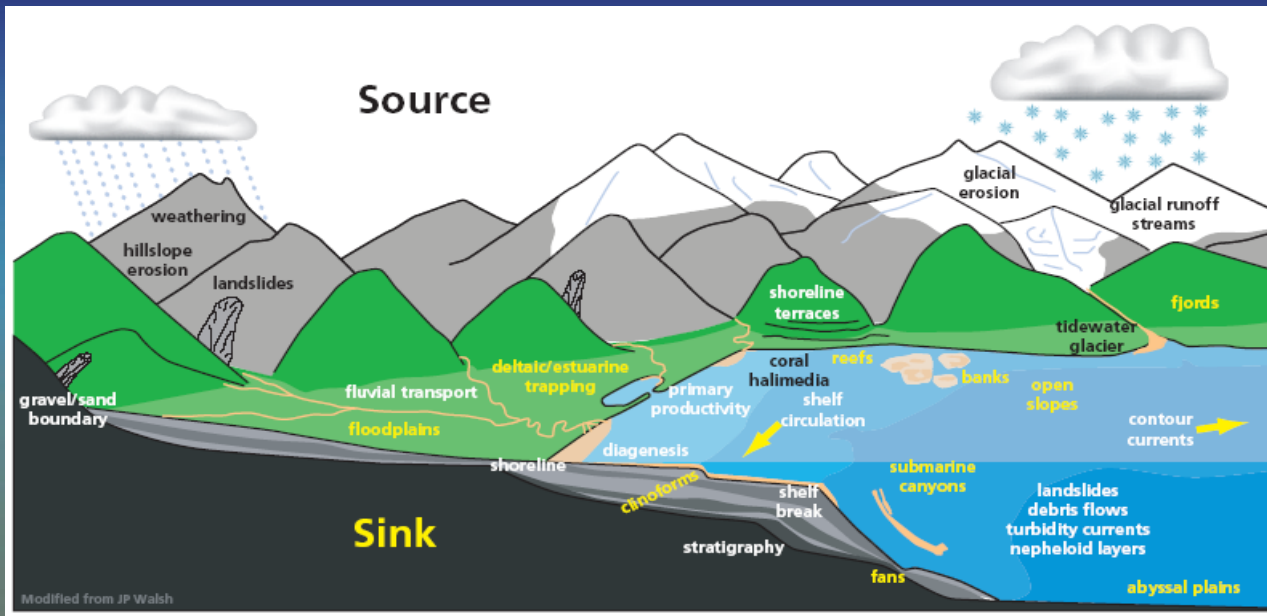


# Sediment transport studies using a cabled observatory: what are the possibilities?

Albert Palanques and Pere Puig

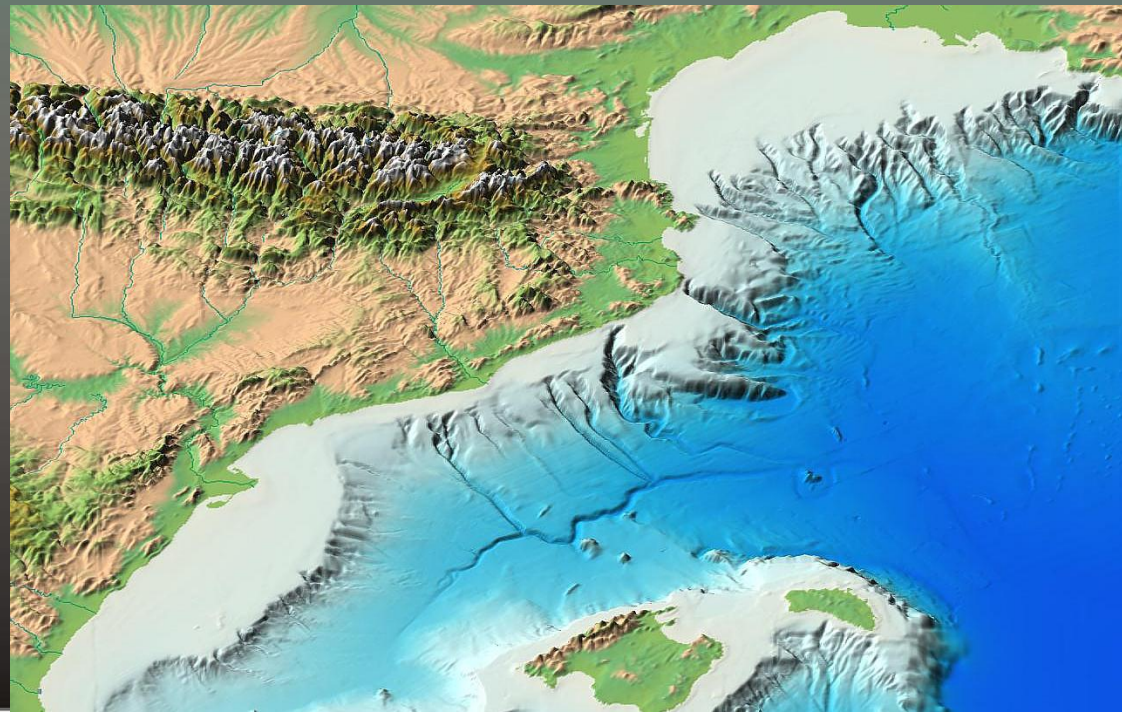
Institut de Ciències del Mar, CSIC Barcelona.  
[www.icm.csic.es](http://www.icm.csic.es)



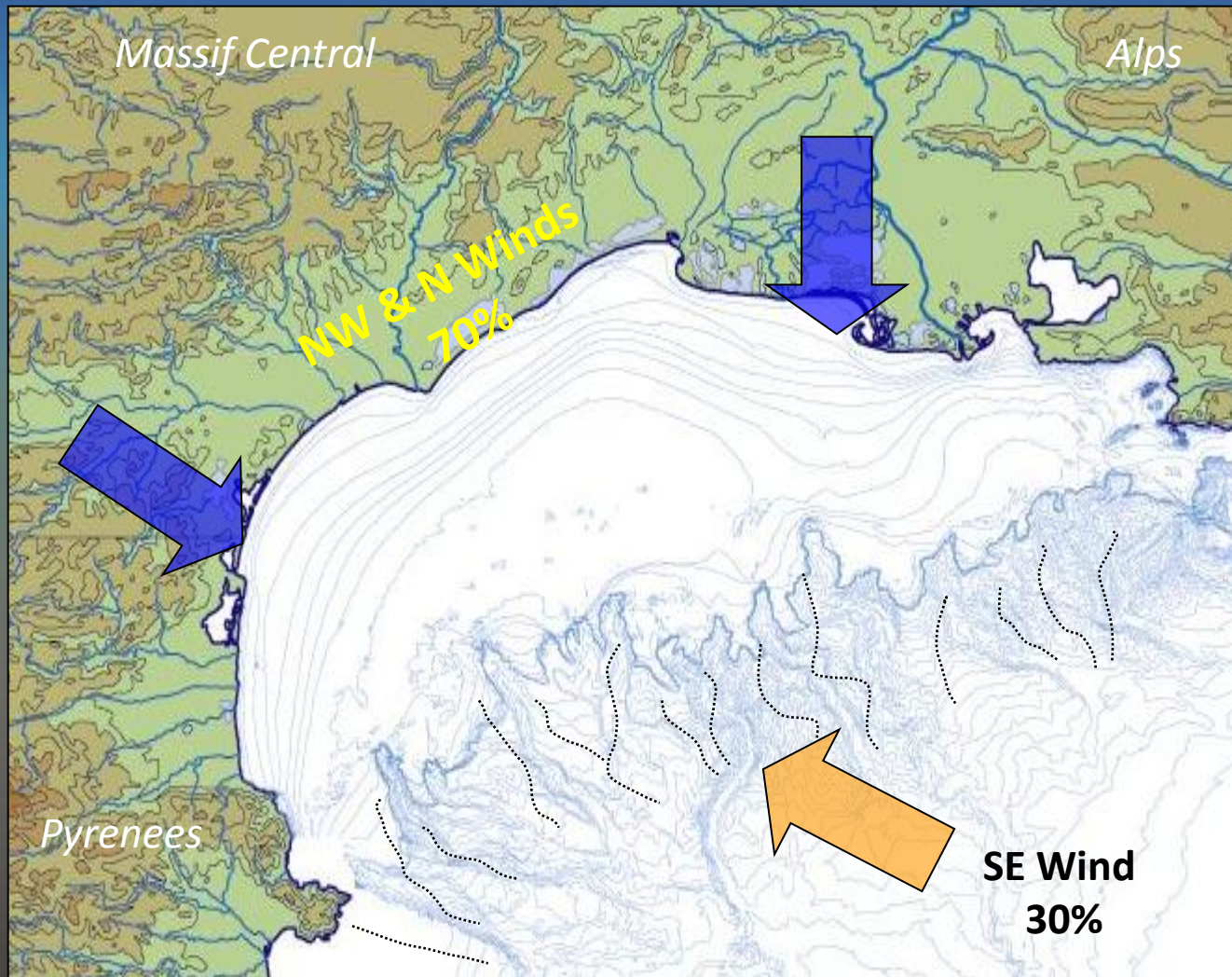
## Sedimentary cycle from the source to sink concept

Sediment dynamics  
Cabled observatories

The NW Mediterranean  
active area from the  
sedimentary point of view  
with several implication  
on deep ecosystems



# Gulf of Lions

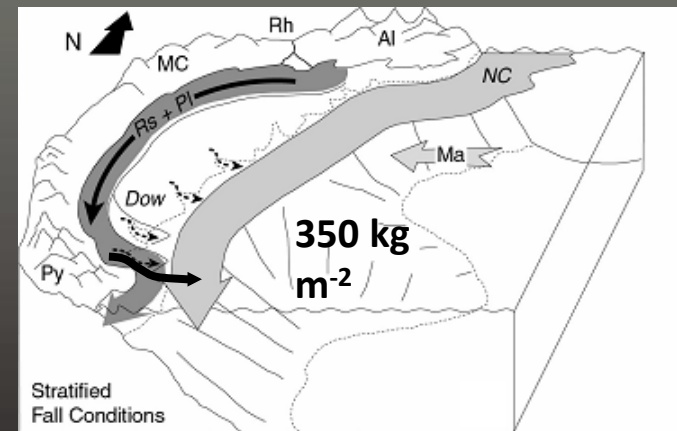
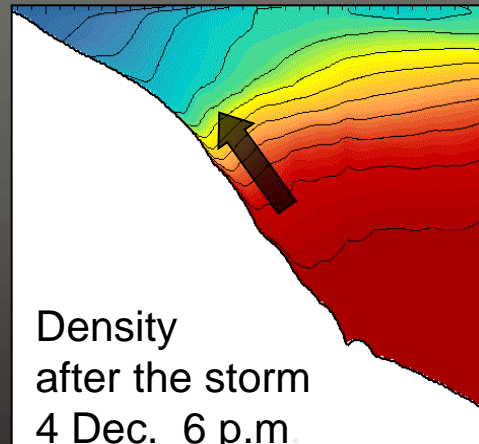
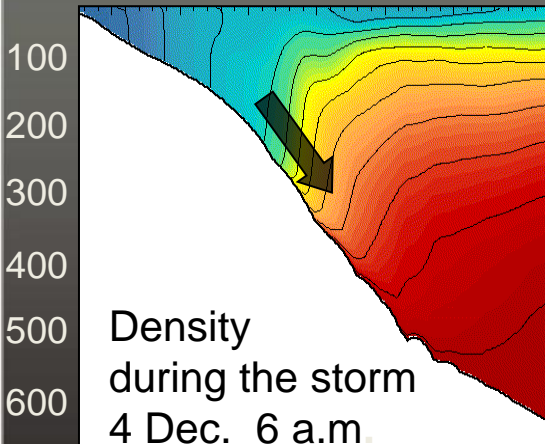
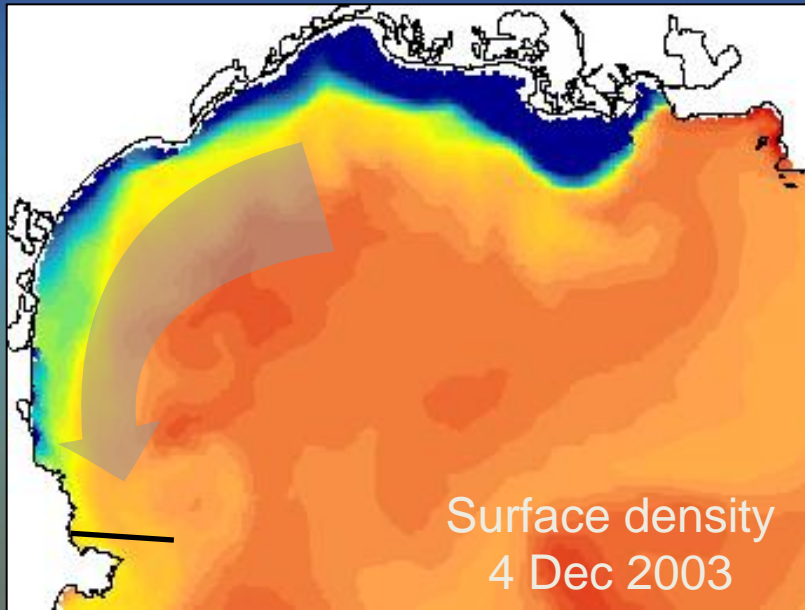


Sedimentary events generated by wind driven processes



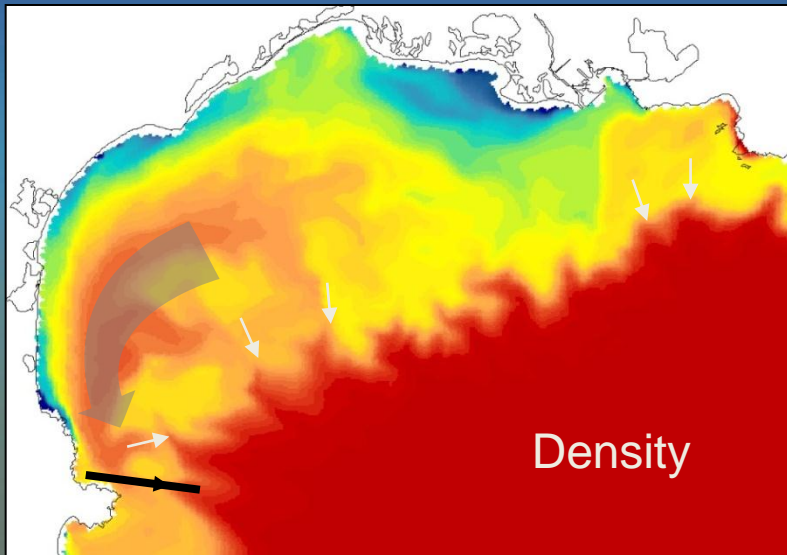
# Storm-induced downwelling

- Massive convergence of surface water on the SW part of the shelf
- Large downwelling of lighter (warmer and fresher) shelf water on the slope
- This process alone does not transfer sediment to the deep sea but to the upper slope

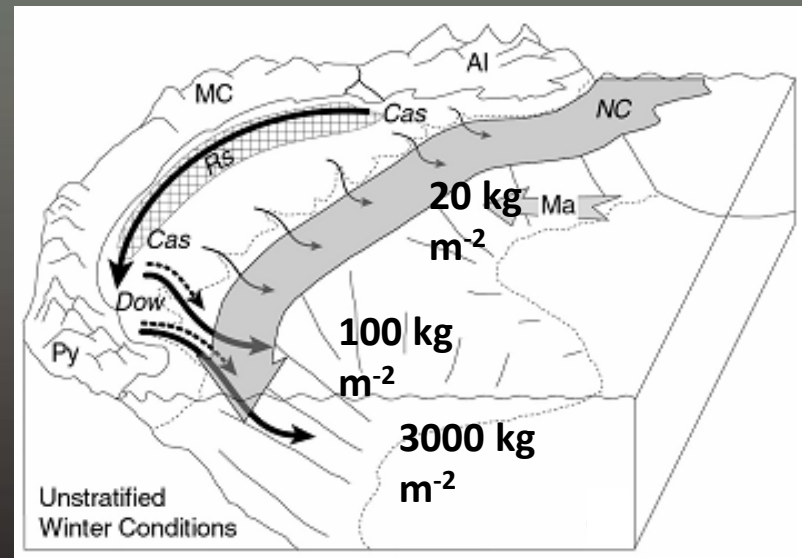
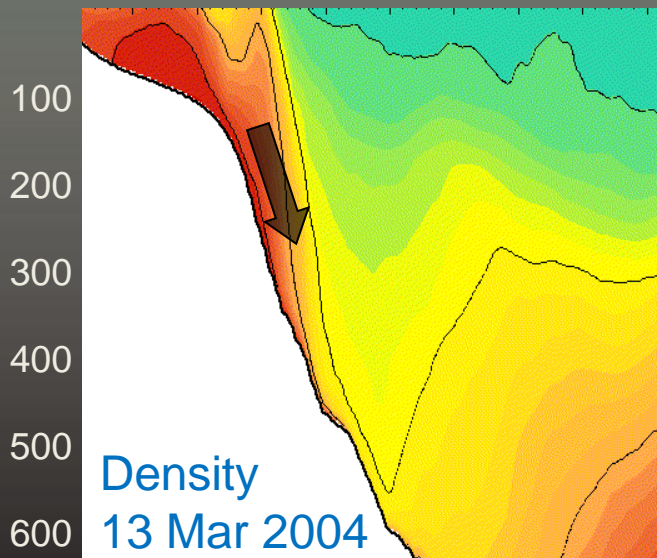




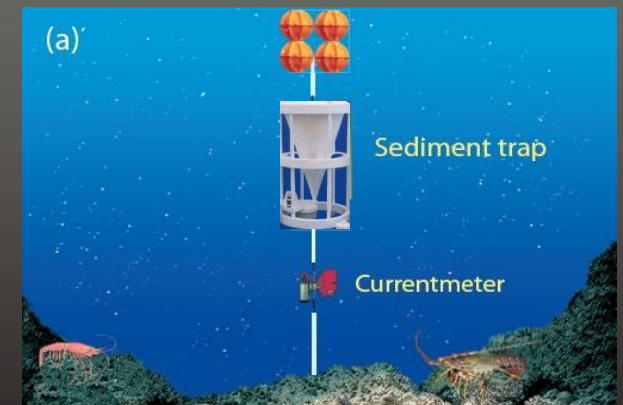
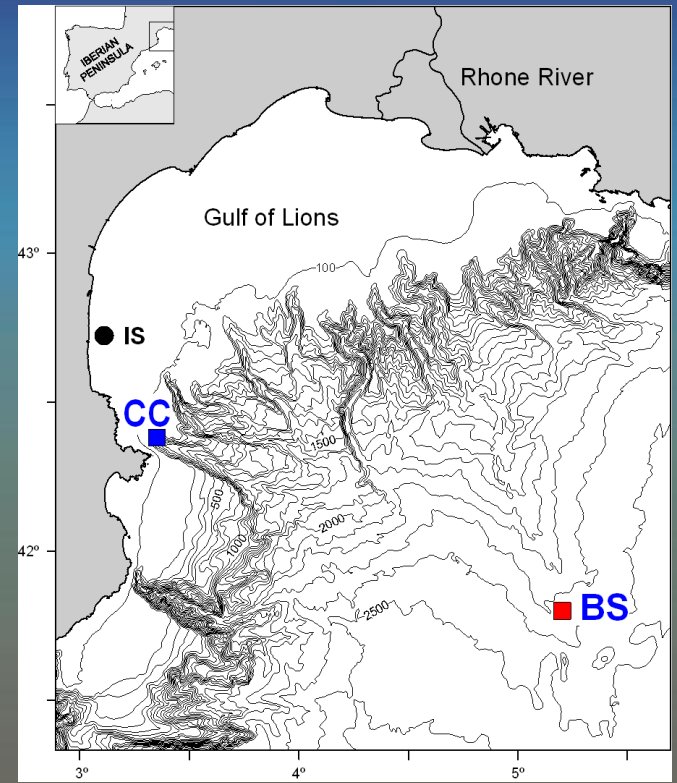
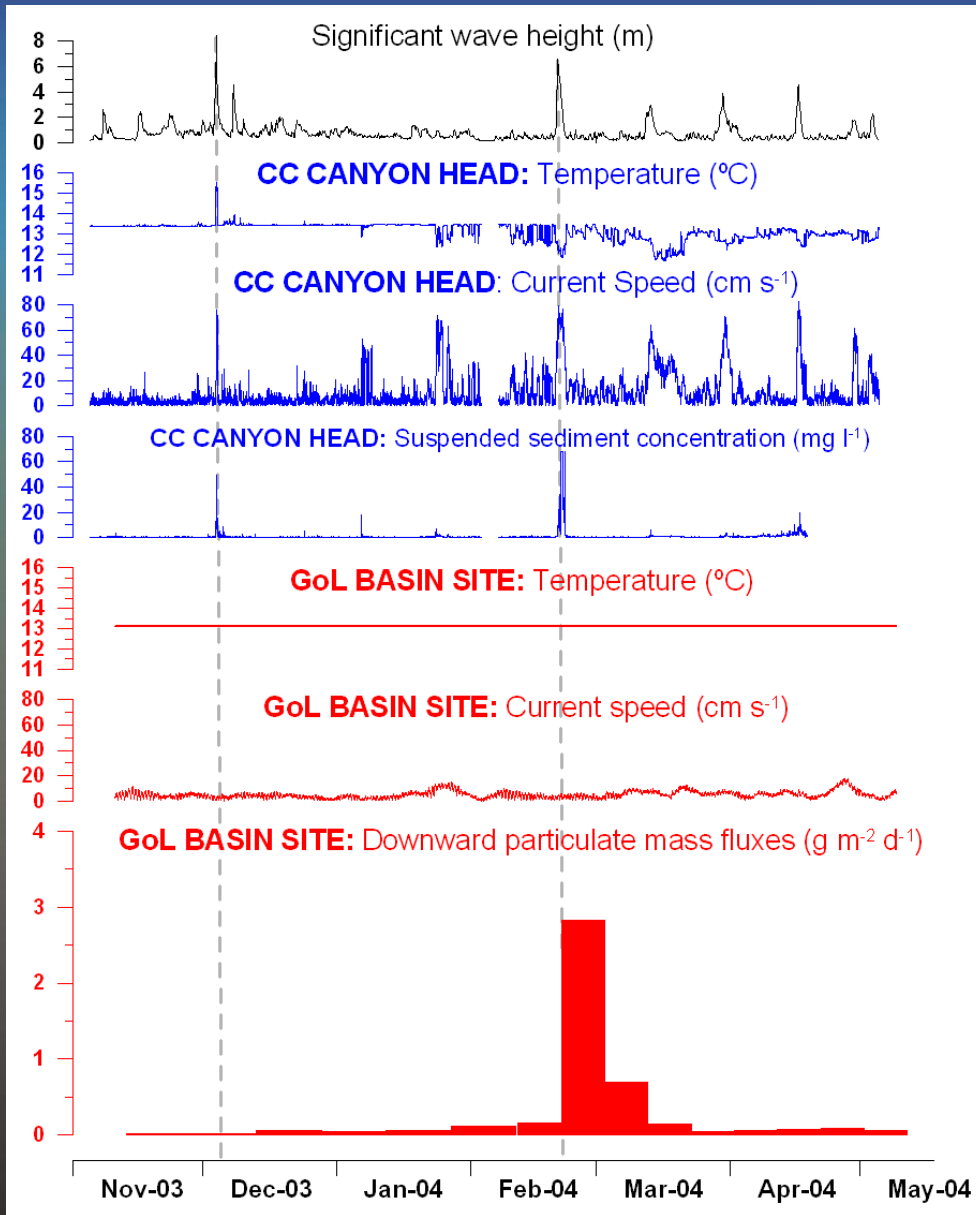
# Storm Induced Downwelling + Shallow Dense Shelf Water Cascading



- When storm-induced downwelling occurs with DSWC sediment transfer follows a flush pattern through the CC canyon
- Sediment reaches the deep sea without the dense water plume

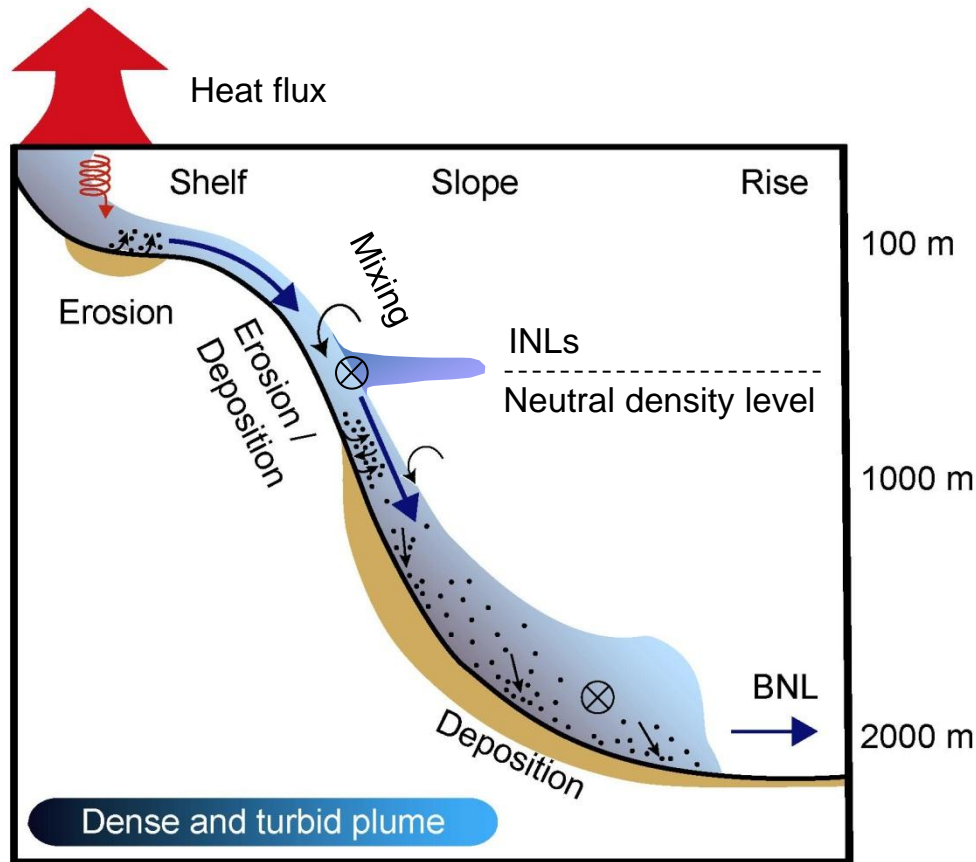


# STORMS + SHALLOW DSWC CAN INDUCE SEDIMENT TRANSPORT EVENTS TO THE DEEP SEA



# Dense shelf water sinking cascading

prescin



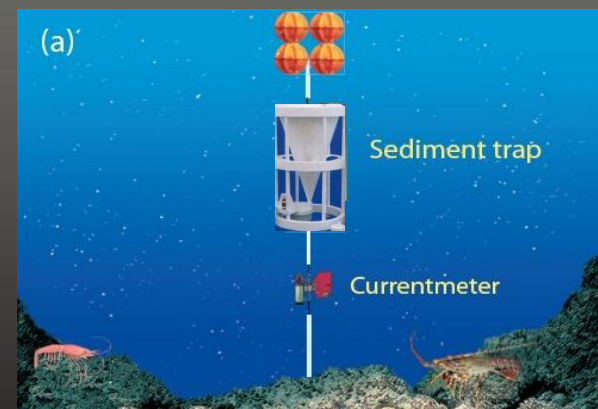
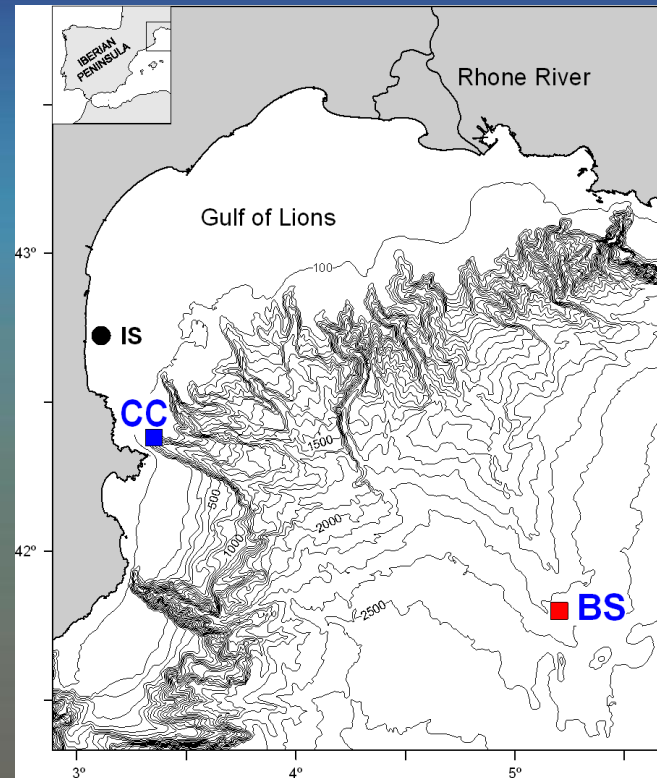
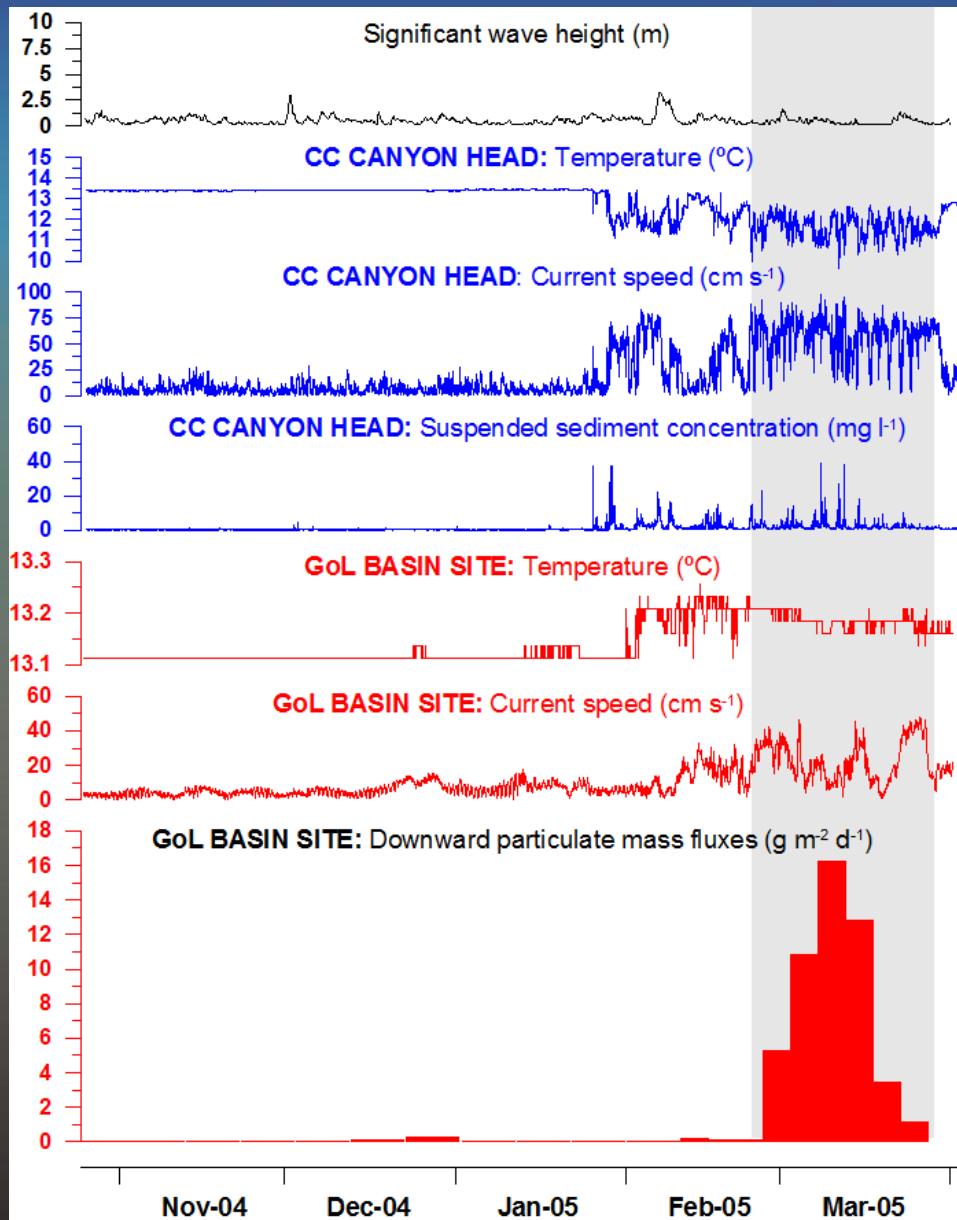
**Cascading usually reaches the upper slopes area, but in very dry cold and windy years dense water can reach the basin with its sediment load.**

Adapted from Fohrmann *et al.*, *J. Phys. Oceanogr.* (1998)

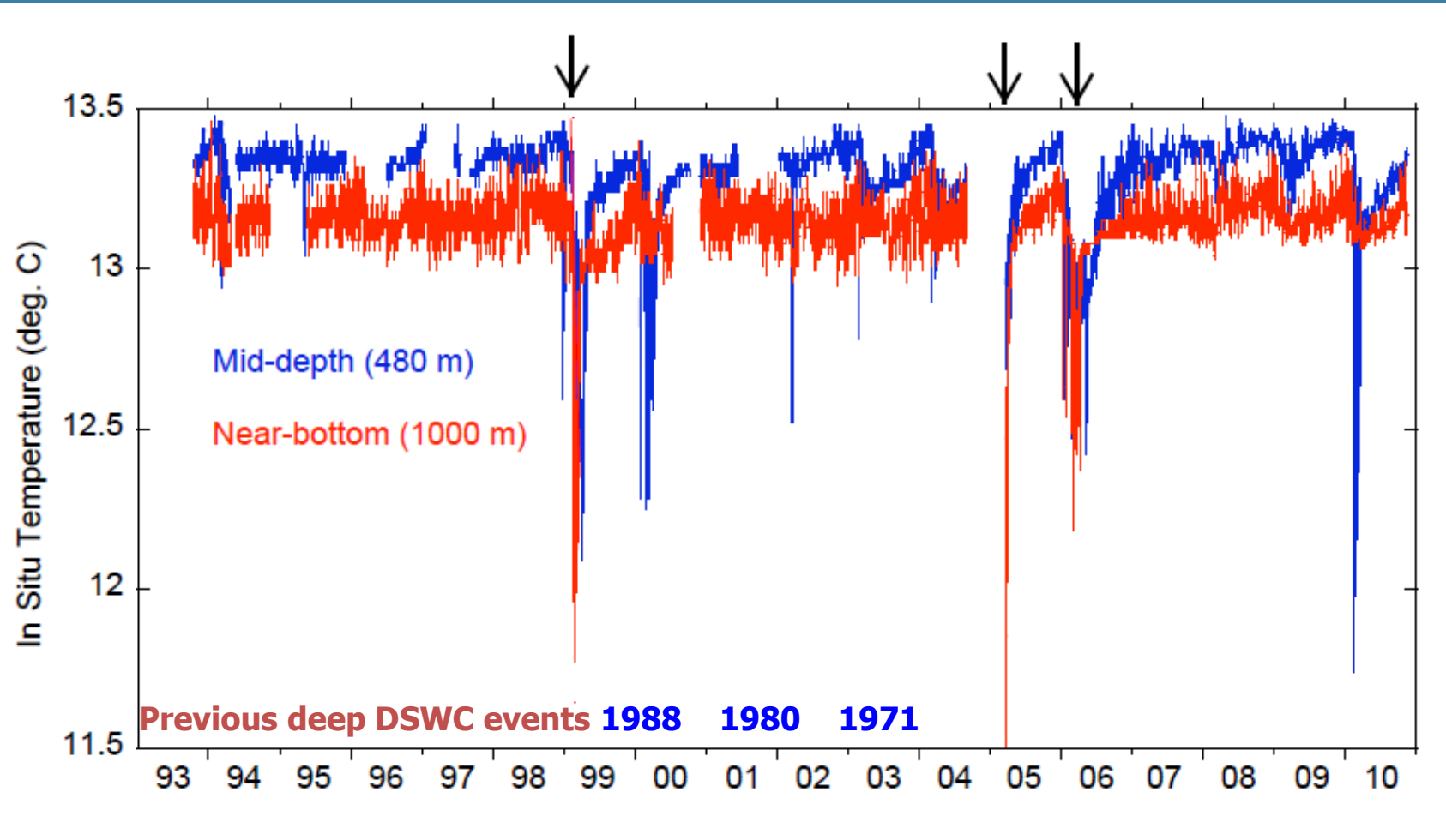
(Adapted from Fohrmann et al, 1998, JPO)



# DEEP DSWC ALONE INJECTS IMPORTANT AMOUNTS OF SEDIMENT INTO THE BASIN



# FREQUENCY OF DEEP DSWC EVENTS

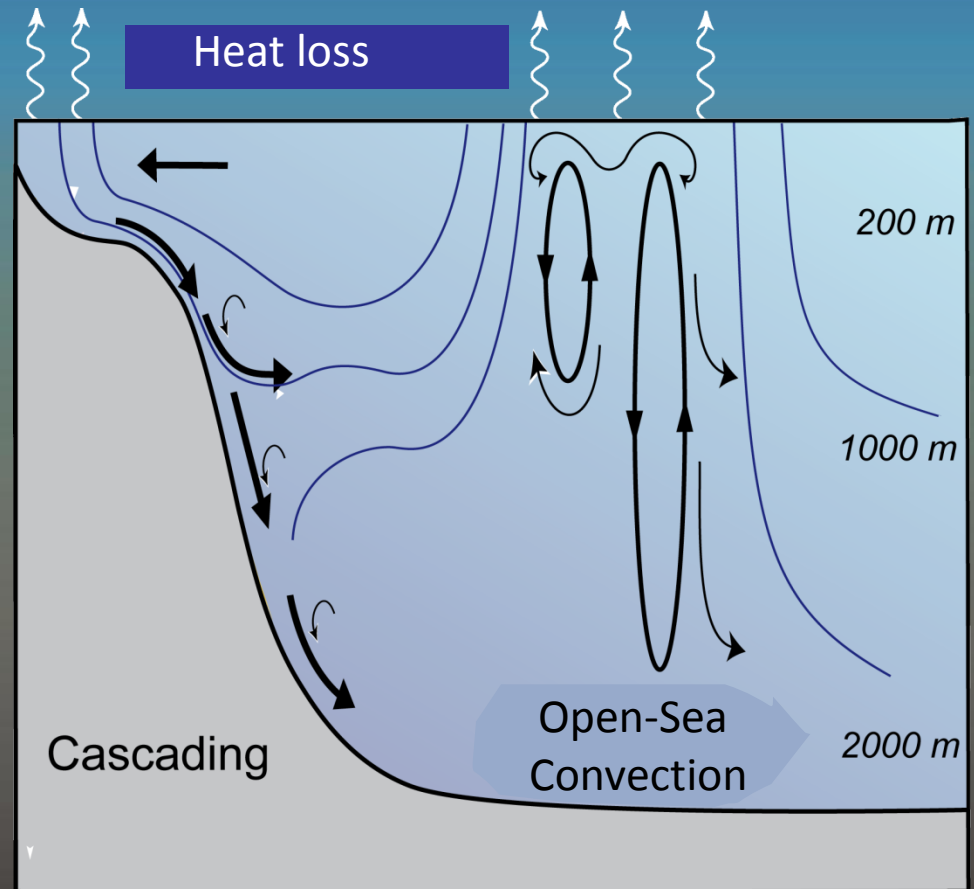


# Deep dense water formation processes

The same wind-driven process that generates cascading also generates Open-Sea Convection (OSC) by mixing and cooling of the upper layer of the open ocean during winter

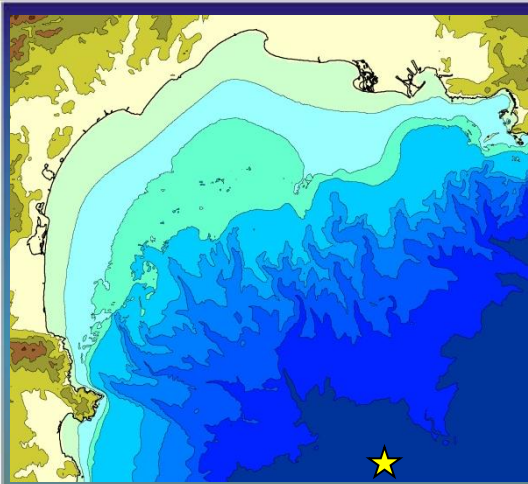
The same years that deep cascading reaches the basin OSC can also reach the deep sea floor.

Deep OSC can occur without deep DSWC

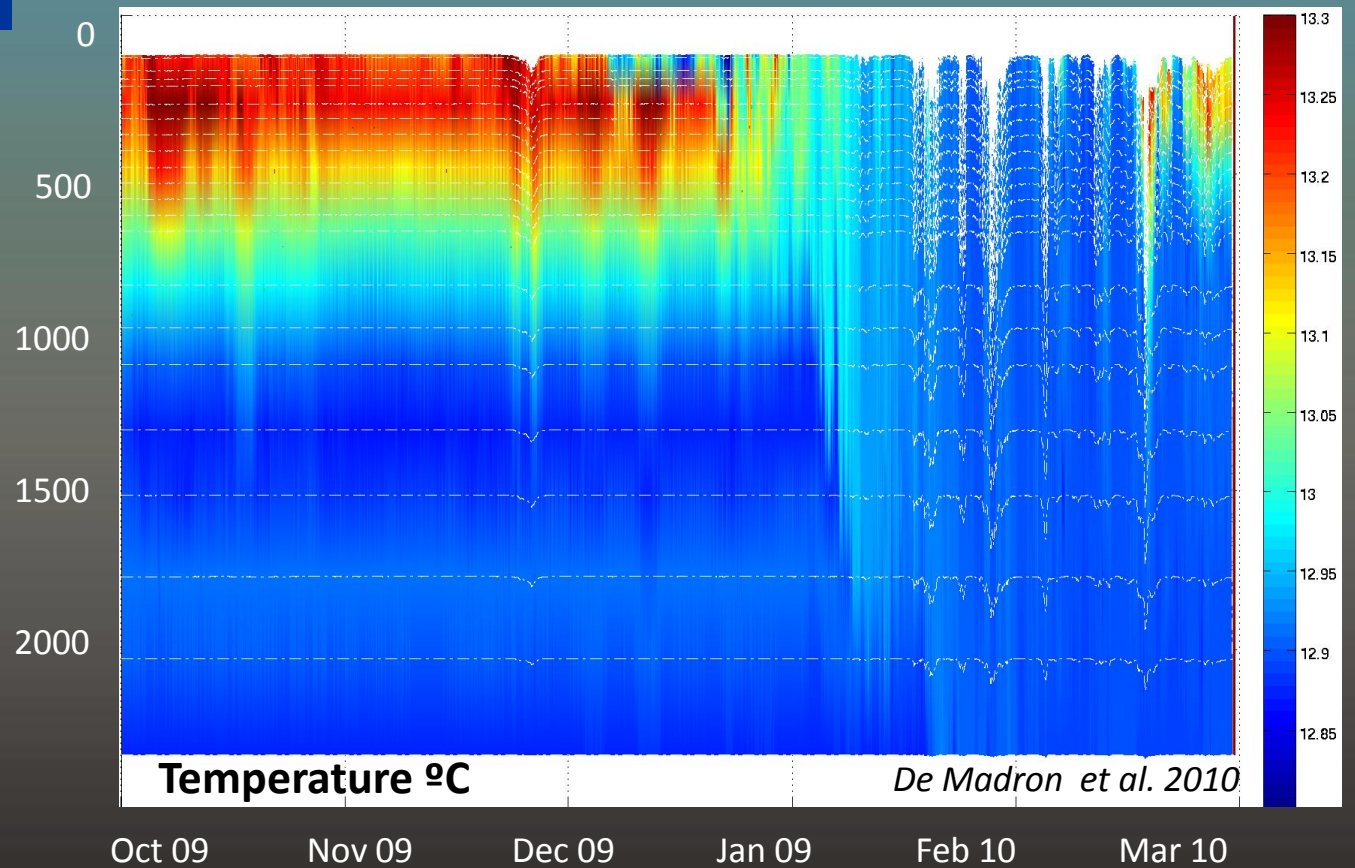




# Deep open-sea convection



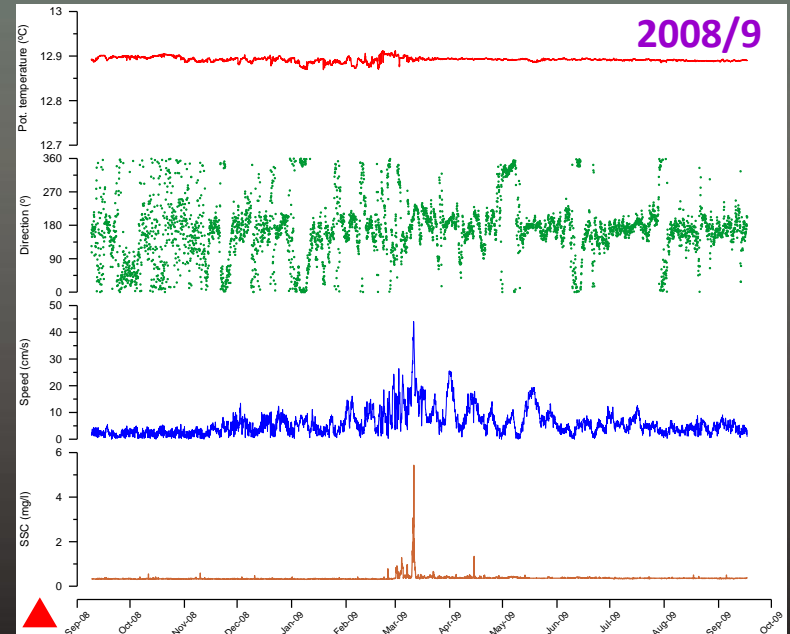
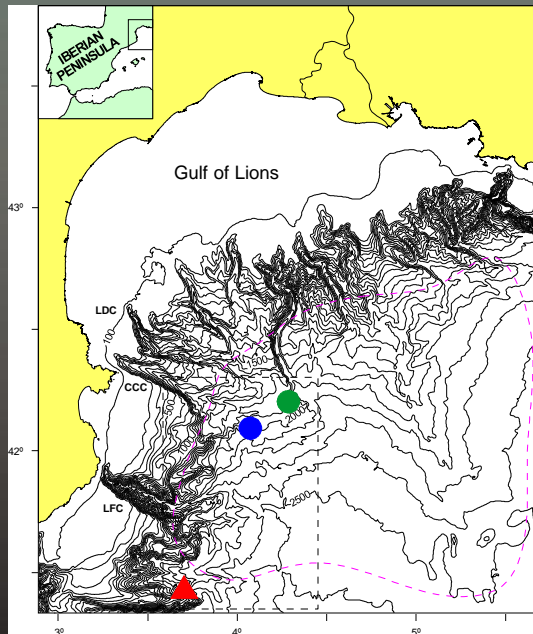
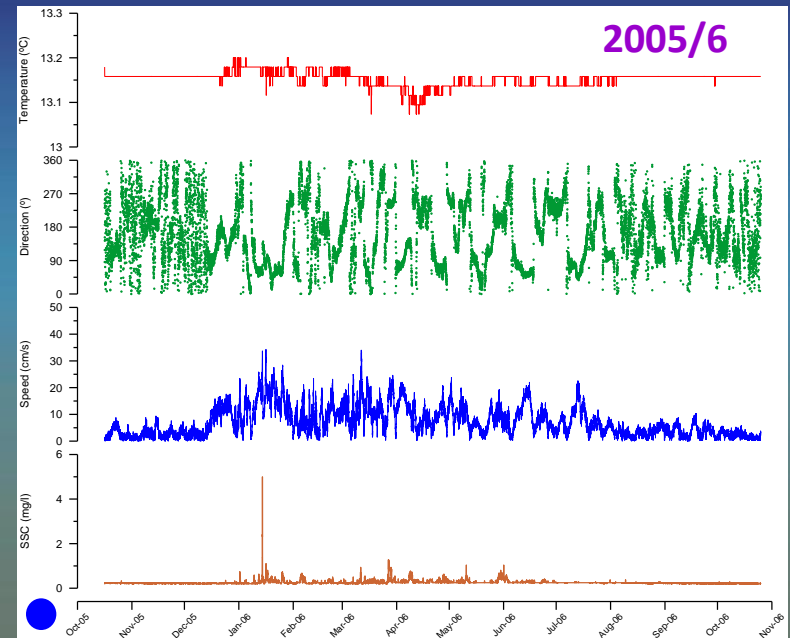
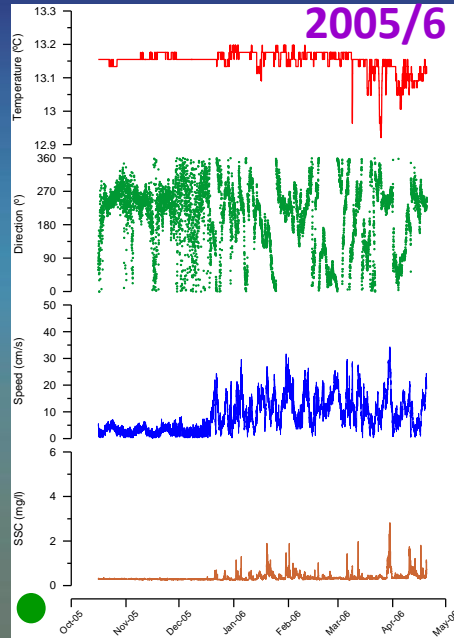
Warmer denser  
water sinks  
reaching the  
deep sea floor



# Effects of open sea convection on the basin

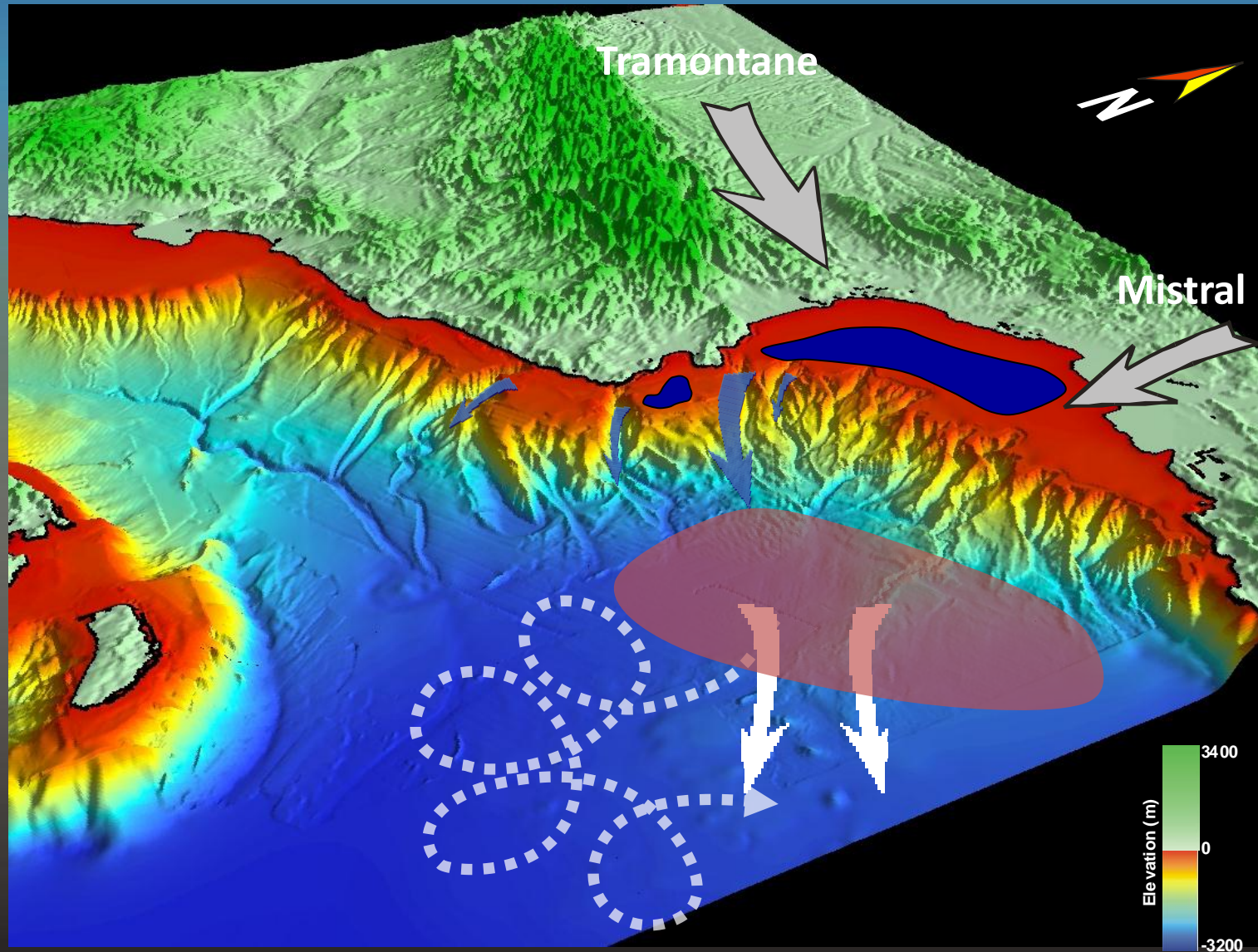
Open-Sea convection causes bottom sediment resuspension events that can be considered “benthic storms”, (Hollister and McCave 1984).

OSC plays a major role in the redistribution of deep sediment particles

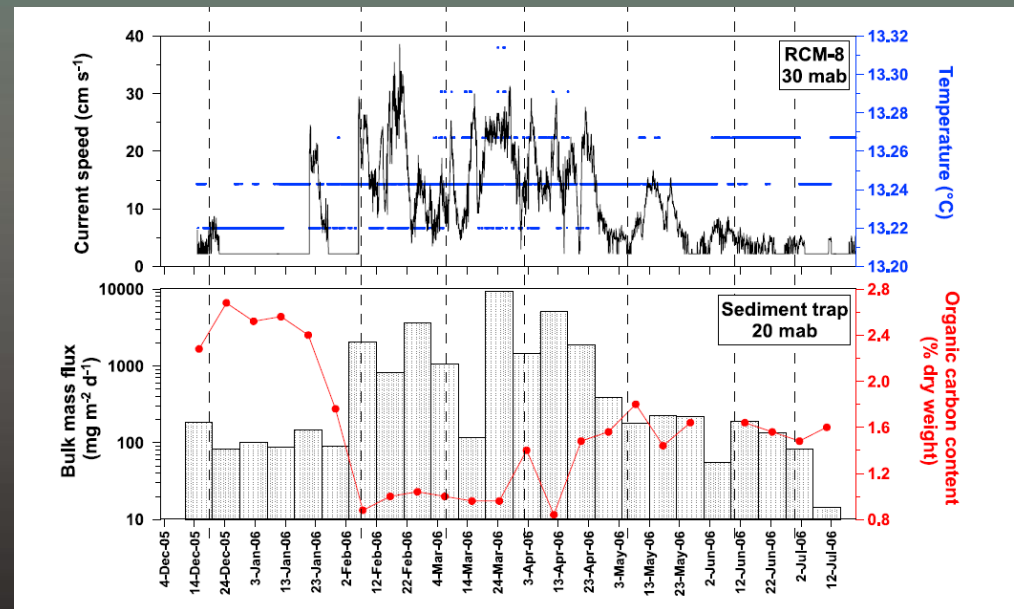
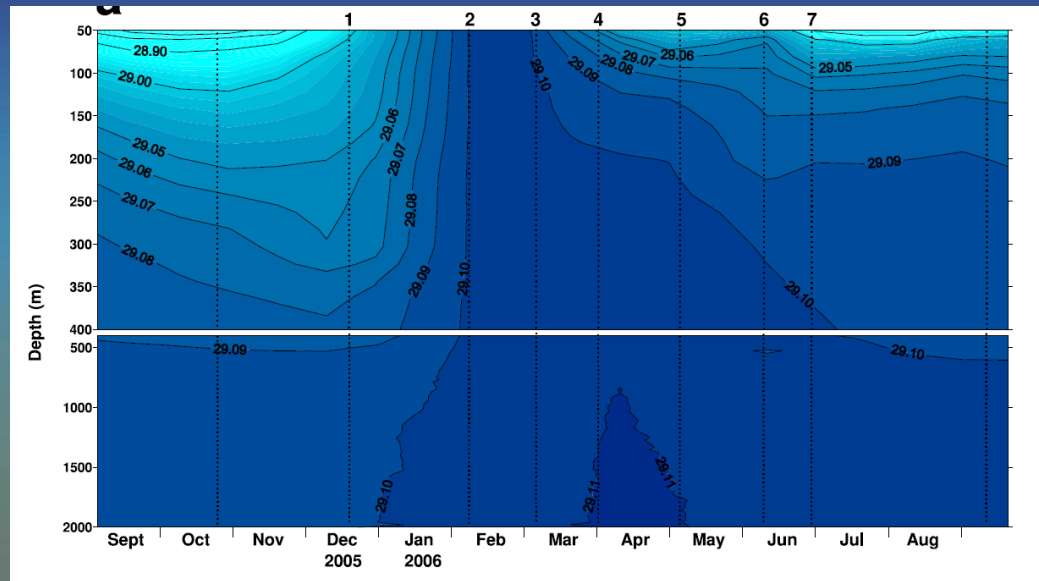
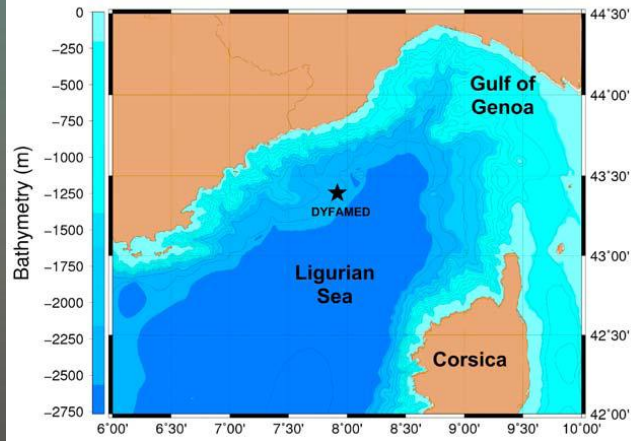
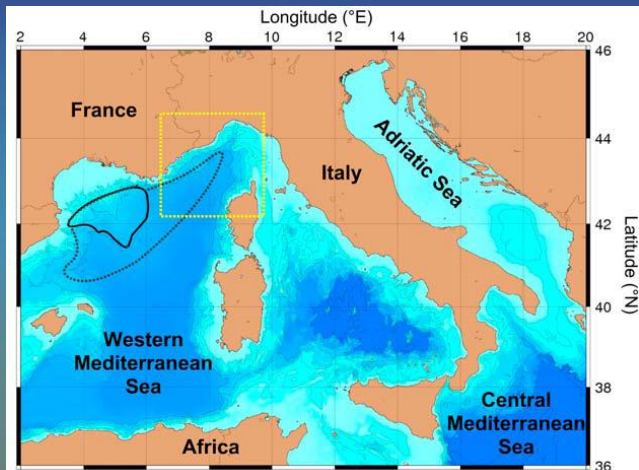




# Sediment transport to the basin in the Gulf of Lion





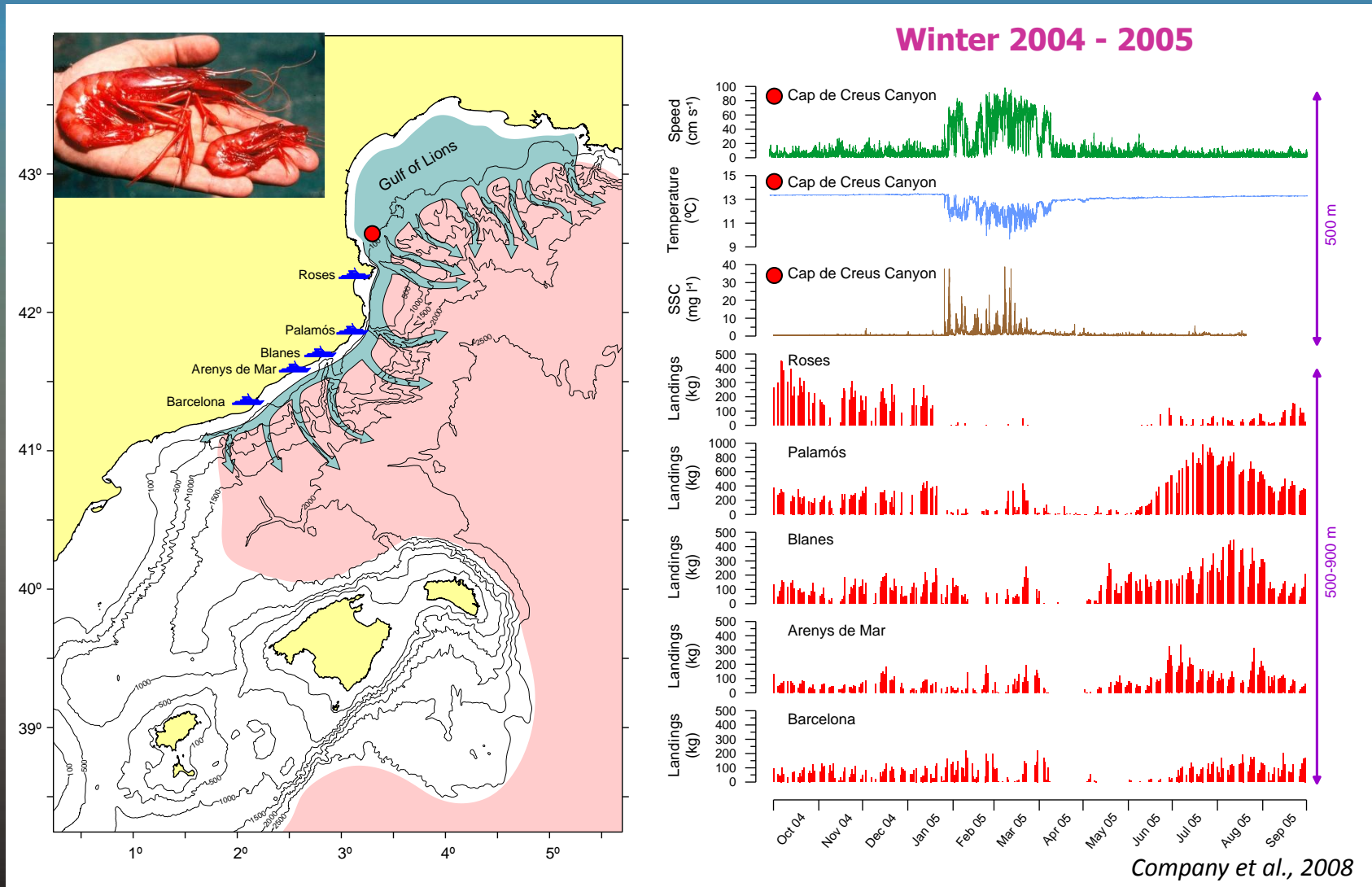


Resuspension by open-sea deep convection was also observed in the Ligurian Sea in 2006 by Martin et al., 2010

# Why monitoring?

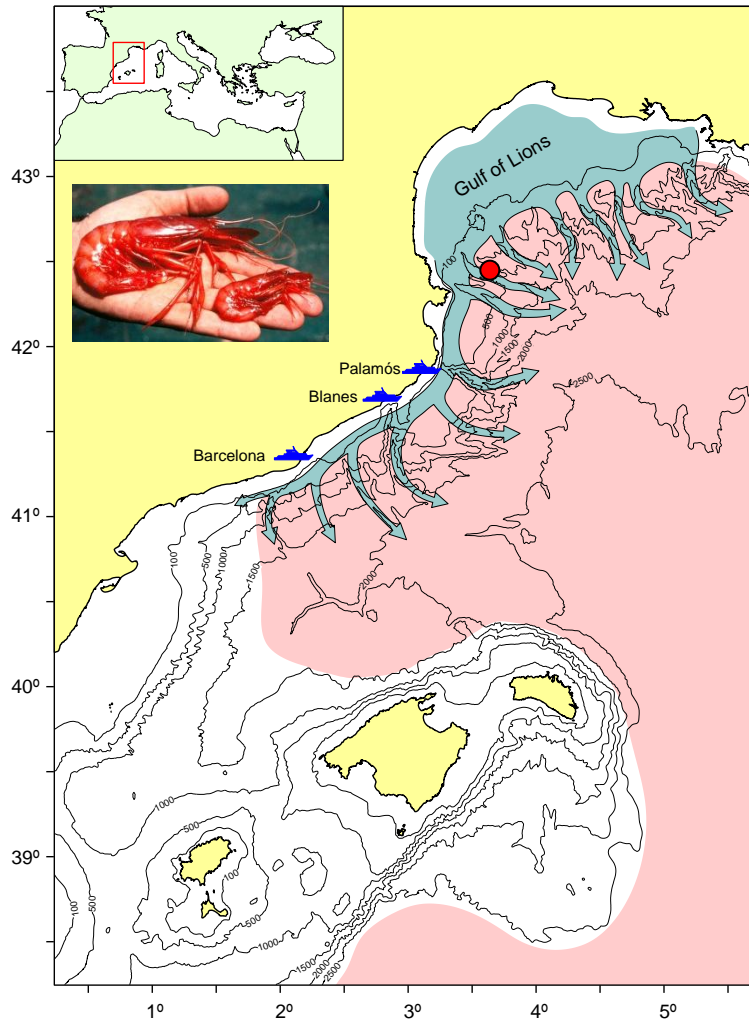
It is the physical component of the deep marine ecosystems with a lot of interactions with living organisms, renewable economic resources, biogeochemical cycles, and so on

# Effects of DSWC on living organisms, e.g. Temporary fishery collapse of *Aristeus antennatus*

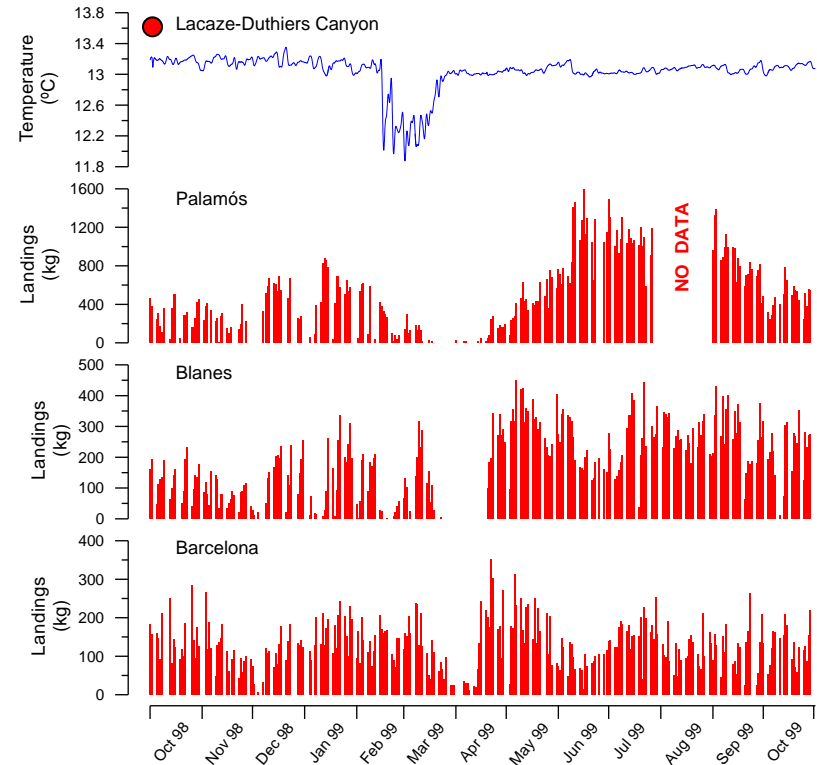




# Temporary fishery collapse of *Aristeus antennatus*



## Winter 1998 - 1999

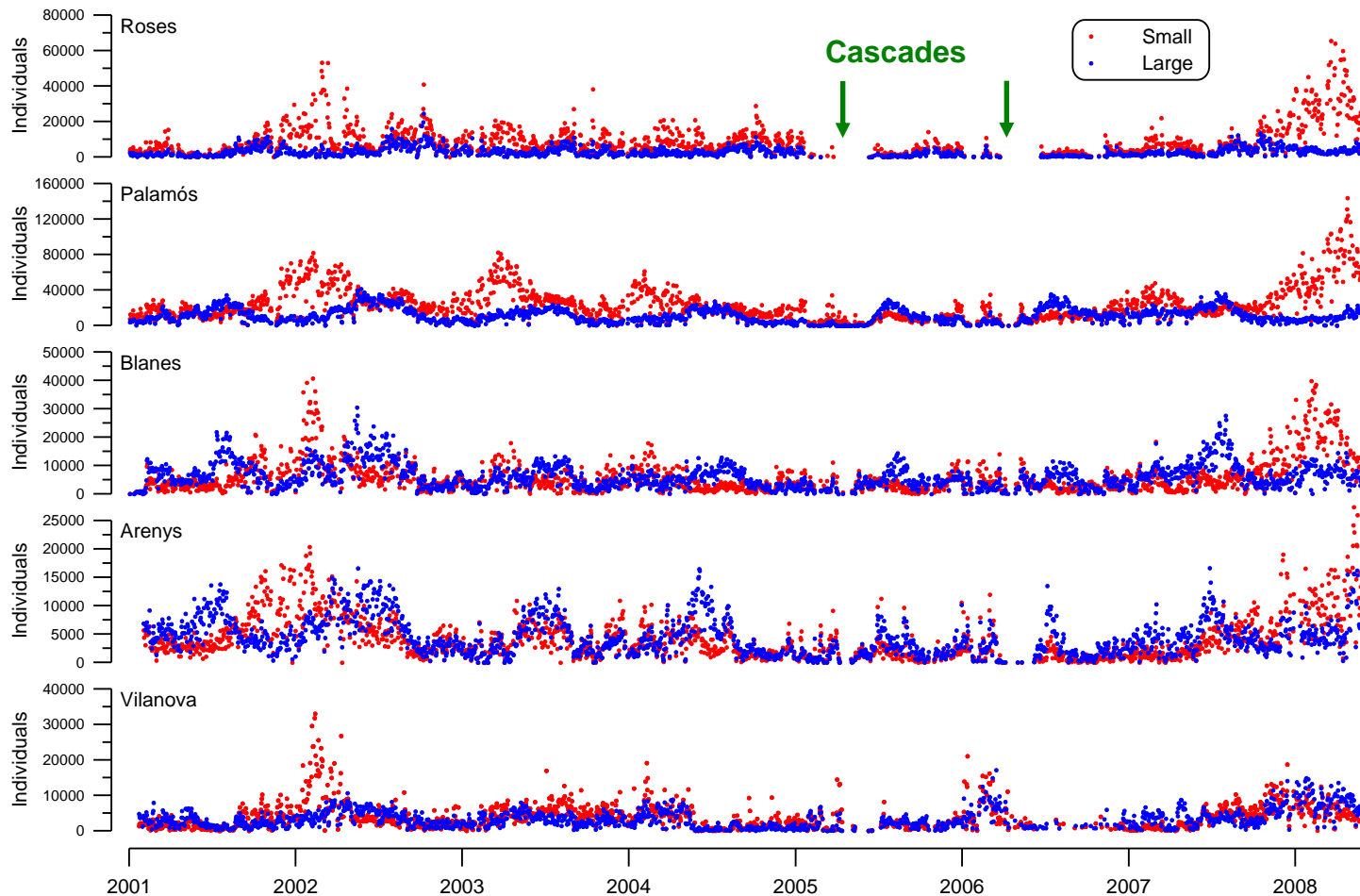


## Previous major cascading events

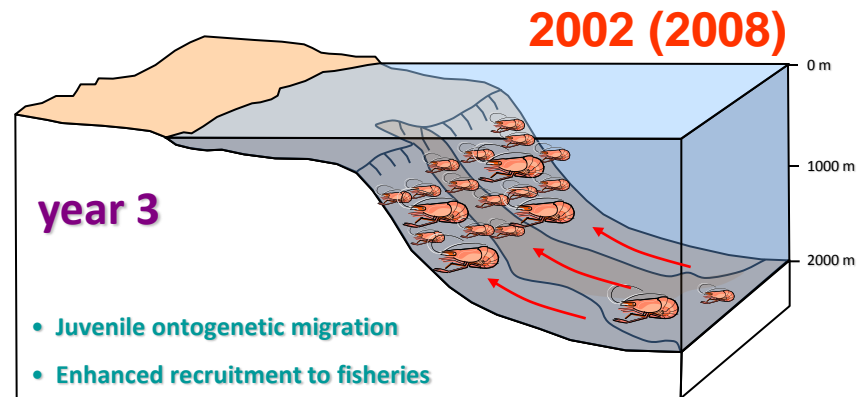
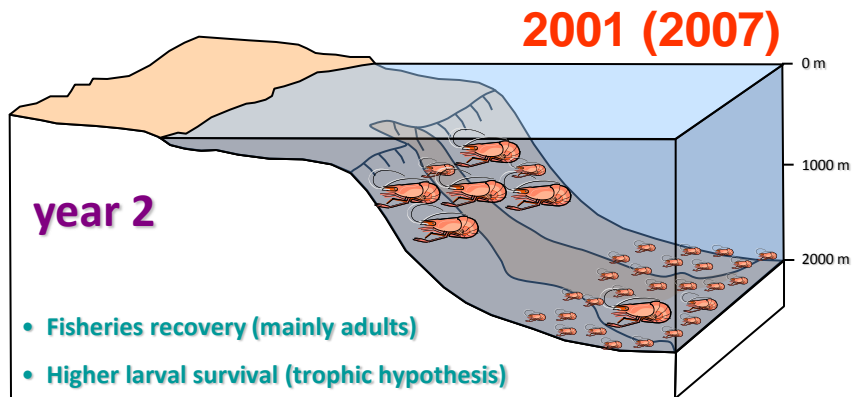
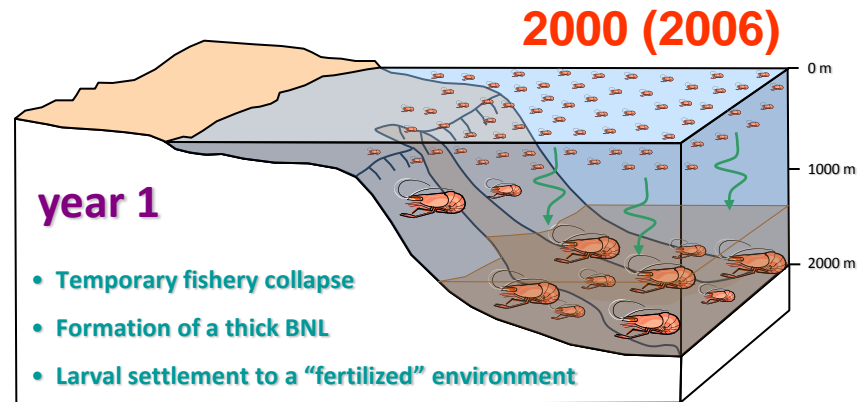
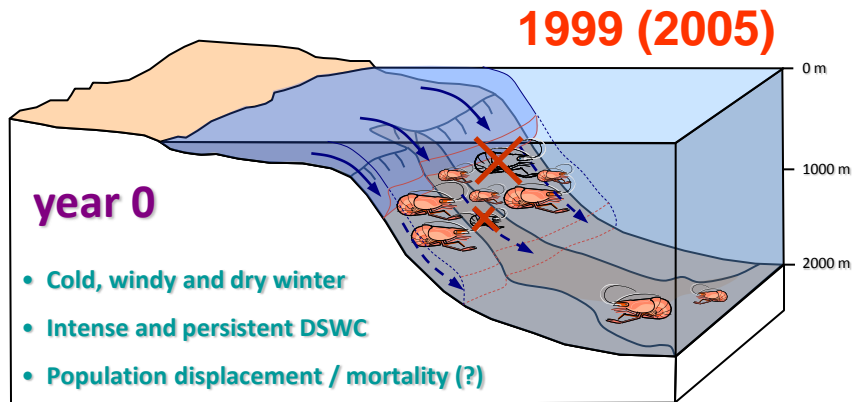
1988 1980 1971

After Bethoux *et al.*, J. Mar. Sys. (2002)

# Enhanced recruitment in 2002 (post cascading 1999) and in 2008 (post cascading 2005)



# Schematics of the interactions between dense shelf water cascades and *A. antennatus* populations



## Possibilities of cabled observatories for monitoring sediment transport

Cabled observatories equipped with turbidity sensors, current meters, CTD, Fluorometers and sediment traps are an excellent tool to monitor and quantify present day sedimentary events affecting deep-sea ecosystems

These events have impacts on geochemical cycles, deep ecosystems, renewable resources, fate of pollutants, and so on.

Monitoring these deep events allows to improve our capacity of measuring deep fluxes for global balances and global change

The North western Mediterranean is a hot spot to monitor these events.  
Relation with ANTARES?