

RESPONS OF MEDITERRANEAN ECOSYSTEM ON ANTHROPOGENIC DISTURBANCES

Global changes, impacts of river and atmospheric inputs

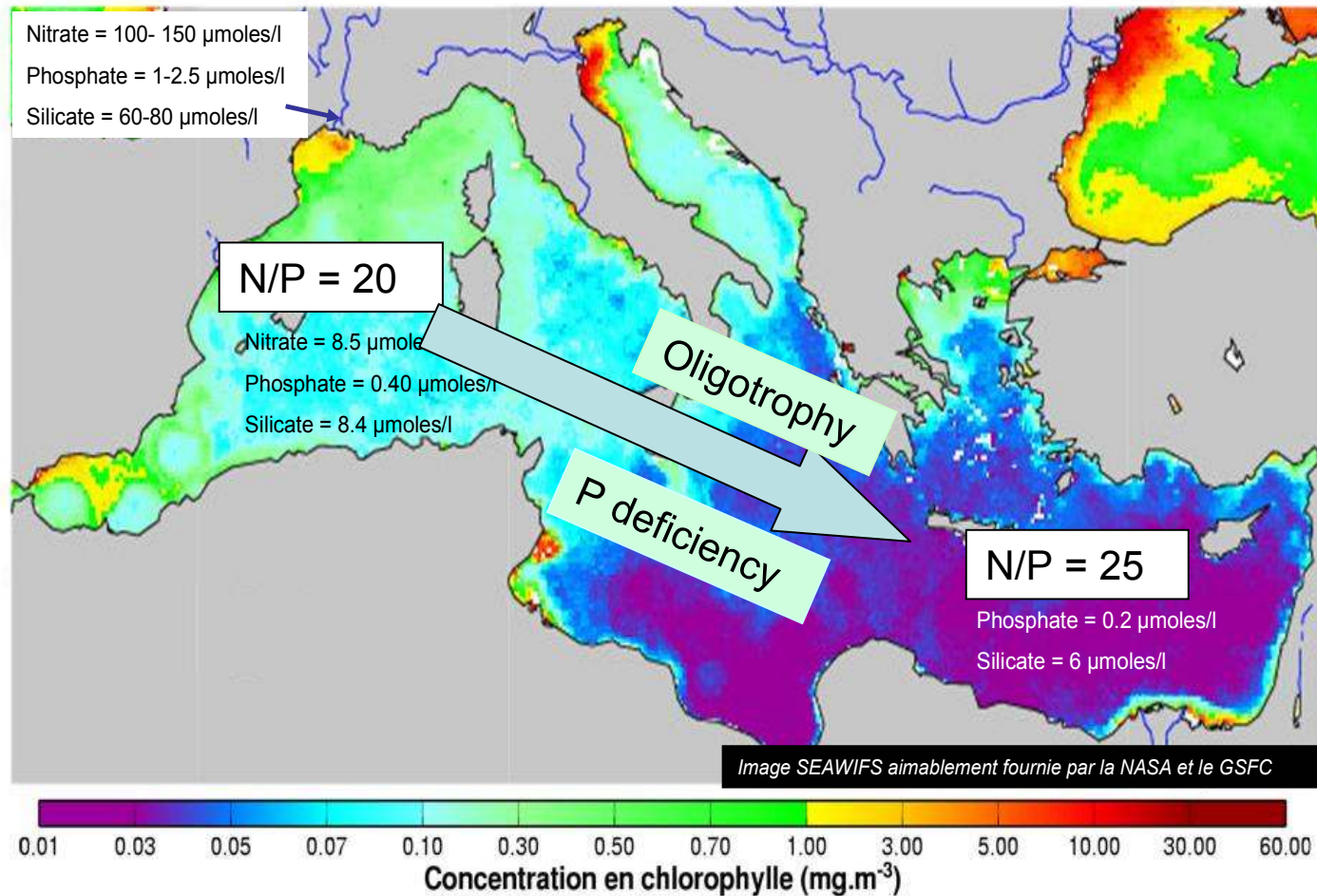


Mediterranean Sea = « small Ocean »

Area for deep water formation

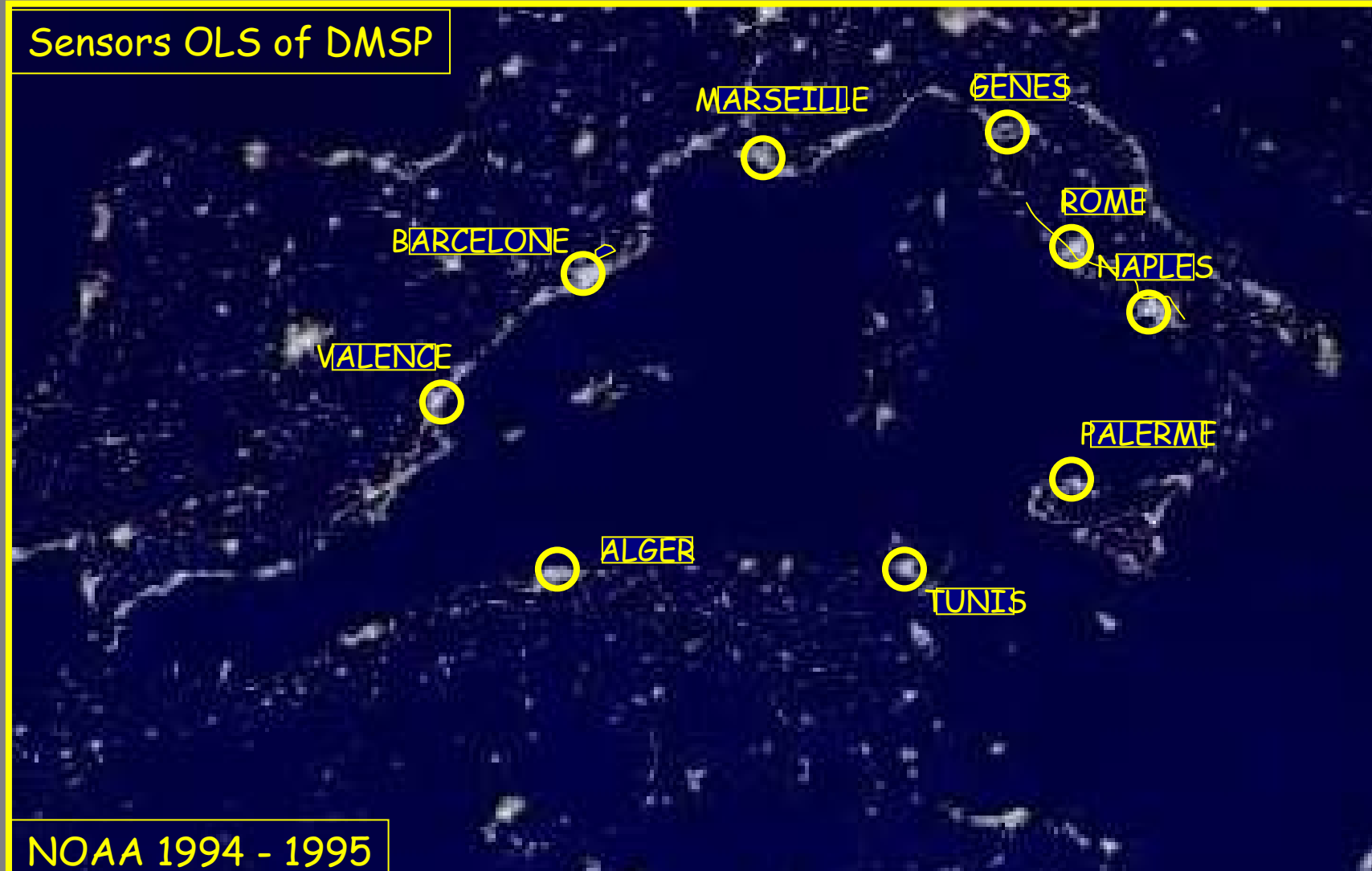
Cyclonic circulation with many mesoscales features (frontal zone, eddies, coastal upwelling...)

Oligotrophic system with a west to east gradient and specific N/P ratios



The Rhône river: most important river in the western Mediterranean

The western basin is strongly urbanized

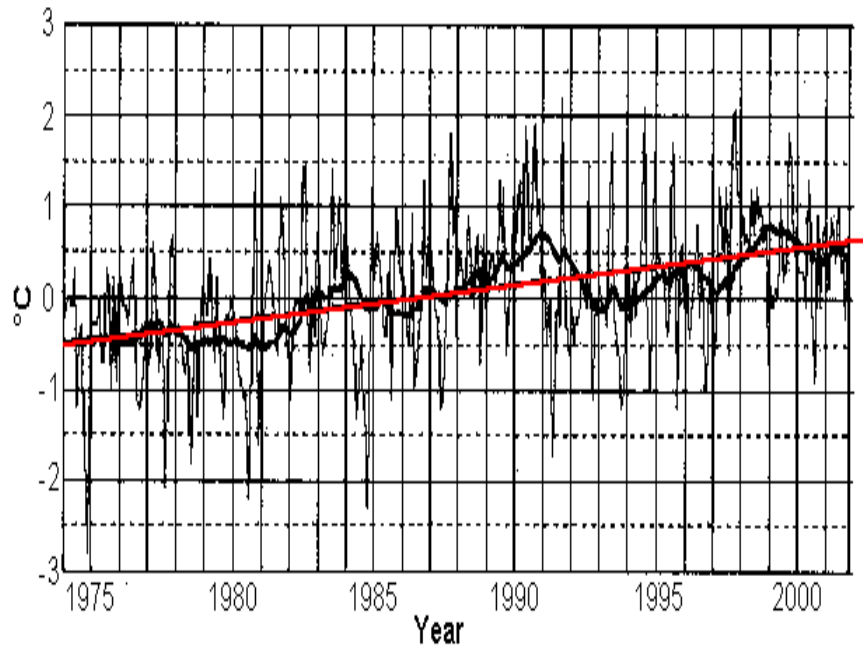


The Mediterranean sea provides a unique environment to observe changes
at local and large scales

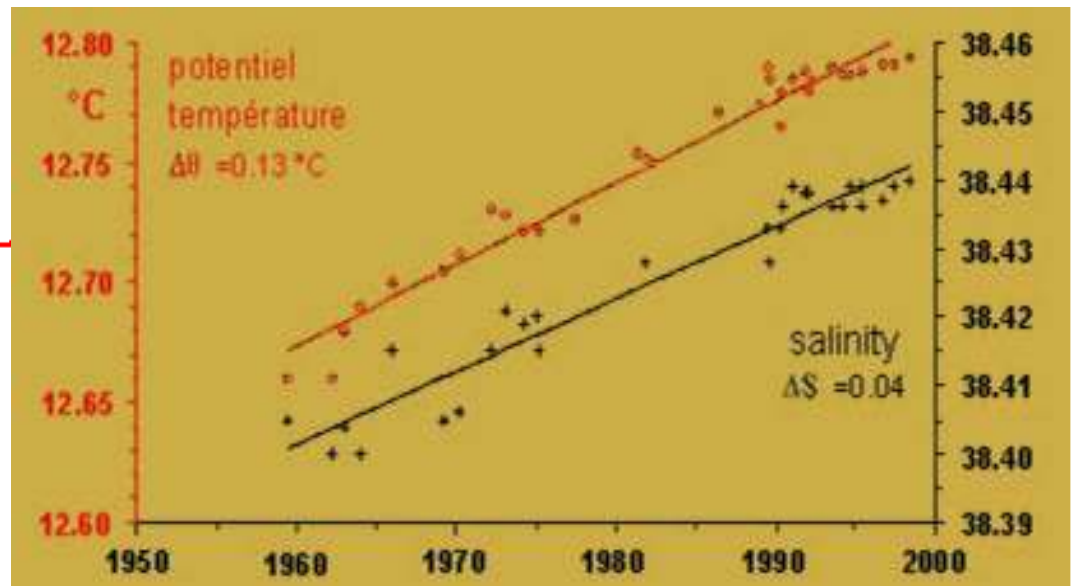
Some changes are already noticeable

Surface temperature

$1.1^{\circ}\text{C} / 27 \text{ ans} = 0.04^{\circ}\text{C} / \text{an}$



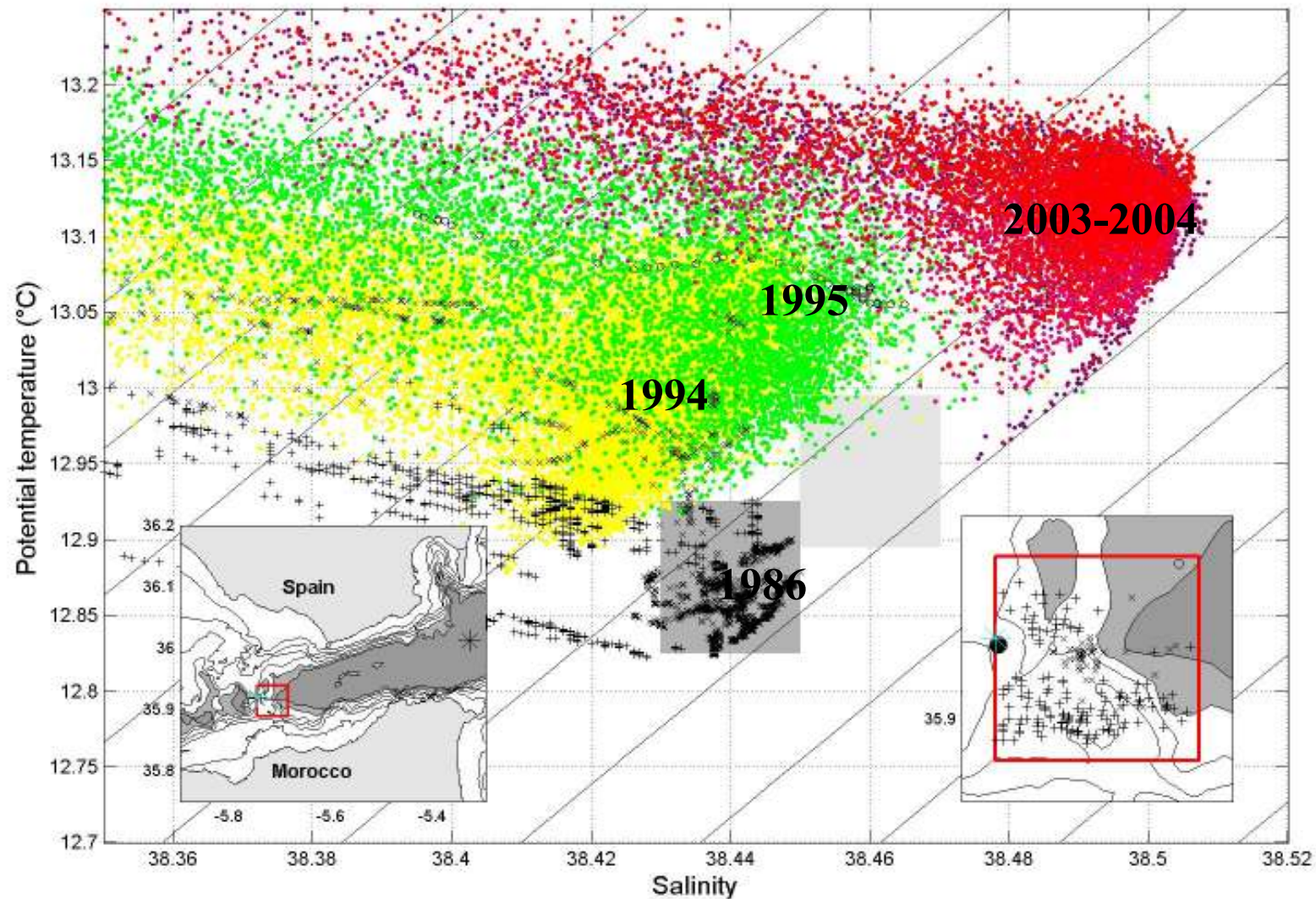
Temperature and salinity at 2000m depth



(Béthoux *et al.*,1992)

Extraits de Salat et Pascual, 2002. CIESM Workshop Series #16
On « Tracking long-term hydrological change in the
Mediterranean Sea »

Spectacular changes !!!

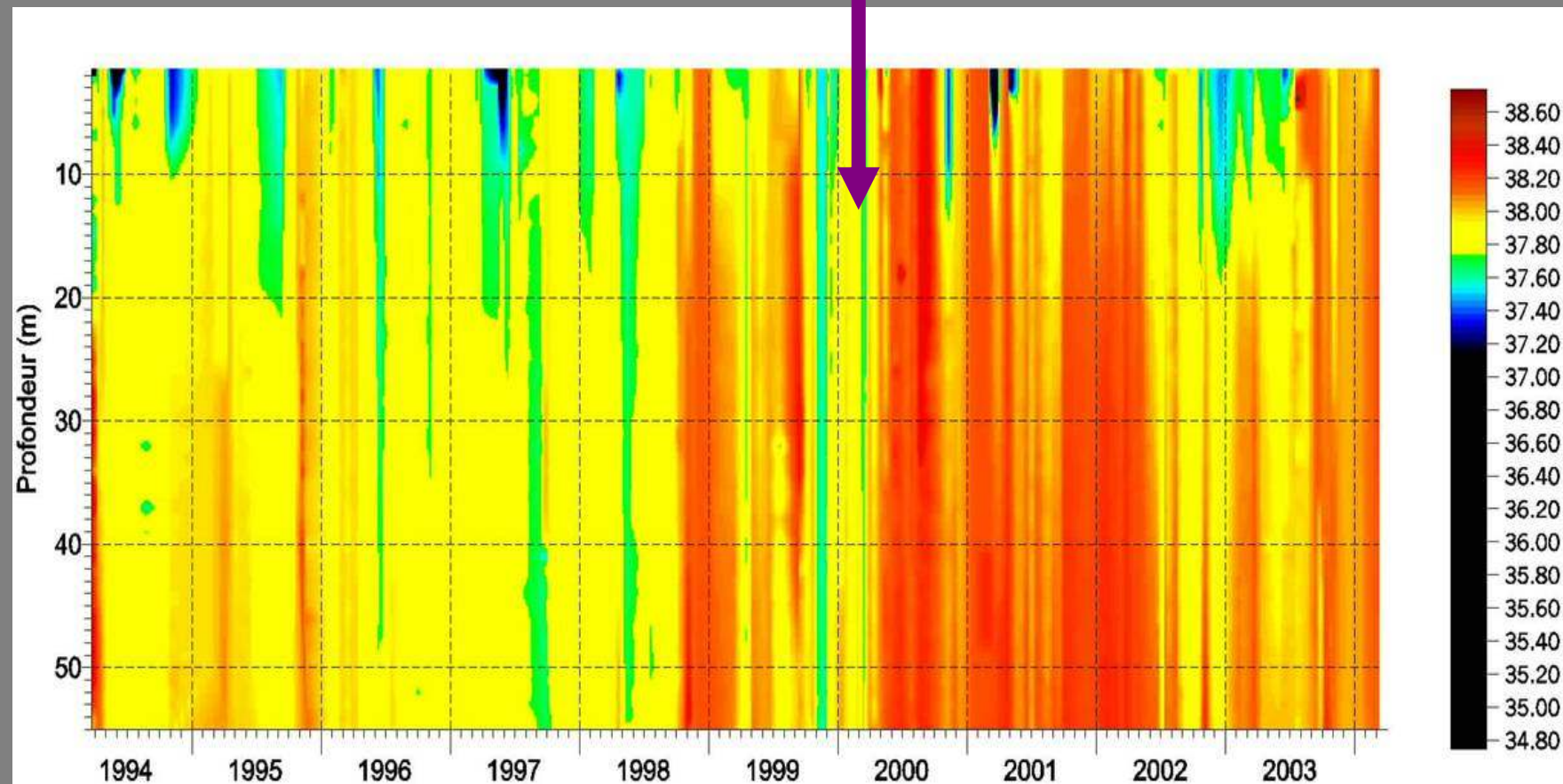


⇒ Hydrological characteristics of water masses have changed in the strait of Gibraltar (*Fuda et al., 2005*)

Near the coast: Bay off Marseille

Drastic changes in 99-2000?

Saltier waters



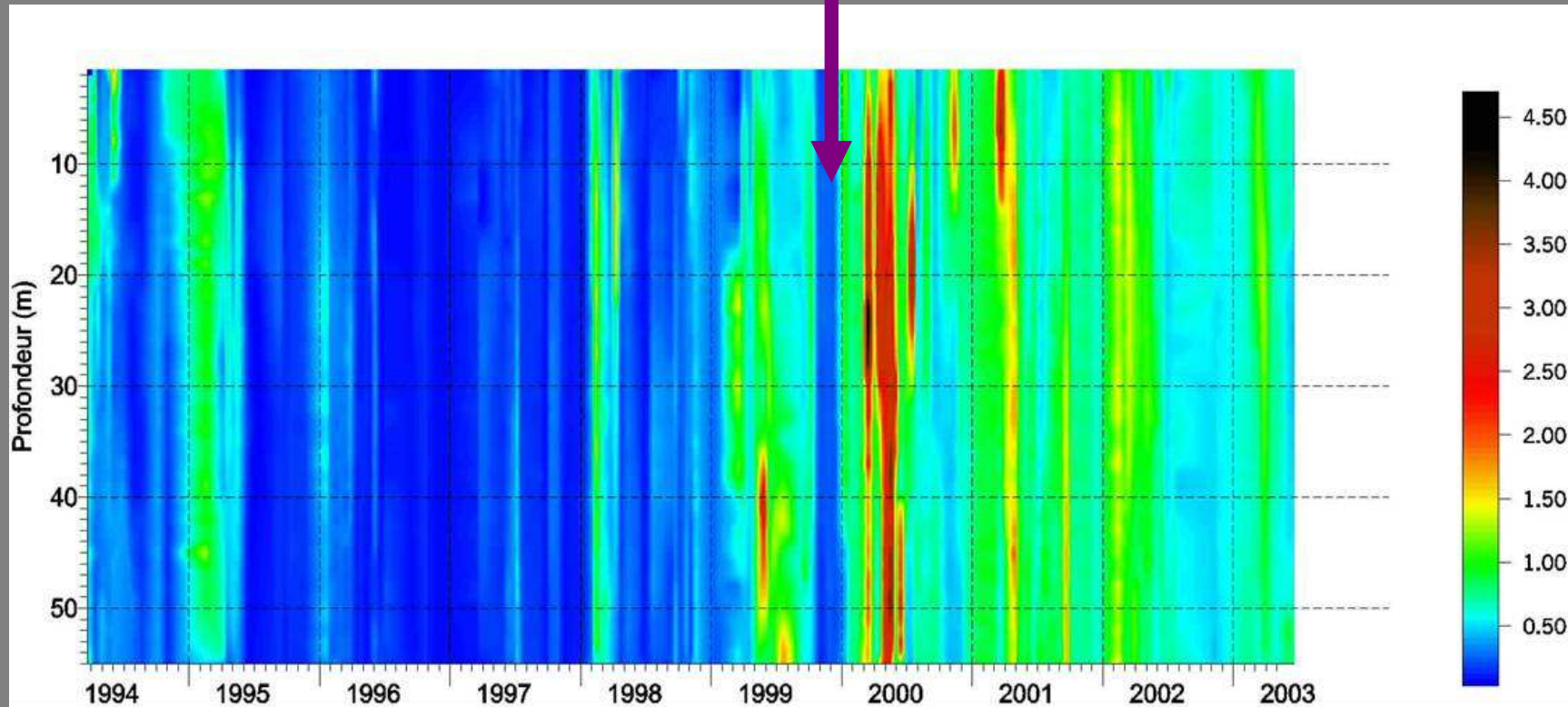
SALINITY

Lafont *et al.*, 2004

Near the coast: Bay off Marseille

Drastic changes in 99-2000?

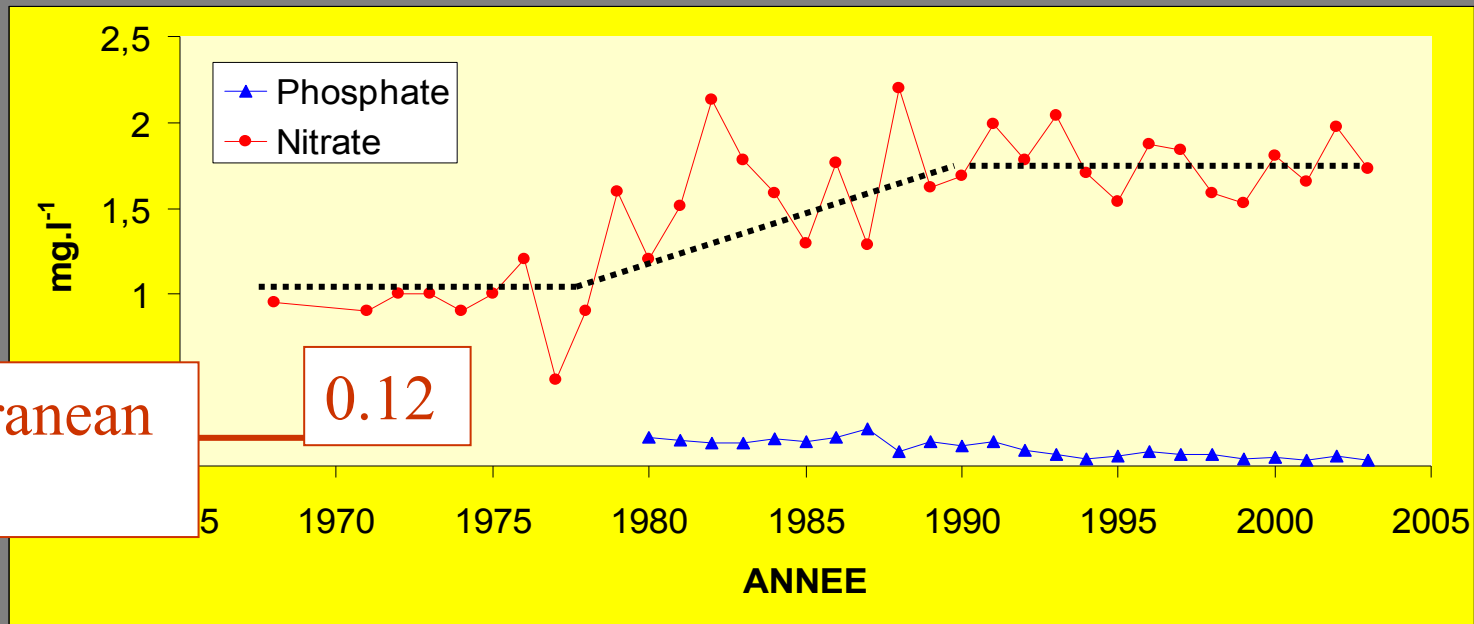
« Green » water



CHLOROPHYLL

Lafont et al., 2004

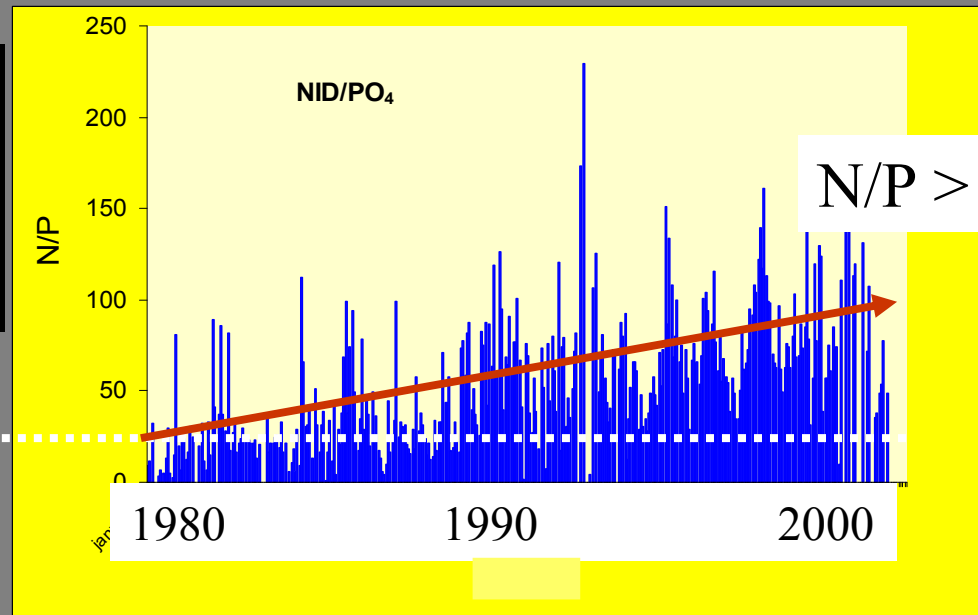
Time evolution of nutrient in the Rhone River



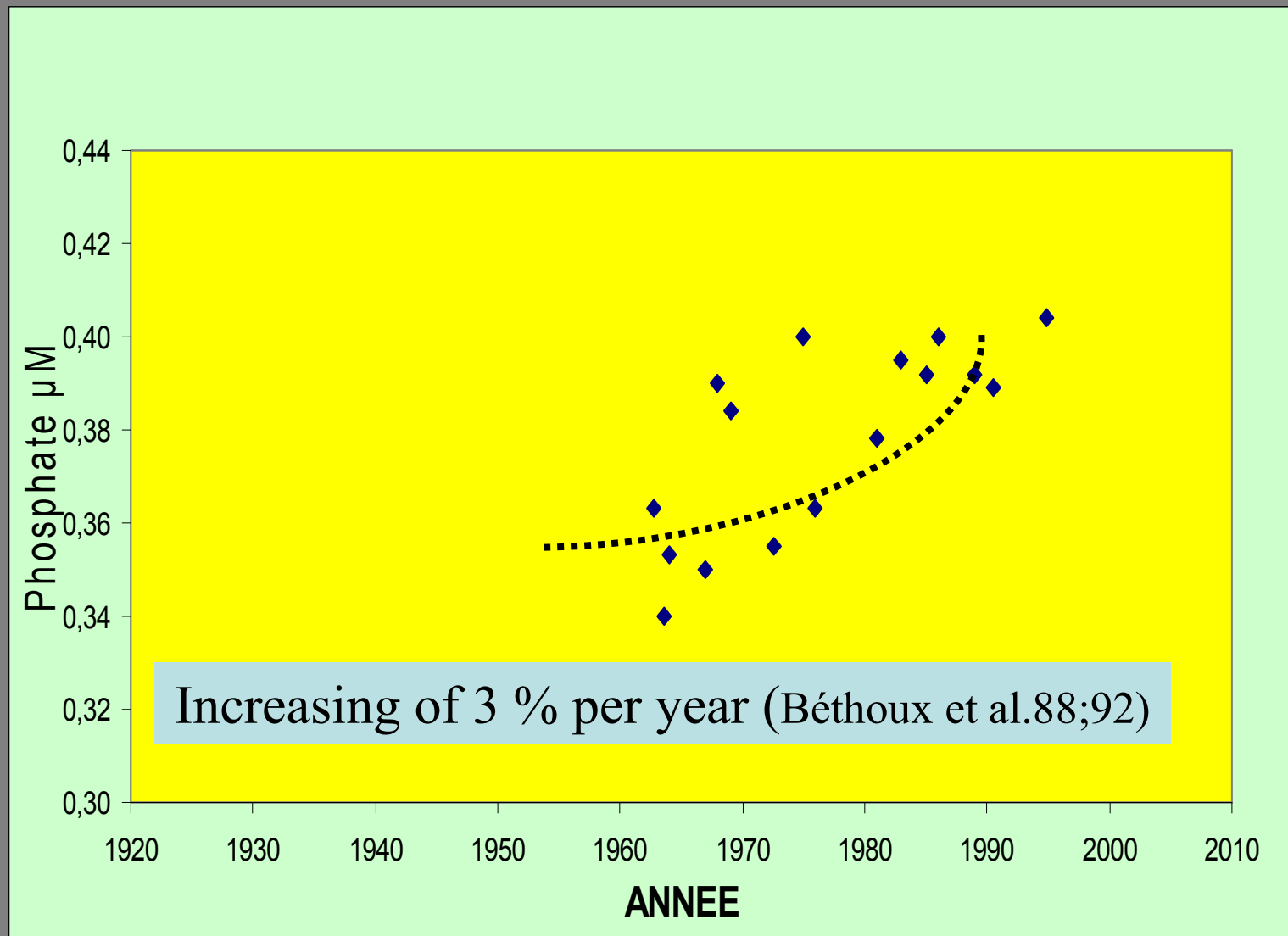
The nitrate/phosphate ratio increases

DYSTROPHY

N/P = 20

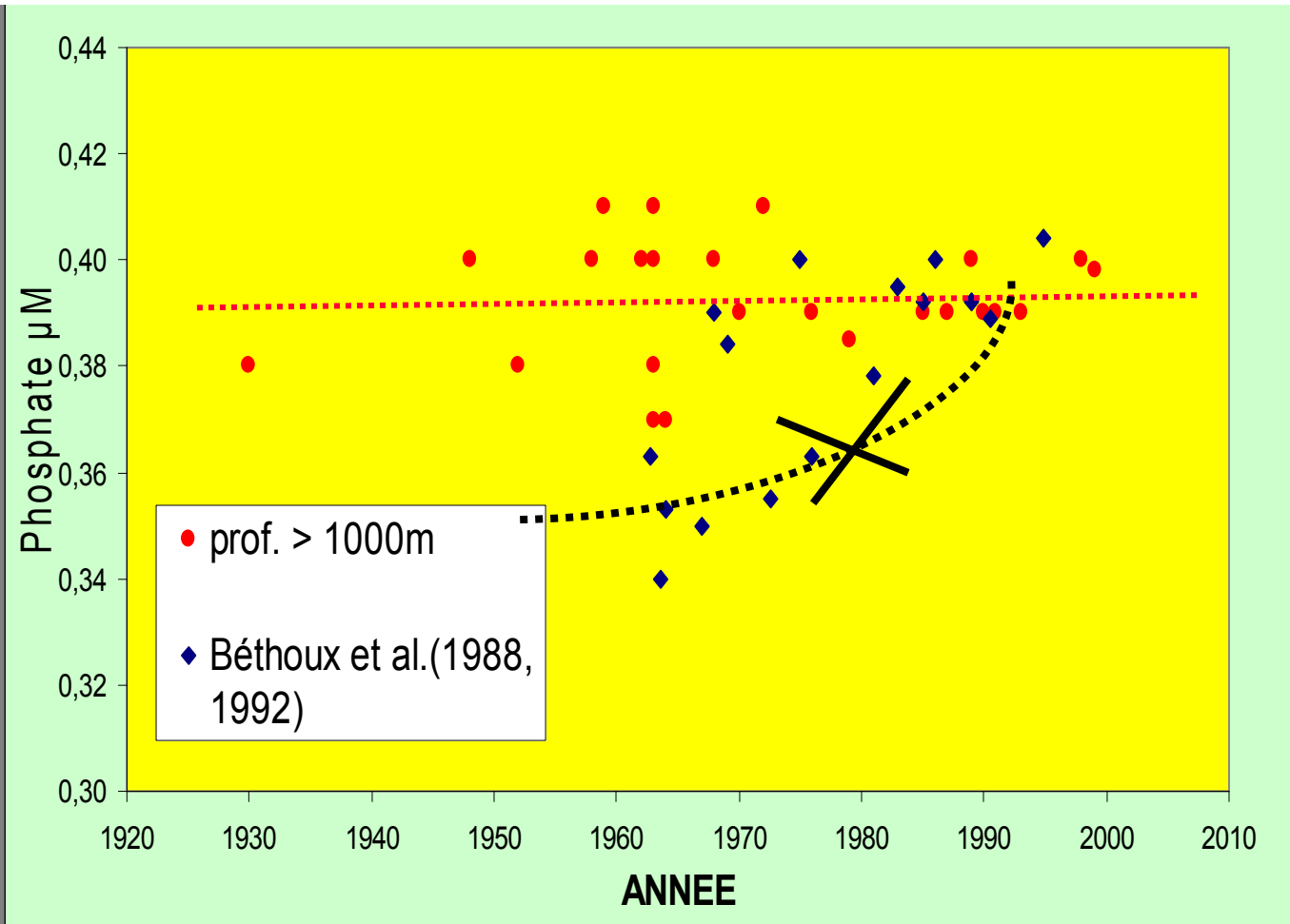


Evolution of chemical composition: Phosphate ?



Consequences : eutrophication - Anoxia

But taking into account the regional variability cancels this temporal evolution



Need of adapted data to correctly detect long term evolution

Western Mediterranean Sea

Threatened system

The anthropic action could be disastrous along the coasts as well as off shore

Despite intensive research efforts undertaken over more than a century, an integrated view of the evolution of Mediterranean Sea is still lacking

The ocean is critically under-sampled both in space and time

Western Mediterranean Sea

Historical data are useful but not enough
sufficient

to quantify temporal evolution

Need for long-term observation...

- near the coast and offshore
- based on multi-sites system

To observe spatio-temporal variability

COM has recently developed long term- time series
associated with new french programmes on the
Mediterranean Sea (HYMEX, MERMEX, MOOSE)

MONITORING OF INPUTS FROM THE RHONE RIVER



Automatic sampling at high frequency

To take into account short and violent flash-floods

Monitoring of meteorological data and atmospheric inputs

(Most important source of pollution in the open sea)

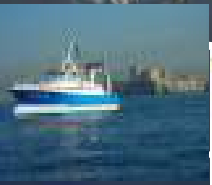


And numerous observations at sea between the Rhone mouth and the bay off Marseille



Inputs from Rhône river

Long-term mooring

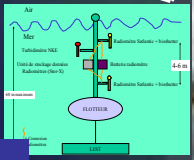


Meteo

Atmospheric inputs

Continuous measurements during transit

Hydrology



Marseille

OBSERVATION SITES NEAR MARSEILLE

Long-term moorings

Altitude 47.59 km



Elaborating a **realistic** monitoring strategy to describe **long-term** hydrological variations at large scale in the Mediterranean Sea



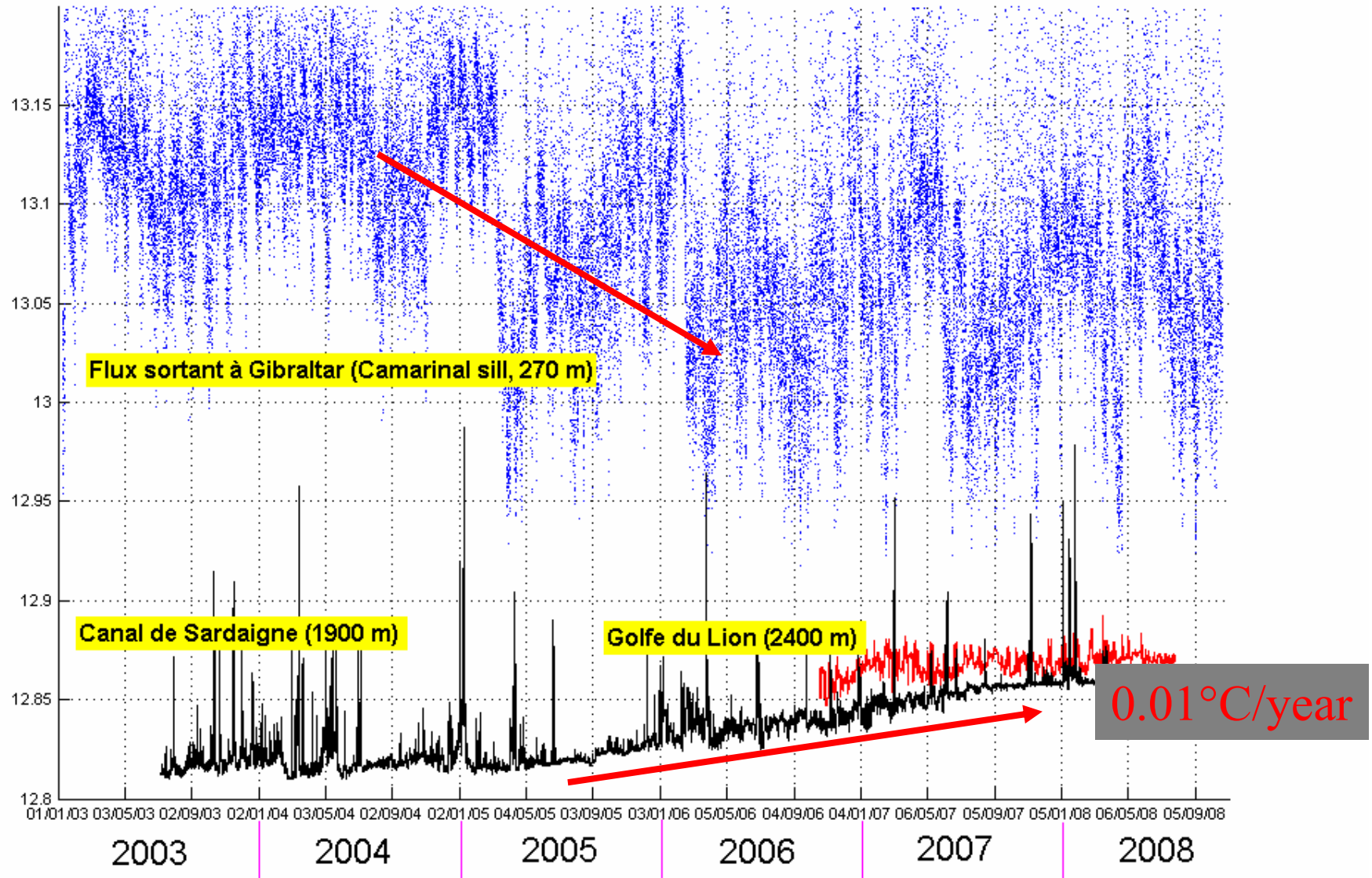
The CIESM observational network : **HYDROCHANGES**

CIESM
THE MEDITERRANEAN SCIENCE COMMISSION



Service d'Observation
Centre d'océanologie
de Marseille

Séries horaires de température potentielle (°C) sur les sites HYDROCHANGES gérés par le COM



Recent results

All these operations have been proposed for the elaboration of the new programme « Mediterranean Ocean Observation On Environment (MOOSE) »

