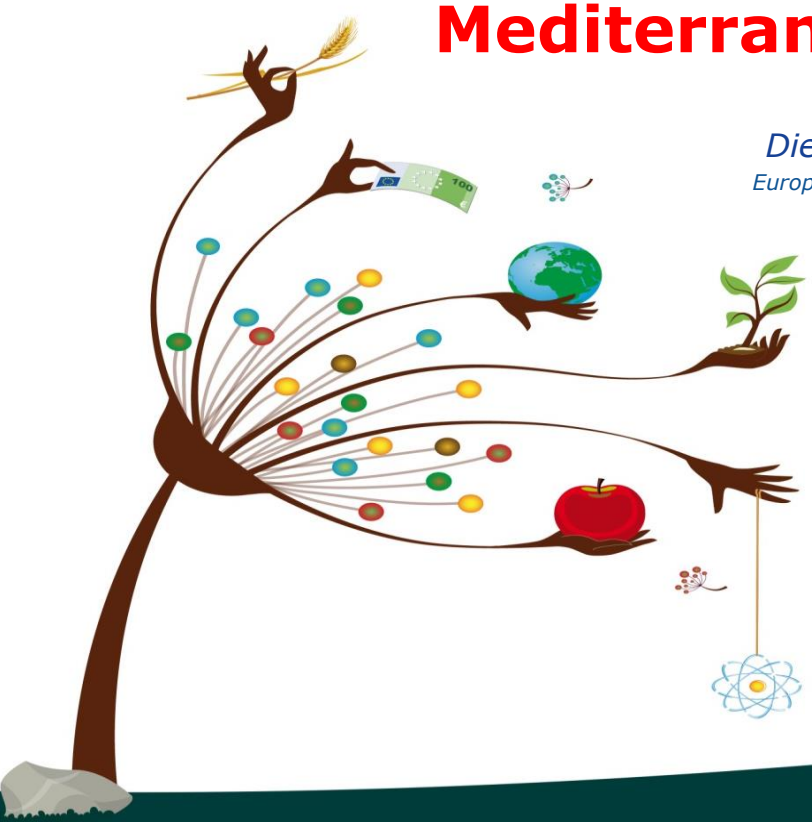
European Commission

The European Commission's science and knowledge service

Joint Research Centre

Exploring future scenarios for the NW Mediterranean Sea for the horizon 2030



Diego Macias, Chiara Piroddi, Elisa Garcia-Gorriz, Adolf Stips

European Commission – Joint Research Centre, Directorate for Sustainable Resources, Via E. Fermi, 2749 (TP270), I-21027 Ispra (VA), Italy

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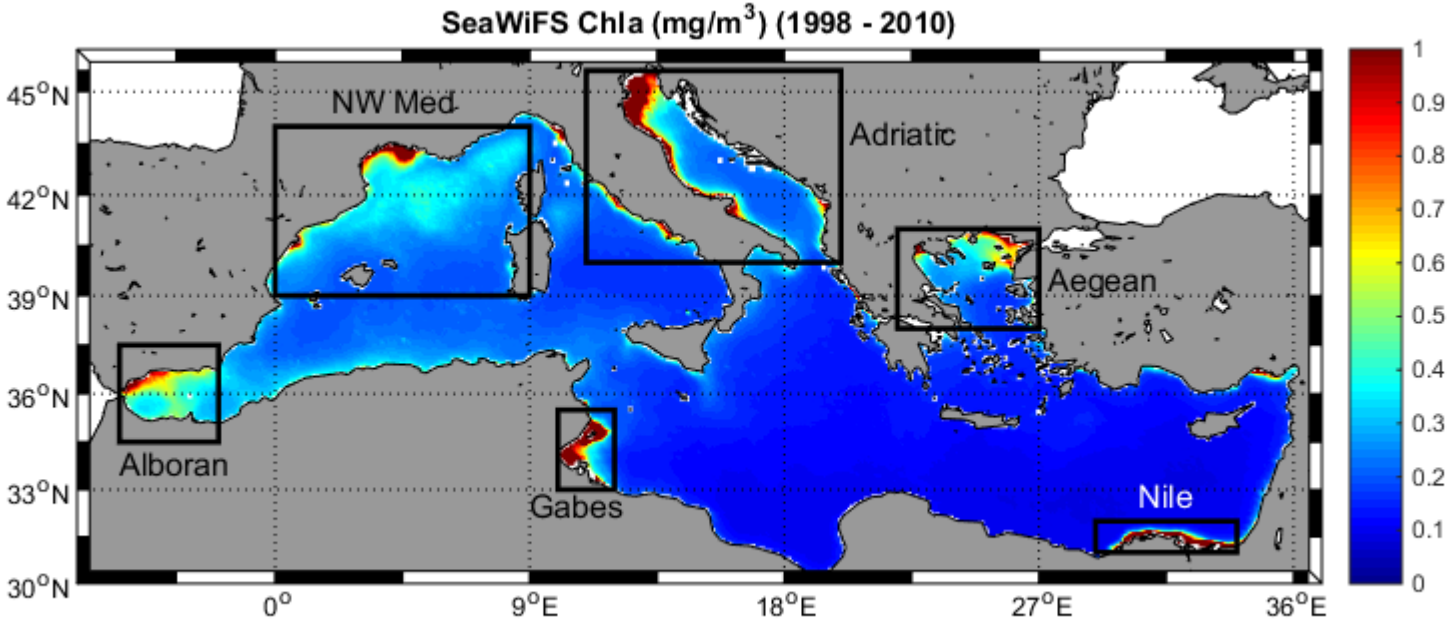
The Mediterranean Sea is typically seen as an oligotrophic basin with few productivity 'hotspots'



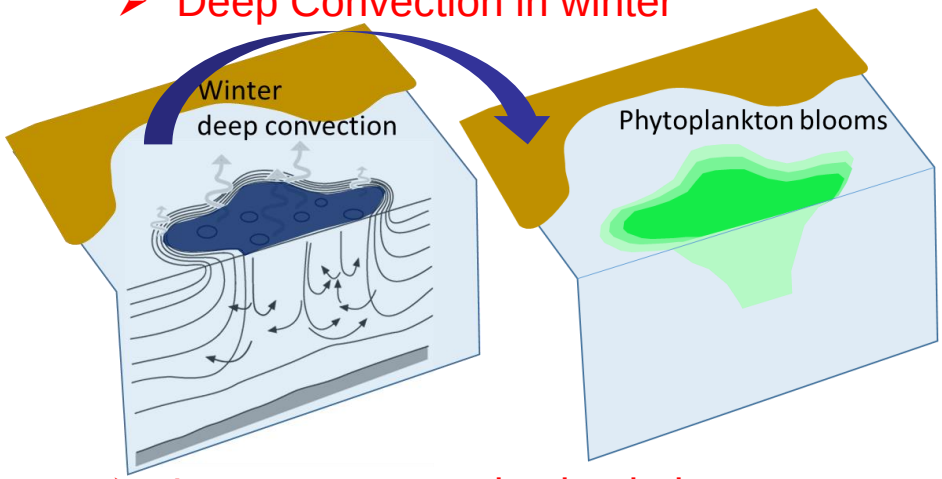
Up to 6 'hotspots' could be identified:

Coastal regions with 'external' nutrients supply (rivers, AJ, mixing)

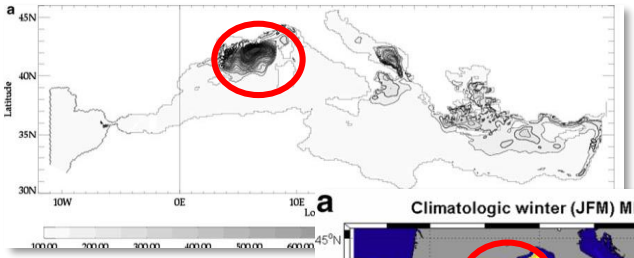
The NW Mediterranean shows open-water primary production

Main oceanographic processes in the NW Mediterranean (related to production):

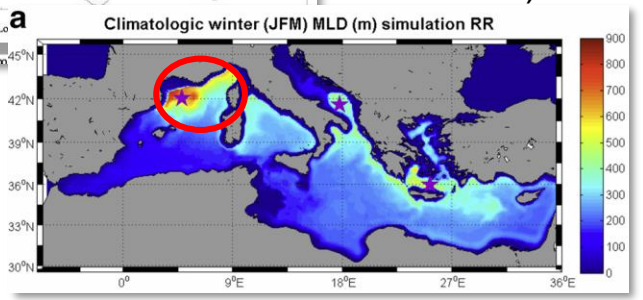
- Deep Convection in winter



Somot et al., 2006

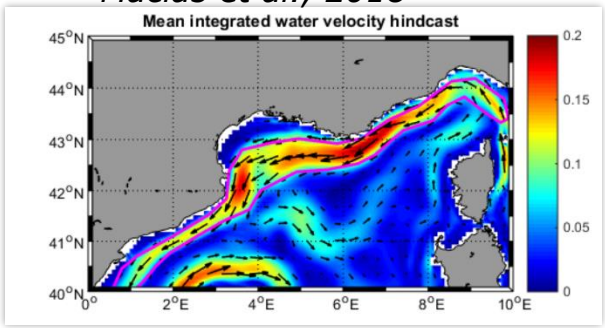


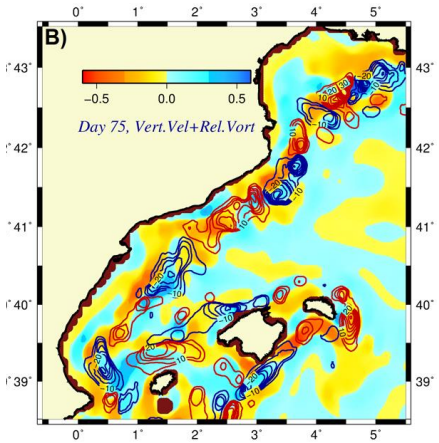
Macias et al., 2016



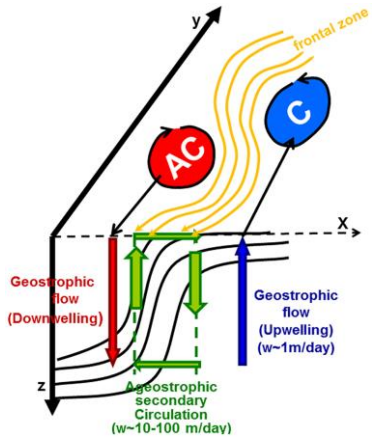
- Intense mesoscale circulation

Macias et al., 2018

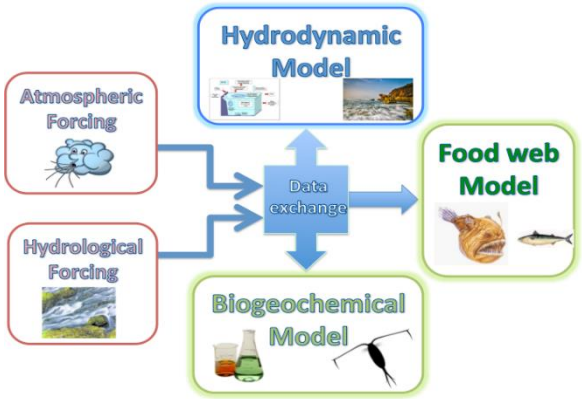




Oguz et al., 2015



OBJECTIVES



EU commission's Marine Modelling Framework

1.- Study the connection between DC and primary production in present day conditions in the NW Mediterranean.

2.- Explore how climatic conditions for the horizon 2030 will affect hydrodynamic and biogeochemical production patterns in the area

1. Present day (satellite)

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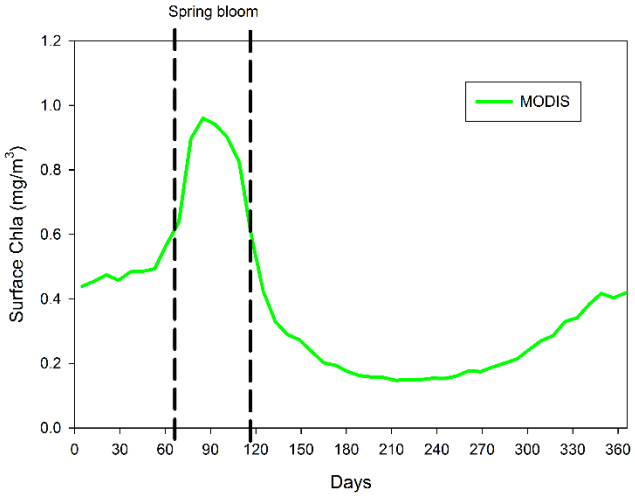
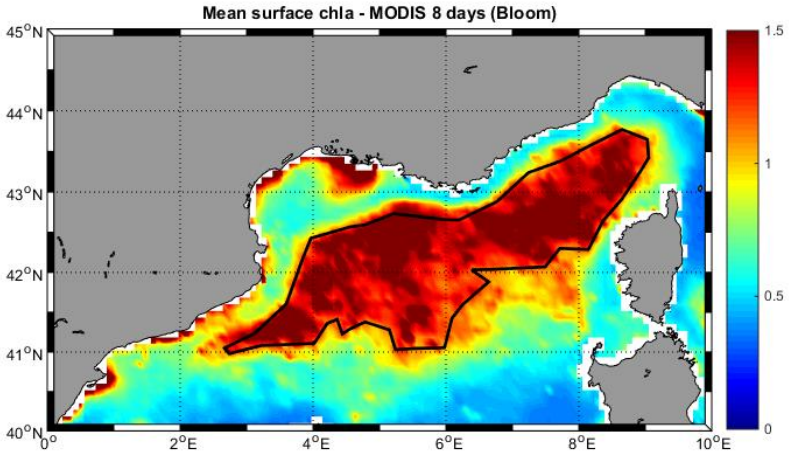
Remote sensing chlorophyll estimates identify a clear, unique winter-spring bloom in the region:



That bloom is located in the off-shore area:



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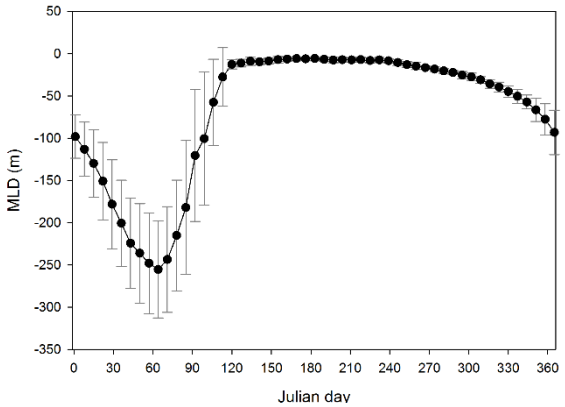
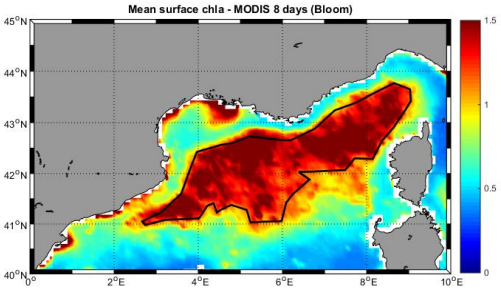
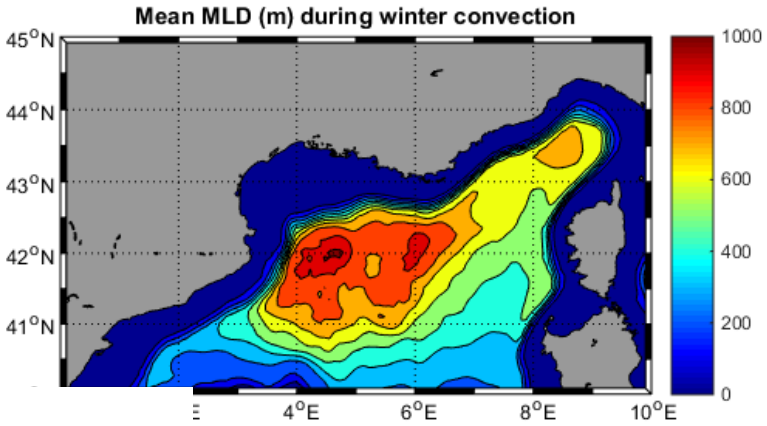
1. Present day (model)

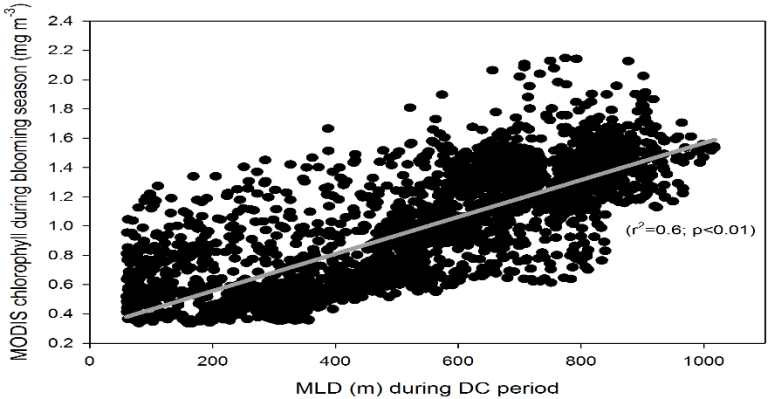
Mean depth of the mixed layer in the region:



MLD during winter convection:



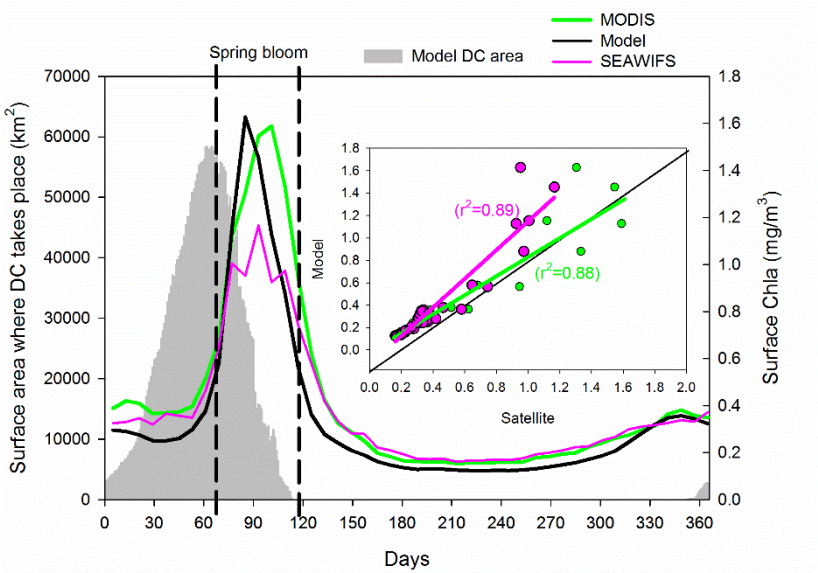




Positive, significant spatial correlation

1. Present day (model vs satellite)

European Commission

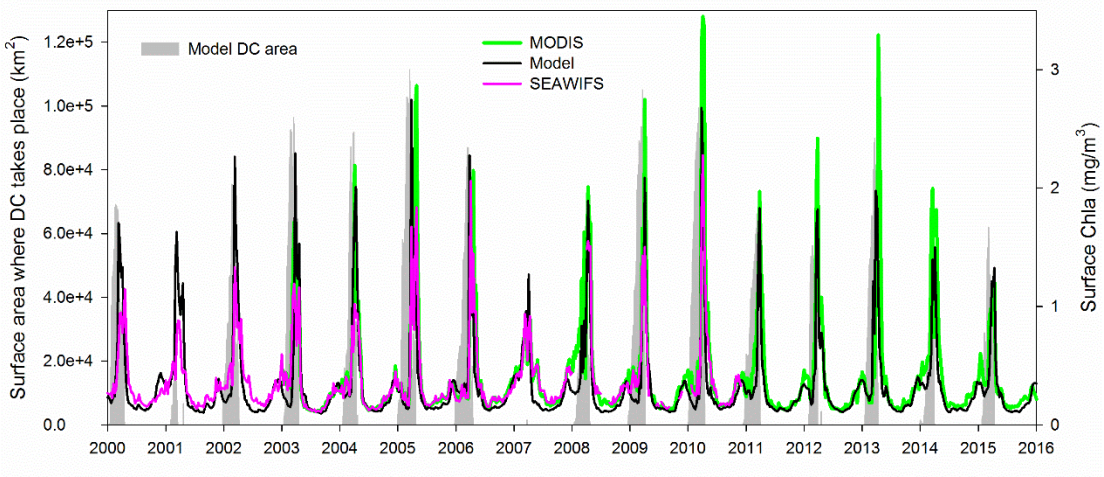


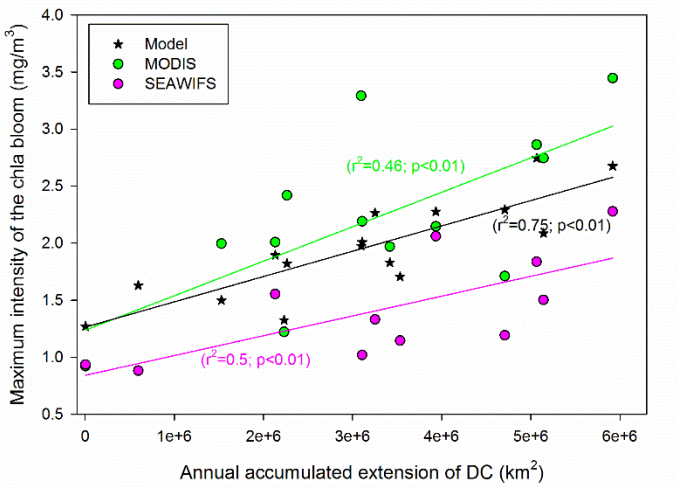
Timing/intensity of the bloom correctly captured by the model

DC occurs just before the main bloom

DC and bloom annual intensities:

- Large inter-annual variations
- Significant correlation





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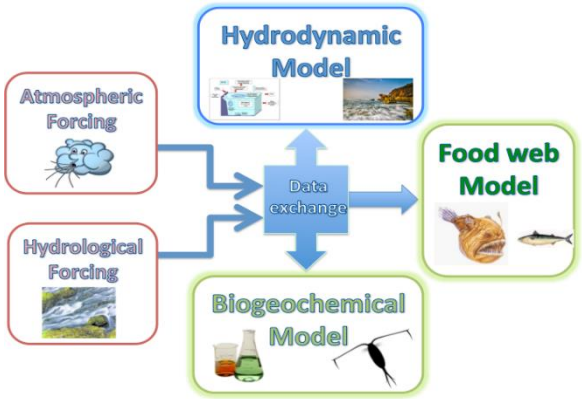

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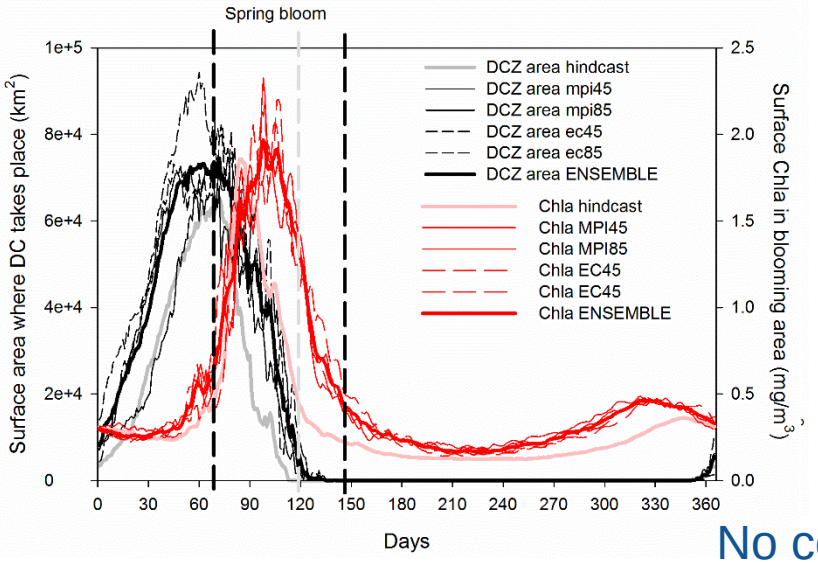
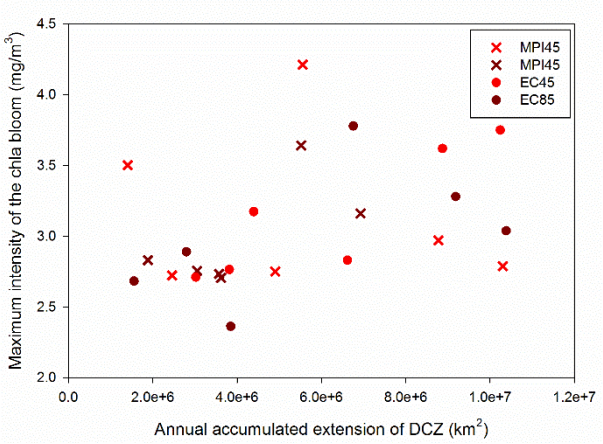
2. Future scenario (2030)

MPI-CCLM & EcEarth-CCLM (CORDEX), continuous run 2013 – 2035, rcp4.5 & 8.5



Phytoplankton bloom larger and later in the year

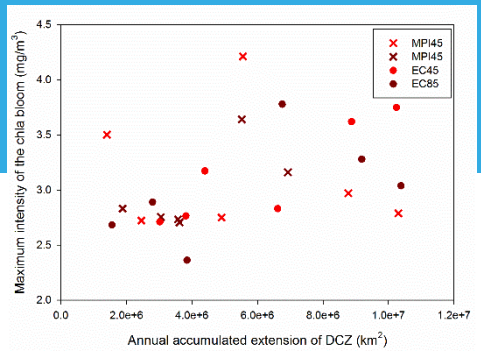
Increased intensity of DC and longer period



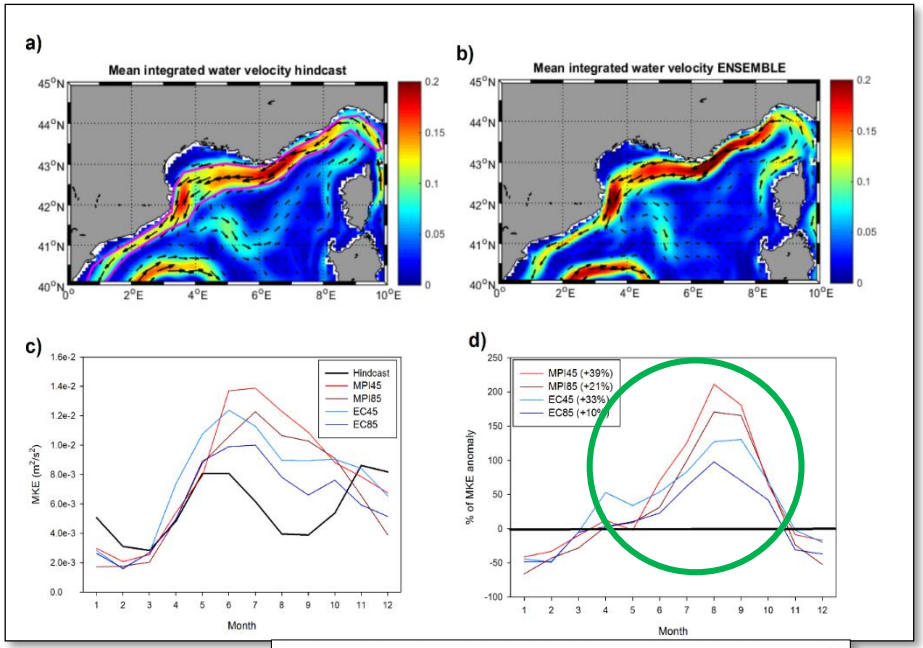
No correlation bloom/DC at interannual scale

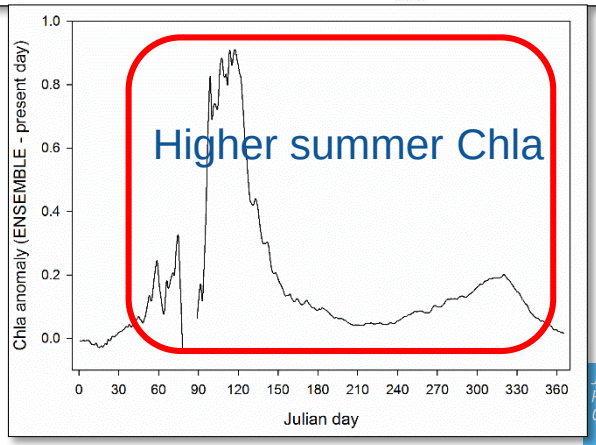
- Deep convection
- Mesoscale circulation

2. Future scenario (2030)

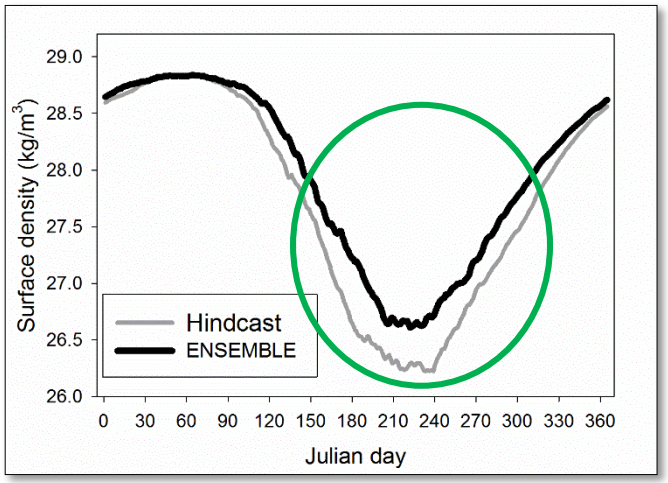


Mesoscale circulation changes





Increase of surface density (summer)



Higher kinetic energy & lower stratification in summer

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2. Future scenario (2030)

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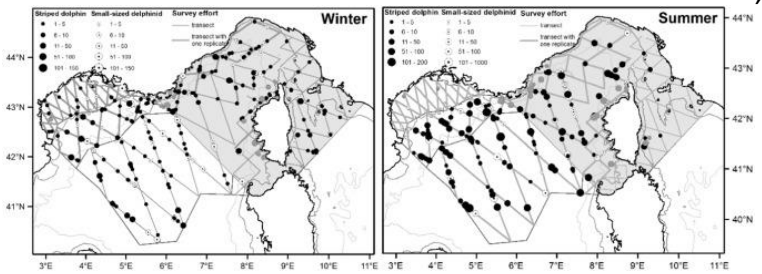
Summer primary production is key in the region

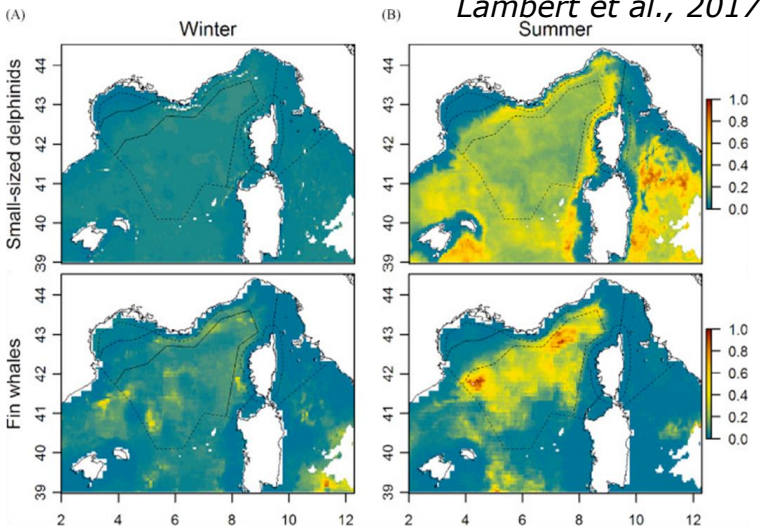
Now: summer months show accumulation of large-scale predators (tuna, cetaceans, etc..)

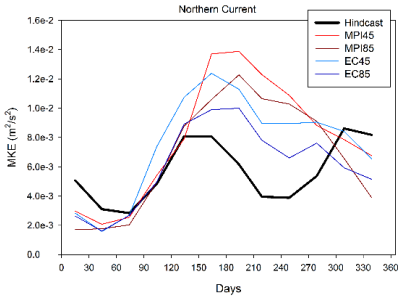
Striped dolphins

Laran et al., 2017



Lambert et al., 2017





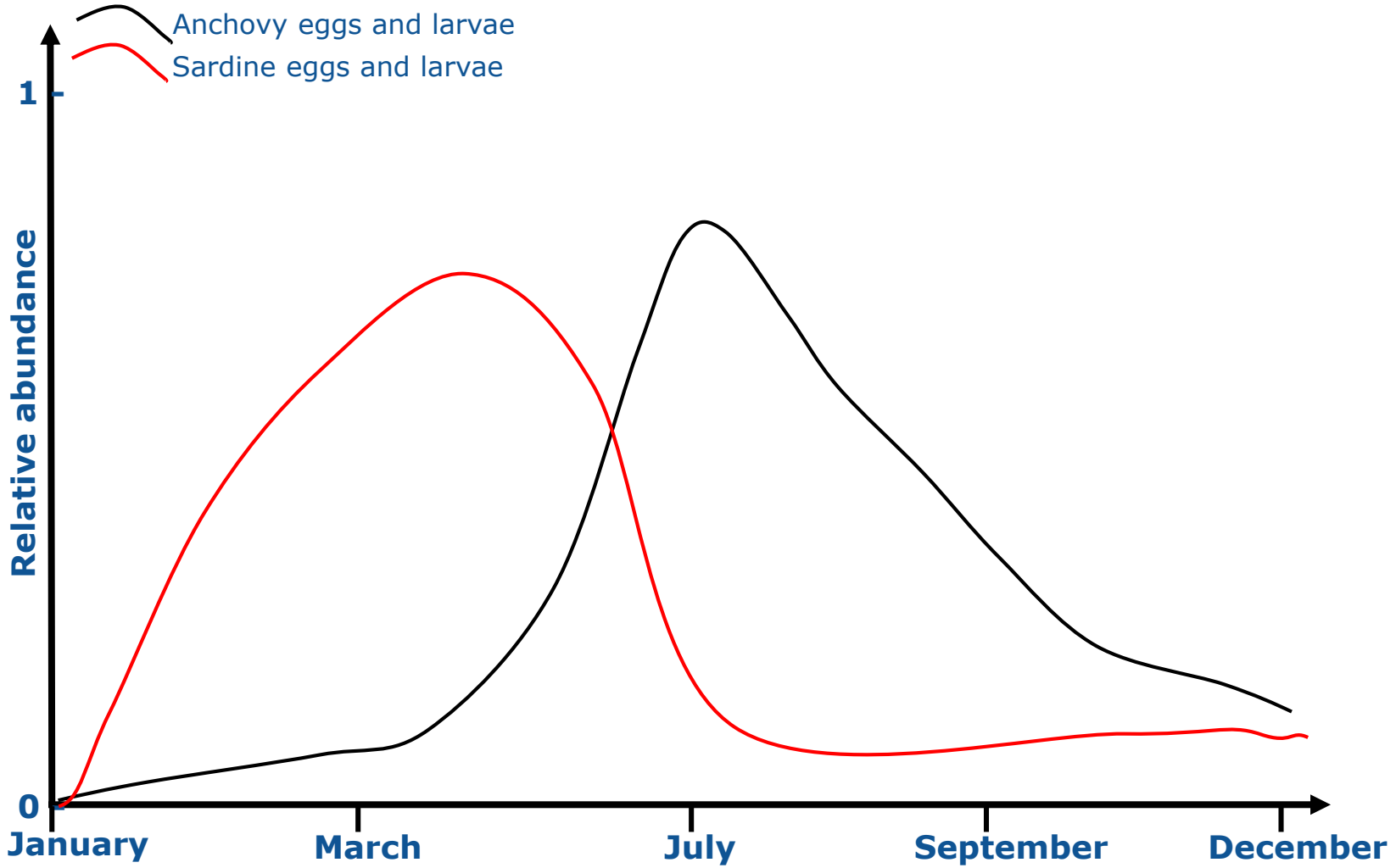
✓Summer: oligotrophy all over the Med

✓Summer: intense North Current (fertilization)

Future: increase 'suitability' for large predators in summer months?

2. Future scenario (2030)

Seasonality of production is also important for foraging species (*e.g.*, small pelagics)



2. Future scenario (2030)

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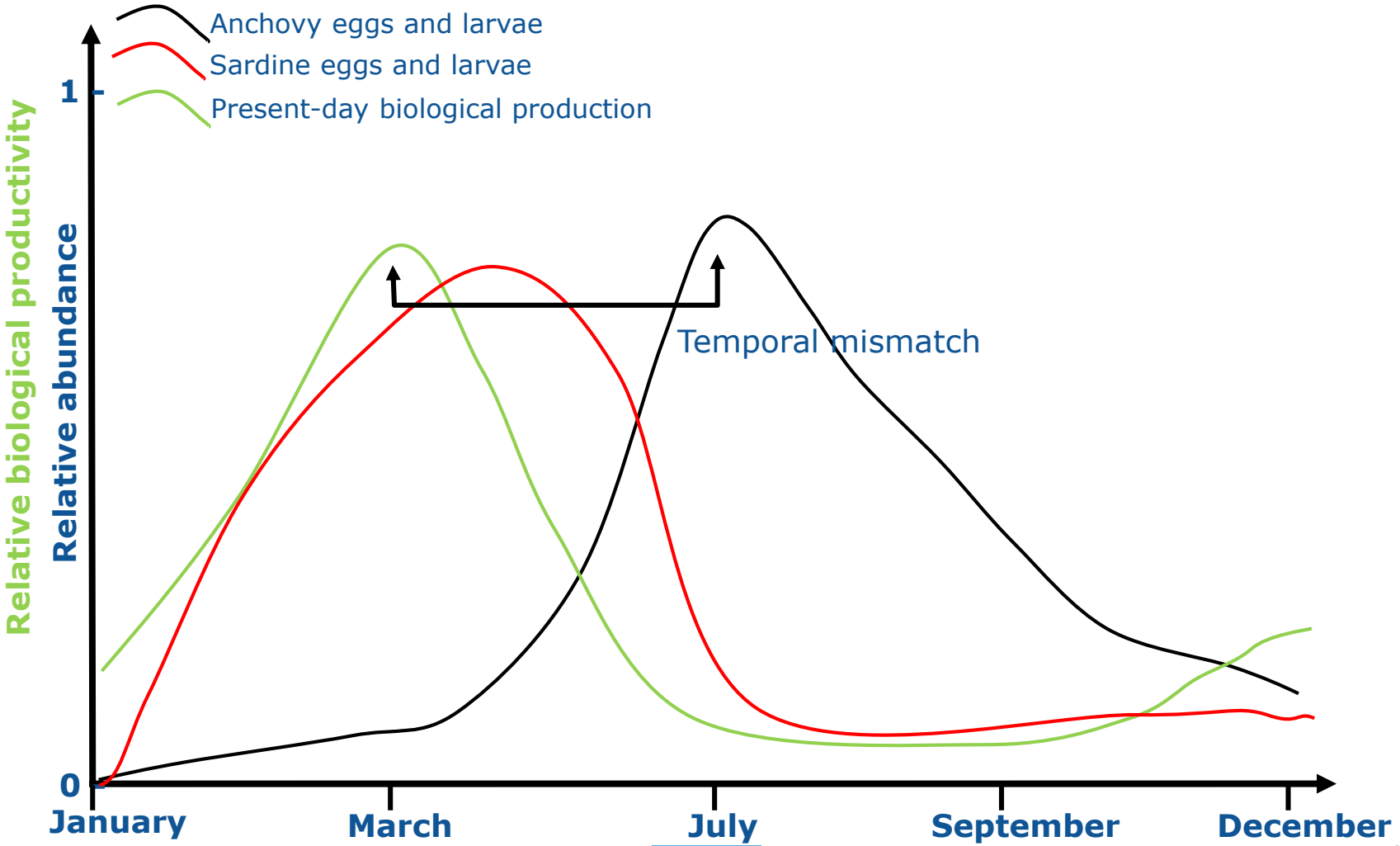

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2. Future scenario (2030)

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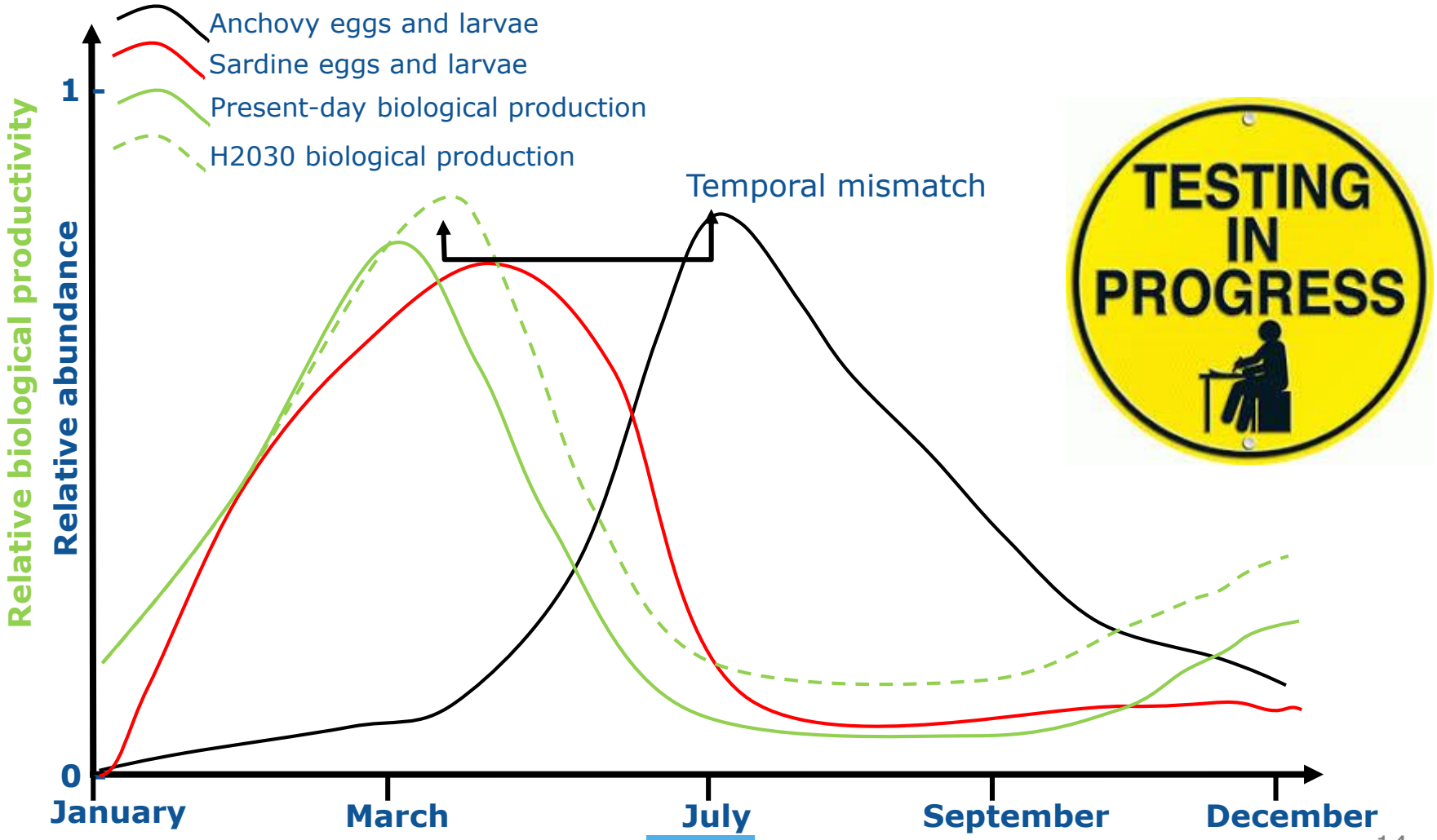
Seasonality of production is also important for foraging species (*e.g.*, small pelagics)



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Concluding remarks

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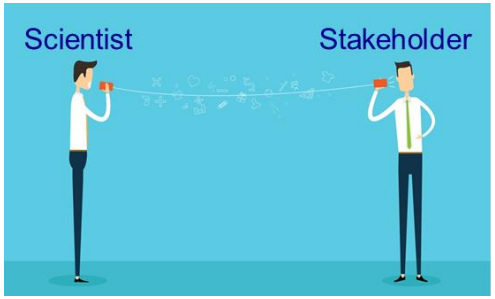
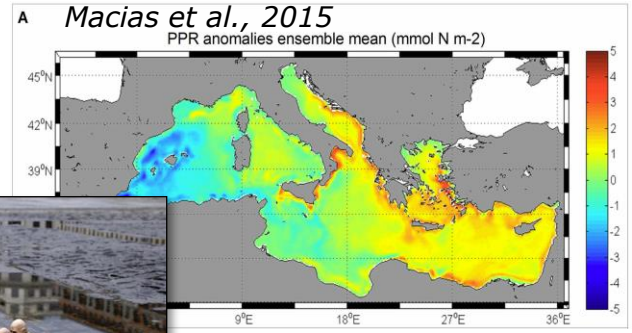
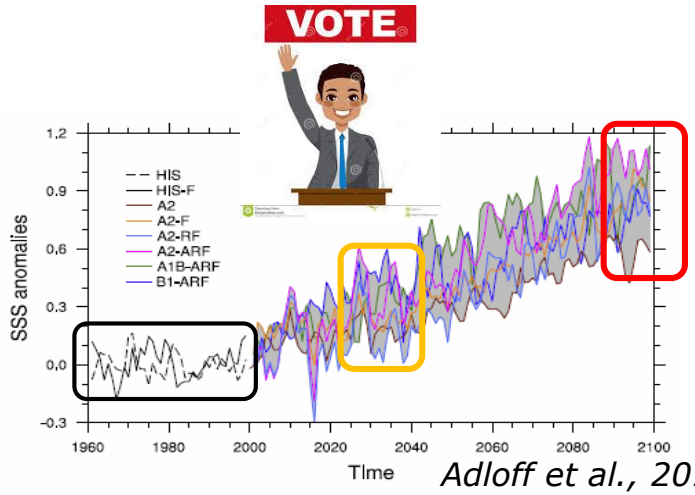
- For year ~2030 the NW Mediterranean will likely face changes in:
  - Surface hydrological properties (density, stratification,..)
  - Intensity and timing of DC events
  - Strength of mesoscale circulation
  - Seasonality of phytoplankton blooms



- Potential implication for high trophic levels (fisheries management)
- Global change is a transient state!



Macias et al., 2015



Adloff et al., 2015

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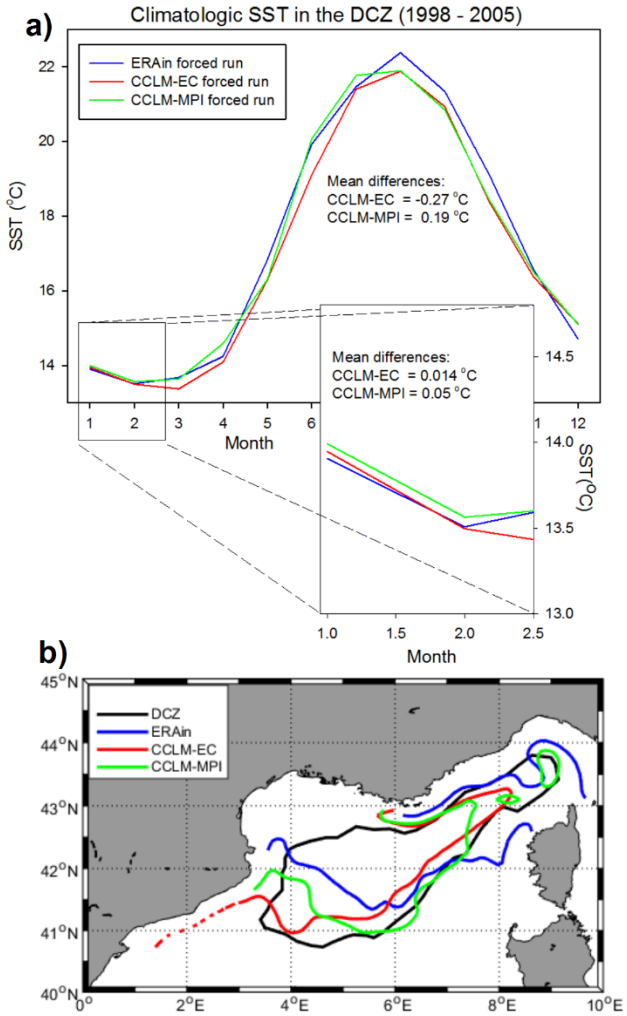

Historical CCLM forced runs reproduce SST values in the NW Med

Position of the 13.8 isotherm in CCLM historical runs corresponds to the DCZ simulated with ERAin forcing