Linking Atlantic Bluefin tuna migration pathways and ocean dynamics

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WOC User Consultation Meeting 2022
10-12 October | ESA-ESRIN | Frascati (Rome), Italy

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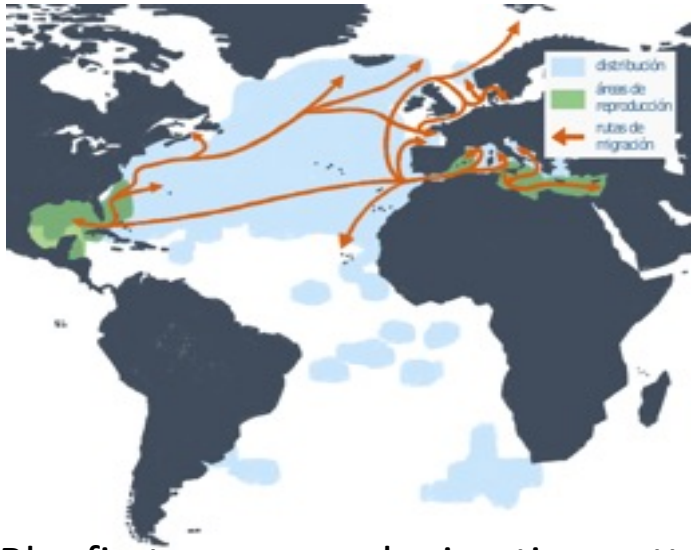
11/10/2022

Background

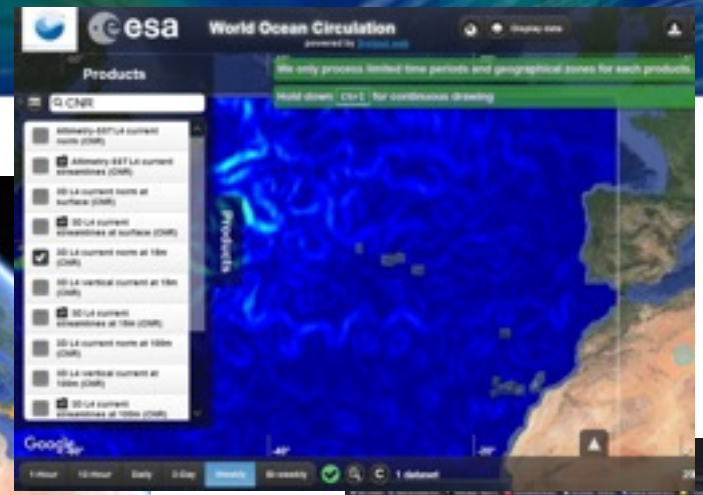
Specific routes from satellite tags

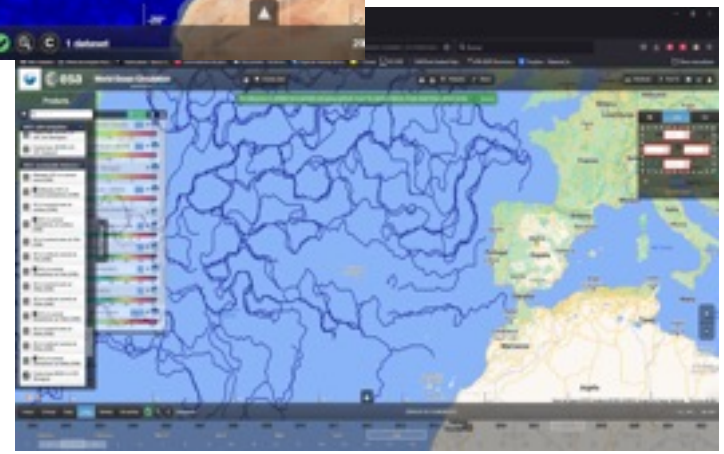


Bluefin tuna general migration patterns (planettuna.com)

Bluefin tuna migration patterns are driven by ocean conditions
Ocean variability derives in spatio temporal changes of main migration routes and distribution of preferred habitats

Background





Specific routes from satellite tags

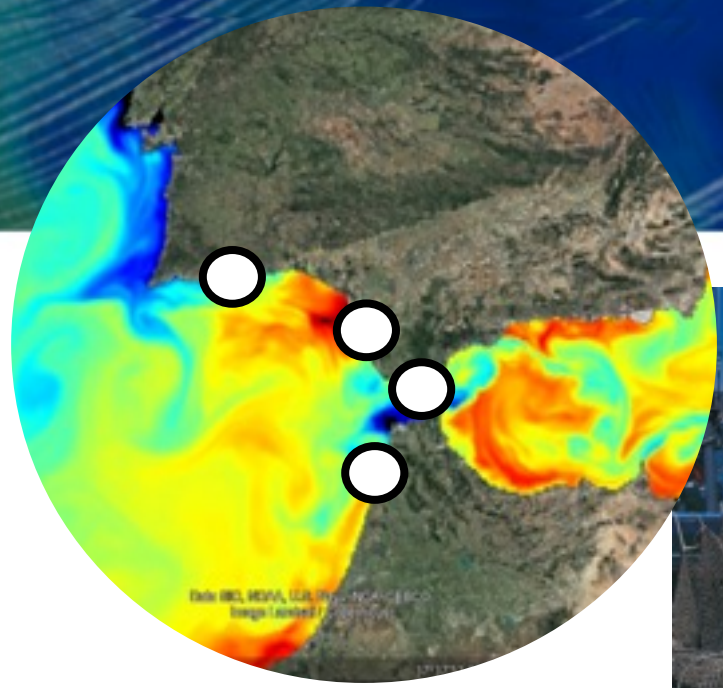
Combining data from satellite tags with WOC ocean products

Exploring how different migration patterns are linked to differences on ocean conditions

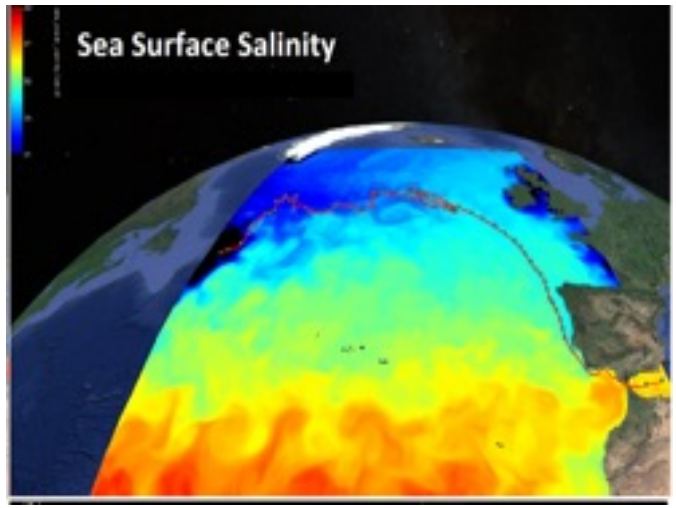
By comparing tagging sensors with WOC data and by extracting WOC data at tag lat,long, date positions

Methods

Sub-regional scale



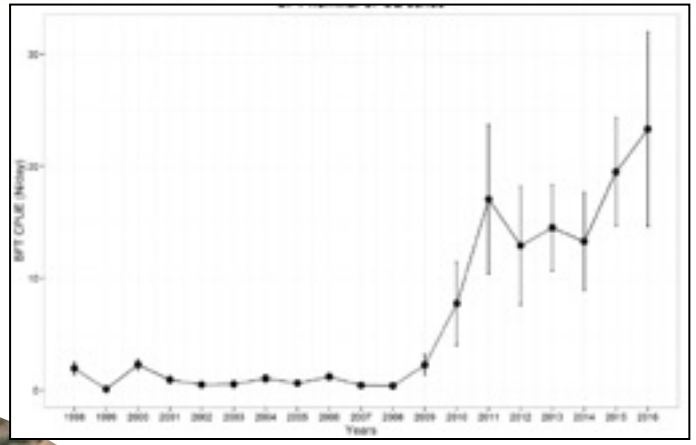
Regional scale

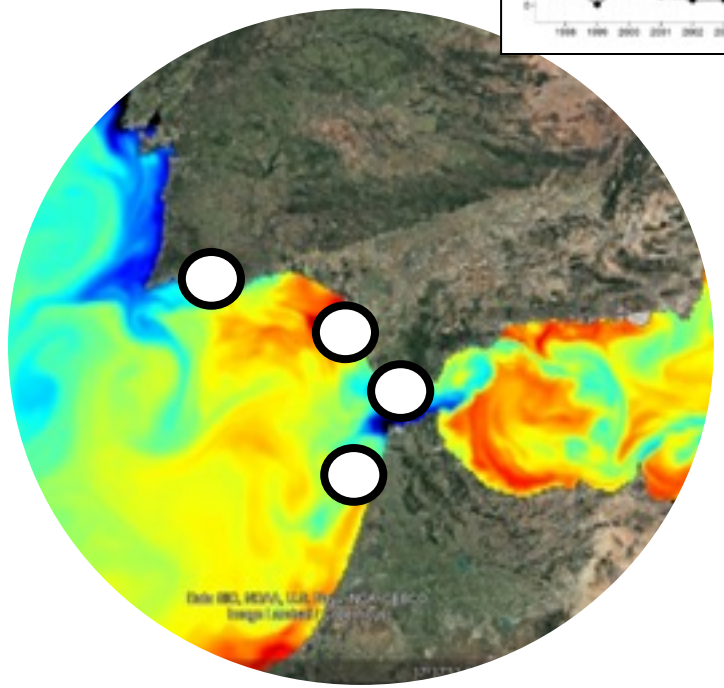


Methods

Sub-regional scale analyses

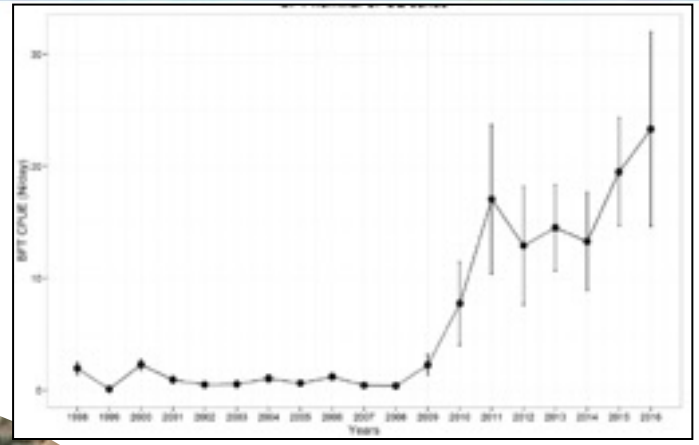
we investigated if bluefin tuna migration (into the Med and out of the Med) in the Gulf of Cadiz is affected by the surface temperature patterns





Methods

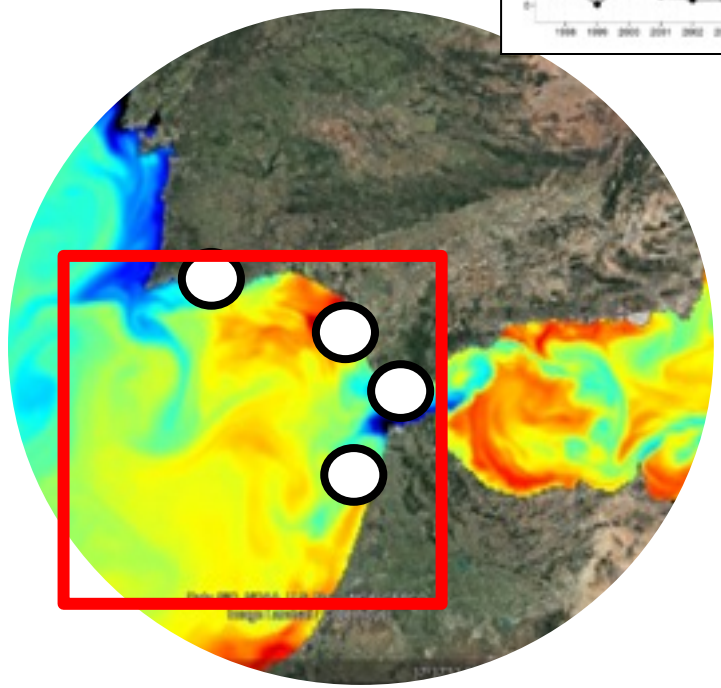
Sub-regional scale analyses



we investigated if bluefin tuna migration (into the Med and out of the Med) in the Gulf of Cadiz is affected by the surface temperature patterns

Main hypothesis

The sea surface temperature measured **by tag sensor** (not at location) is not a random sample of the sea surface temperature in the area, indicating thermal preferences.



Implications

Catches at the trap nets could be influence spatial variability of surface temperature in the area, specific indicators at trap locations could improve standardization of the abundance indices

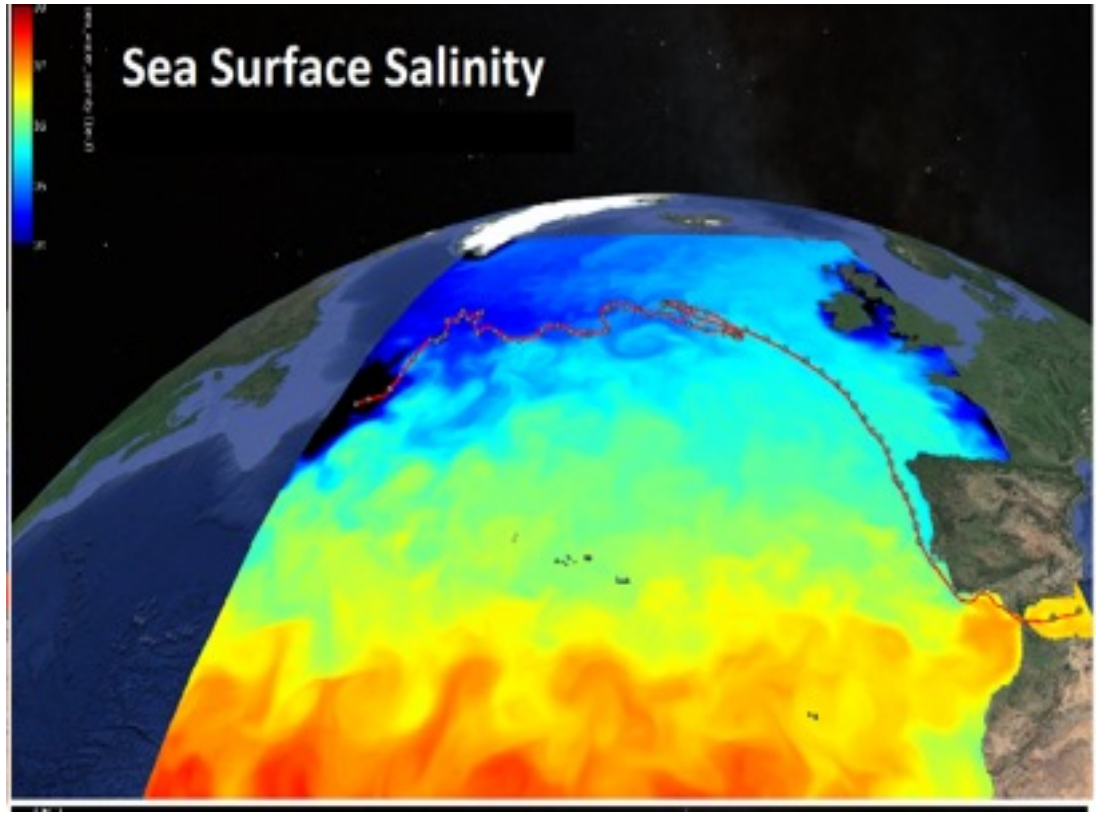
Methods

Regional scale analyses

We investigate if oceanographic scenarios determine migration patterns along the Eastern Atlantic

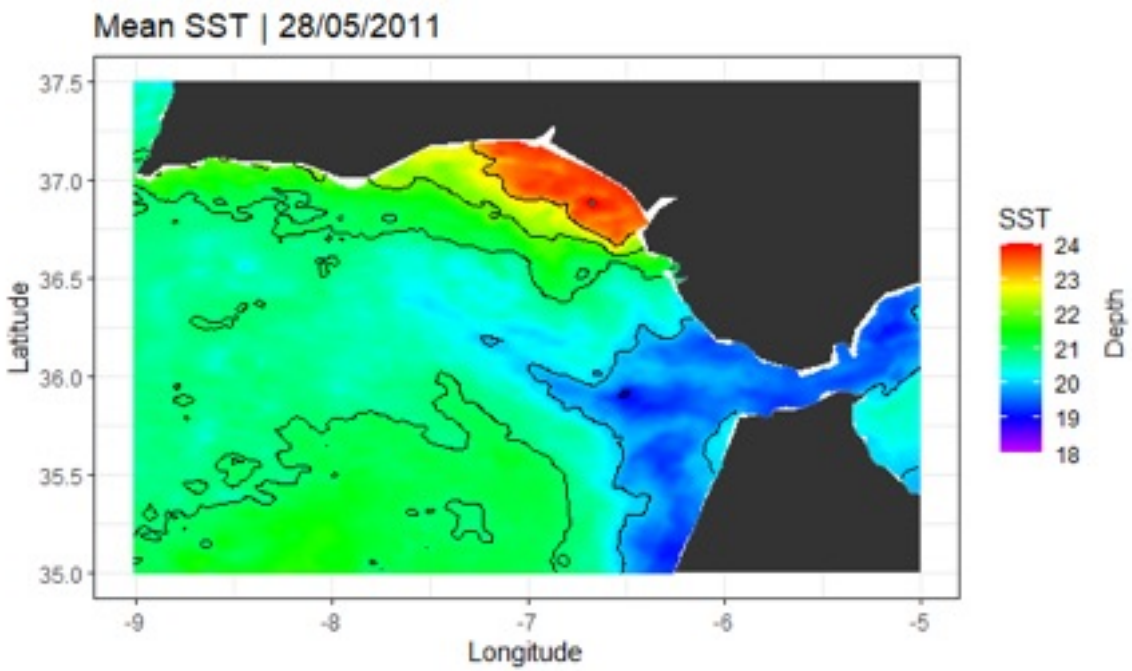
Main hypothesis
There are specific preferred ranges of ocean variables along the tracks (at lat,long) for the different individuals depending on their reproductive phase (before and after spawning)

Implications
Spatial distribution of bluefin tuna could be assessed and integrated in the new fisheries assessment models.

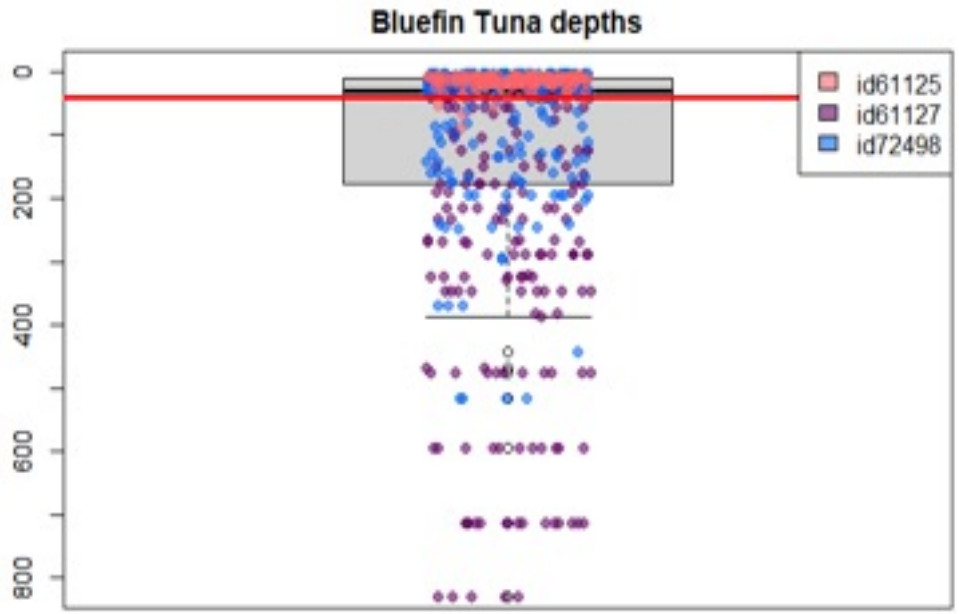


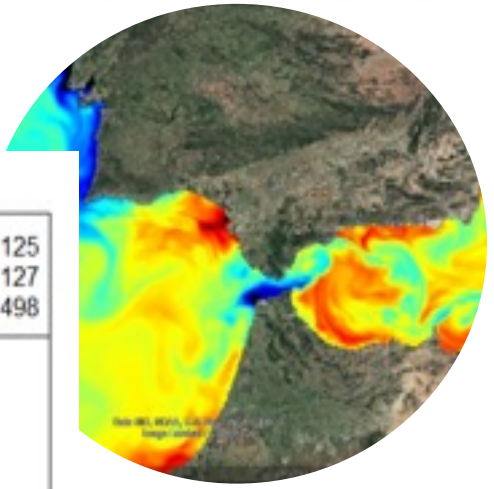
Sub-regional scale analyses

Relevant and dynamic spatial patterns on SST

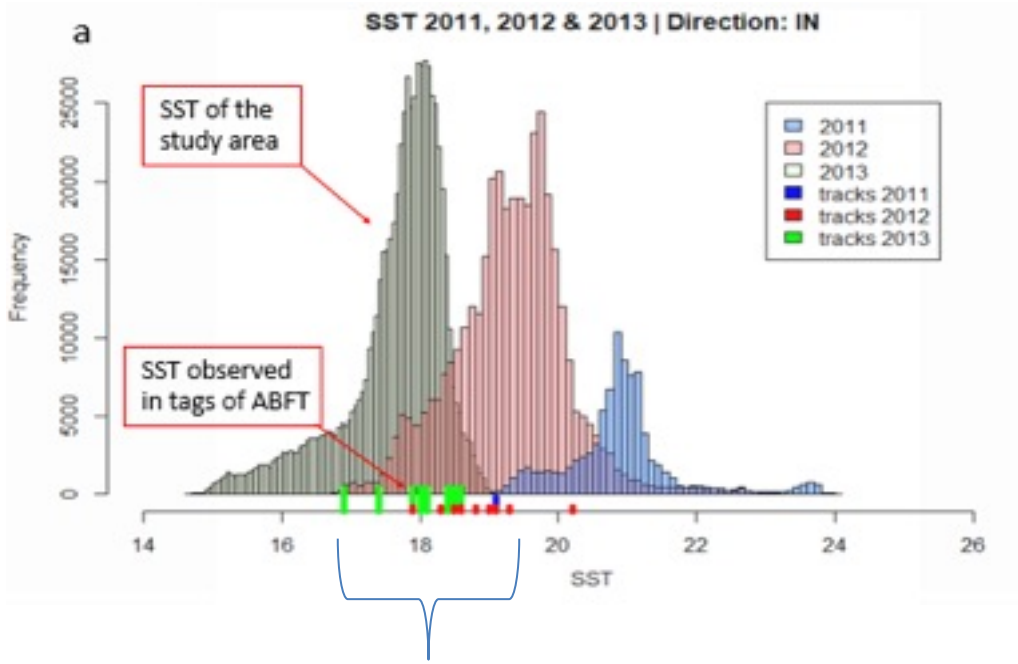


Is bluefin tuna in the surface?

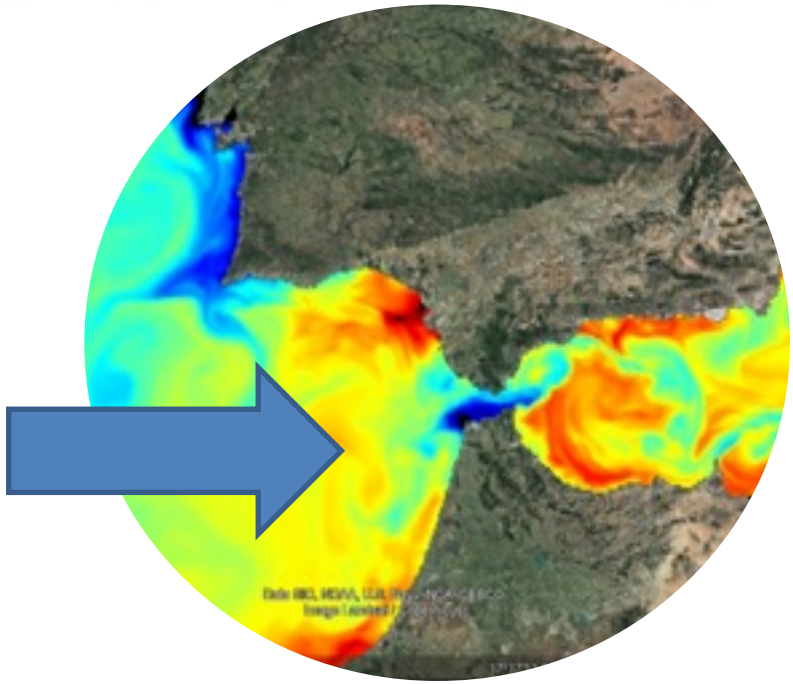




Sub-regional scale analyses



SST values from tuna tags



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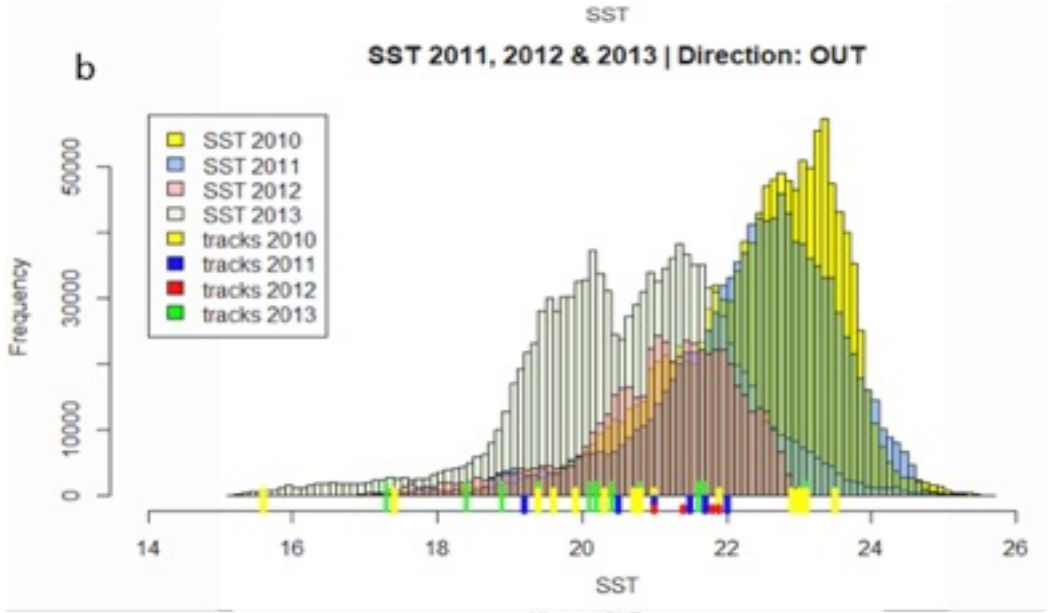

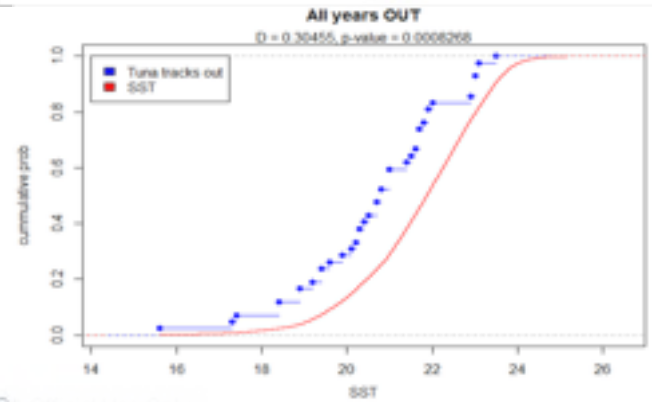

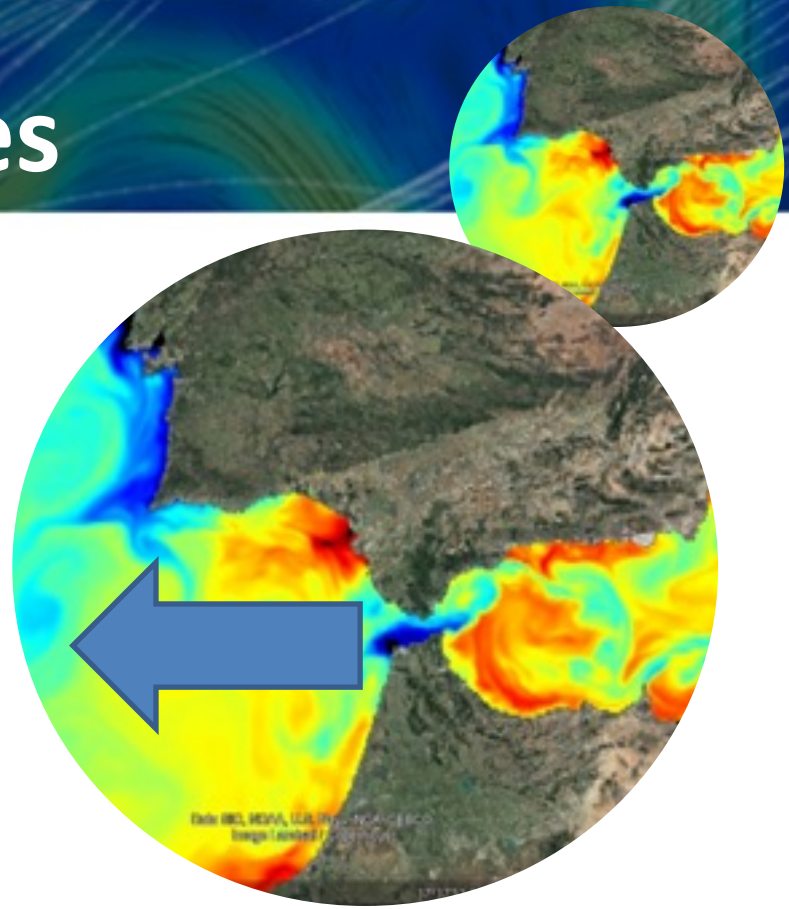

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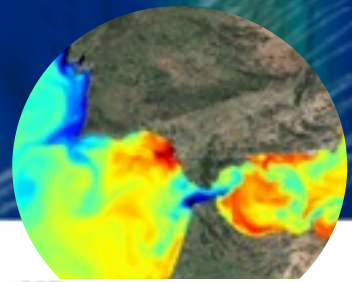
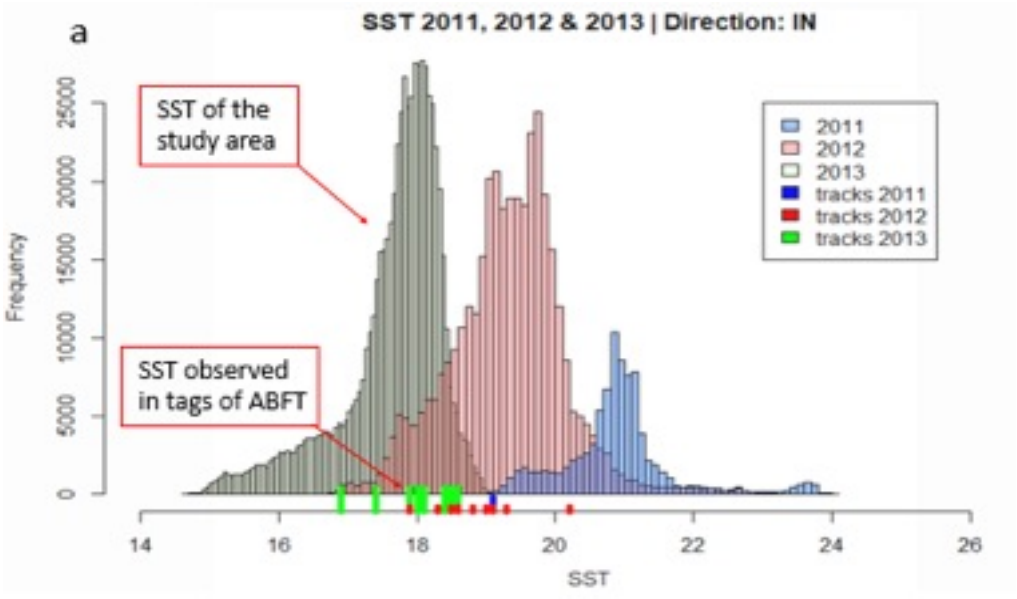
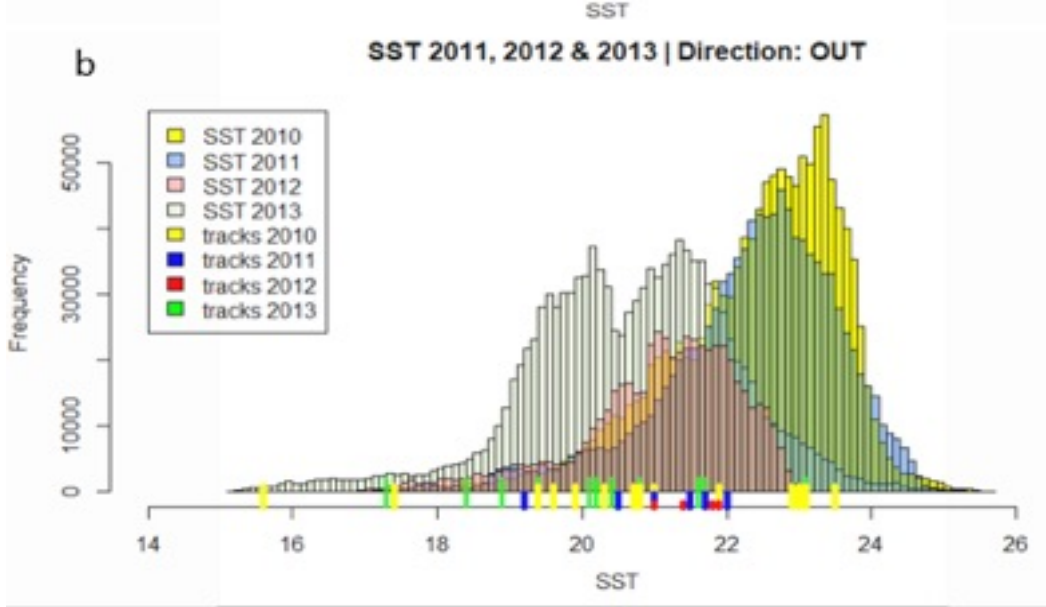


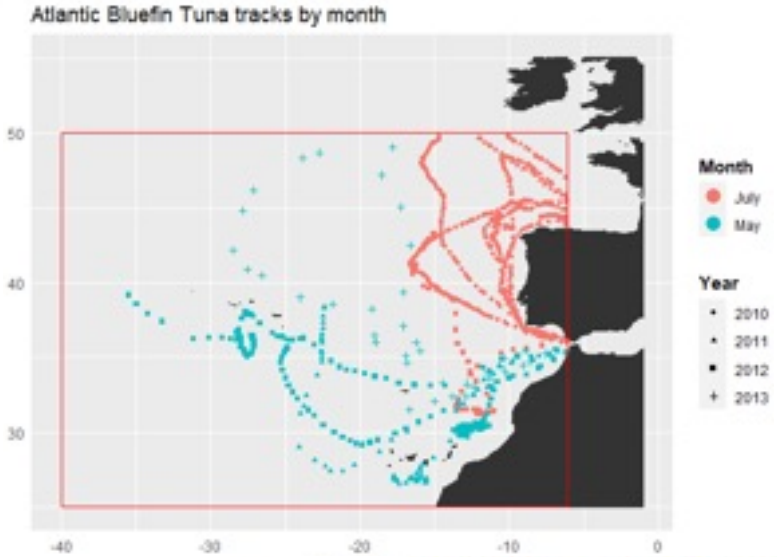




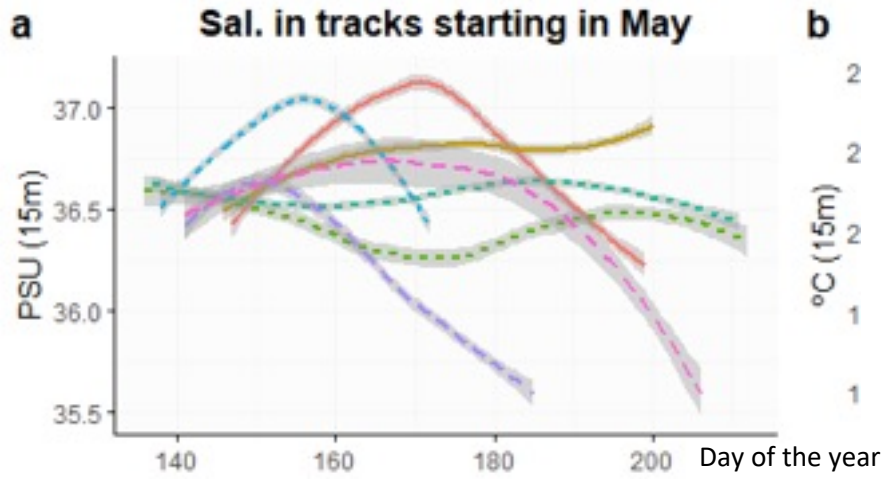
Significant differences ($p<0.001$) between SST distribution in the area and the SST at tuna tags sensors (direct measurements) in the migration from the Med to Atlantic, possible associated to energetic constrains after spawning (metabolic restricted temperatures or preferred water masses with favorable currents).

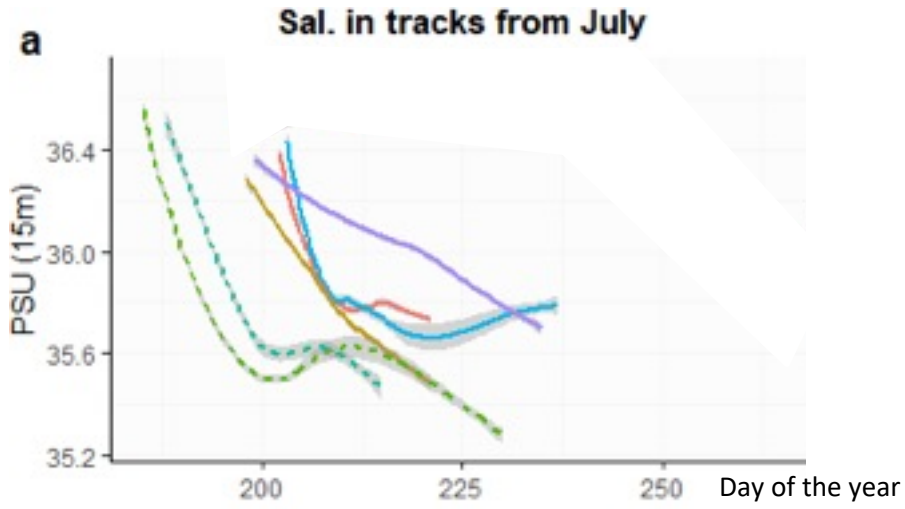
IMPLICATIONS: Standardization of indices of abundance could benefit from specific temperature derived indicators in the area, discussed with researchers of the bluefin tuna working group

Results, Regional scale analyses



Variables analyzed from the WOC 4D model:
Salinity, temperature and density at 15m and 100m (and spatial gradients)
Current vertical and horizontal velocities,
Effect of current direction on tuna
Variables analyzed from frontal indices :
Front probability
Front direction





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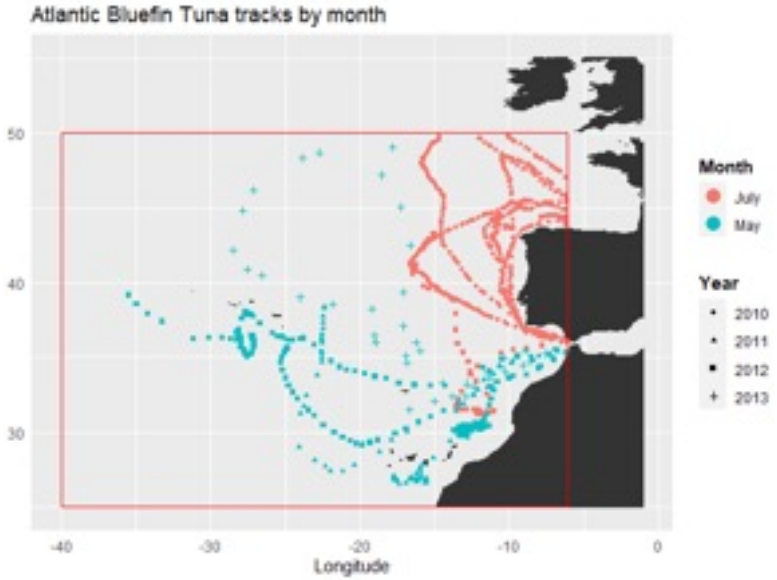

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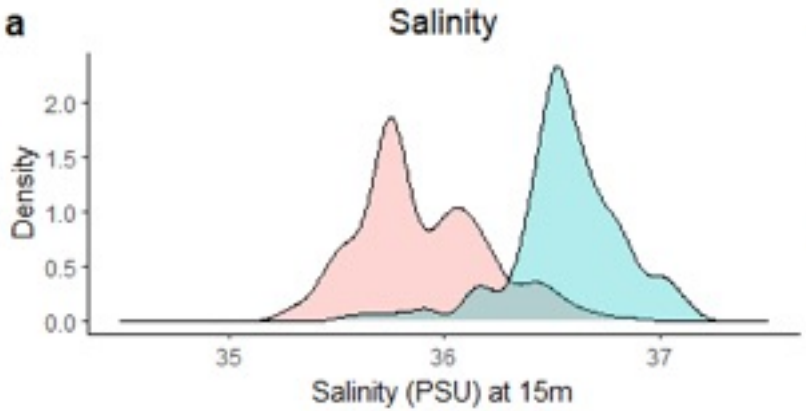

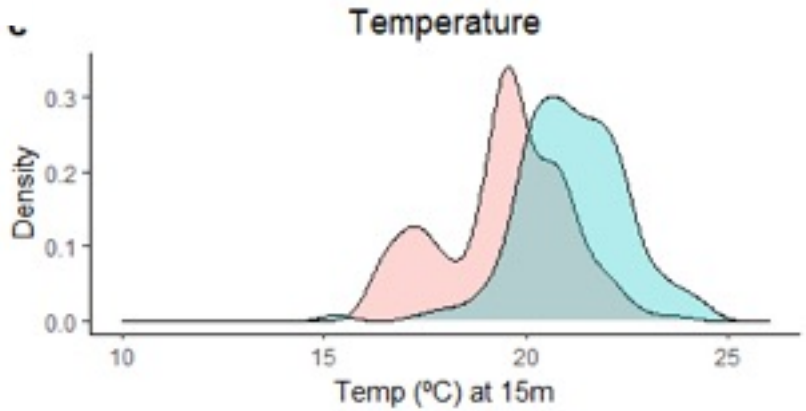

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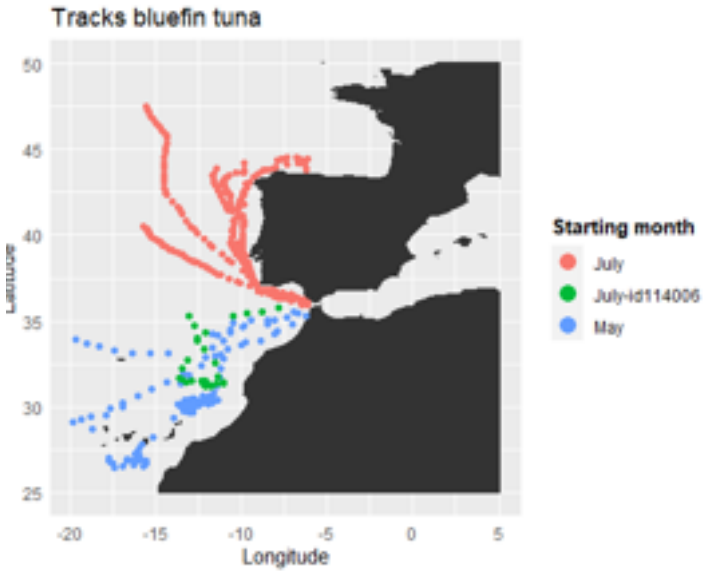

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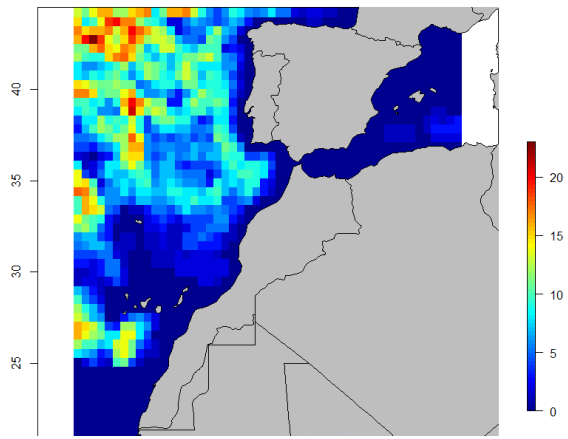

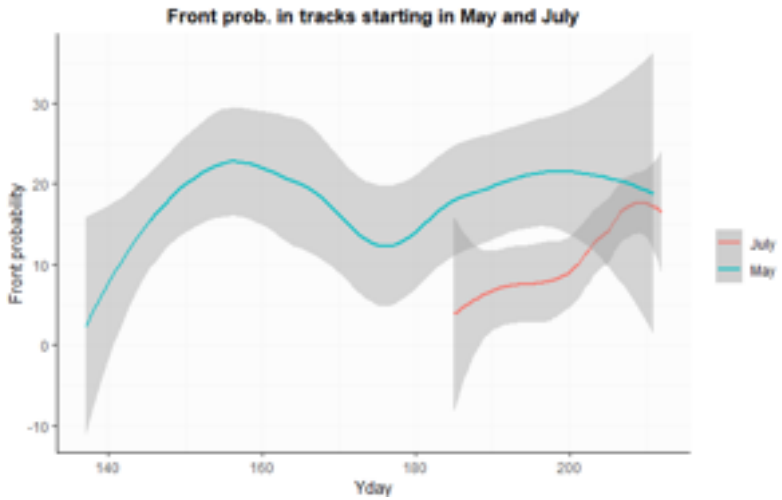

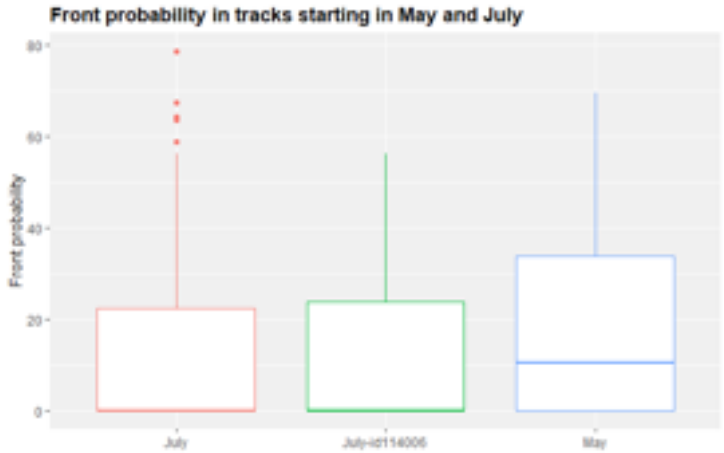

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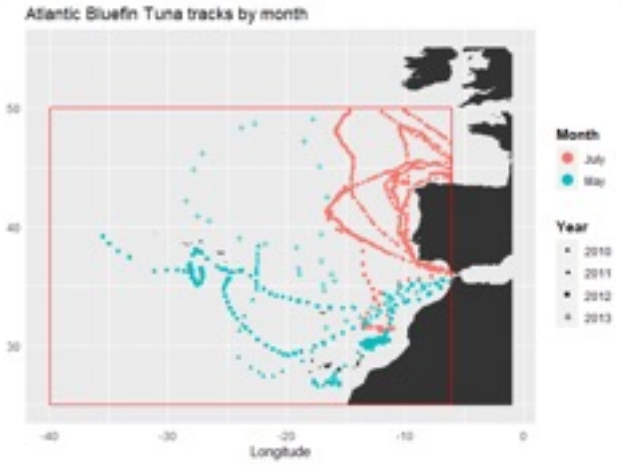

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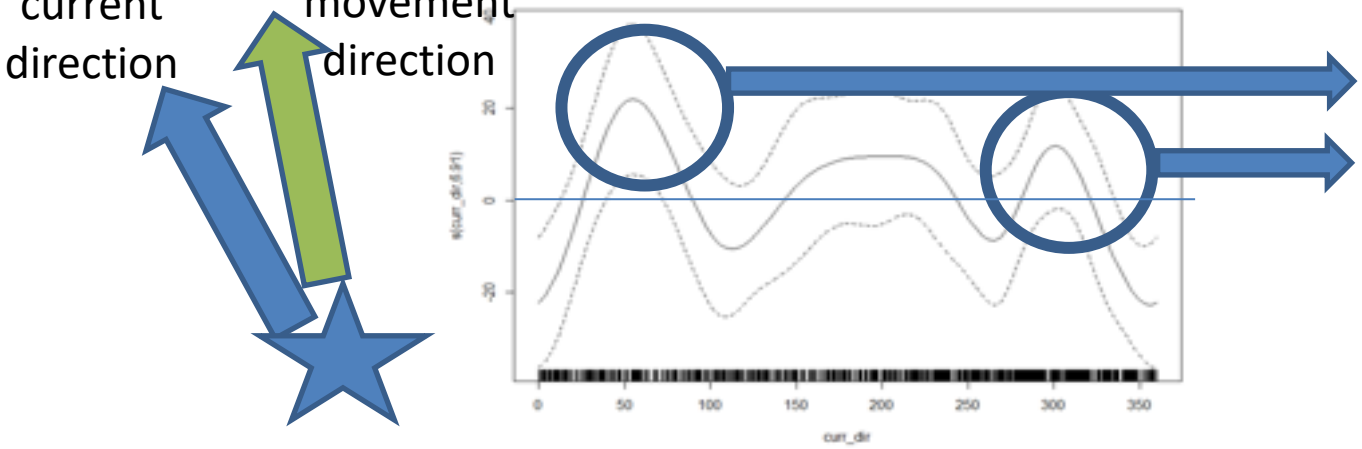
Front direction

Surface current direction

Tuna movement direction



GAM(fish direction)=S(surface current direction)+err ;

Significant positive correlation between bluefin tuna and surface current directions at 50º and 300º

Conclusions and implications

conclusions:

•bluefin tuna individuals at different reproductive phases present different associations with ocean conditions.

•Specific ocean variables can provide qualitative and quantitative cues on migration ecology

Implications:

• WOC products could provide input to spatial modeling of adult distributions, providing input data for the new models integrating changes on spatial distributions

•Could provide key information for advanced standardization of abundance indices

•Results presented at various scientific working groups of ICCAT (bluefin tuna, ecosystems, tagging)

General messages

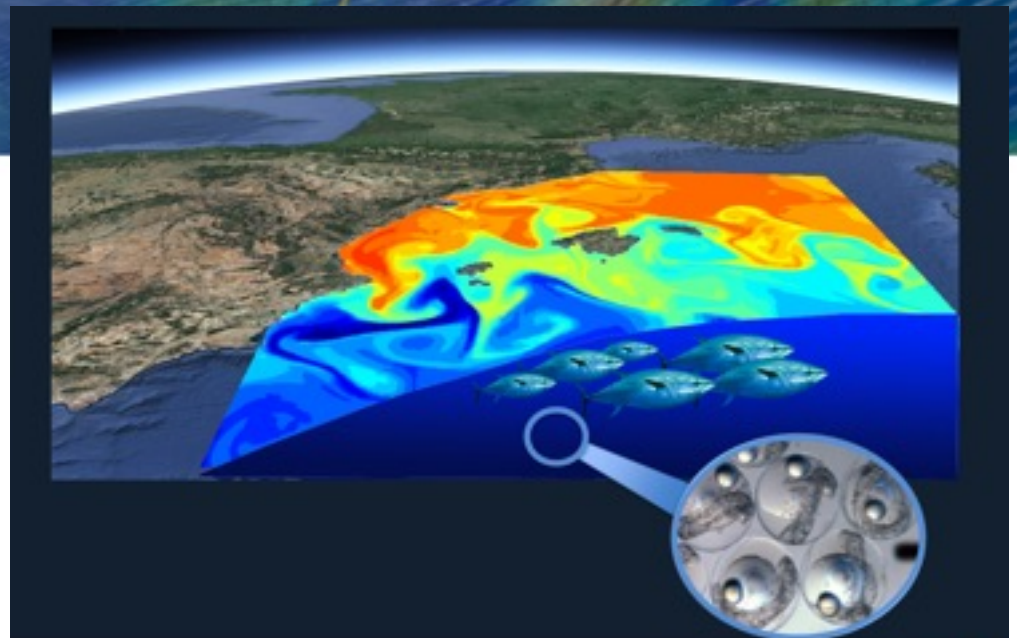
•Global fisheries stocks are assessed by methods that do not integrated environmental information, quantitative integration of ocean variability in fisheries models is very rare

•Current fisheries assessment is more about time series (20 years?), than forecast.

•Accuracy and applicable scales of ocean products needs to be well assessed.

•There is strong gap between fisheries assessment and new opportunities from operational oceanography, we need to advance towards an effective “operational fisheries oceanography”.

•We need to link RFMO strategies and Ocean obs strategies



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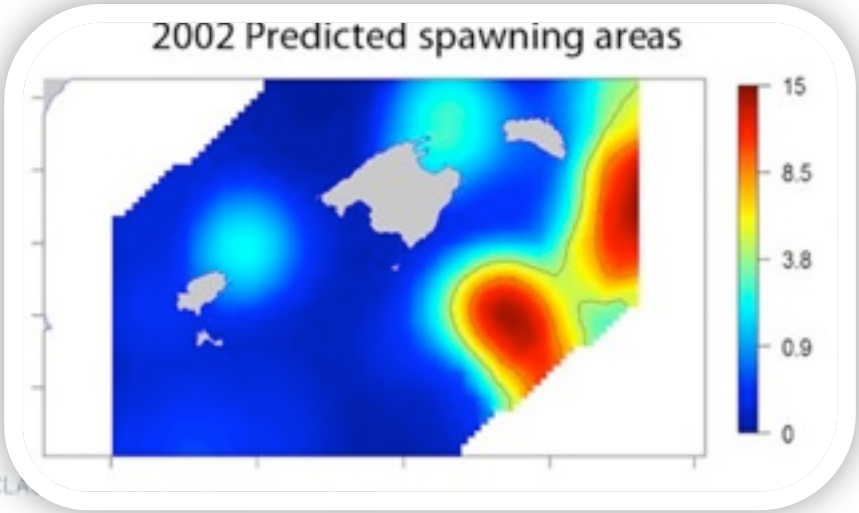
Pelagic seascape ecology for operational fisheries oceanography: modelling and predicting spawning distribution of Atlantic bluefin tuna in Western Mediterranean

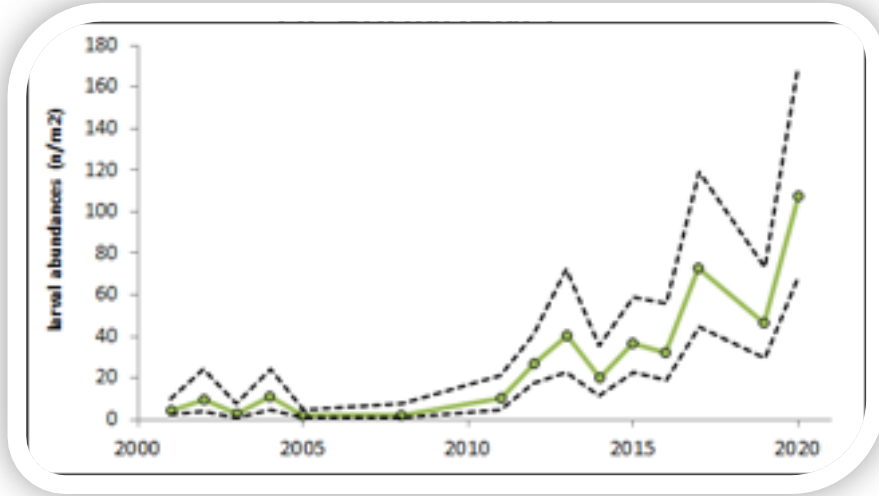
Diego Alvarez-Berastegui[1]*, Manuel Hidalgo[2], María Pilar Tugores[2], Patricia Reglero[2], Alberto Aparicio-González[2], Lorenzo Ciannelli[3], Mélanie Juza[1], Baptiste Mourre[1], Ananda Pascual[4], José Luis López-Jurado[2], Alberto García[5], José María Rodríguez[6], Joaquín Tintoré[1,4], and Francisco Alemany[2]

PREDICTING SPAWNING HABITATS



Alvarez-Berastegui. et al ICES 2016

HABITAT STANDARDIZED INDICES



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Planettuna.com
https://youtu.be/fHE7jwmMeBc