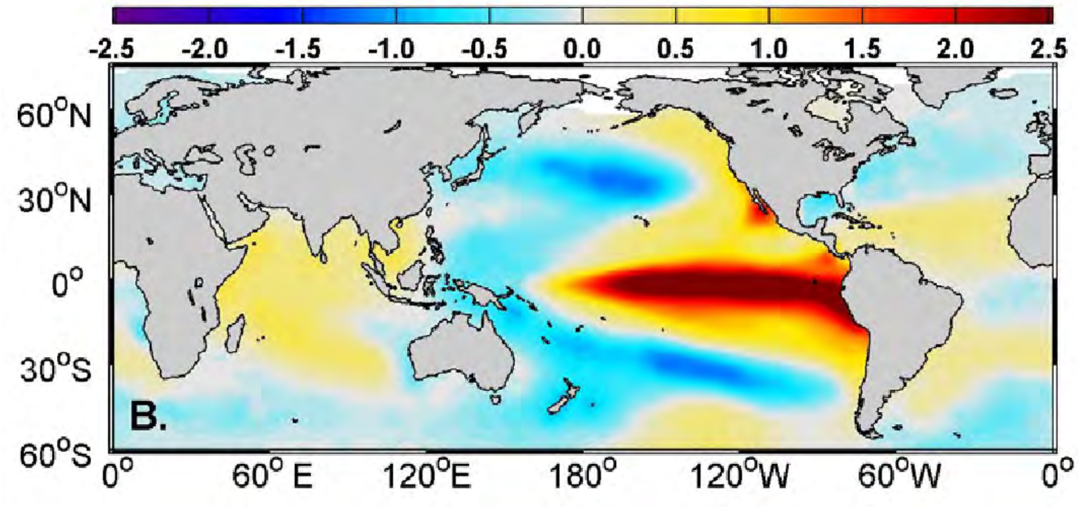
Changes in the oxycline depth and their impacts on fish distribution

D. Grados, R. Castillo, M.Pozada, M. Graco and A. Bertrand

The Humboldt Current System: General characteristics

SST variability



HCS: Region where el Niño, and climate variability in general, is most notable

The Humboldt Current System: General characteristics

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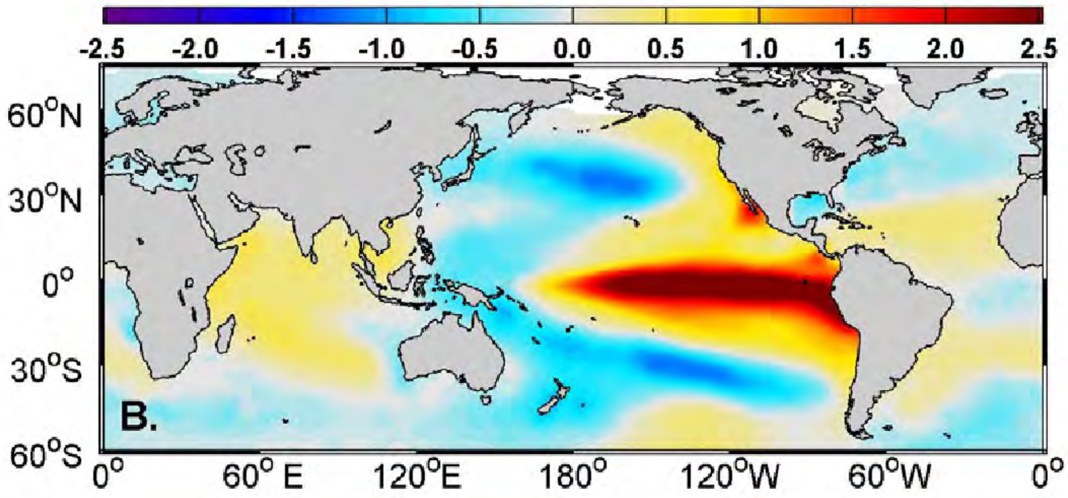

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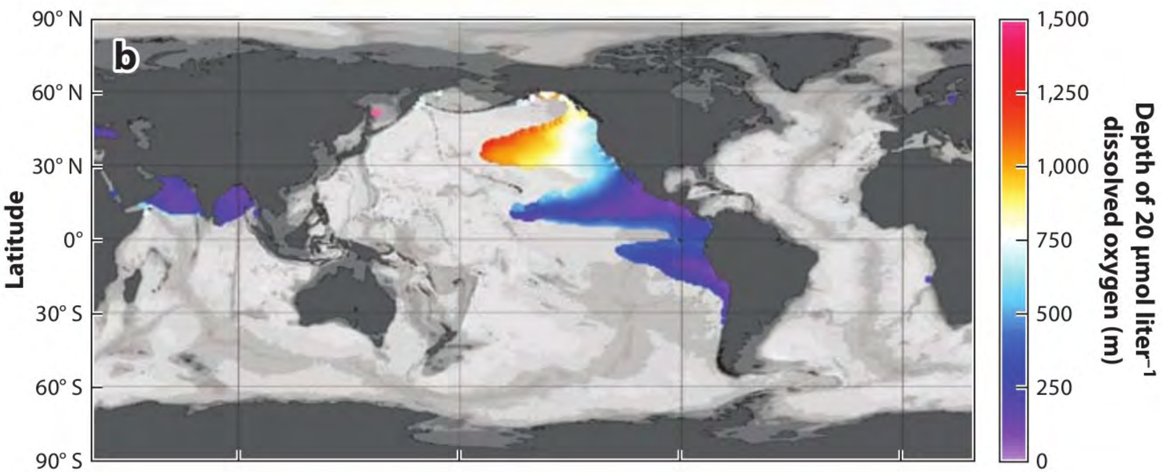
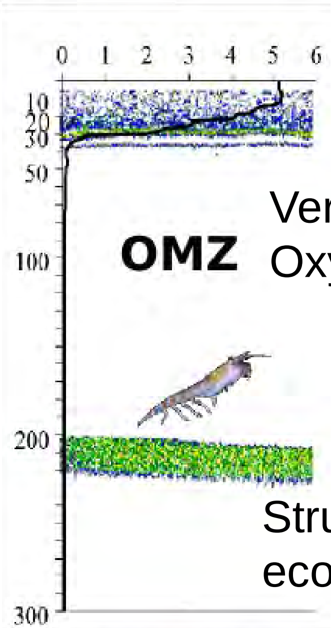




Ballón et al. (2011, PinO)

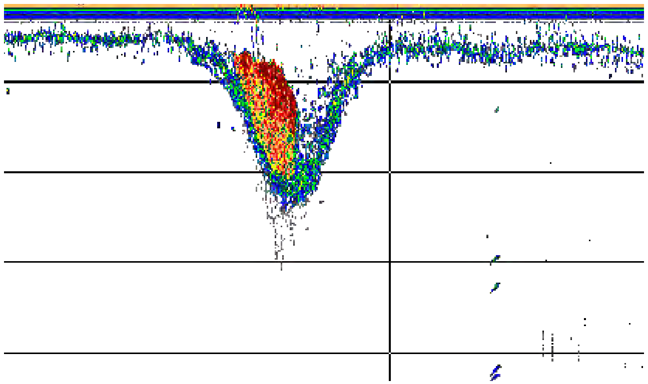
Very intense and shallow Oxygen Minimum Zone (OMZ)

Structure the marine ecosystem, vertically

The Humboldt Current System: General characteristics

Physical forcing of the surface ocean includes a variety of processes, ranging from internal waves (IW), to Submesoscale and mesoscale

Recent work showed that ocean dynamics at scale < 10km play the foremost role shaping the seascape (Bertrand et al., 2014)



Goals

Quantify the impact of climate variability of the oxycline depth

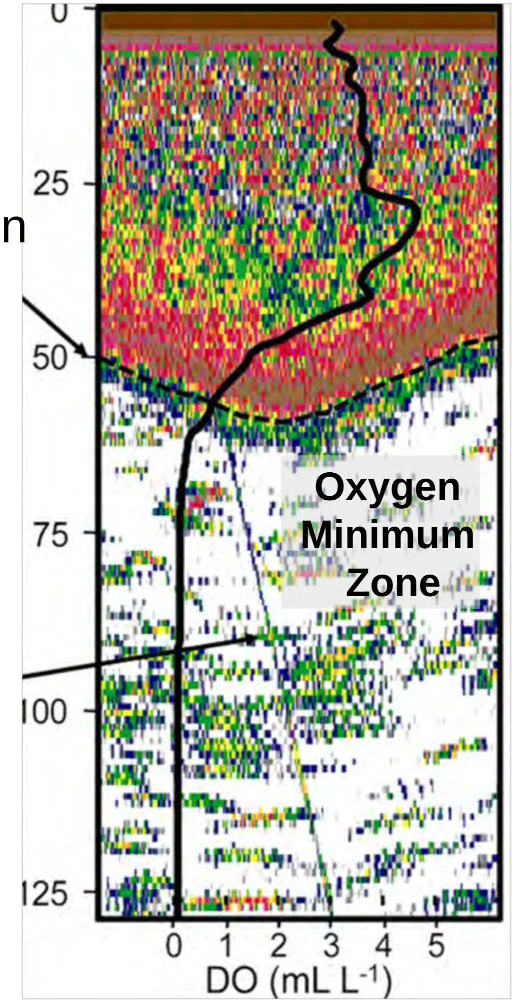
Quantify the impact of climate variability on the fine scale physical structures (< 2 km)

Characterize the effects of climate variability on the spatial distribution of fish

The Humboldt Current System: Data

Vertical extension of the epipelagic communities

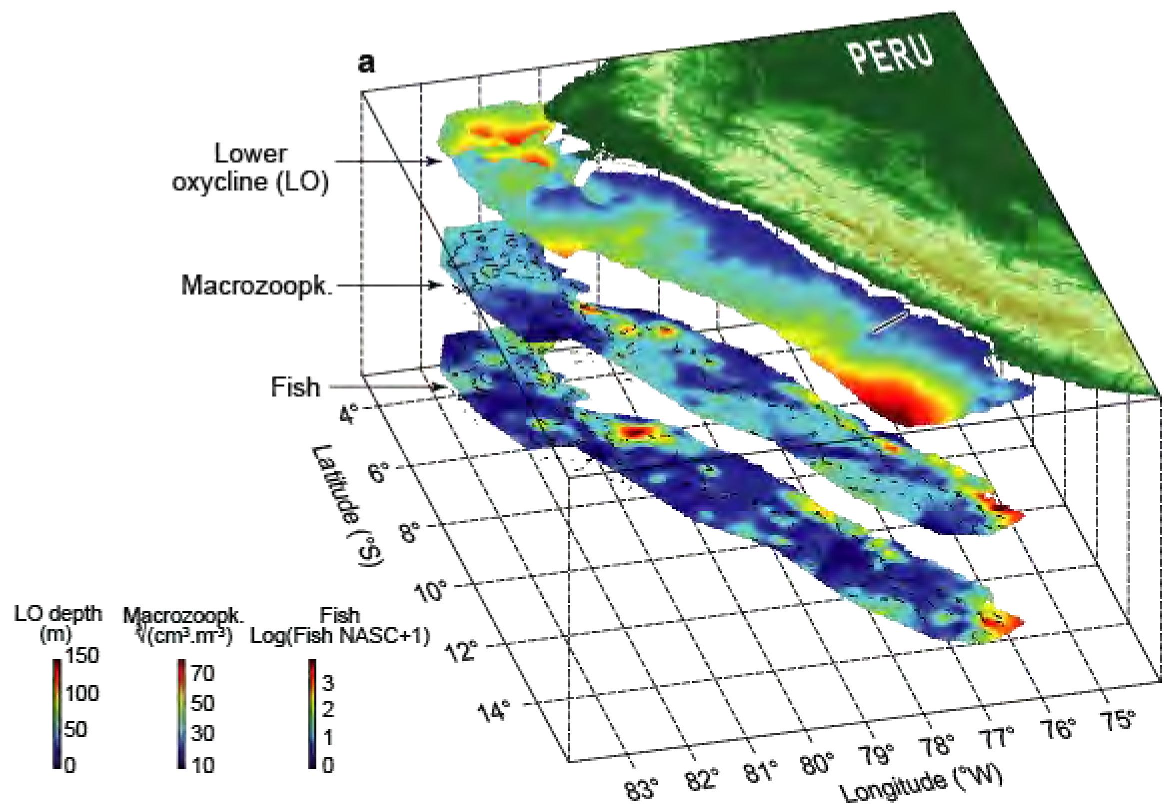
CTDO track



Data between 2002 – 2013

- Robust proxy of the oxycline depth
- Robust proxy of the physical forcing

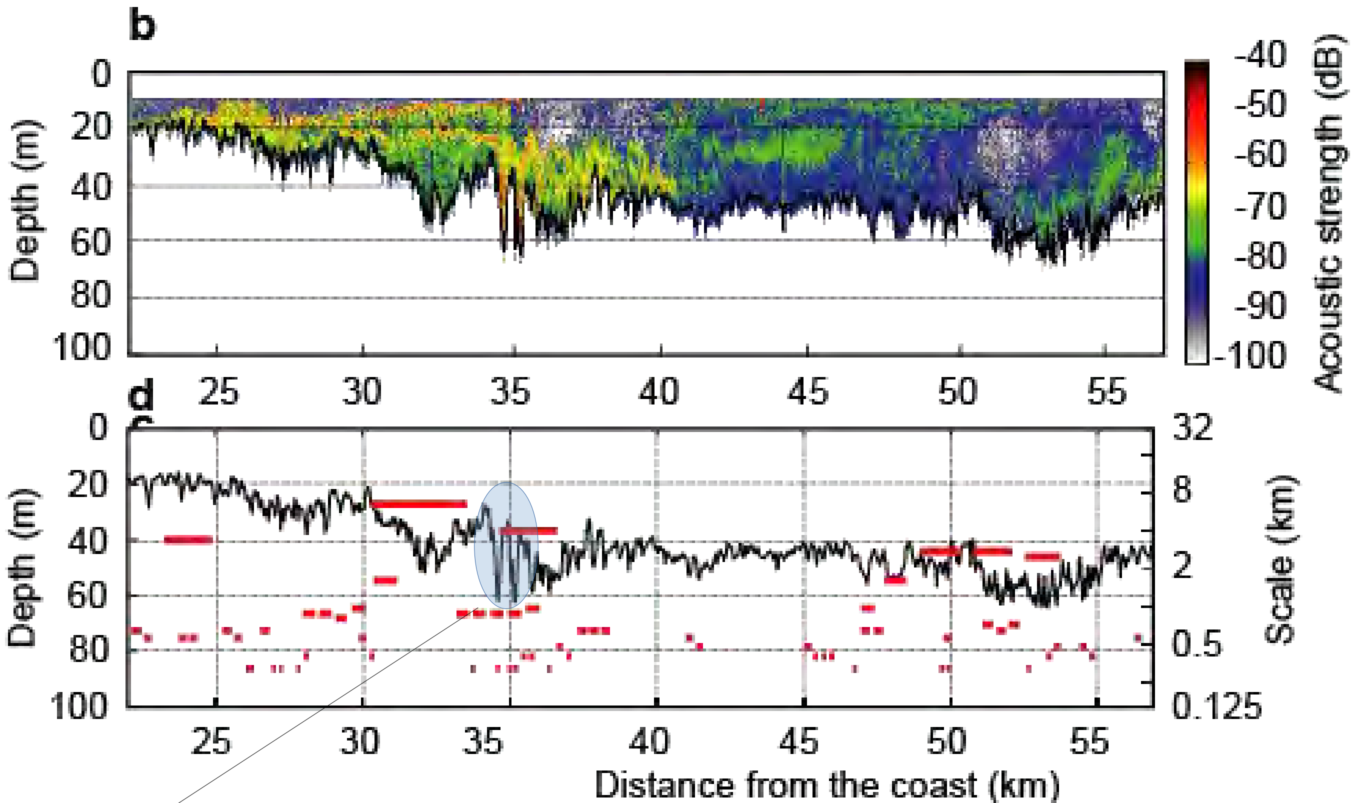
- Acoustics: high resolution data on upper ocean turbulence, and zooplankton and fish abundance

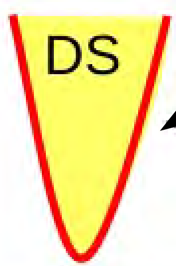


The Humboldt Current System: Data

Oxycline depth: Proxy of ocean turbulence

Extract physical structures along scales

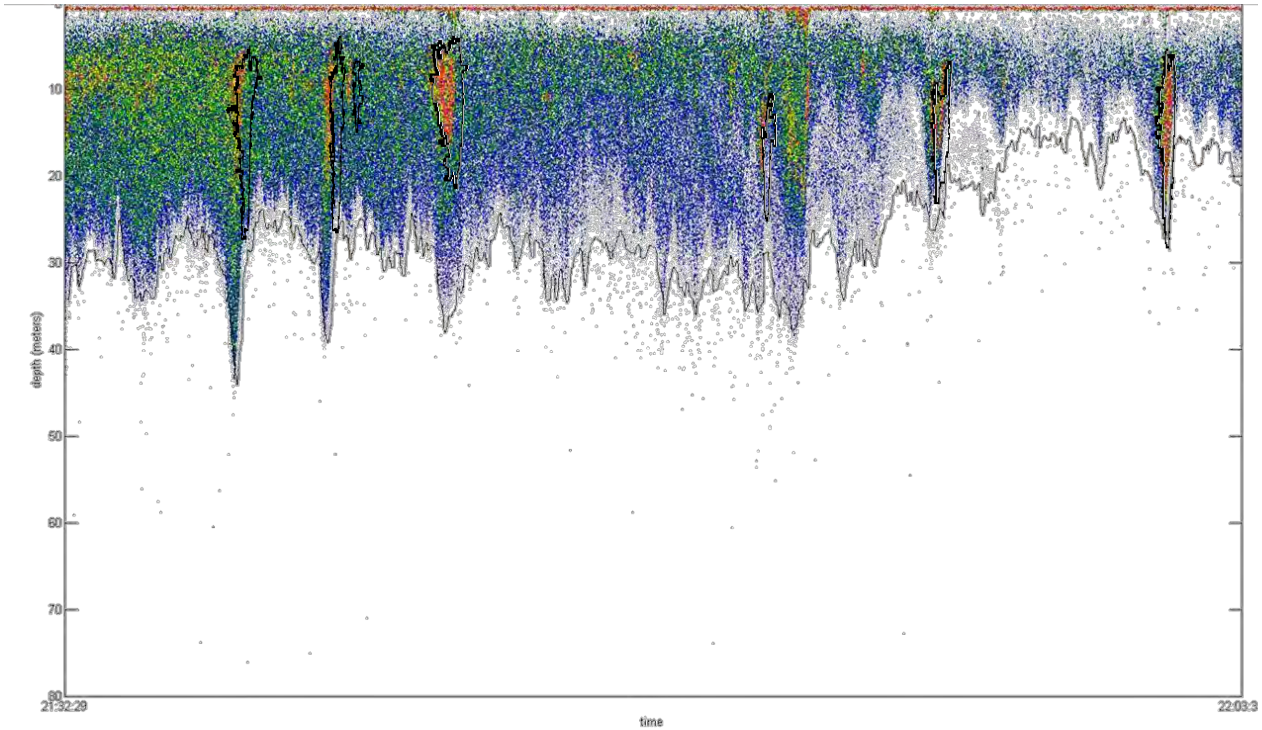




DS: downward deformation surface (m^2)

The Humboldt Current System: Data

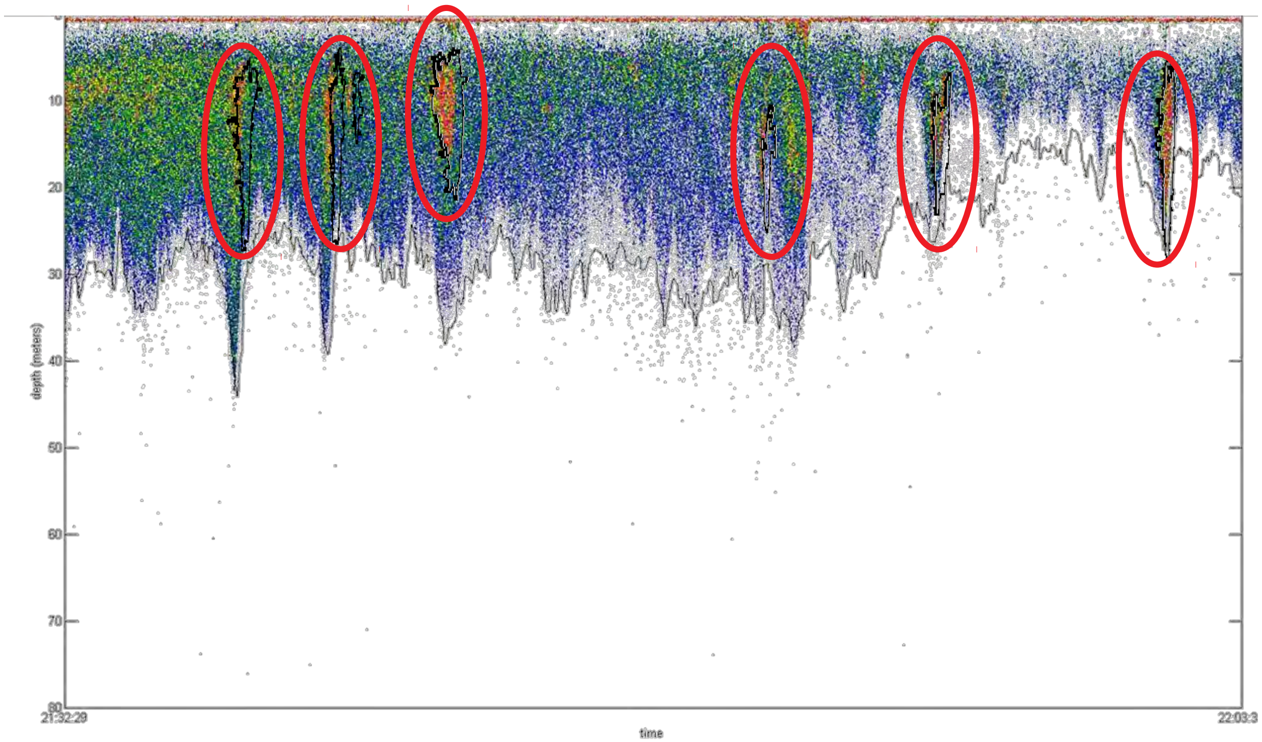
Shoal detection



Echoview, detect patterns of the schools of fish
To quantify spatial and vertical patterns of this schools

The Humboldt Current System: Data

Shoal detection



Echoview, detect patterns of the schools of fish
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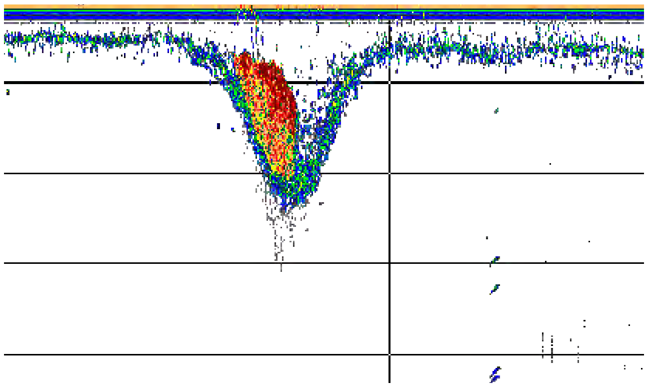
The Humboldt Current System: Data

High resolution of the oxycline depth

fine scale physical structures



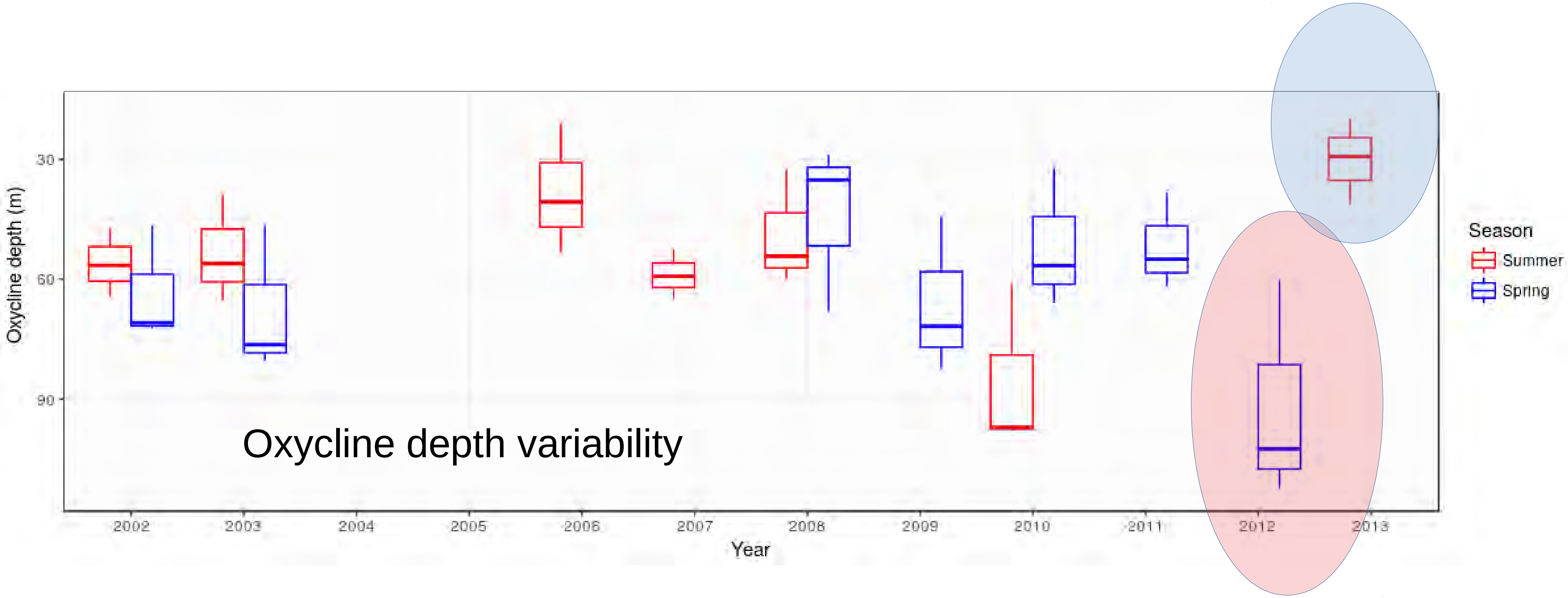
Depth mean of the school

Anisotropy index

Gravity center of the fish

Distance to the coast of fish

Oxycline depth variability



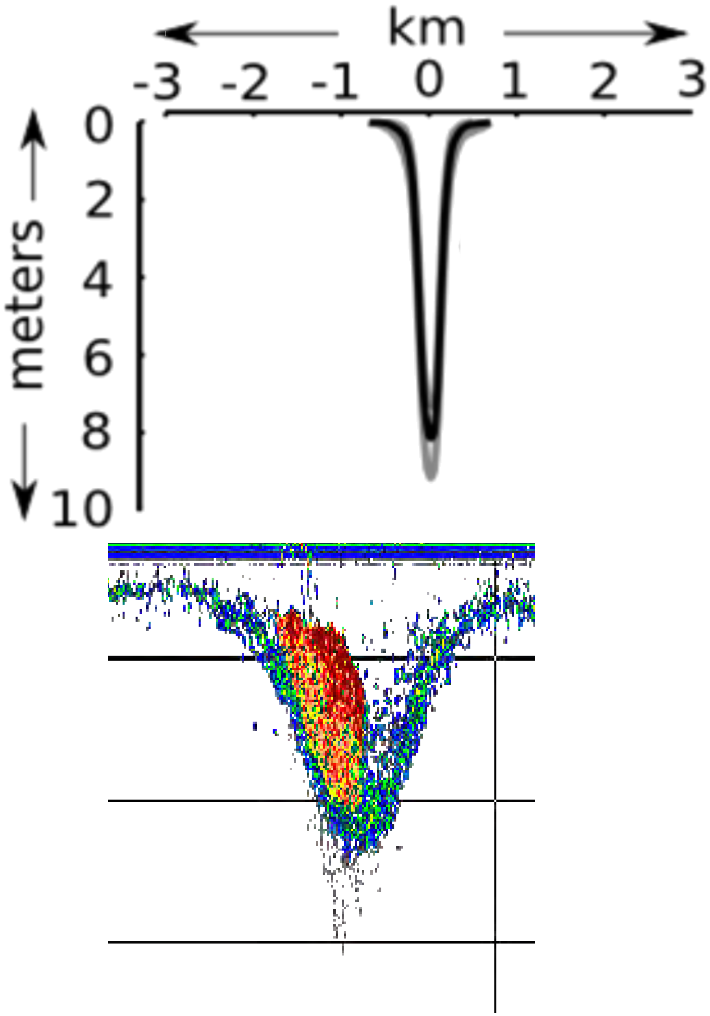
High variability

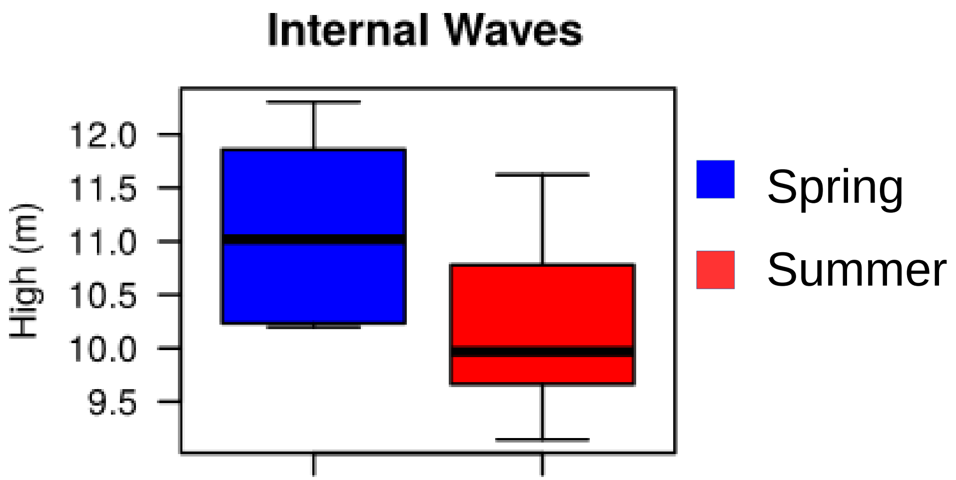
Some periods the oxycline depth is deeper → Correspond to warm period (ICEN classification)

Fine scale physical structure variability

Physical structures smaller than 2 km

Cluster at the Internal Wave scale



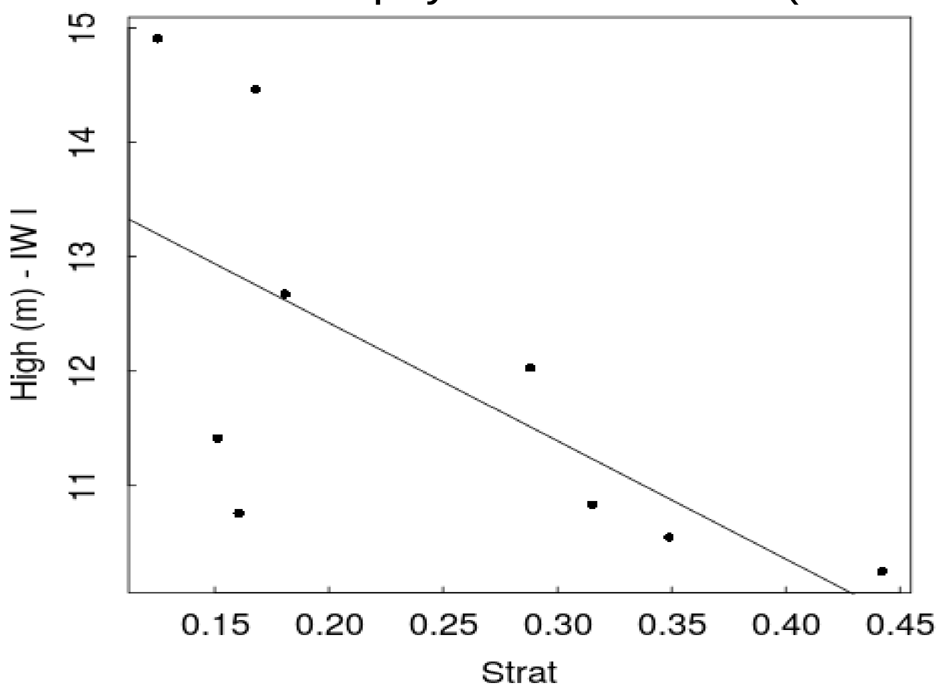


Clear seasonal pattern of the physical structures

Higher structures in spring

Working at the survey scale along the stratification gradient

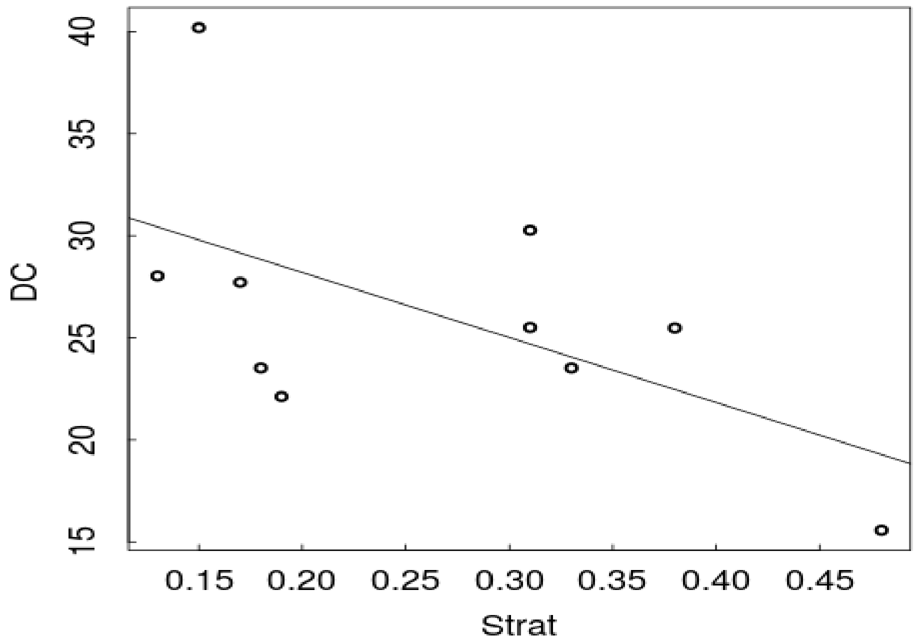
Small scale physical structures (< 2 km)

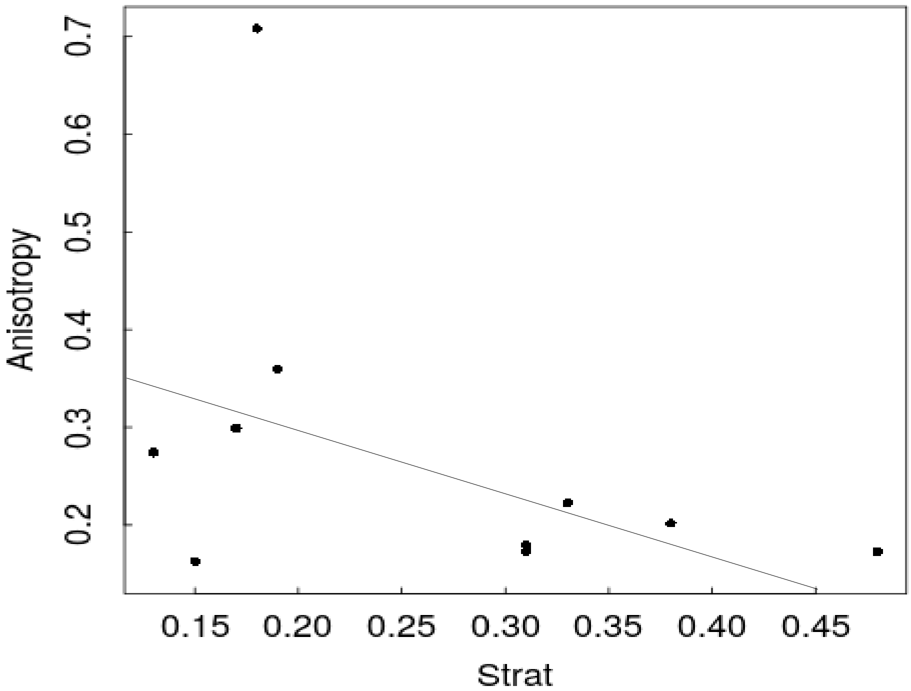


Ocean stratification significantly reduces the vertical deformation of fine scale physical structures

Working at the survey scale along the stratification gradient

Spatial fish characteristics





More stratification → fish distribution are closer to the coast

More stratification → Anisotropy is smaller

- Oxycline depth is deeper during warm period

- The strength of small scale physical structures decreases with high stratification

- Climate variability impact spatial aggregation of fish –> evidence for horizontal distribution

- More stratification → fish schools closer to the coast

- Not strong evidence of the effect of climate variability of vertical distribution of fish

Gracias!