The size, trophic and spatial-temporal scaling of environmental selection in pelagic species

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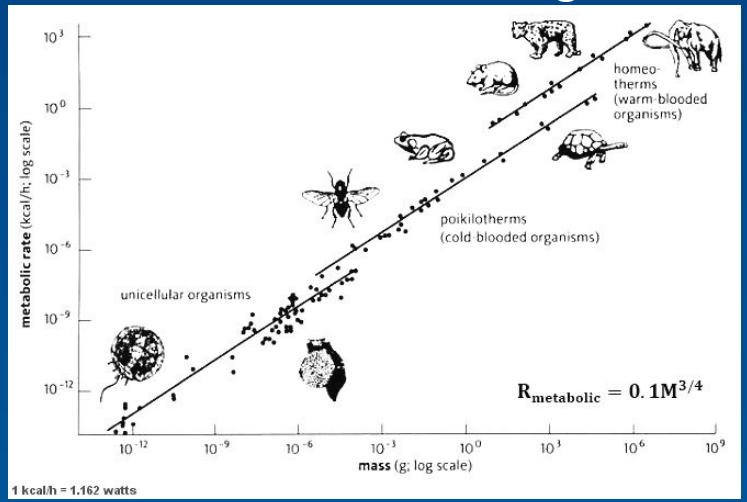
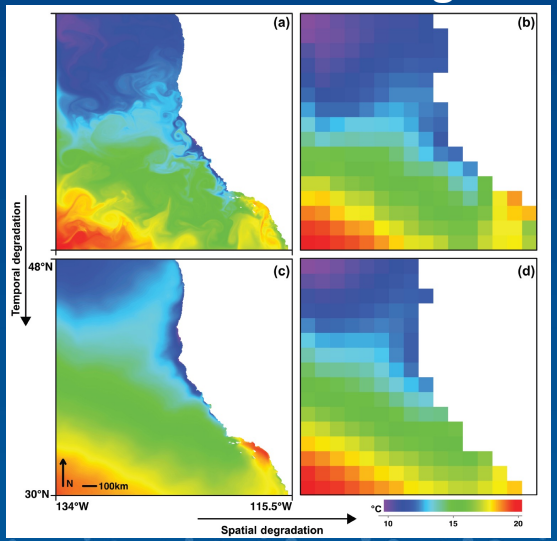
*Metabolic Scaling



Balmer, 2011

*Grain Size Scaling

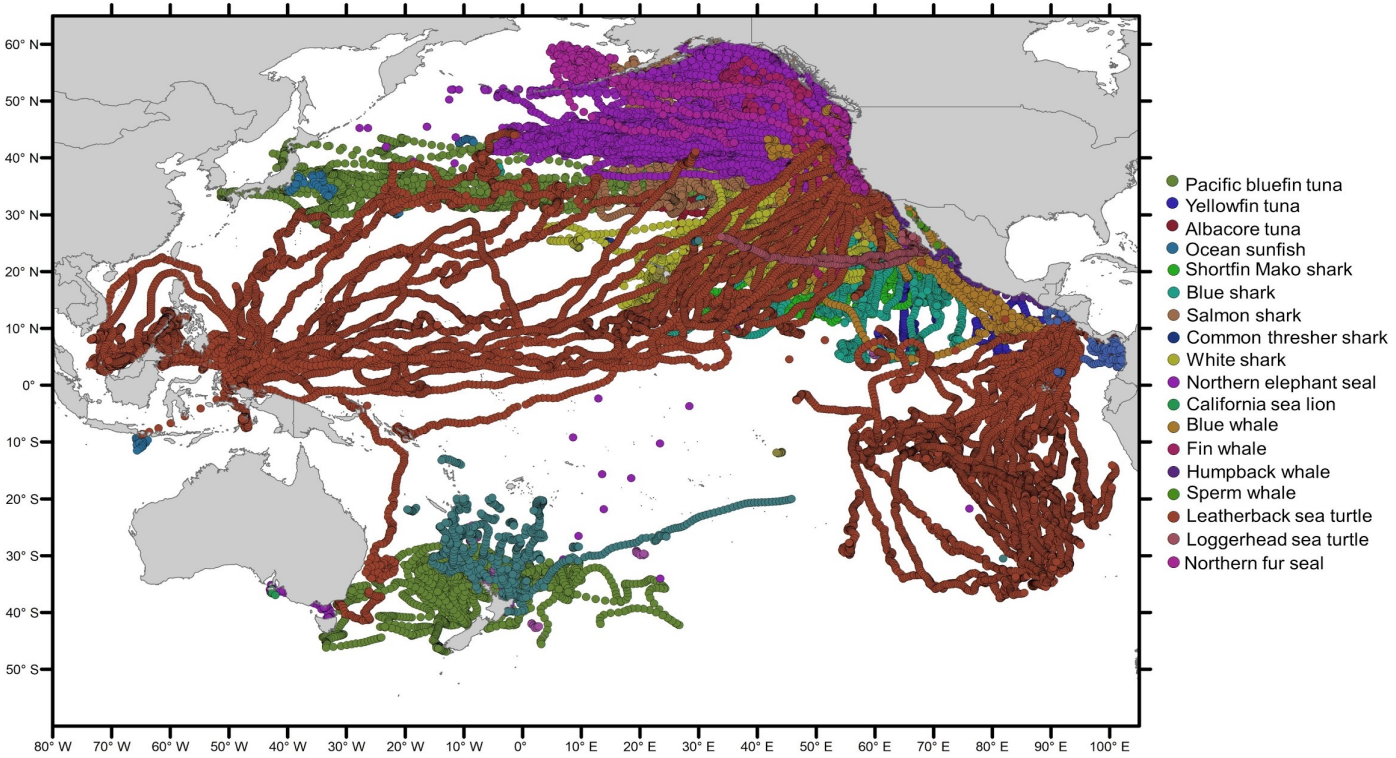


Scales et al, 2016

UNIVERSITY OF DELAWARE

Tagging of Pelagic Predators (topp.org)

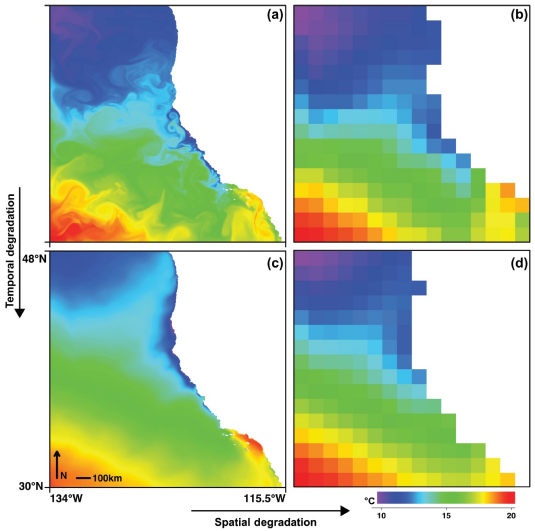
Block et al, 2011

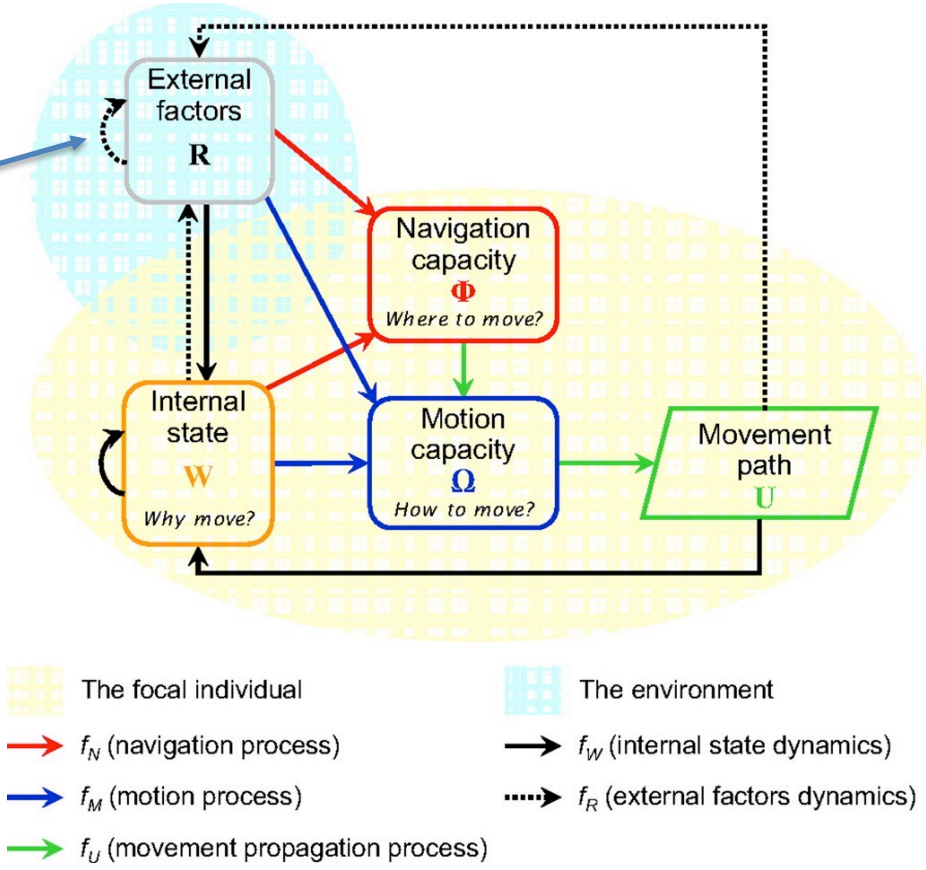


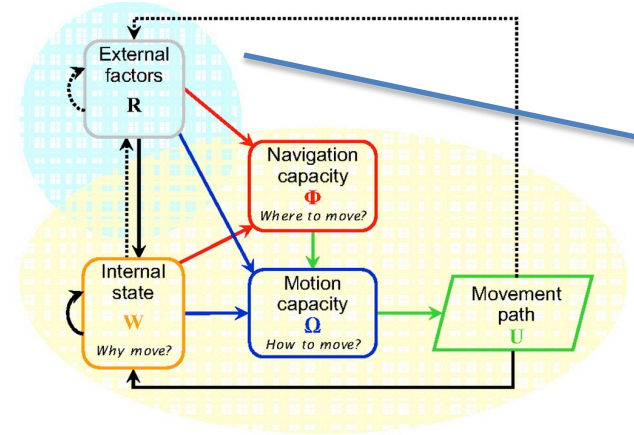
Nathan R et al. PNAS 2008;105:19052-19059

Movement Ecology focuses more on the individual, rather than broad taxonomic groups

External factors are important, but at what space and time scales?







The focal individual

f_N (navigation process)

f_M (motion process)

f_U (movement propagation process)

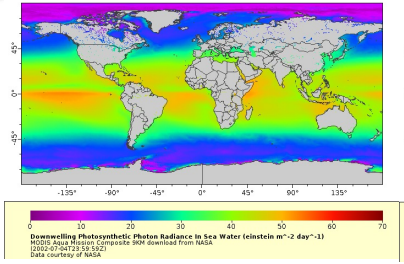
The environment

f_W (internal state dynamics)

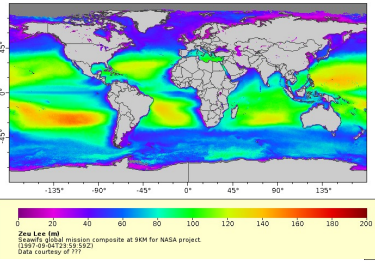
f_R (external factors dynamics)

Potential environmental conditions forcing movement

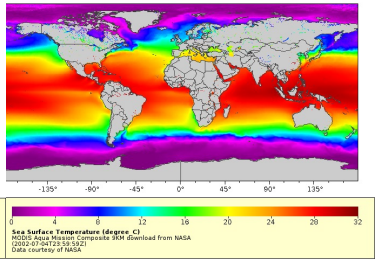
PAR

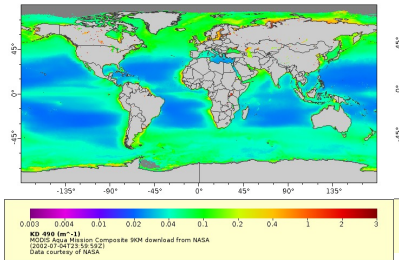


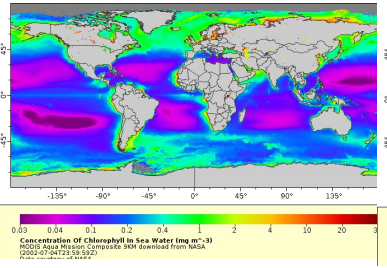
Euphotic Depth

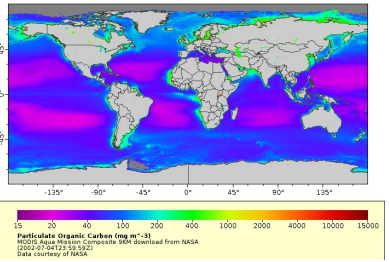


Temperature







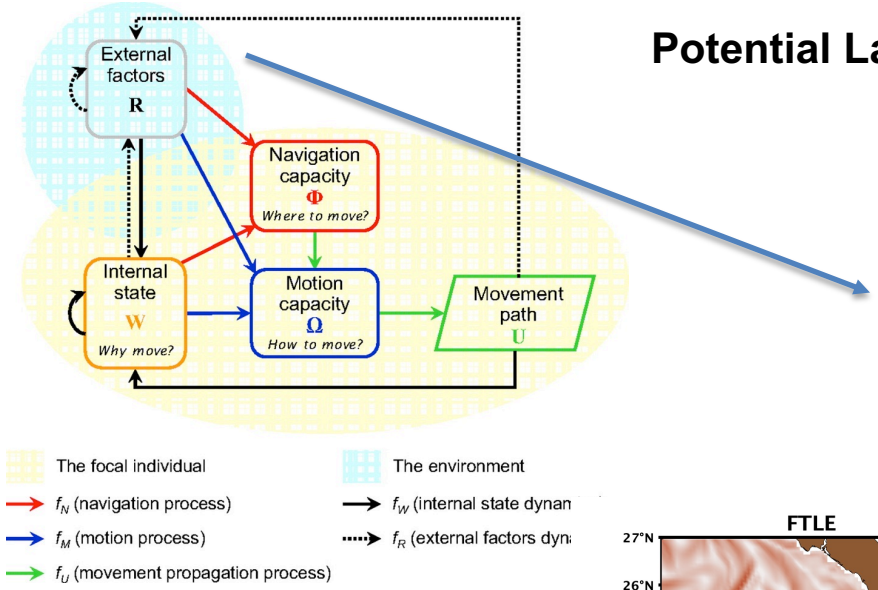


Diffuse Attenuation

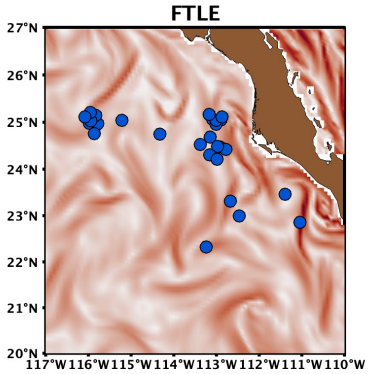
Chlorophyll

POC

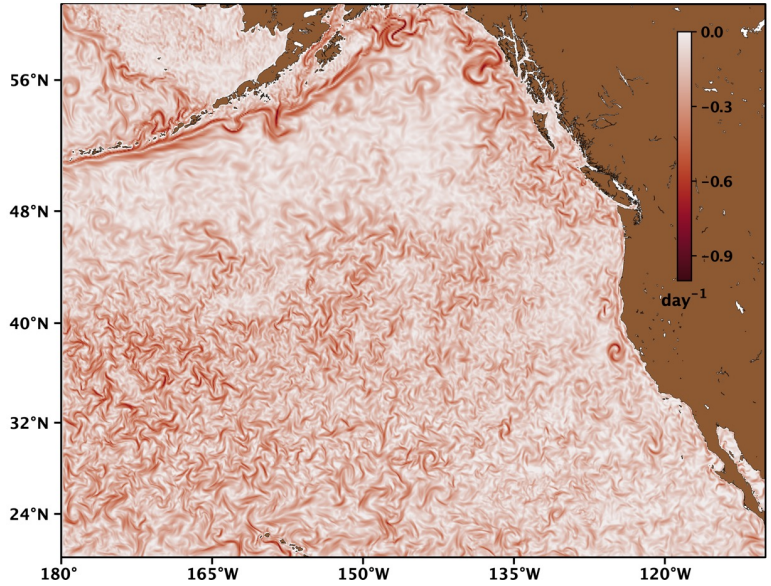
Potential Lagrangian conditions affecting movement



Yellowfin tuna appear to be located near FTLE ridges



FTLE from HYCOM reanalysis



Temporal and spatial grain size scaling of FTLE

Why attractive FTLE's?

Food resources are diffuse in the ocean

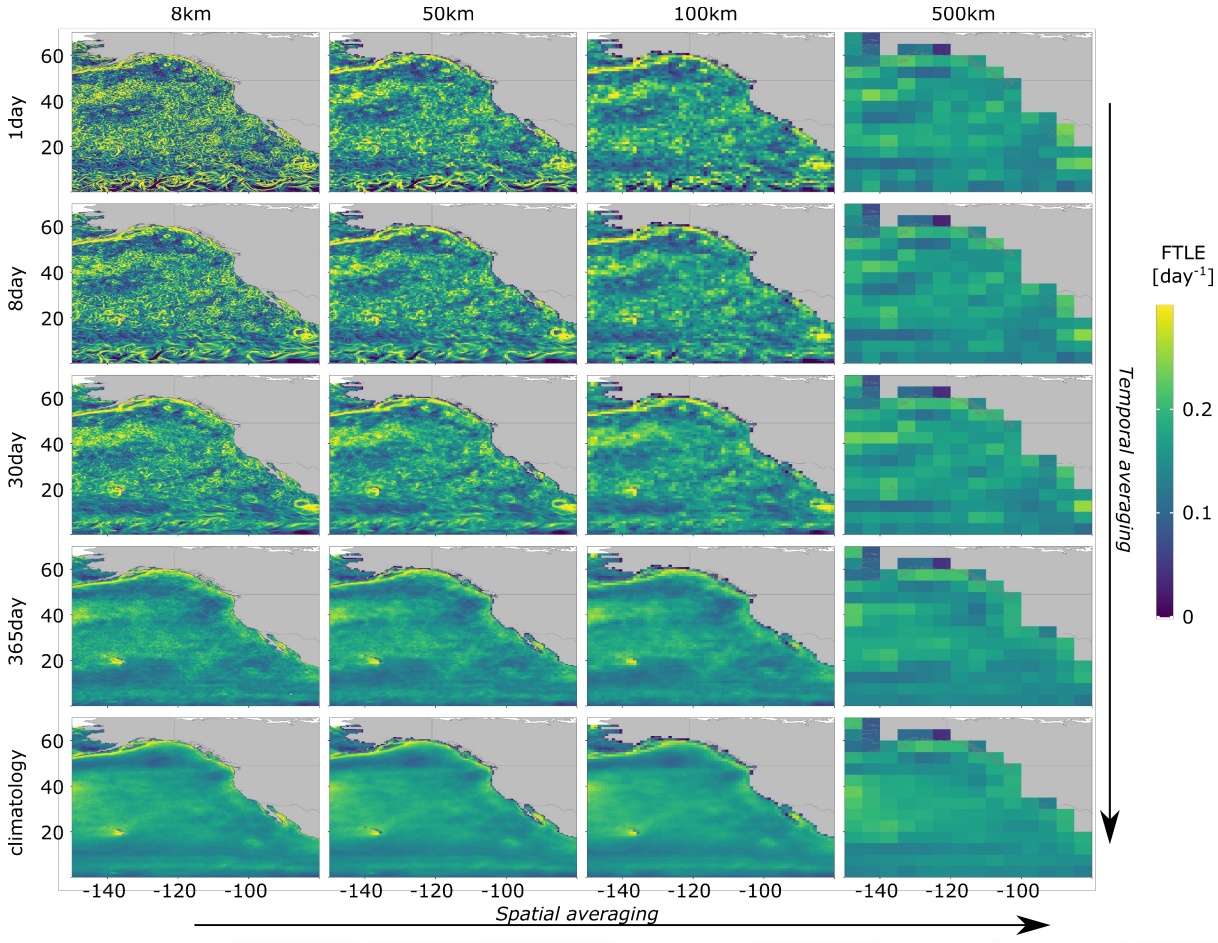
Plankton (primary and secondary consumers) have very low Reynolds numbers.

In low growth conditions, plankton are aggregated by Lagrangian Structures

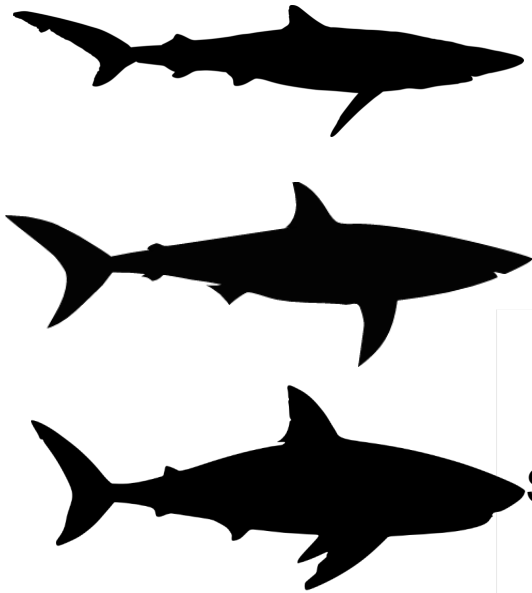
FTLE's are possible proxy for prey fields

Low grain size = Importance of immediate conditions

High grain size = Importance of average conditions



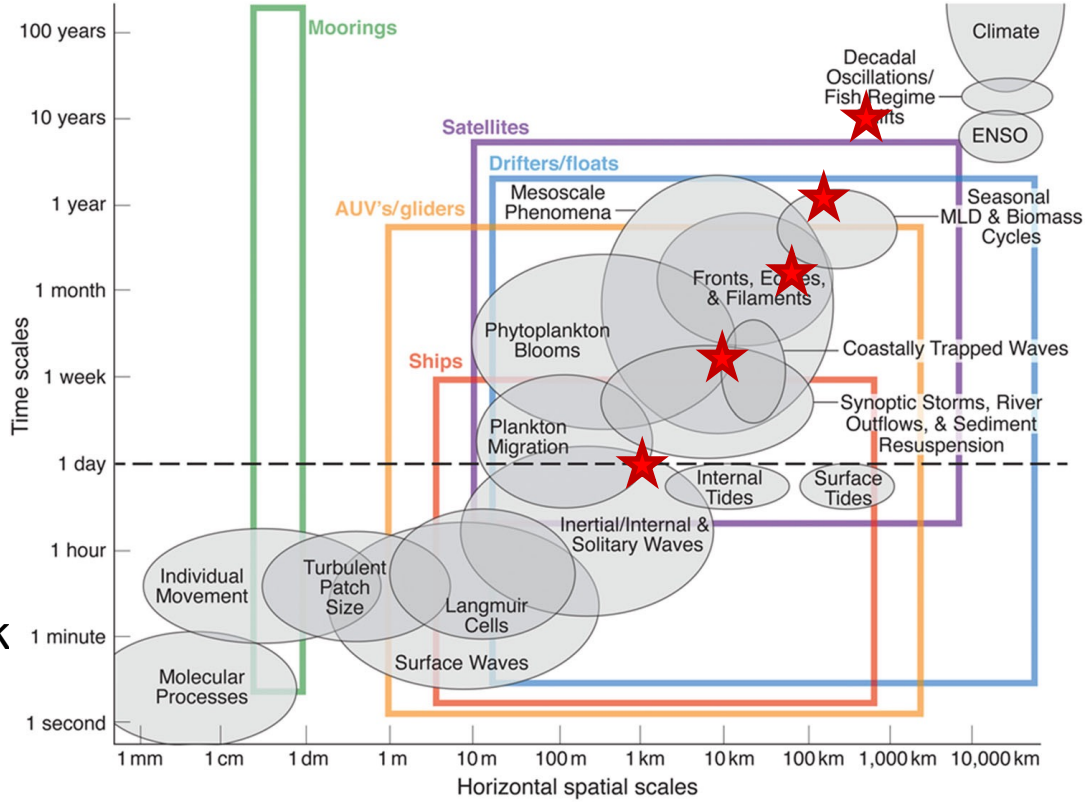
Scaling and Selection of Ocean Phenomena



Blue shark

Mako shark

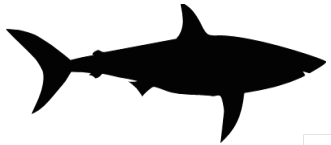
Salmon shark

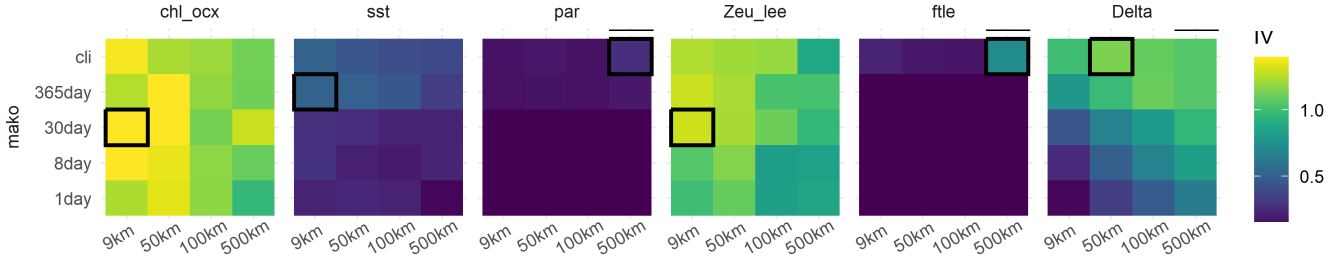


Karl & Church 2017

Scaling and Selection of Ocean Phenomena

Maximum information value for each variable





Scaling and Selection of Ocean Phenomena

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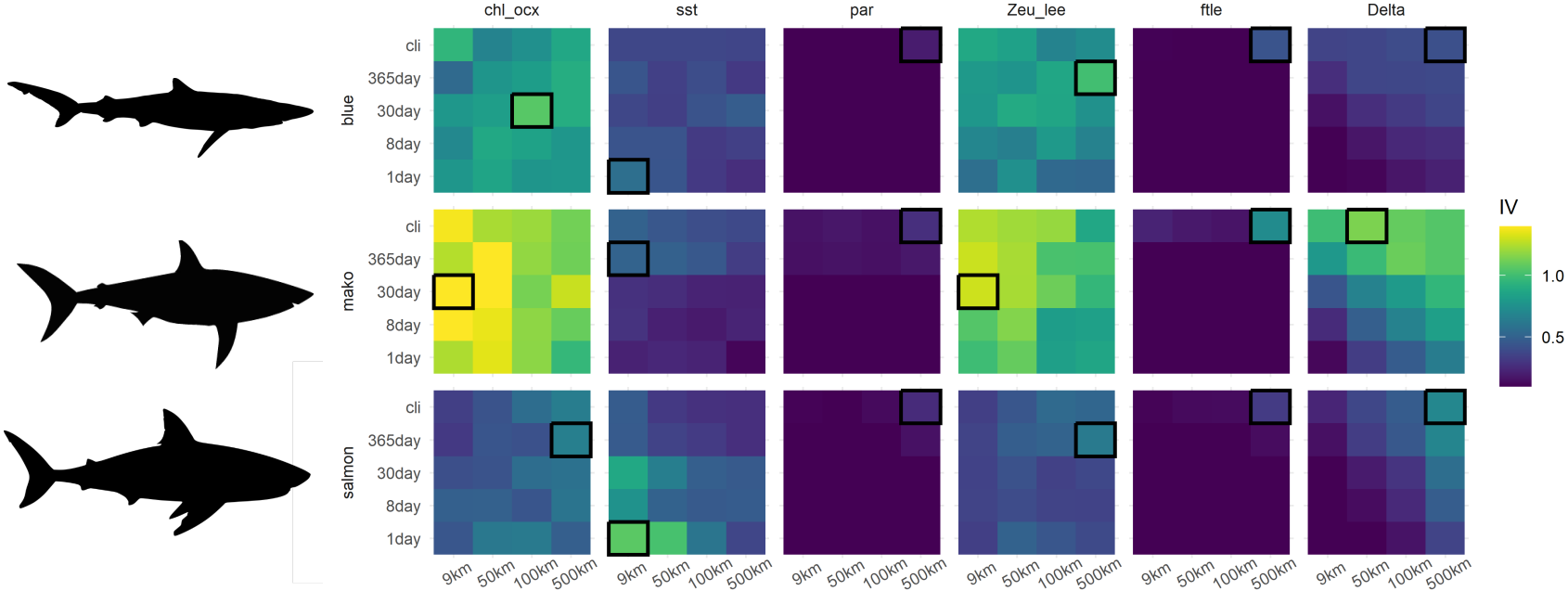
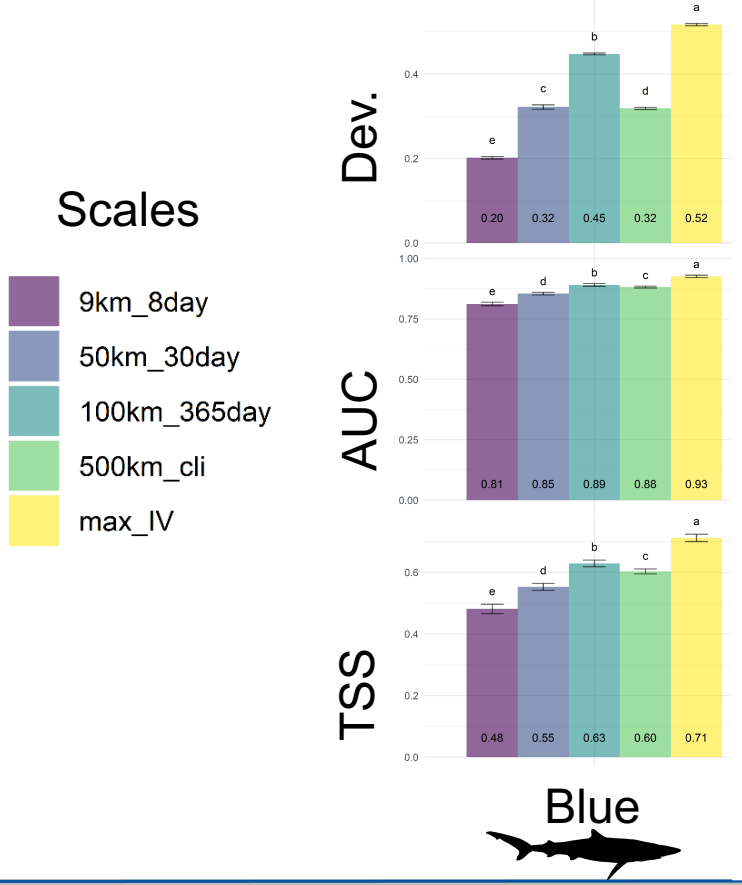


Boosted Regression Trees to Predict Scales of Selection

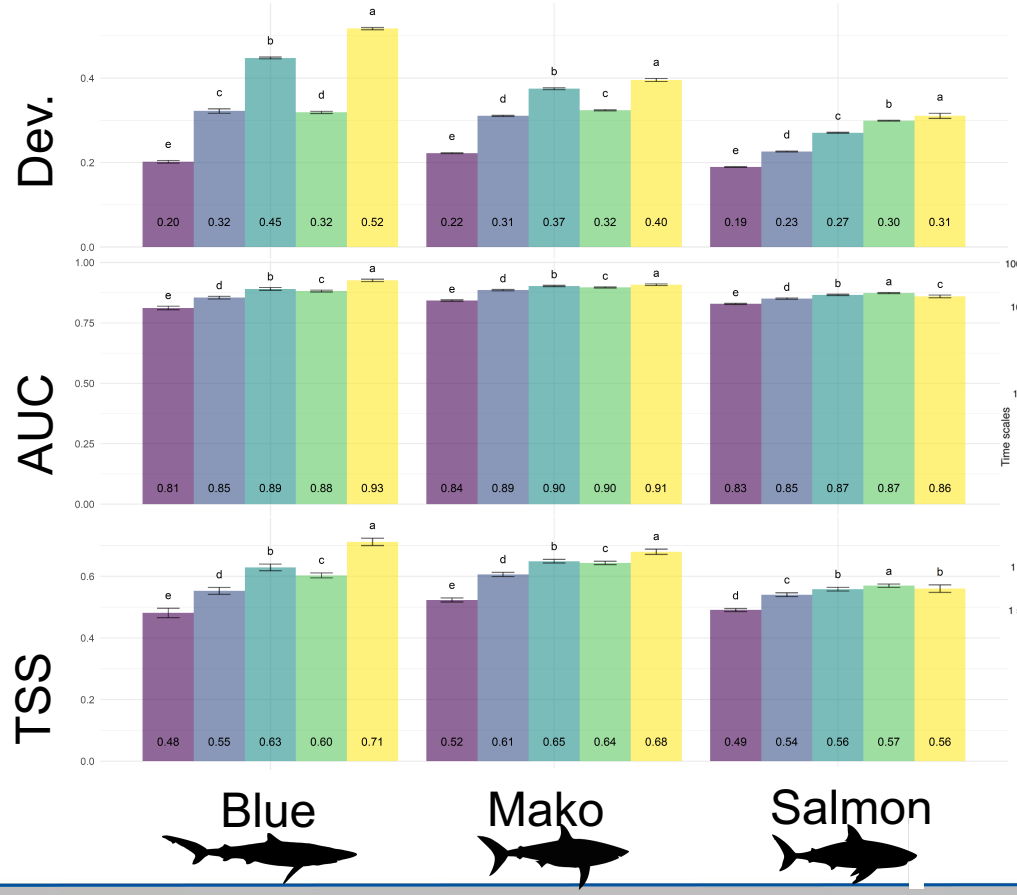


100 km – 365 day

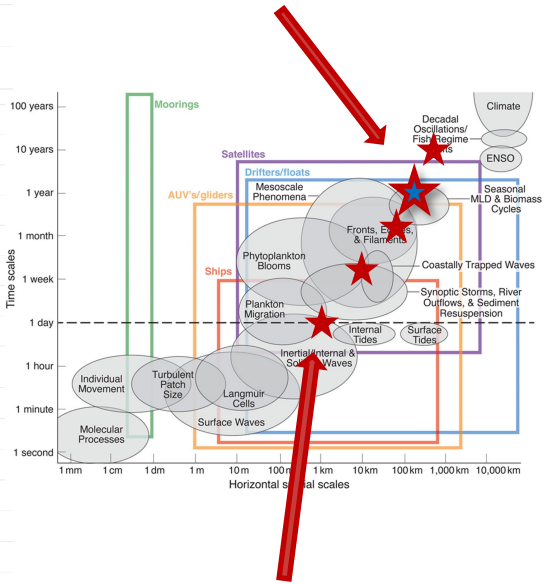
Boosted Regression Trees to Predict Scales of Selection

Scales

- 9km_8day
- 50km_30day
- 100km_365day
- 500km_cli
- max_IV

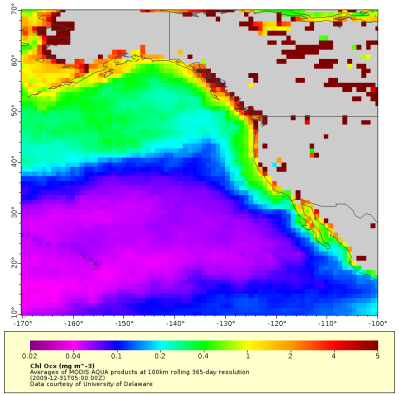


Seasonal/MLD/Biomass Cycles

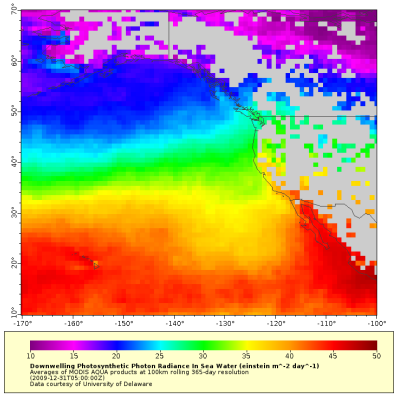


Not tested due to lack of match-ups

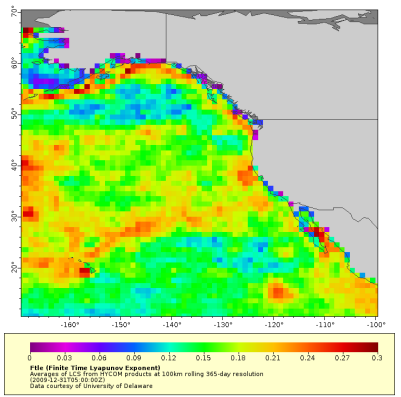
100 km – 365 day	100 km – 365 day	100 km – 365 day



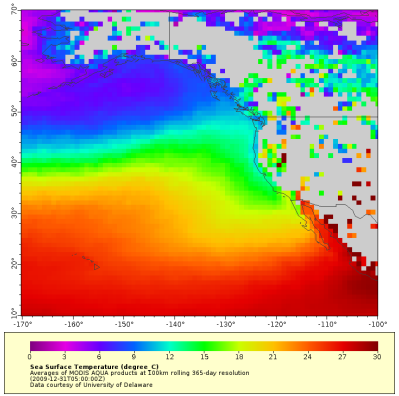
Chlorophyll



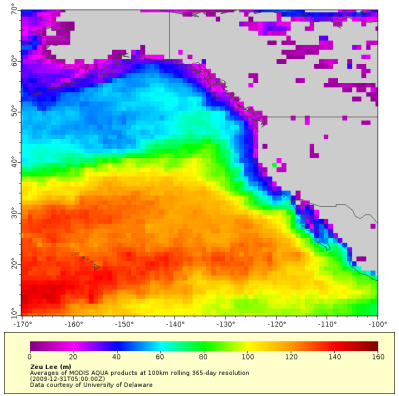
PAR



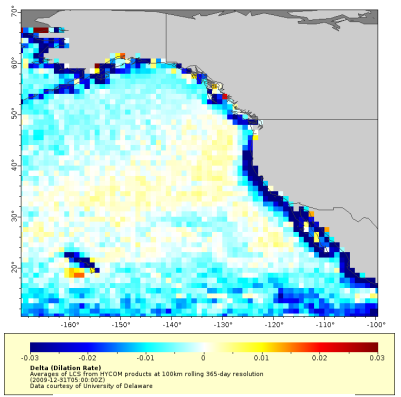
FTLE



SST



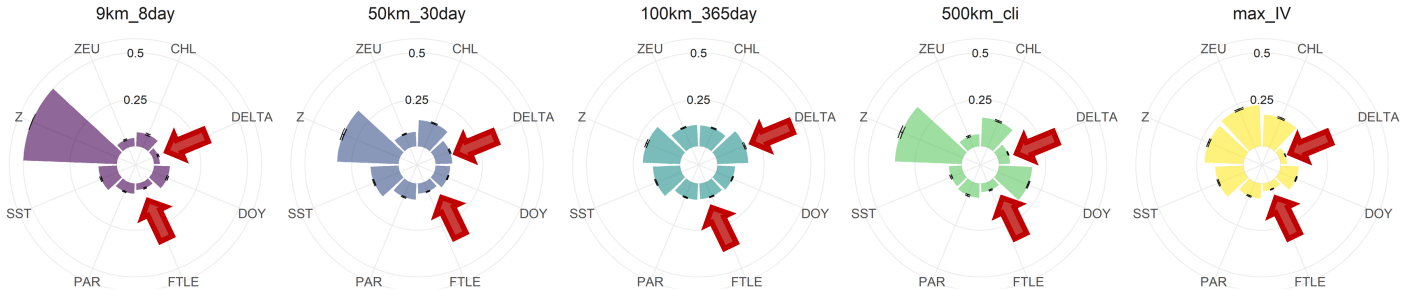
Euphotic Depth



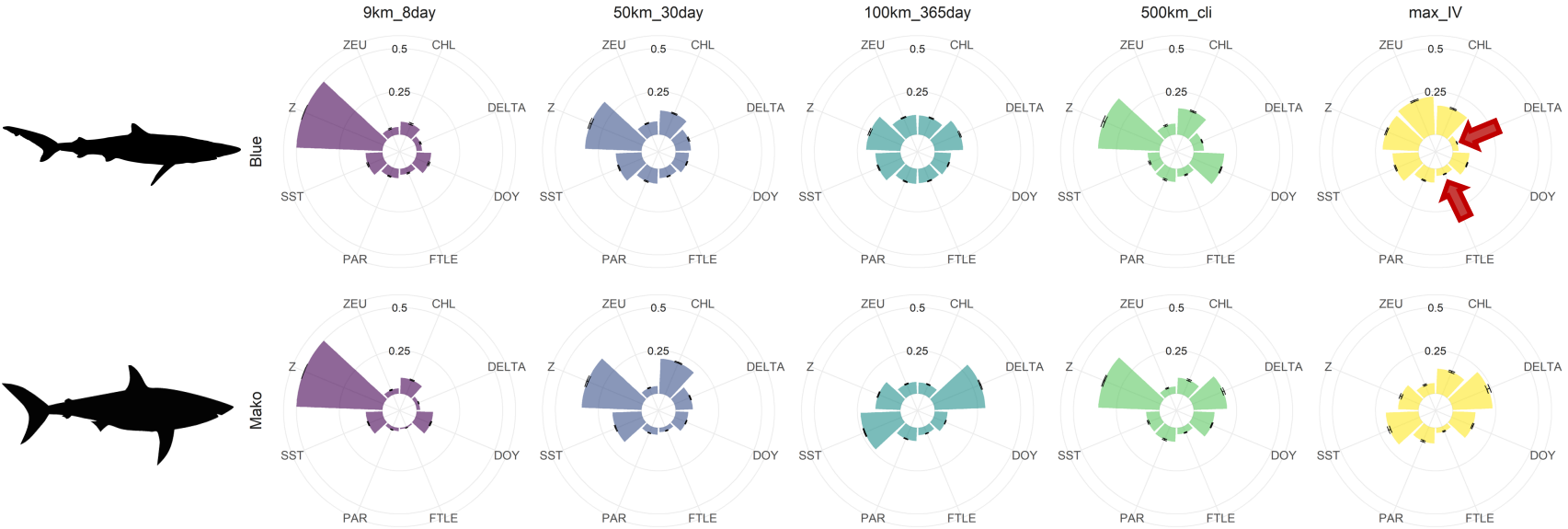
Delta

Relative importance of Lagrangian and Eulerian predictors

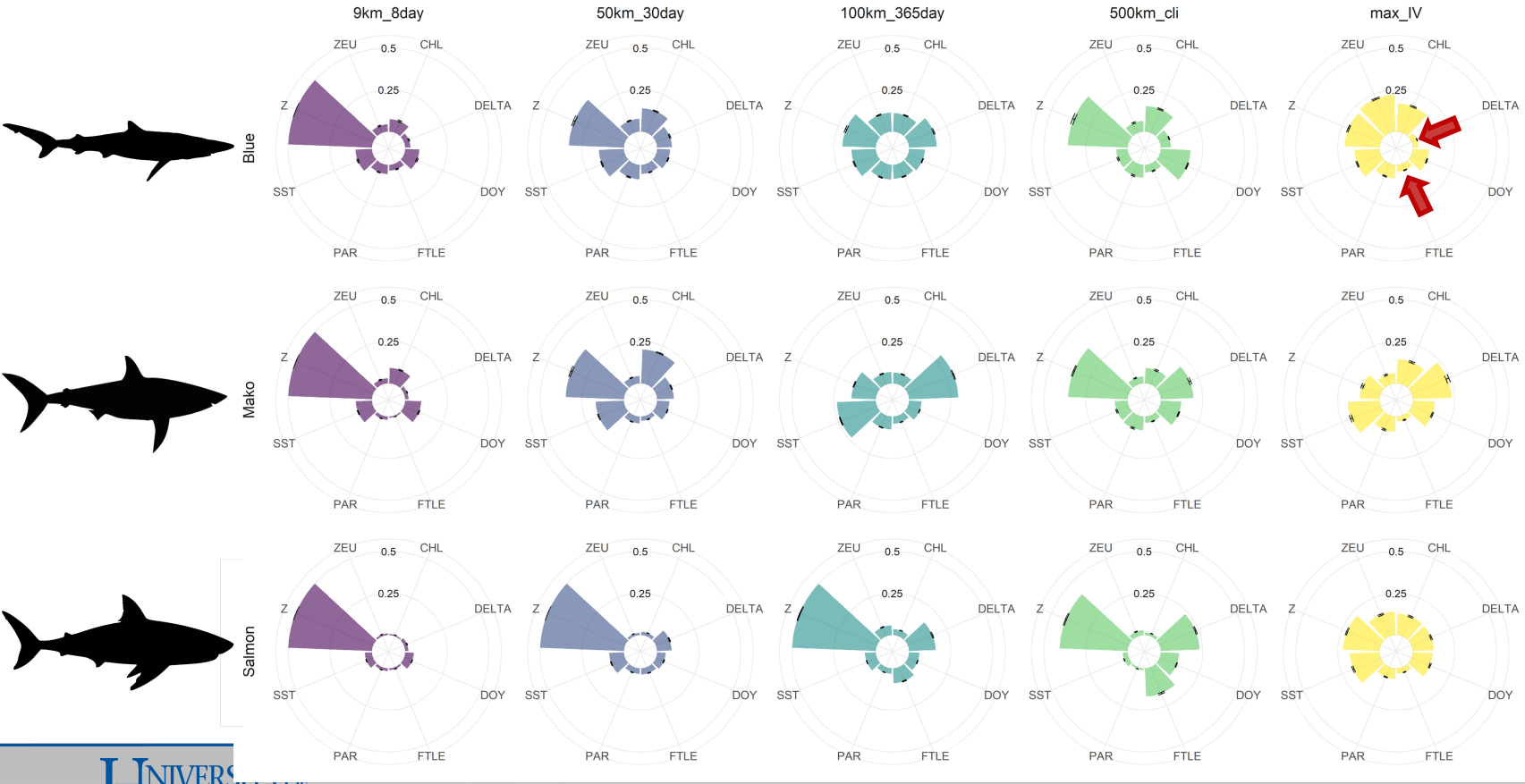
Blue



Relative importance of Lagrangian and Eulerian predictors



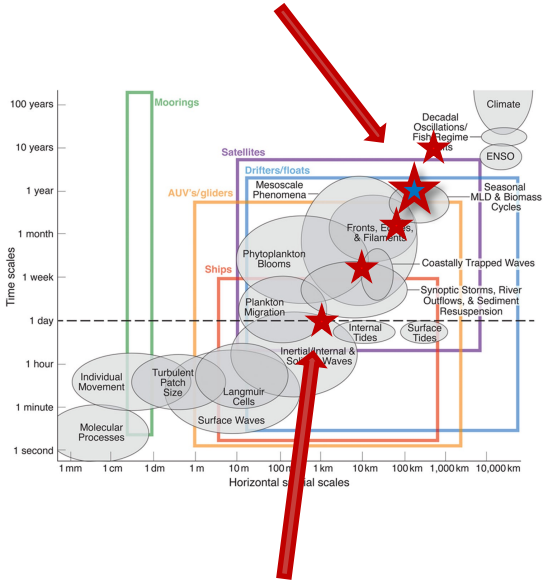
Relative importance of Lagrangian and Eulerian predictors



Conclusions and Future Directions

1. **For these top predators 100 km, 365 day scale is best predictor**
2. **Each predator has a different mix of scales for each variable**
3. **Further investigate smaller scales with Lagrangian only features.**
4. **Will apply these to other tagged organisms at different trophic levels and metabolic states.**

Seasonal/MLD/Biomass Cycles



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