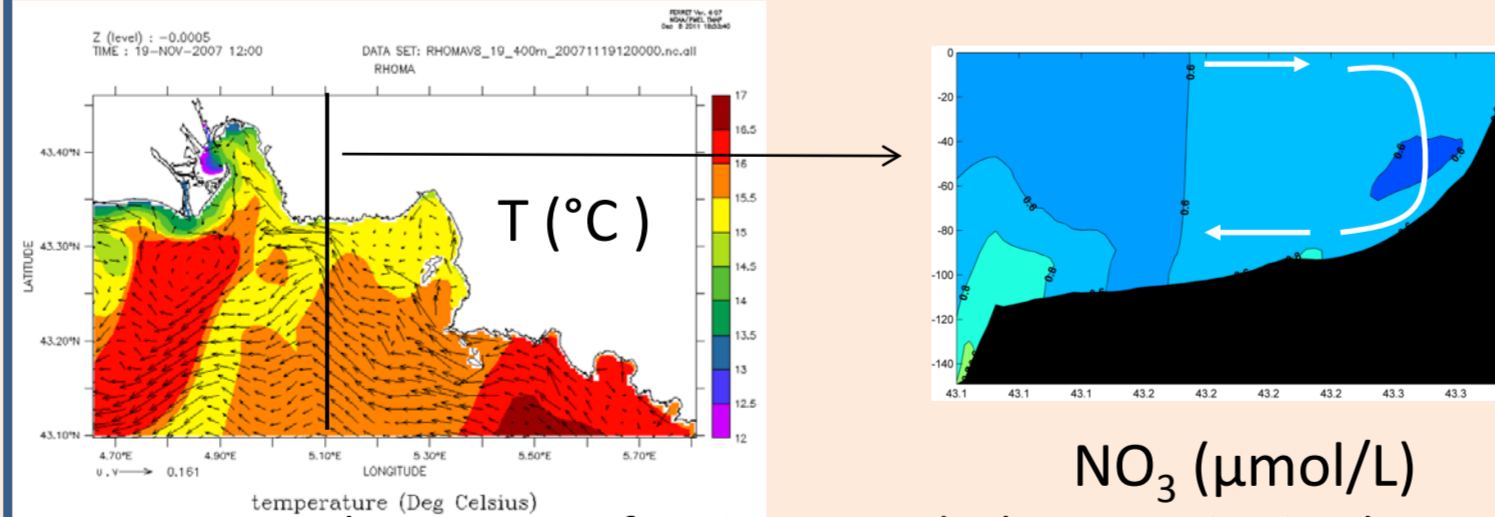


Sediment erosion (SPM, particulate CB153) in the Southern Bay and offshore export at the sea surface

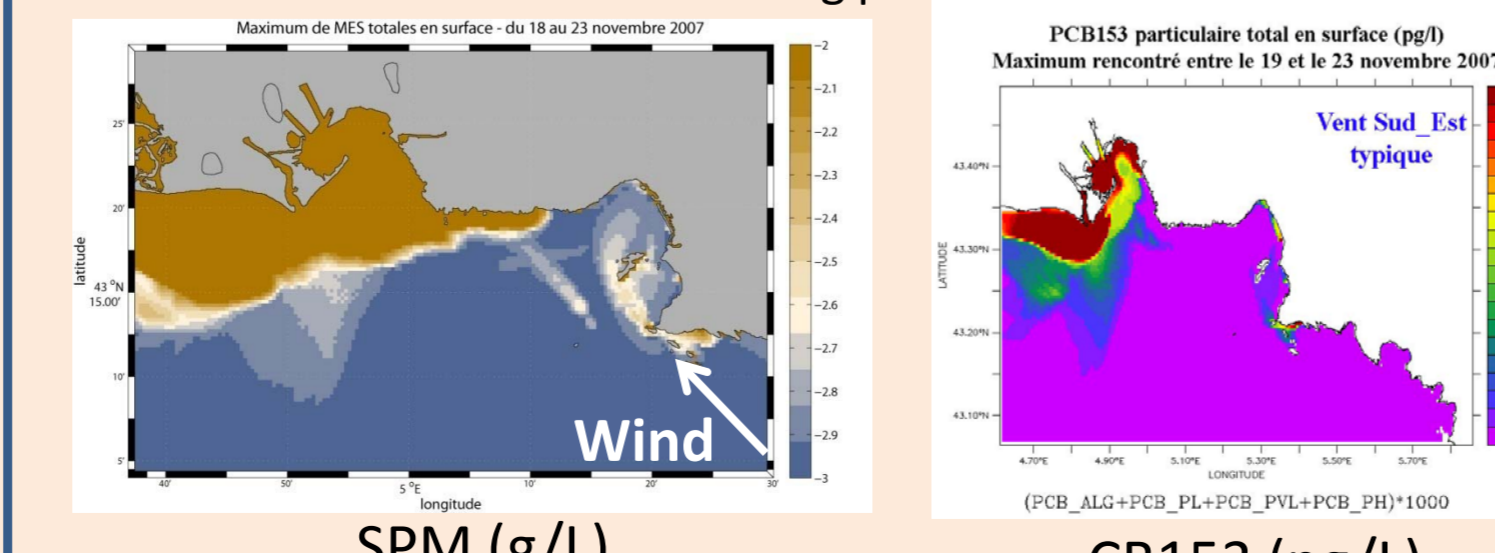
Numerical Tools System



South-easterly wind event

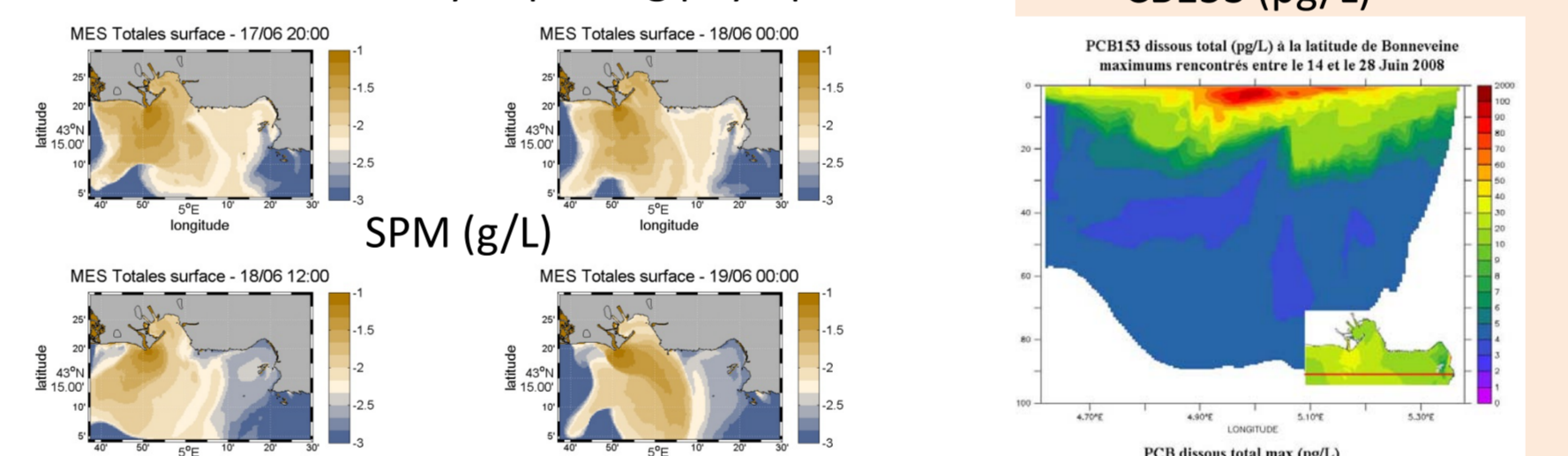


Large-scale waters surface inputs and a homogenization by a downwelling process



Erosion event in Cortiou (WWTP) and transport nearshore inside the Bay of Marseille

High Nutrients and Organic Matter inputs inducing a high increase of these surface concentrations directly impacting phytoplankton



High SPM and CB153 inputs increasing these surface concentrations in the first 20 meters depth in the Bay of Marseille

CONCLUSION

- Building of a Numerical tools system of the area off Marseille available for further studies
- Reliable simulation of meteorology, hydrodynamics, biogeochemistry, sedimentology and CB153 transfers in the Bay of Marseille
- Characterization for each event of the inputs of Nutrients, OM, SPM and CB153, their spatial impact and their export (see Table)
- The complete results could be found in the scientific report of the Massilia Project and in scientific publications:

Pairaud, L., Gatti, N., Bensoussan, R., Verney and P. Garreau, 2011. Hydrology and circulation in a coastal area off Marseille: Validation of a nested 3D model with observations. *Journal of Marine Systems*, 88, 20-33.
 Fraysse M., C. Pinazo, V. Faure, R. Fuchs, P. Lazari, P. Raimbault, I.L. Pairaud, 3D, 2013. Coupled physical-biogeochemical model development around Marseille's coastal area (NW Mediterranean Sea) : What complexity is required in coastal zone?, *Plus One*, in press.
 Verney, R., Jany, C., Thouvenin, B., Pairaud, I., Voussdoukas, M., Pinazo, C., Arduin, F., Cann, P., 2013. Sediment transport in the bay of Marseille : role of extreme events. *Proceedings of Coastal Dynamics'13*, Arcachon, France, 1811-1822.
 Thouvenin et al., CIEM 2013 (Poster 3008) Export of chemical contaminants from a big mediterranean city: modelling of dissolved and particulate transport in the bay of marseilles <http://archimer.ifremer.fr/>

Strong SPM and CB153 localized inputs inducing strong variations these concentrations locally and in Calanques area and the Southern Bay

Event	Inputs		Spatial Impact	Exports
Rhone River Intrusions	Strong Nutrients and OM inputs	Strong SPM and CB153	On the sea surface over a large area	--
Rainfall	Nutrients and OM	SPM and CB153	On the sea surface Over a limited area	--
Mistral Wind	Strong Nutrients inputs by upwelling	Erosion Southern Bay	The whole water column (upwelling)	Offshore Export of surface water
South-easterly Wind	Weak inputs (most of events)	Erosion WWTP	The whole water column (downwelling)	Offshore Export of deep water + Nearshore Export Of surface water