Changes in the oxycline depth and their impacts on fish distribution

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The Humboldt Current System: General characteristics

What do we know?

SST variability

HCS: Region where el Niño, and climate variability in general, is most notable
What do we know?  What do we want?  How do we work?  Results  Conclusion

The Humboldt Current System: General characteristics

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

- SST variability
- Very intense and shallow Oxygen Minimum Zone (OMZ)
- Structure the marine ecosystem, vertically

Grados

Ballón et al. (2011, PrmO)
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

**What do we know?**
- Robust proxy of the oxycline depth
- Robust proxy of the physical forcing

**What do we want?**

**How do we work?**
- Acoustics: high resolution data on upper ocean turbulence, and zooplankton and fish abundance

**Results**

**Conclusion**

**Vertical extension of the epipelagic communities**

- **CTDO track**

**Data between 2002 – 2013**

- Oxygen Minimum Zone

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**Grados**
Oxycline depth: Proxy of ocean turbulence

Extract physical structures along scales

DS: downward deformation surface (m²)
Echoview, detect patterns of the schools of fish
To quantify spatial and vertical patterns of this schools
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To quantify spatial and vertical patterns of this schools
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

What do we know?      What do we want?      How do we work?      Results      Conclusion

High variability

Some periods the oxycline depth is deeper → Correspond to warm period (ICEN classification)
Physical structures smaller than 2 km

Cluster at the Internal Wave scale

Clear seasonal pattern of the physical structures

Higher structures in spring
What do we know?      What do we want?      How do we work?      Results      Conclusion

Results: Impact of ocean stratification on physical structures

Working at the survey scale along the stratification gradient

Ocean stratification significantly reduces the vertical deformation of fine scale physical structures
Results: Impact of ocean stratification in fish distribution

What do we know?      What do we want?      How do we work?      Results      Conclusion

**Results**

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

Graphs showing the relationship between stratification (Strat) and fish distribution characteristics (DC, Anisotropy)
- 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!