Linking small pelagics and ecosystem in CCLME region: an overview of recent studies carried out by the IEO

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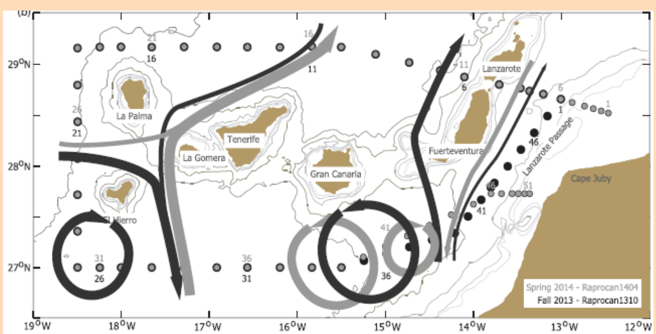
Workshop on climate change and small pelagics in the CECAF area
Online, 29th June 2021

‘Take home’ message:



From Vélez-Belchí et al. (2017)

Despite the evidences about the link between the abundance of small pelagic fish and the environmental and climatic variations, and that several monitoring programs exist in the CCLME region (including the Canary Islands), few interdisciplinary studies have been performed.

Let’s work together!

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- CCLME: overview and indicators of Climate Change

- Previous IEO studies linking climatic/oceanographic features and small pelagics:
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- Next steps: interdisciplinary work between IEO monitoring programs
  - RAPROCAN
  - DCF
  - Preliminary findings

- Answering the raised questions

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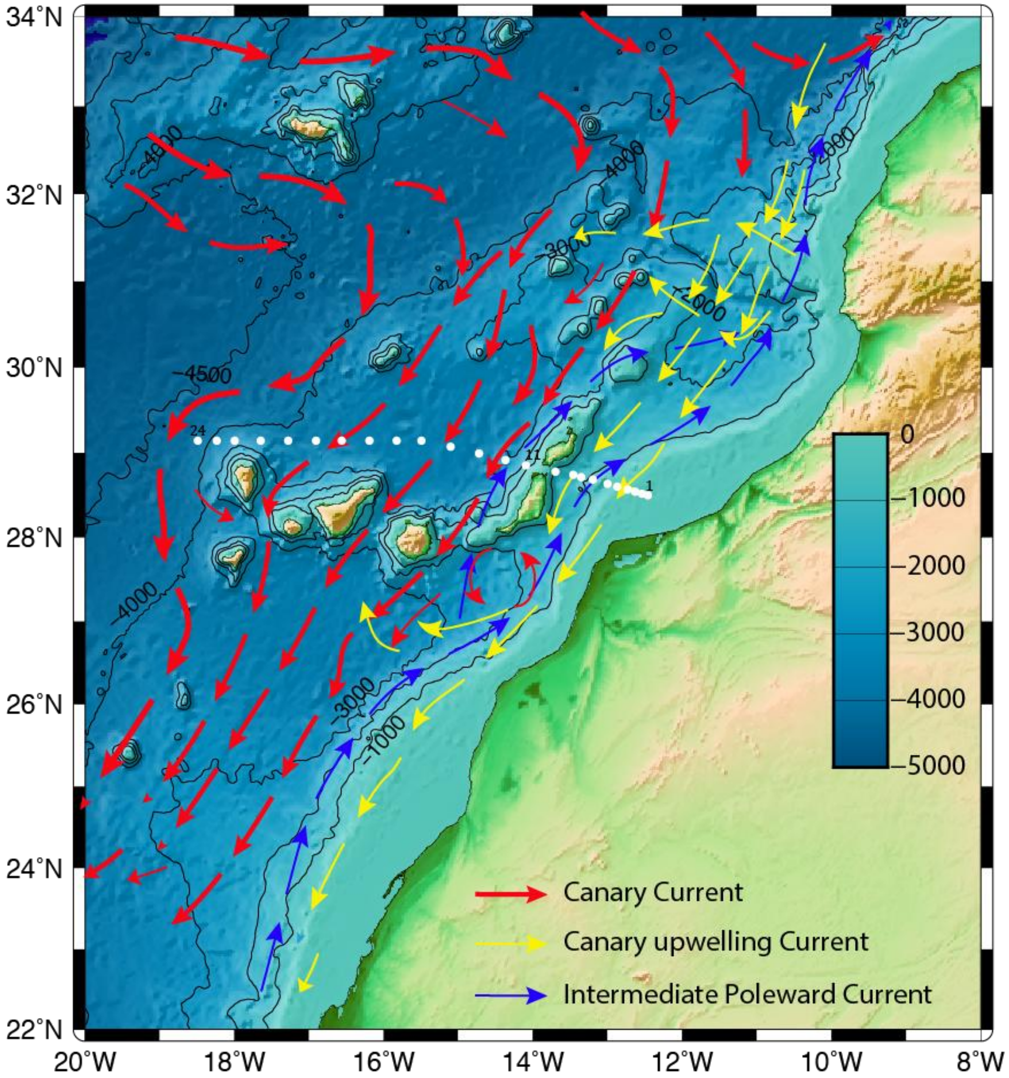
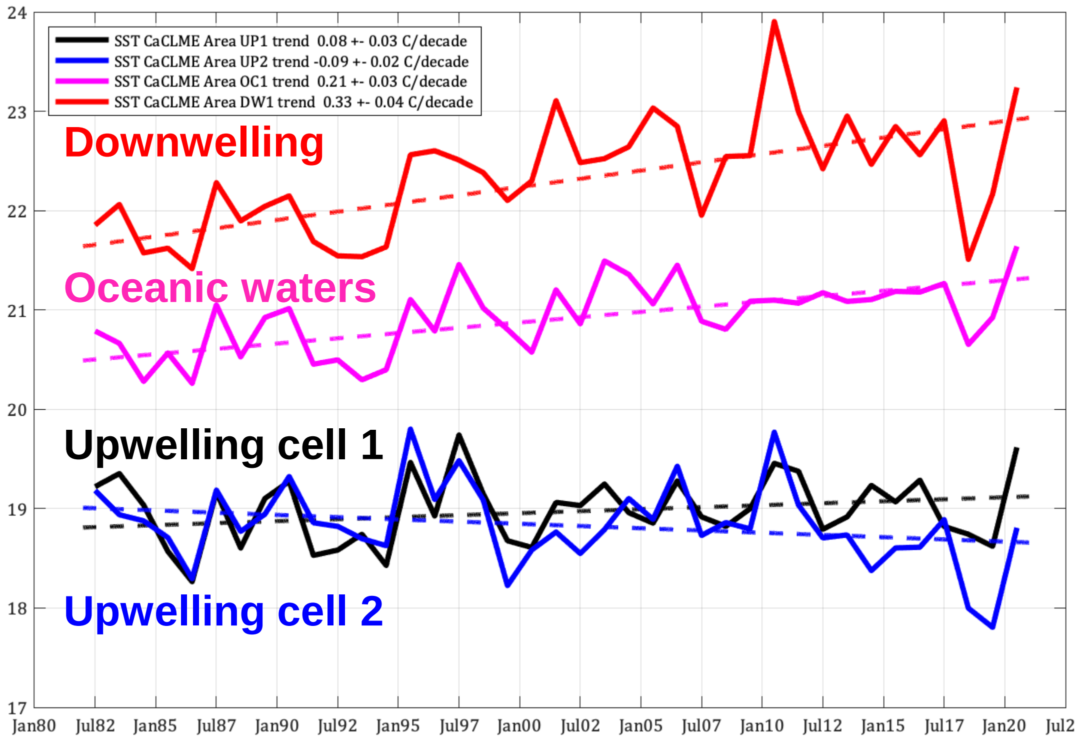
CCLME: Overview and indicators of Climate Change



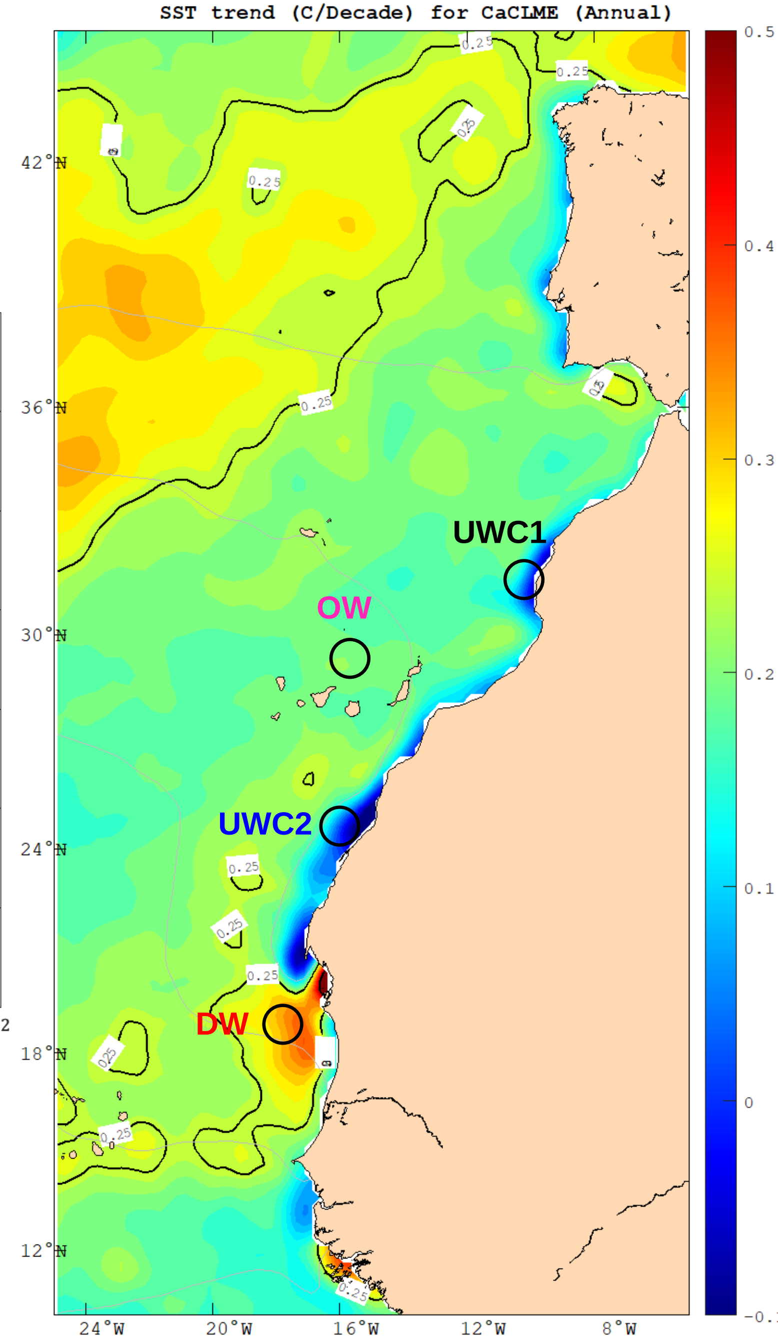
Available in: http://www.oceanografia.es/pedro/research_IROC2018_Canary.html

Long term changes in the CCLME:

SST [Calibrated with CTD observations]



Source: NOAA high-resolution (1/4°) blended analysis of Daily SST (period: 1982–2020)



Updated from Vélez-Belchí et al. (2015)

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Case of study in NW Africa:

Influence of some climatic indices on *Sardina pilcharchus* off NW Africa

Main large-scale climate indices:

- AMO - Atlantic Multidecadal Oscillation
- NAO - North Atlantic Oscillation
- AO - Arctic Oscillation
- SOI - Southern Oscillation

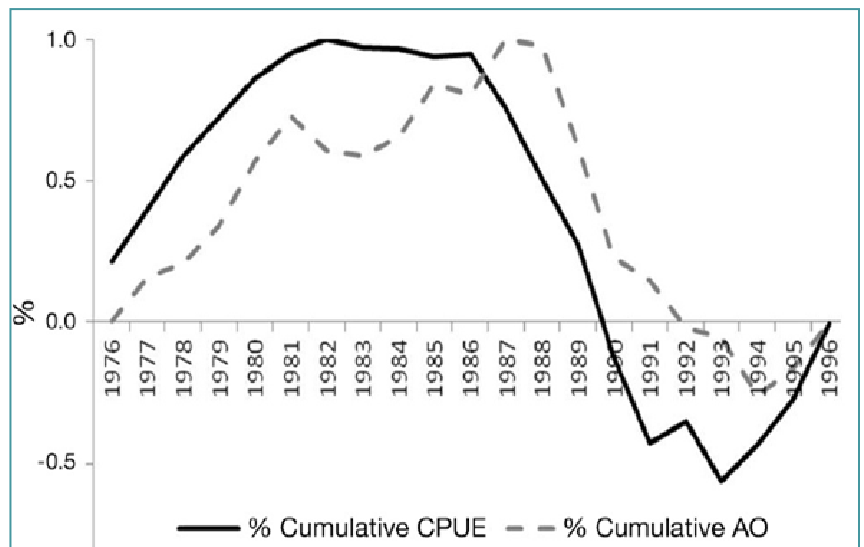
Fishery data:

Annual sardine CPUEs of the Spanish purse-seiners operating in NW Africa (26°-29°N).

1976 – 1996 → Different curve regression models were applied to find correlation between the CPUE of sardine and the climatic oscillations used as independent variables.

MAIN FINDINGS

An effect driven by **AO** affected the sardine's CPUE in the study area for the period 1976-1996, which could be related to SST variability.



Báez J.C., Santamaría M.T.G. García A. González J.F. Hernández E. & Ferri-Yáñez F. 2019. Influence of the Arctic oscillations on the sardine off Northwest Africa during the period 1976-1996. *Vie et Milieu*. Vol. 69 (1): 71-77.

Case of study in NW Africa:

Influence of some climatic indices on *Sardina pilchardus* off NW Africa

CONCLUSIONS:

- Although changes in species distribution and abundance in pelagic ecosystems are difficult to relate to environmental dynamics, an effect driven by AO affected the sardine's CPUE.

- A positive AO phase increases the intensity of trade winds impacting across the NW African region, subsequently intensifying the hydrodynamic activity, and inducing mesoscale features as upwelling/downwelling processes.

- This can enhance productivity in the area, maintaining the condition status of the small pelagic resources by ameliorating the physical fitness of fish and their relative abundance, despite the increasing temperatures in the region attributed to climatic changes.

Báez et al. (2019)

Case of study in the Canary Islands:

Seasonal evolution of small pelagic landings in relation to oceanographic variables

Oceanographic/environmental parameters:
- SST
- SSTAs
- Chl-*a*

→

Purse seine landings:
- *Scomber colias*
- *Trachurus* spp
- *Sardina pilchardus*
- *Sardinella* spp

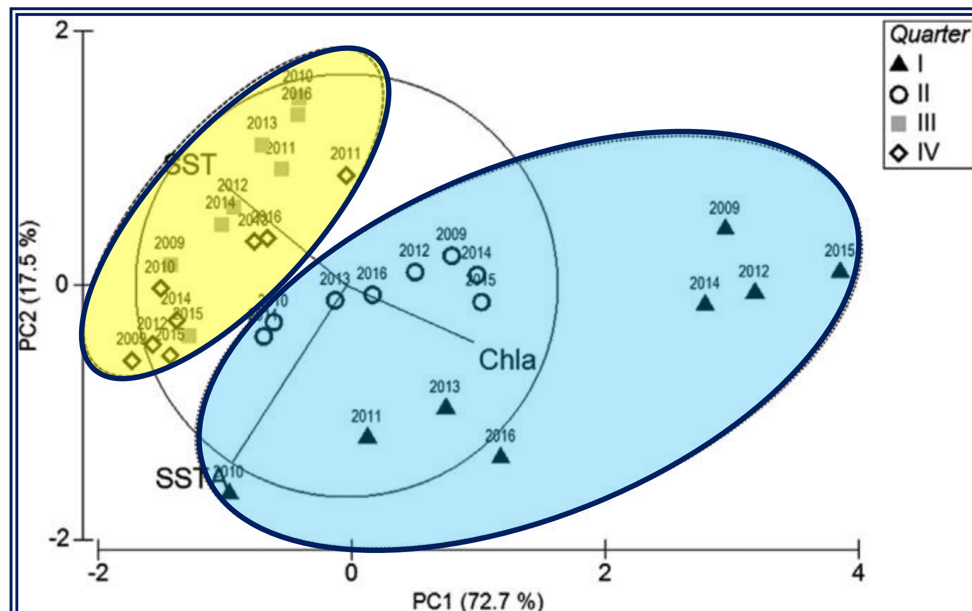
Environmental parameters: quarterly averaged values

Landings: quarterly standardized

2009-2016 → Different multivariant tests were used to identify seasons, seasonality and interannual variability.

MAIN FINDINGS

Two seasons clearly differentiated (PCA):
- A cooler season (C): January to June
- A warmer season (H): July to December

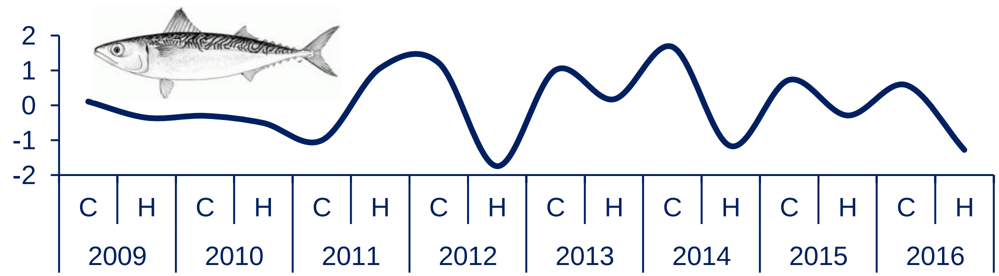


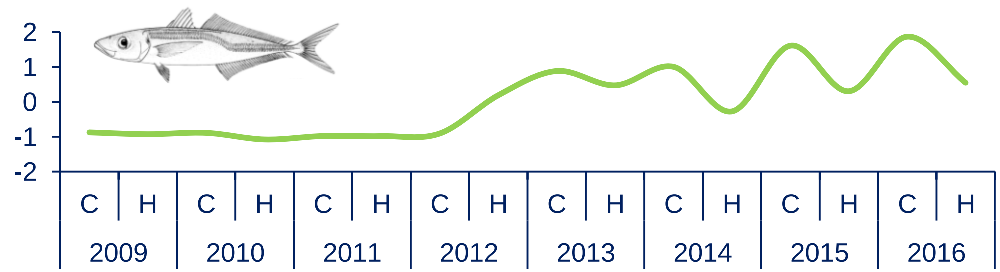
Jurado-Ruzafa A., González-Lorenzo G., Jiménez S., Sotillo B., Acosta C., Santamaría M.T.G. 2019. *Deep-Sea Research* Part II. 2019. Vol. 159: 84–91 https://doi.org/10.1016/j.dsr2.2018.07.002

Case of study in the Canary Islands: Seasonal evolution of small pelagic landings in relation to oceanographic variables

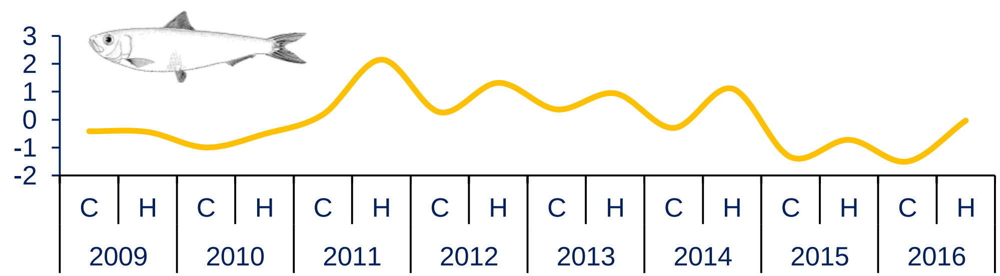
MAIN FINDINGS

- **Landings *S. colias* and *Trachurus* spp:**
  - Higher during the cold season.
  - Negative relation with SST and positive, with Chl-*a*.
  - Also influenced by SSTAs, specially *S. colias*.

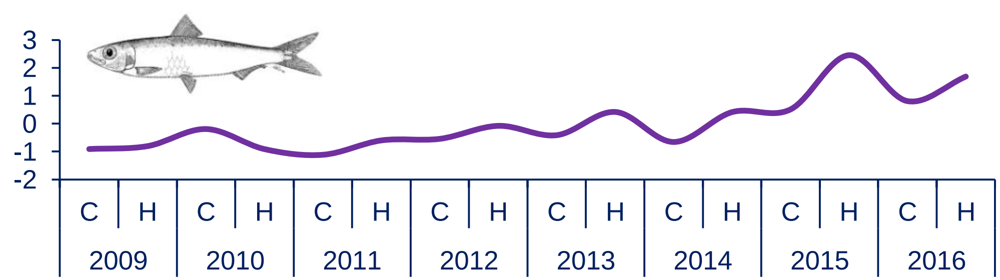




- **Landings *Sardinella* spp:**
  - Higher during the warm season.
  - Negative relation with Chl-a and positive, with SST.
  - Less influenced by SSTA.



- **Landings *S. pilchardus*:**
  - Higher during the warm season.
  - Influenced by SSTA.



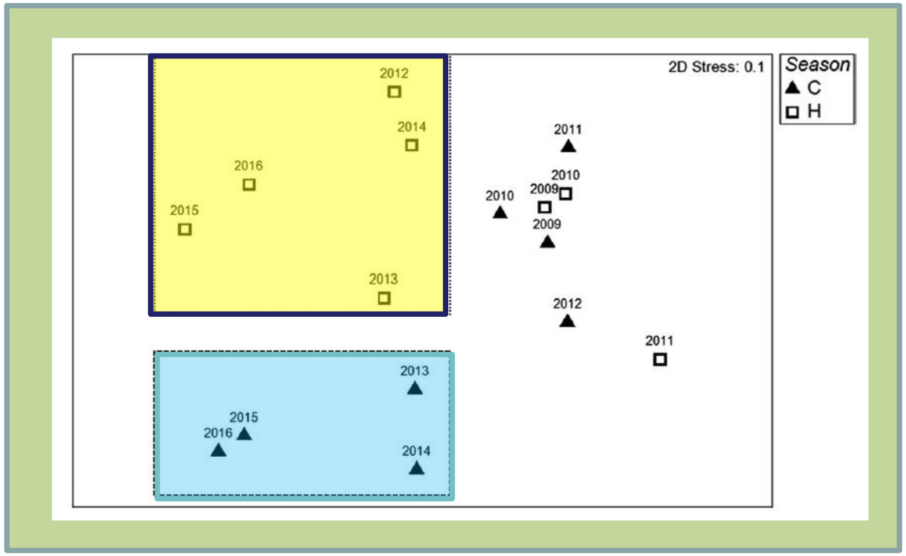
Statistically correlations between landings and environmental parameters only found significant for ***S. colias***.

Jurado-Ruzafa et al. (2019)

Case of study in the Canary Islands: Seasonal evolution of small pelagic landings in relation to oceanographic variables

MAIN FINDINGS

- Interannual variability (nMDS ordination):
  - ✓ showed greater influence on landings variations than the seasonal factor.
  - ✓ seemed to be explained by SSTAs (PERMANOVA).
- From 2012H→ clearly separated seasonal landings.
- Previously, high SSTAs occurred during cooler seasons.



✓ Season cold «C»: *S. colias* and *Trachurus* spp were more frequent in landings.
✓ Season warm «H»: *S. pilchardus* and *Sardinella* spp.
(SIMPER analysis)

CONCLUSIONS

Despite the short time series, some relationships between fishery landings and the considered environmental parameters were found. Likewise, seasonal variations were explained by the 2-seasons scenario assumed.

Jurado-Ruzafa et al. (2019)

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    - **DCF**
    - **Preliminary findings**

- Answering the raised questions

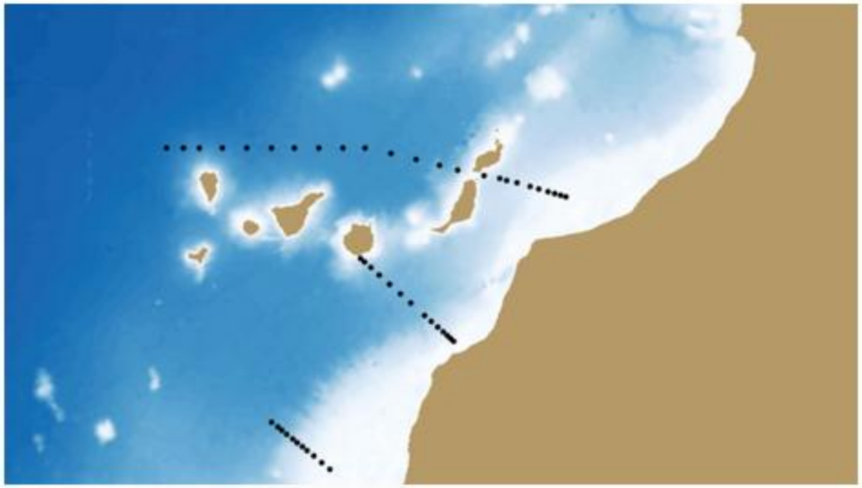
NEXT STEPS: interdisciplinary work between IEO monitoring Programs

RAPROCAN Program (1997-2020)

'Deep hydrographic section around the Canary Islands' → to establish the decadal and/or subdecadal variability in the eastern margin of the subtropical gyre.

DCF- Spanish Program (2013-2020)

- Biological data (LF, mean weight and age distribution of catches, sex-ratio, maturity)
- Data to assess the fisheries impact on marine ecosystems (i.e: discards)
- Detailed data on the activity of EU vessels.



Main species targeted by *the artisanal purse seiners* in the Canary Islands:

- *Trachurus picturatus*
- *Somber colias*
- *Sardina pilchardus*
- *Sardinella aurita*

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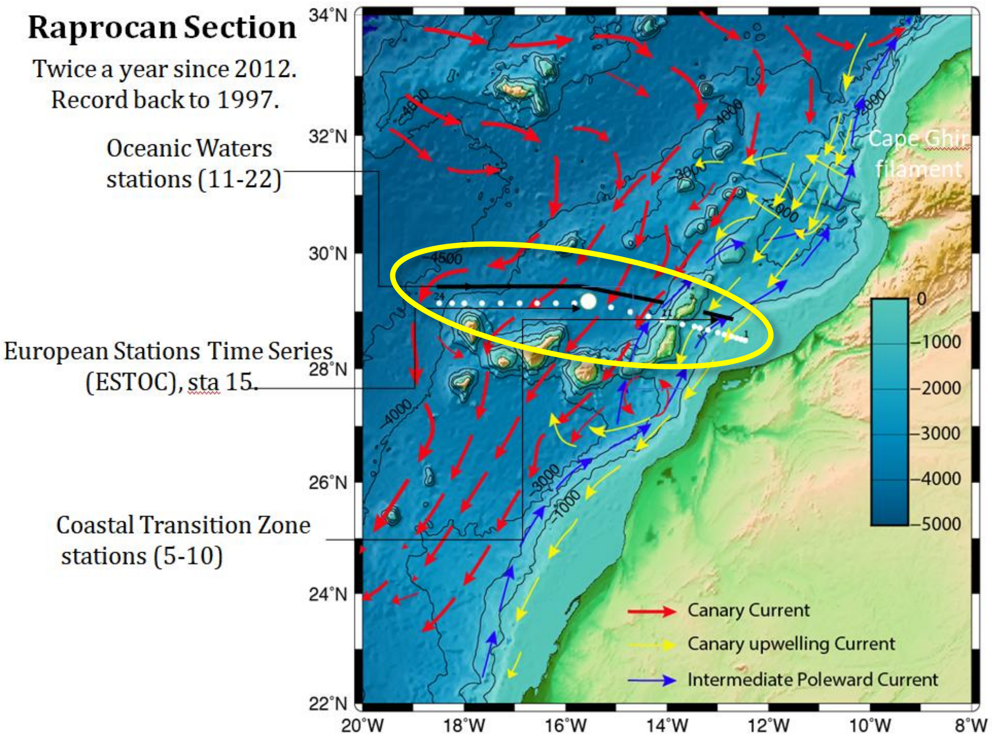
RAPROCAN

http://www.oceanografia.es/pedro/research_IROC2018_Canary.html

The RAPROCAN observational strategy consists of:

- 2 hydrographic cruises per year (winter and summer),
- including 51 hydrographic stations around the Canary archipelago.
- In each station, velocity, temperature, salinity, pressure, oxygen, turbidity and fluorescence are continuously measured (CTD) from the surface to the bottom.
- 24 samples are taken in each station to calibrate the above variables, as well as for determination of alkalinity, carbon content and chlorophyll concentration.



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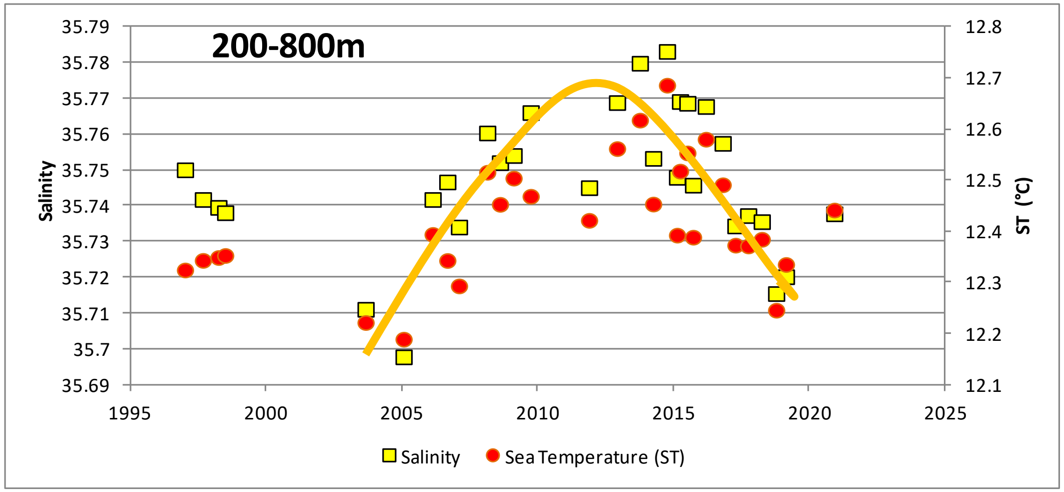
RAPROCAN

Climatic/Oceanographic parameters time series since 1997.

A 10-15 years' cycle seems to be reflected in temperatures and salinity in the oceanic registers between 200 and 800 m depth, from 2005 to 2017.



Available in: http://www.oceanogrfia.es/pedro/research_IROC2018_Canary.html

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DCF-Spanish program

Based on Jurado-Ruzafa et al. (2017)

Characterization of the fish populations:

- Biological parameters
- LFs monitoring

→ For stocks assessment

Biological sampling
(IEO-COC laboratory)

Length samplings
(landings and on board)

Fishermen knowledge

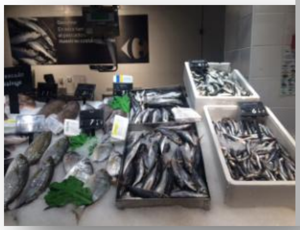
Fishery statistics
(Official Sale Notes and census of boats)

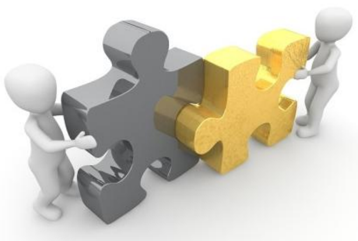
Characterisation of the fishery:

- *Métierization* based on the fleet activity
- Technical characteristics of the fleet
- Main landing and selling sites
- Landings and fishing effort analysis

Pilot Acoustic Surveys
(methodological and technical issues)
↓
Direct Assessment

Further incorporation

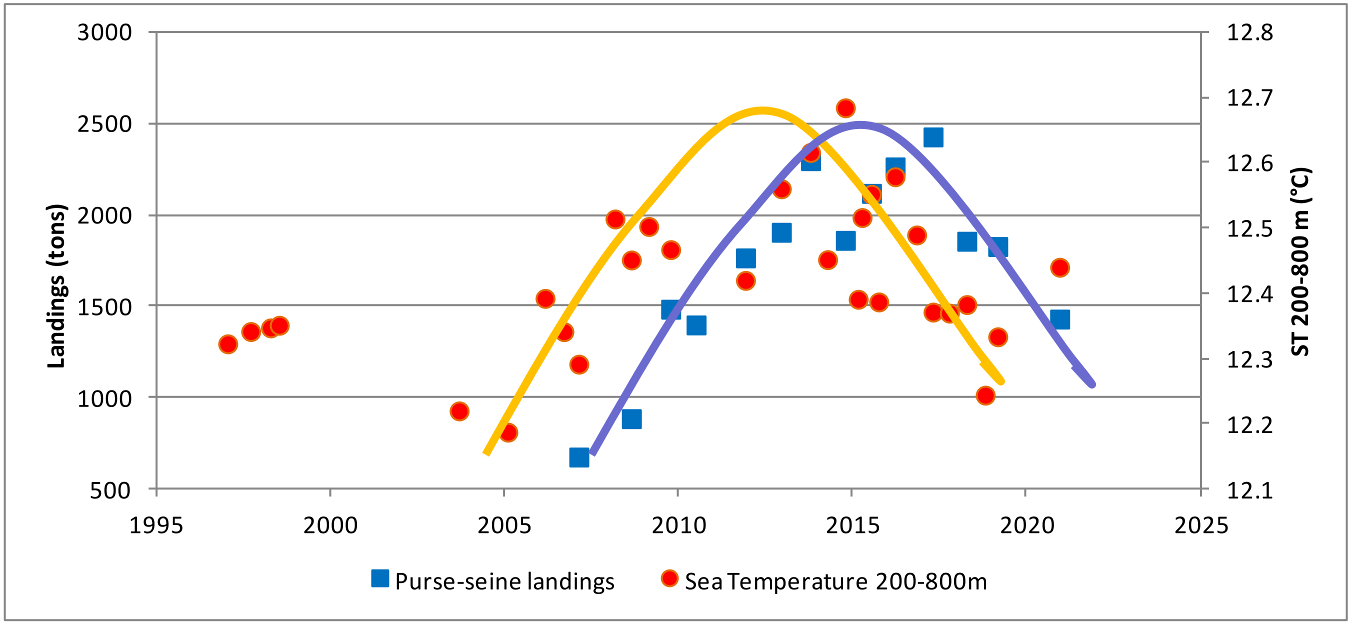




Preliminary findings (WIP)

- **Climatic parameters:** since 1997 (Source: RAPROCAN)
- **Small pelagic data**: (2007) 2013-2020 (Source: DCF EU-Program)

	ST (200-800m) vs Landings
Pearson correlation	0.454
p	0.119



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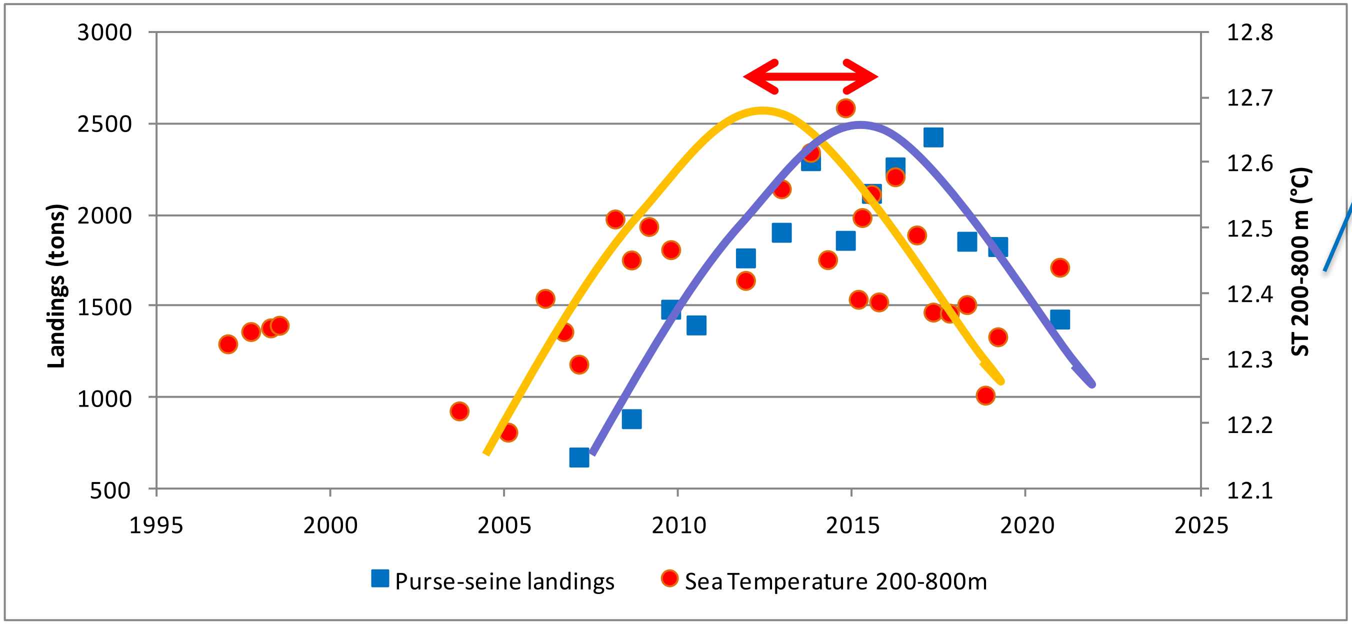
Preliminary findings (WIP)

With **1-year's time-lapse**:

- **Climatic parameters:** since 1997 (Source: RAPROCAN)
- **Small pelagic data**: (2007) 2013-2020 (Source: DCF EU-Program)

	ST (200-800m) vs Landings
Pearson correlation	0.595*
p	0.032

*bilateral significance p<0.05



No SST, but sea temperature between 200 and 800m depth, less influenced by atmosphere variations

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  - RAPROCAN
  - DCF
  - Some interesting preliminary findings...

- **Answering the raised questions**

Answering the raised questions

Are the data from this research available?

- Small pelagic landings: FAO/CECAF Reports (FAO/CECAF website: http://www.fao.org/cecaf/es/).
- Open source:
  - SST, SSTAs→ IGOSS-IRI (https://iridl.ldeo.columbia.edu/SOURCES/.IGOSS/);
  - Chl-*a* → GIOVANNI (https://giovanni.gsfc.nasa.gov/giovanni/);
  - Large-scale Climate indices (i.e. AMO, NAO, AO, SOI→ NOAA website http://www.cpc.noaa.gov).
- RAPROCAN: some public data in ICES Report on Ocean Climate (Working Group on Oceanic Hydrography https://ocean.ices.dk/core/iroc)

Answering the raised questions

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What additional data (or analyses) would benefit this research?

Data:

- Fishing data: Geo-referenced catches (including discards)
- Hydrographic properties: further chemical data (oxygen, nutrients, etc.). Gathered in RAPROCAN surveys, although not in as regularly as hydrographic data.
- Validation/calibration of satellite observations with *in-situ* measurements (i.e: chlorophyll).
- Biological information on phytoplankton and/or zooplankton.

Analyses:

- Joint analyses including environmental features, landings and biological information (i.e. phytoplankton and/or zooplankton).
- Comparison with Moroccan information (bio-geographically linked) and other NW African areas.
- Validate current operational models in the area, starting with the hydrographic parameters.

Answering the raised questions

What are the implications of your findings for the CECAF area?

- Improving fishing data: obtaining time-series from the official First Sale Notes for the artisanal fisheries in the Canary Islands (since 2007; reliable from 2013 onwards).
- Hydrographic properties: there is a temporal large scale variability (approximately 10-15 years-cycle), and possibly in the dynamics of the area. Therefore, this should be further observed and taken into account to evaluate the consequences of these changes in the ecosystem.

What would you suggest as next steps to advance knowledge on this topic?

- Fishing geo-referenced data and more scientific observations on-board the commercial fleet.
- Hydrographic properties: To reinforce *in-situ* observations in the coastal transition zone, specifically those that complement the observations currently taken, for instance bio-chemical parameters and biological sampling (i.e. plankton).
- To keep the monitoring systems, to follow up the correlations detected and to explore other possible interactions.

Citations

Báez, J.C., M.T.G. Santamaría, A. García, J.F. González, E. Hernández and F. Ferri-Yáñez. 2019. Influence of the Arctic Oscillations on the sardine off Northwest Africa during the period 1976-1996. *Vie et Milieu.* Vol. 69 (1): 71-77.

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Online resources

http://www.oceanografia.es/pedro/research_IROC2018_Canary.html
http://www.fao.org/cecaf/es/
https://giovanni.gsfc.nasa.gov/giovanni/
https://iridl.ldeo.columbia.edu/SOURCES/.IGOSS/
https://ocean.ices.dk/core/iroc
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