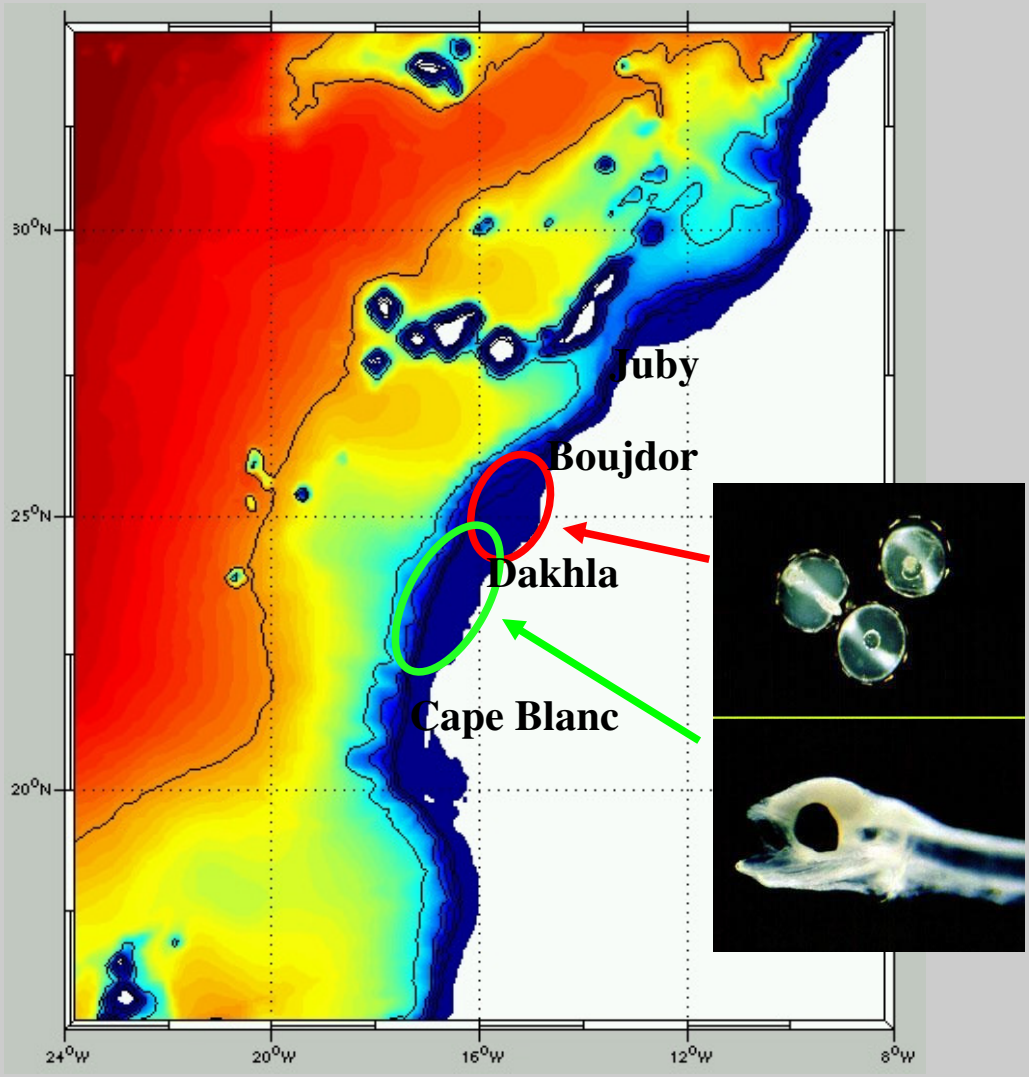
Modelling the environment of *Sardina pilchardus* off the Saharan Bank to investigate the collapse of the stock in 1997

Eric Machu (machu@ird.fr)

O. Ettahiri, S. Kifani, A. Benazzouz, A. Makaoui, H. Demarcq

Casablanca, March 11th-14th 2008 – Small Pelagics Symposium

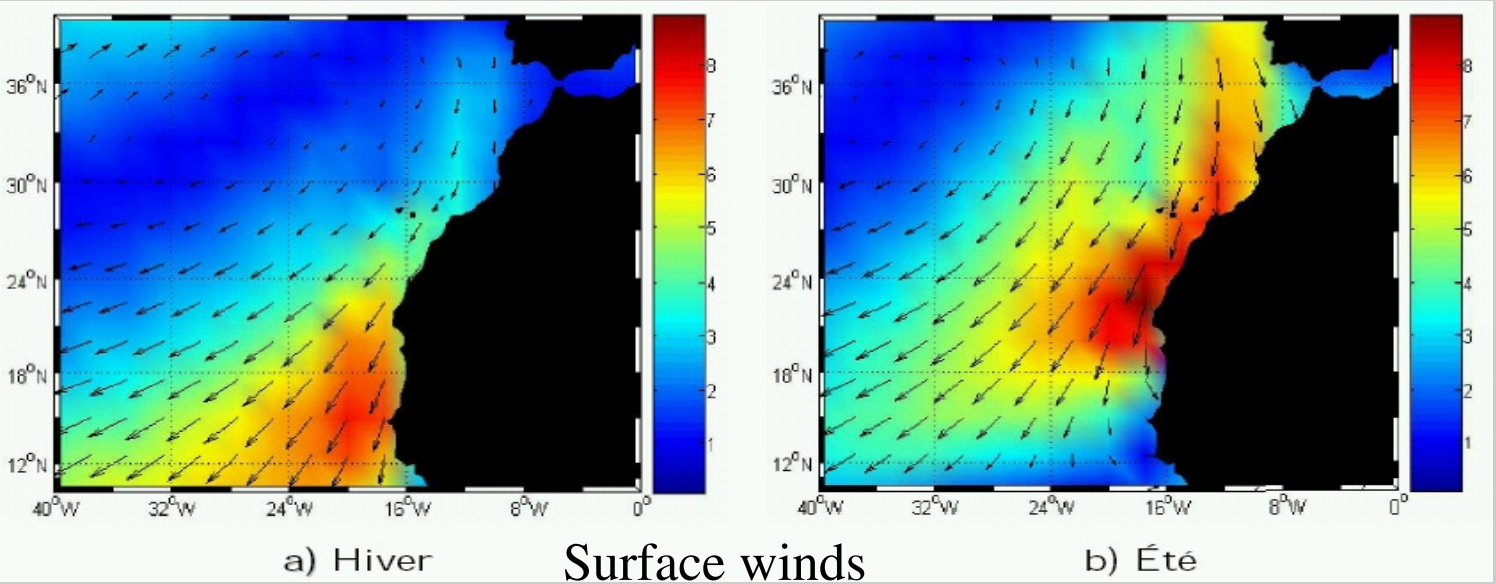
Modelisation of the northwest african sardine in its environment



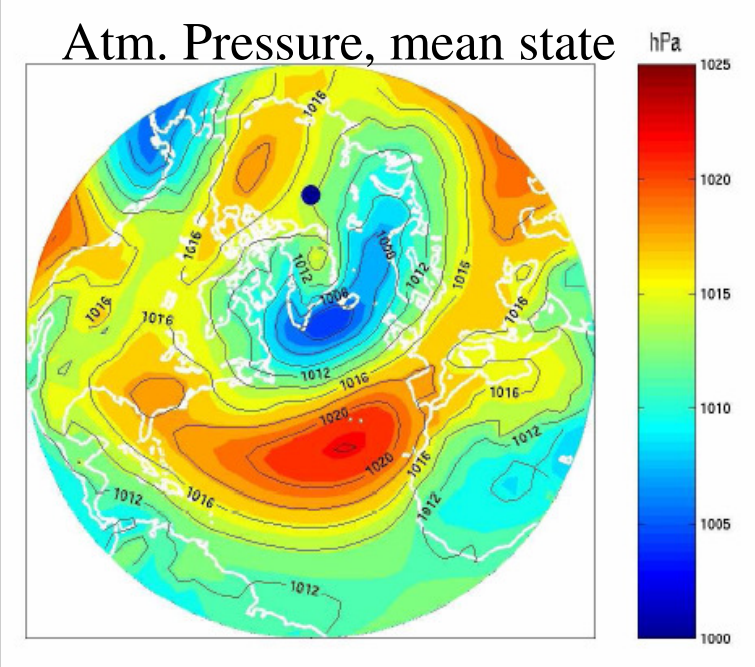
- Presence of eggs all along the year with a main spawning season in winter

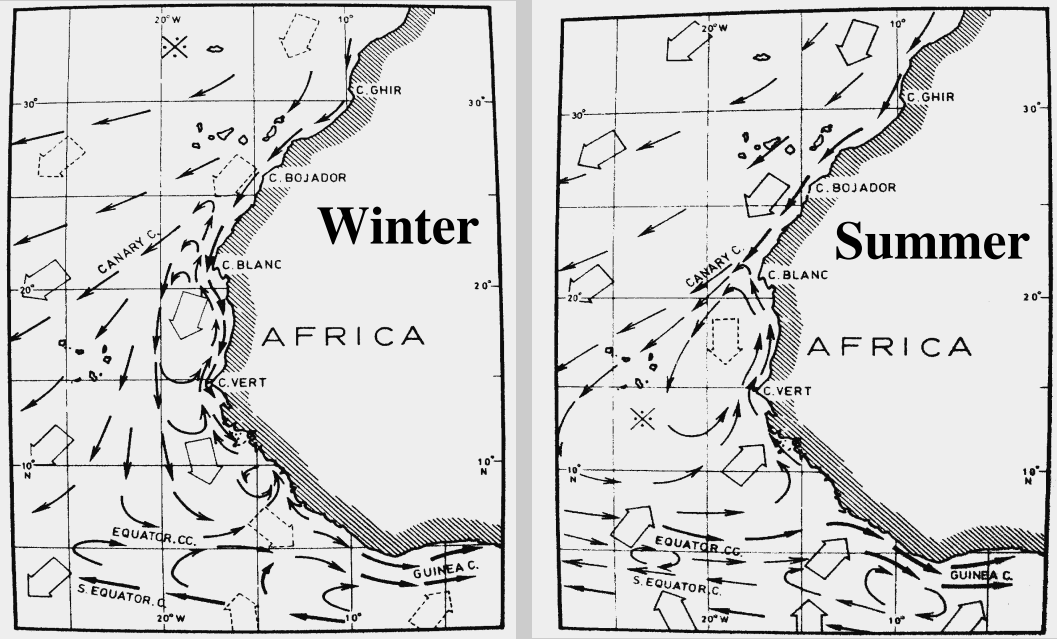
Ettahiri et al., *Fish. Res.*, 2003

Atmospheric & Hydrodynamic conditions



Surface winds

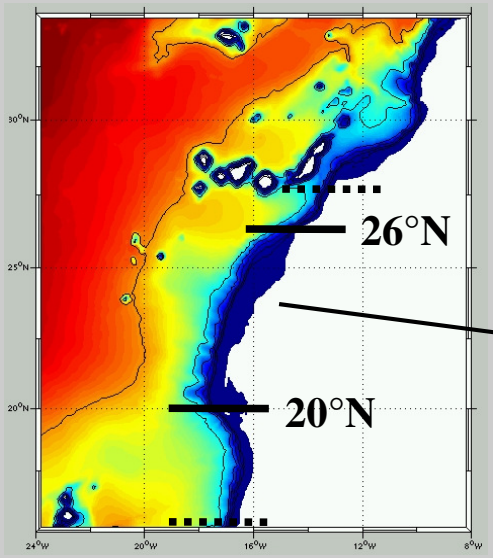


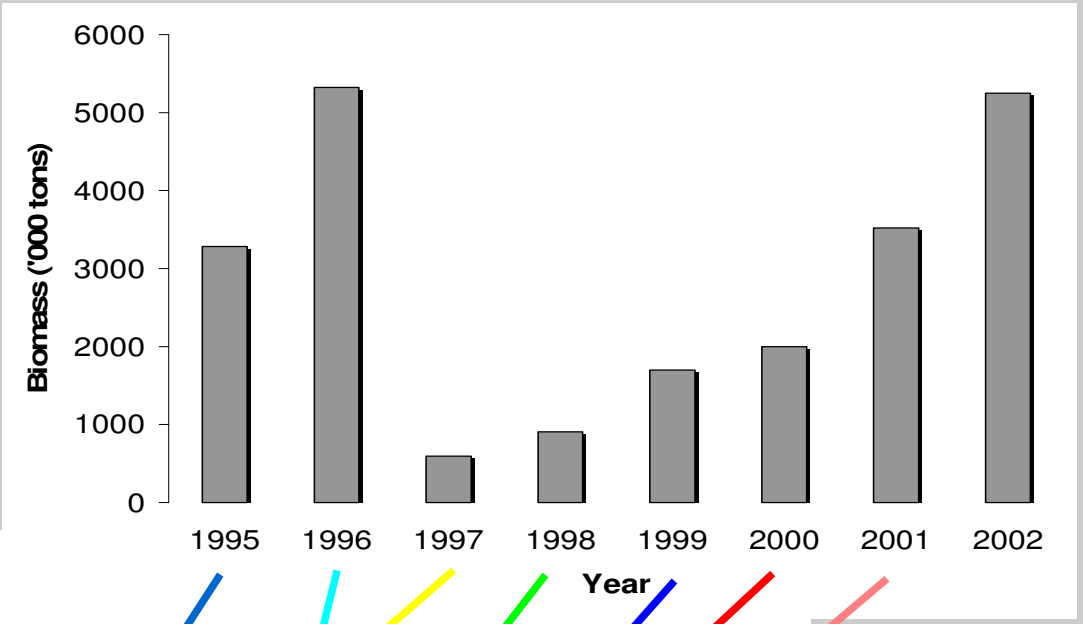


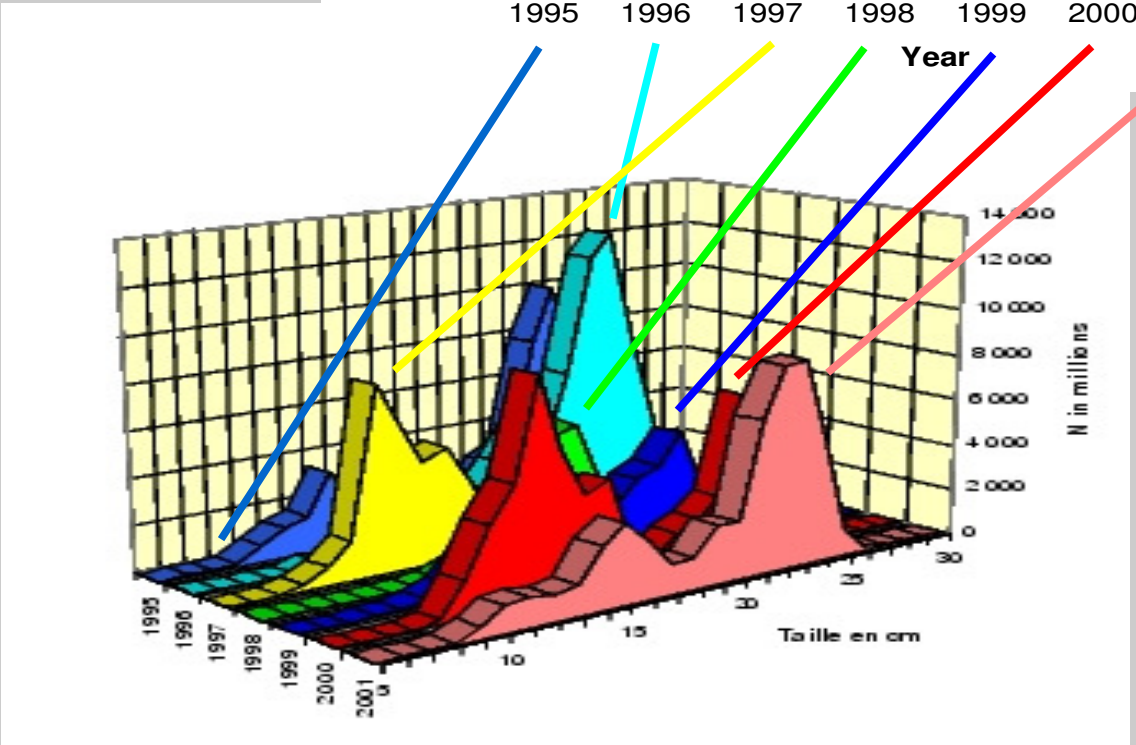
Mittelstadt, 1991

Superposition of a high frequency spatial-temporal variability

Biomass evaluation of sardines off northwest Africa from the N/R Dr Fridtjof Nansen surveys 1995-2002







Context :

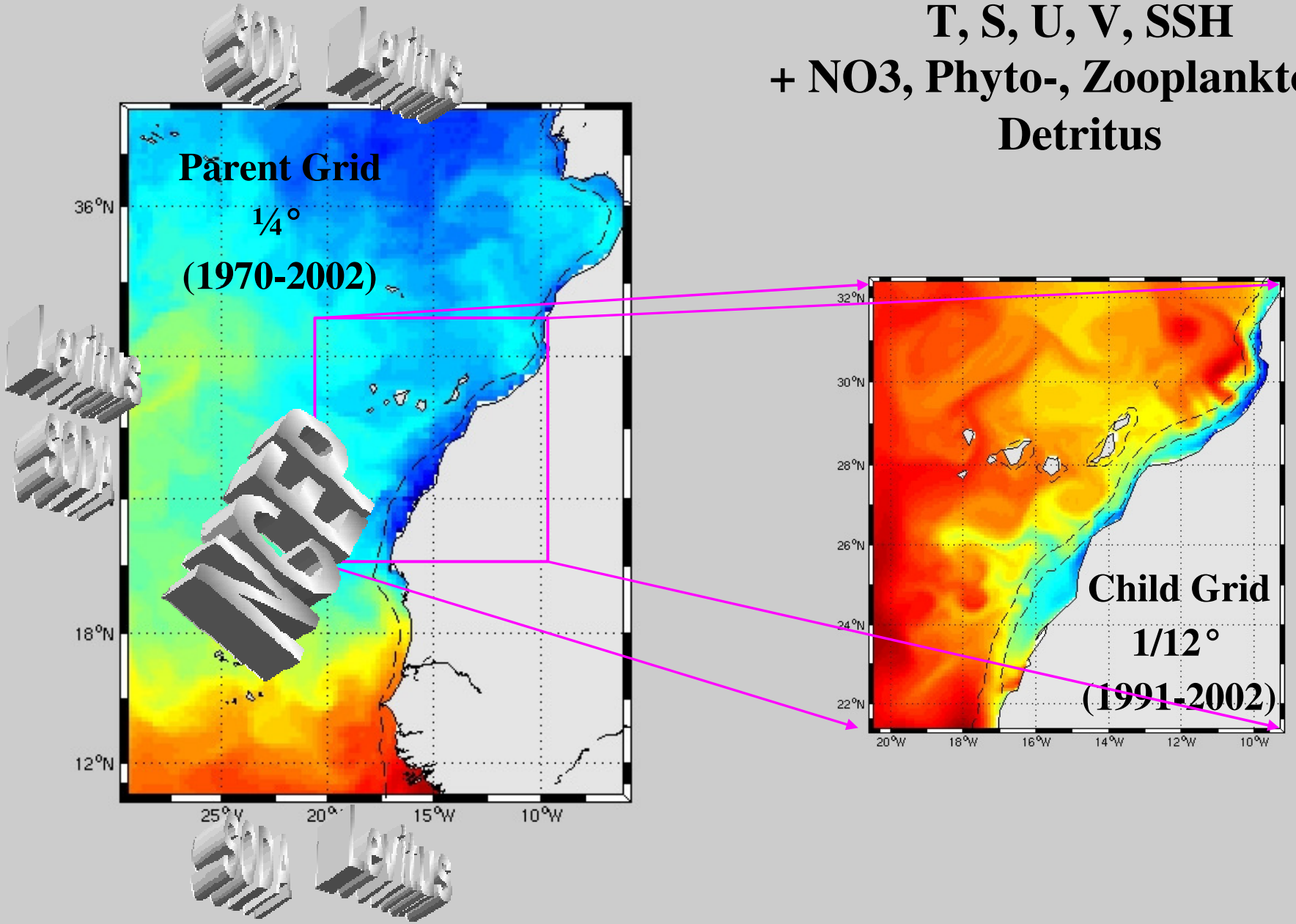
✔ Sardine biomass collapsed between 1996 and 1997
✔ Size spectrum of the sardine stock changed from a bi-modal distribution to an adult population (~23 cm)
✔ Neither epizootic event nor major fishing changes have been reported

Hypotheses :

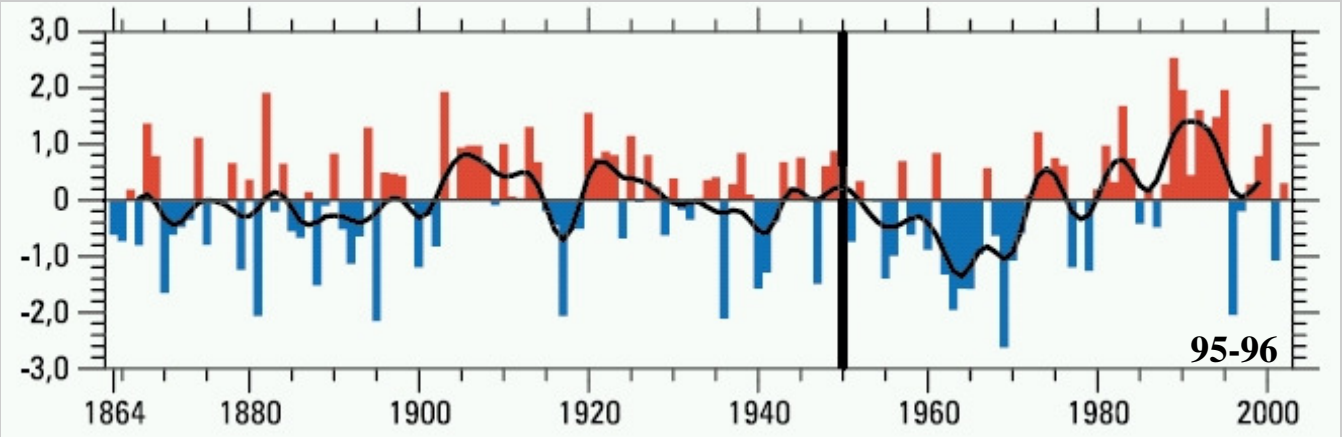
✔ Very bad sardine recruitment in 1996 (no juveniles) ?
✔ Weak spawning in 1996 ?
✗ Important predation on egg, larvae and juvenile stages ?

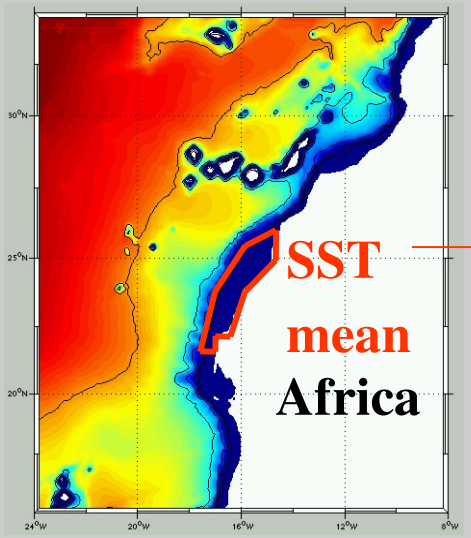
ROMS Experiment (3D model)

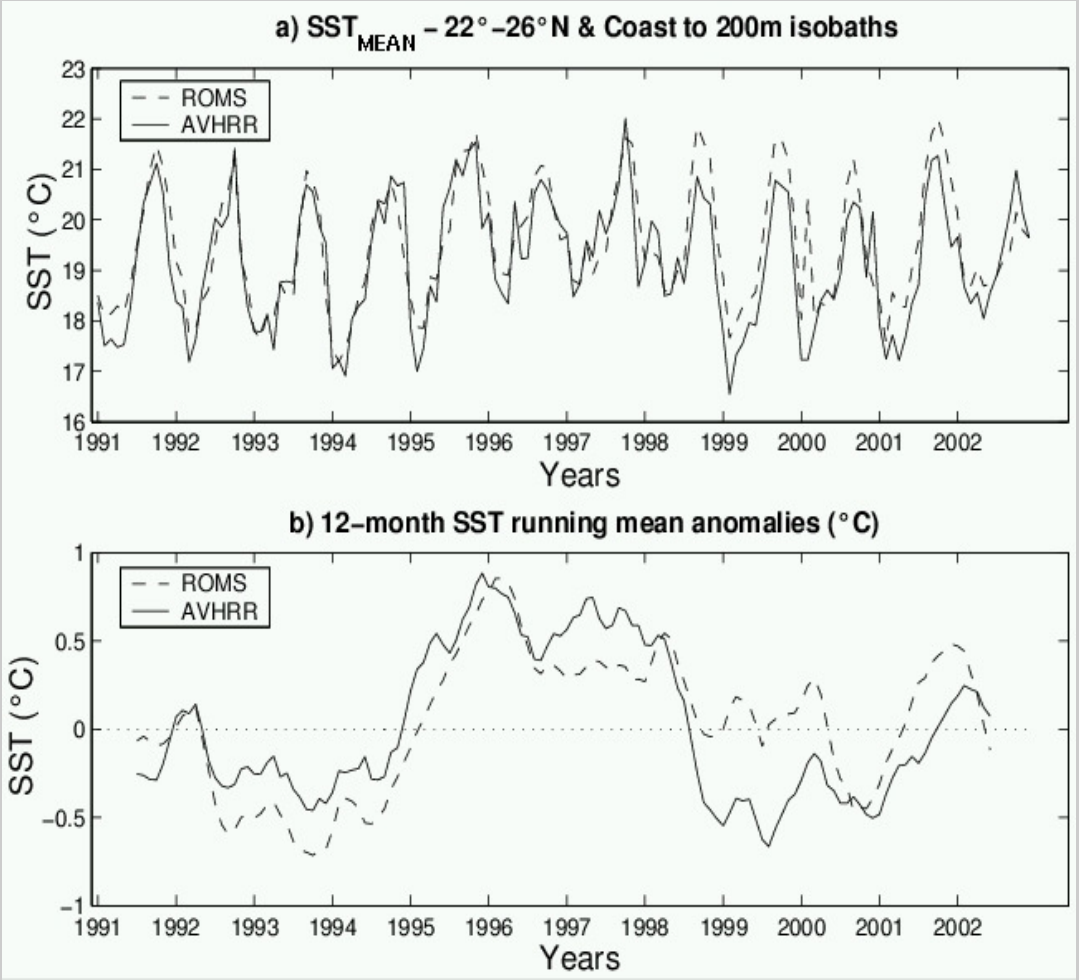
T, S, U, V, SSH
+ NO3, Phyto-, Zooplankton & Detritus



NAO Index

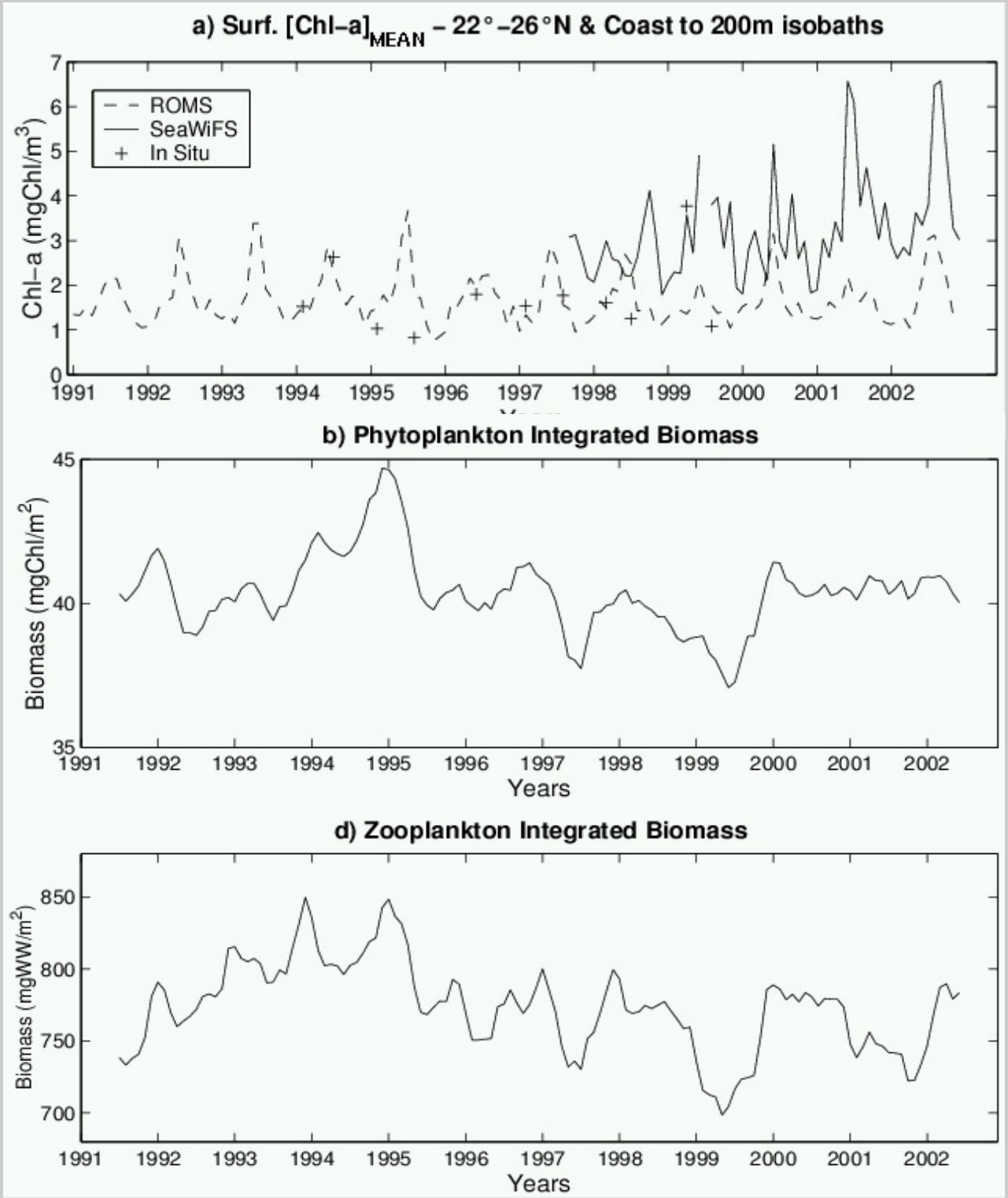






How does an anomaly of 0.5 to 1℃ act on sardines ?

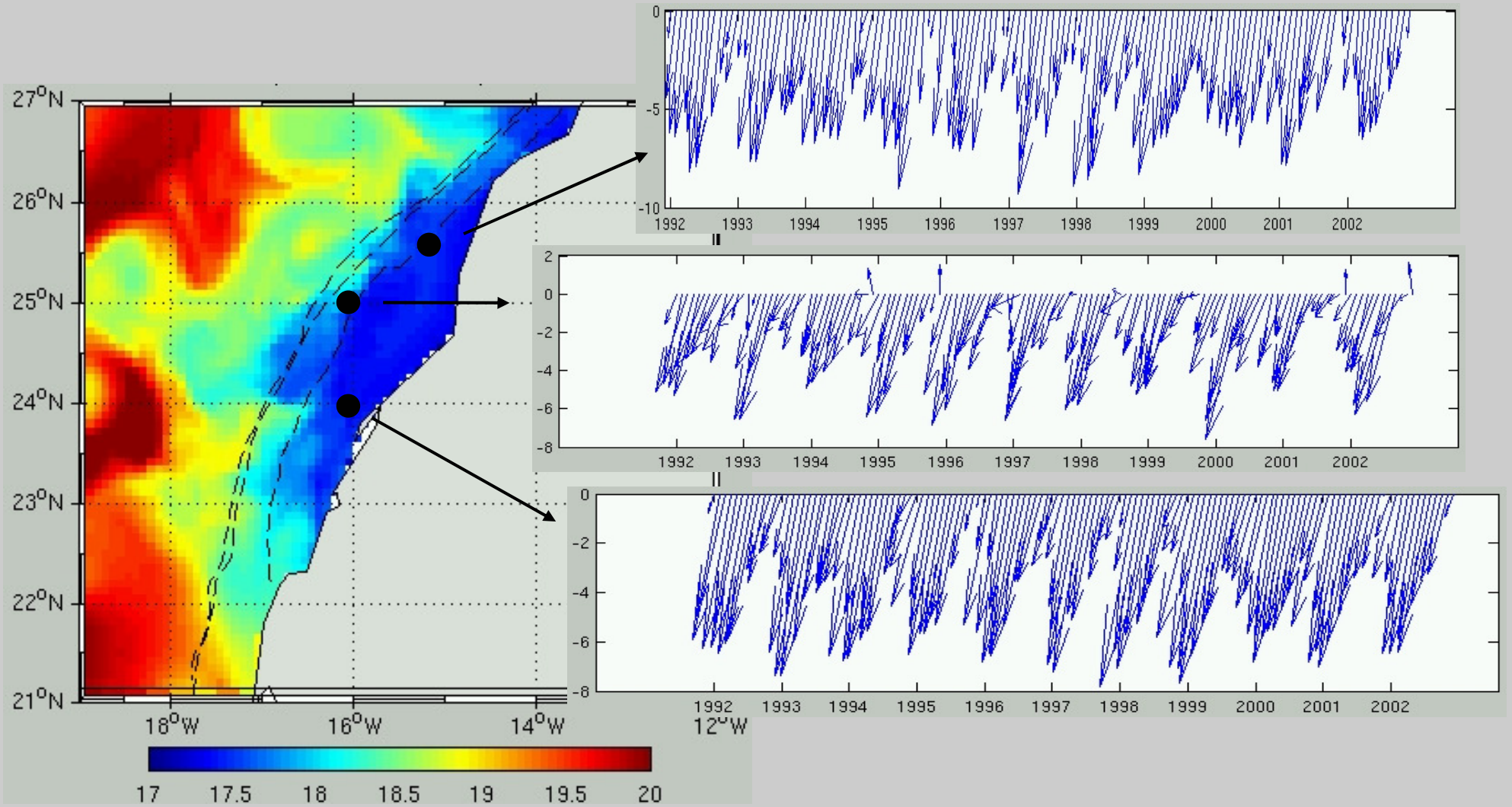
Machu et al., *Fish. Ocean.*, subm



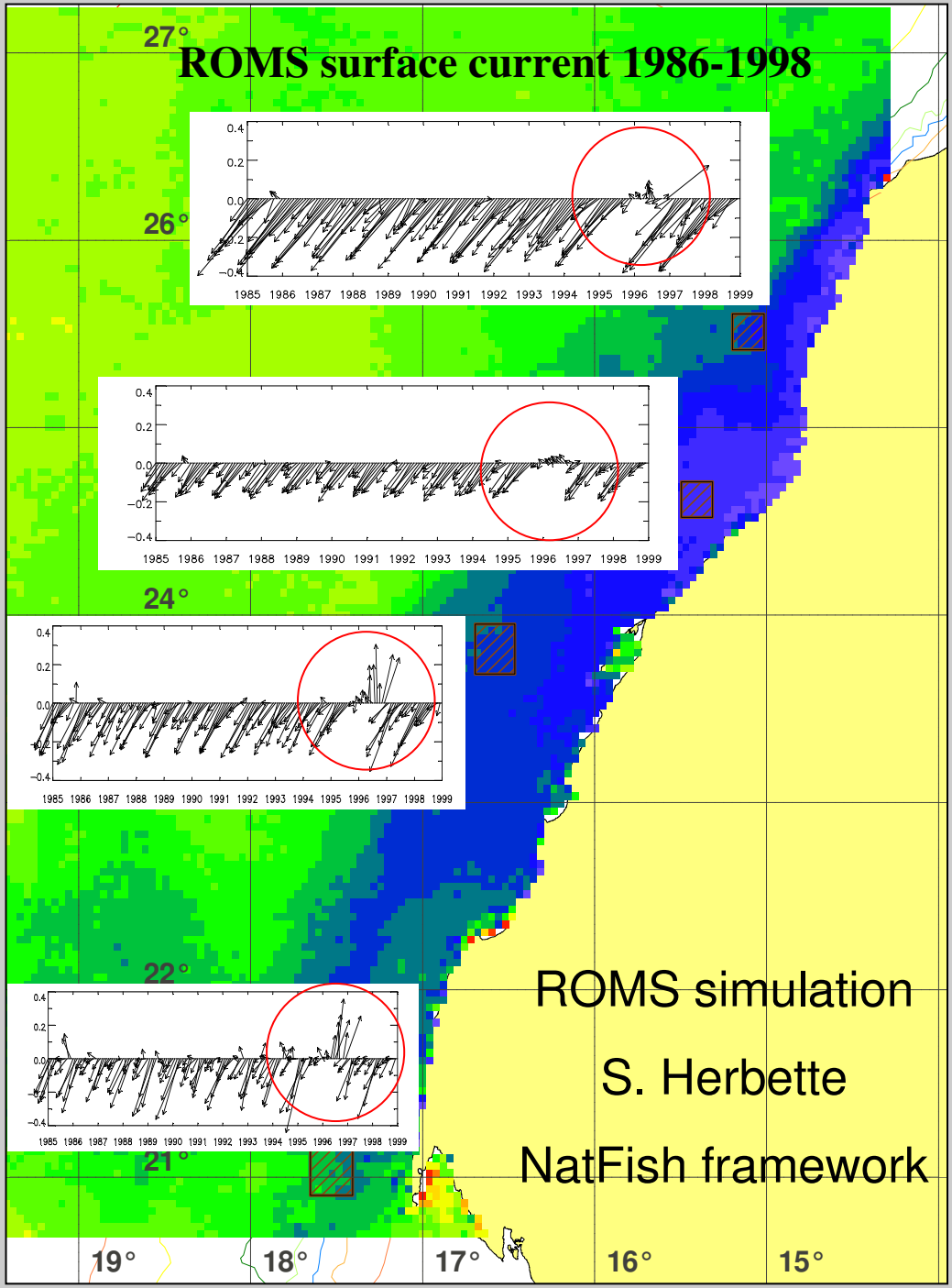
Plankton biomass apparently not responsible for collapse of 97 sardine stock nor for reduction of larvae or juvenile "pool"

Surface Currents

(from ROMS experiment)

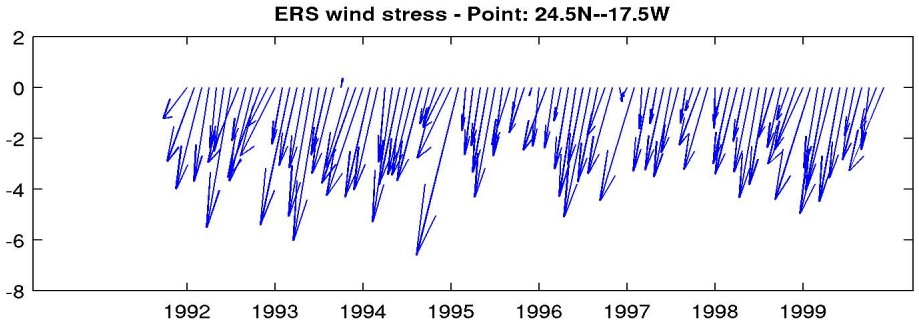


No obvious interannual signal in the currents that could be responsible for massive mortality of eggs and larvae

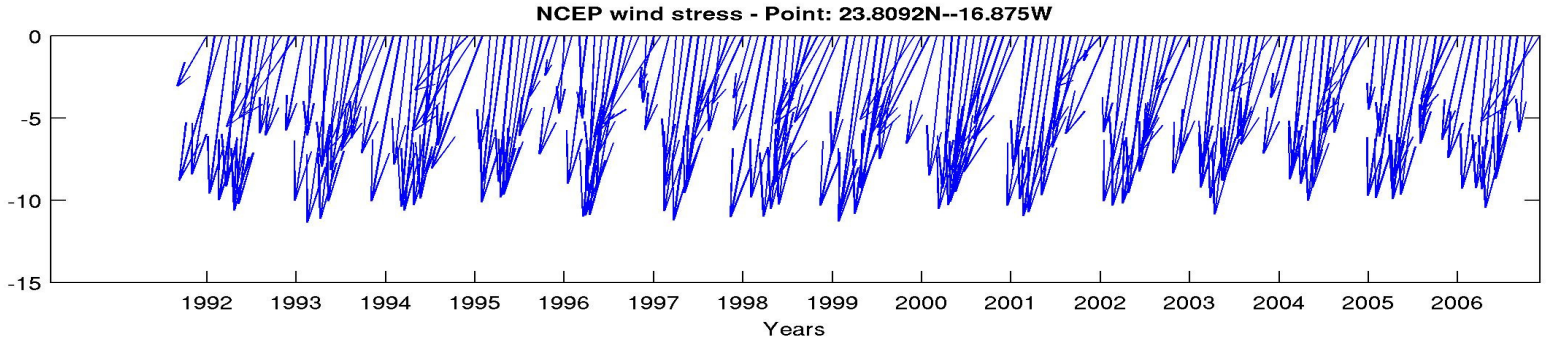


Ostrowski, CCLME, Dakar, 2005

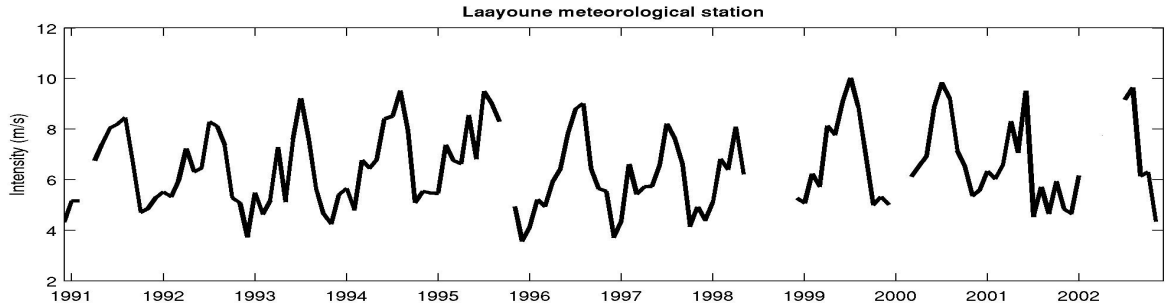
ERS



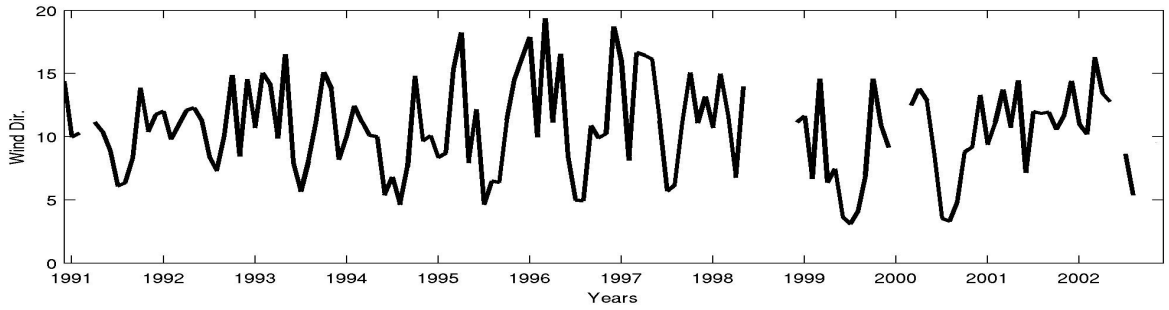
NCEP



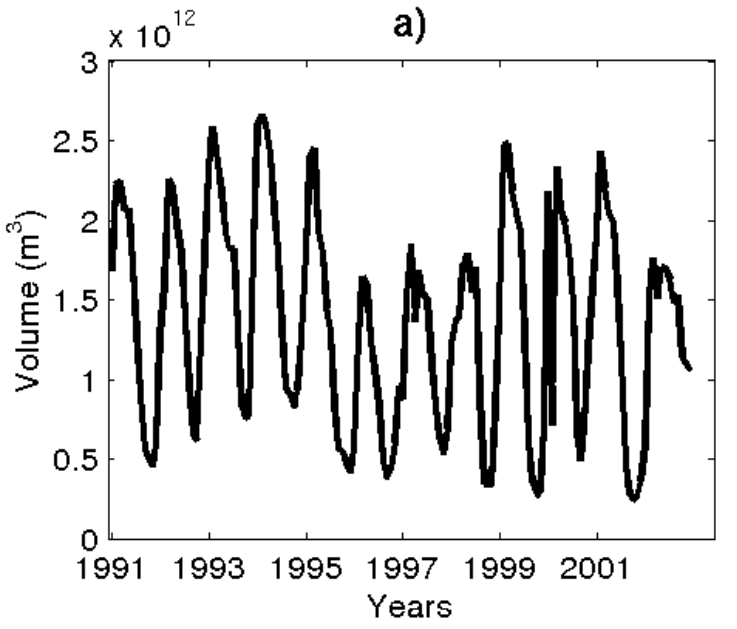
Laayoune Station

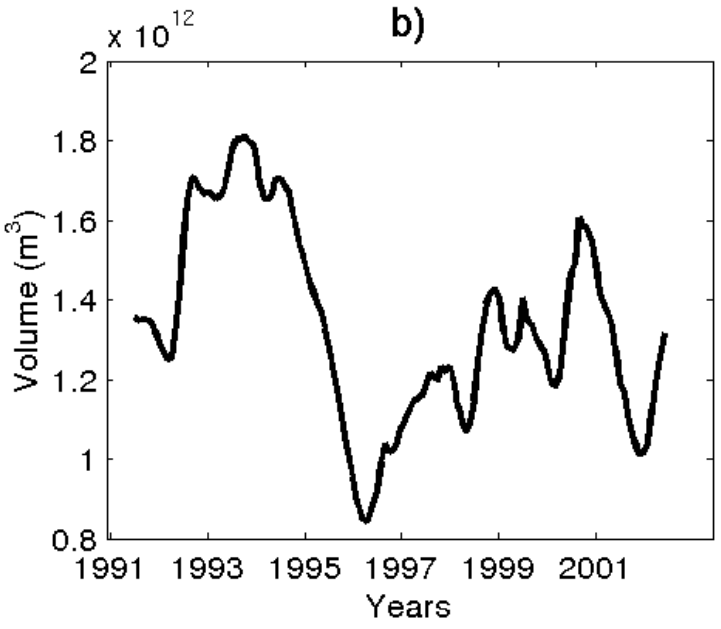


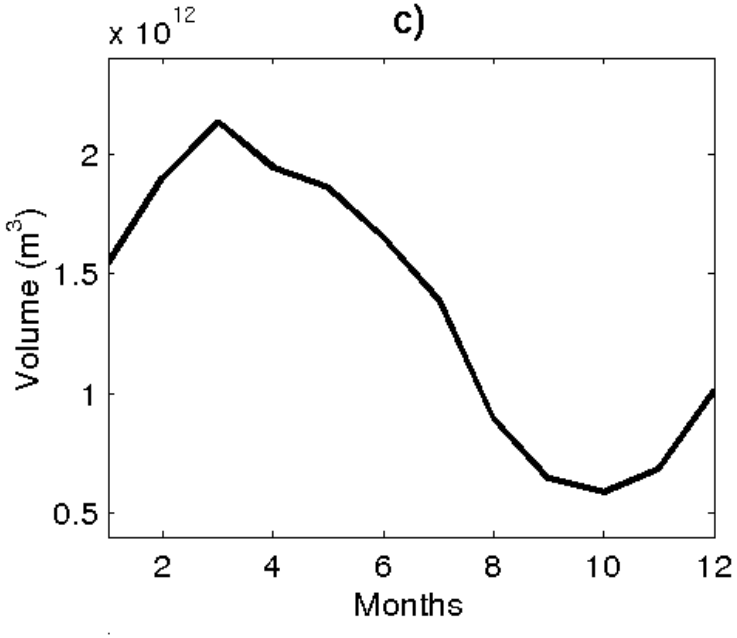
Intensity



Direction







Variability of the potential spawning habitat (defined from *in situ* observations) volume

Conclusions

✔ We have used a coupled physical-biogeochemical model to look at the role of the interannual variability of the environment (temperature, salinity, currents, plankton biomass) on the early-life stages of sardines (through the spawning habitat and the food availability)

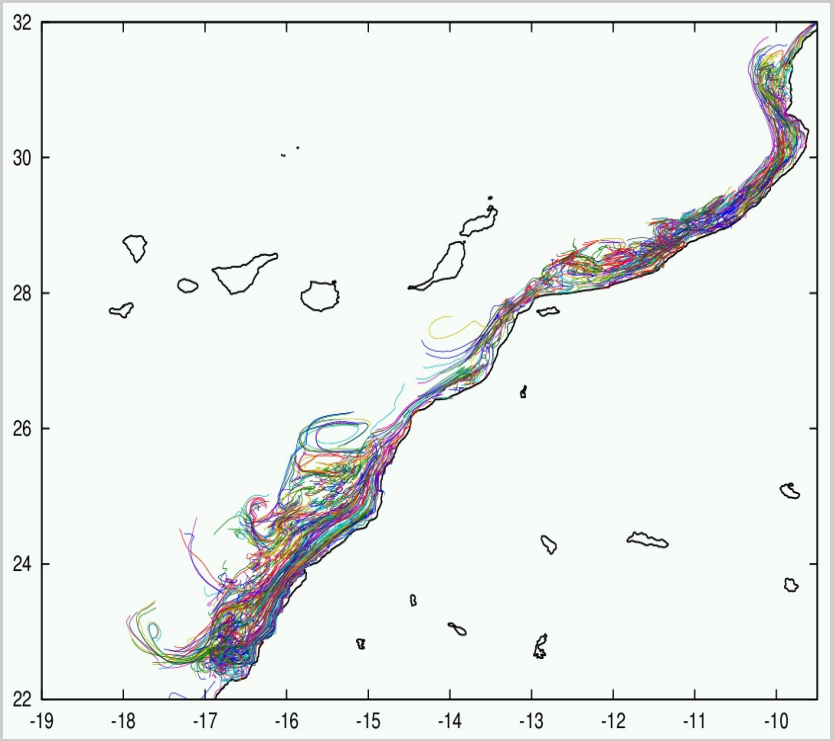
✔ From this modelling experiment, the shrinking of the sardine spawning habitat is the only interannual signal that could be responsible for the absence of juveniles in the sardine stock evaluation done end of 1996

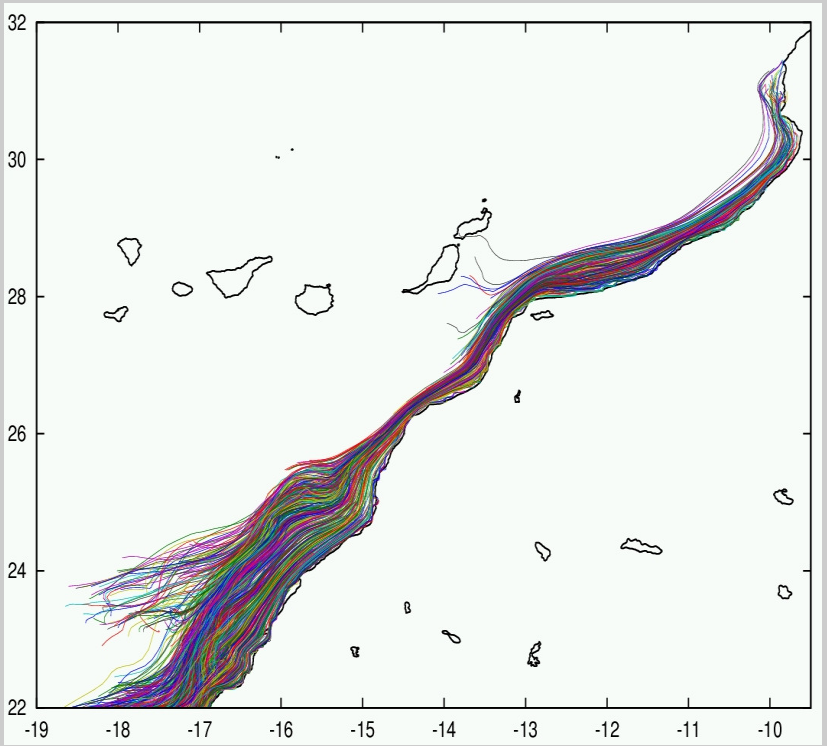
✔ This result could be used in a management perspective since it concerns the recruitment success

✗ With this model, we could not test the predation on egg, larvae and juvenile stages. Nevertheless, any other species did significantly increased ...

Perspectives

✔We will look at the interannual variability of the larvae survival using a Lagrangian model





From T. Brochier