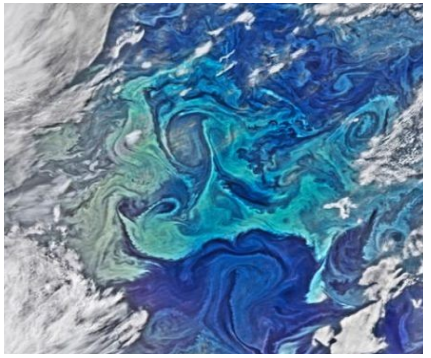
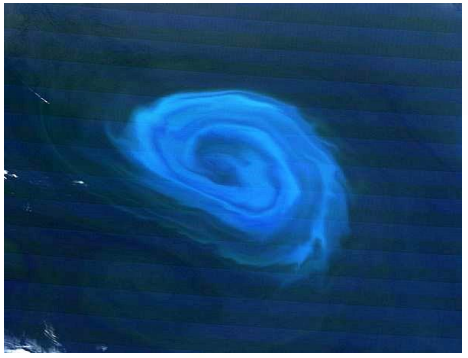
Investigating ocean life at the mesoscale: a Lagrangian perspective

Alice Della Penna

S.Wotherspoon, C. Johnson, S. De Monte, C. Guinet, T. Trull, F. d'Ovidio





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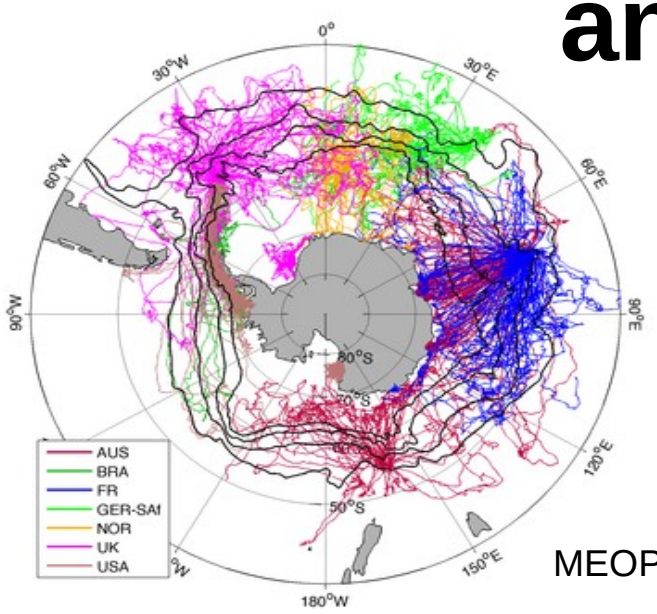
Satellite-based Lagrangian approach for ecological questions

- Example # 1: ocean currents and animal behaviour

- Example # 2: biogeography of diatom favourable niches

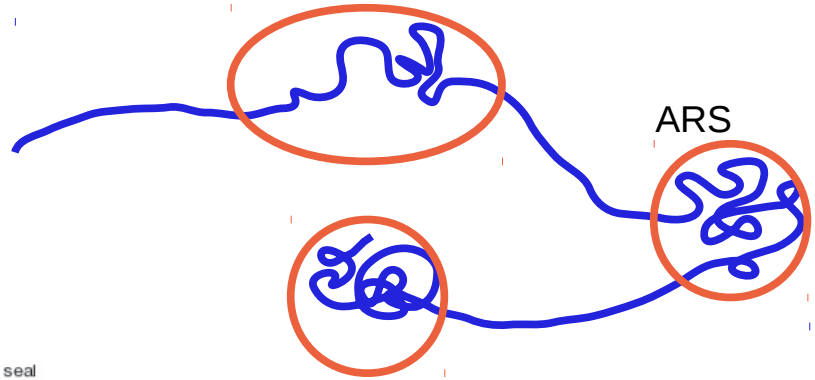
Example # 1: ocean currents and animal behaviour

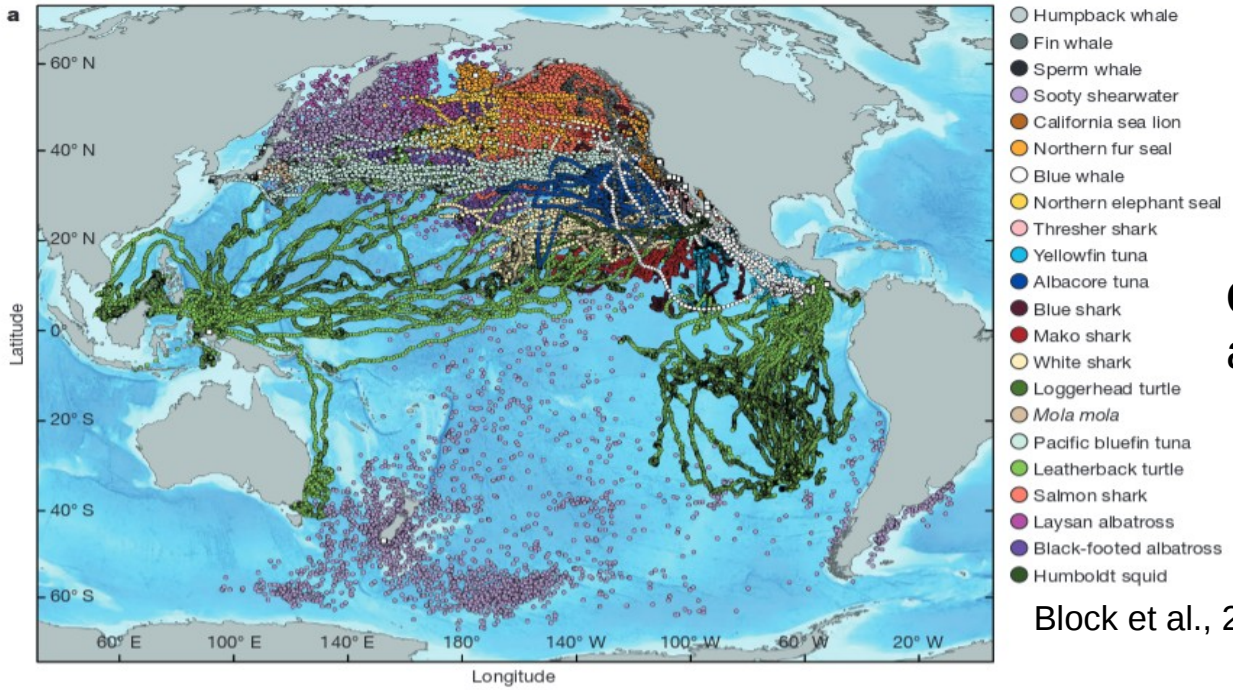


MEOP program

Motivation:

- increase in the use of animal tracking data
- Models linking movement patterns and foraging behaviour

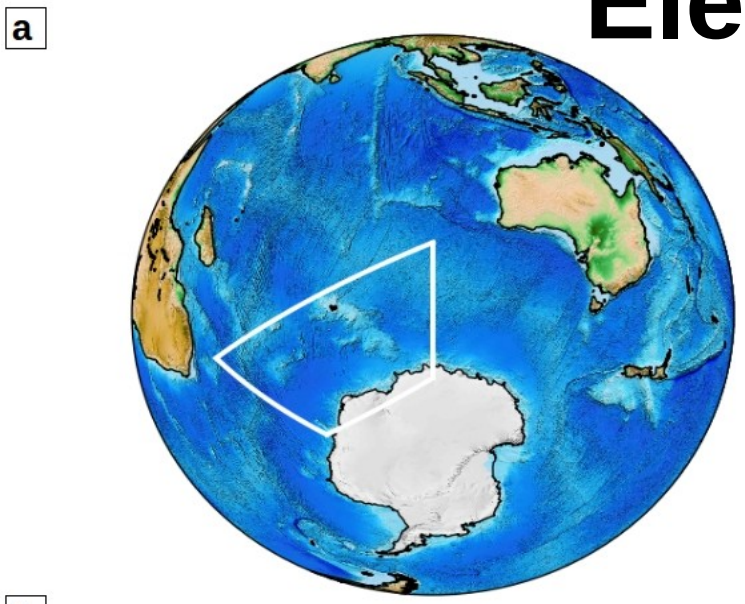


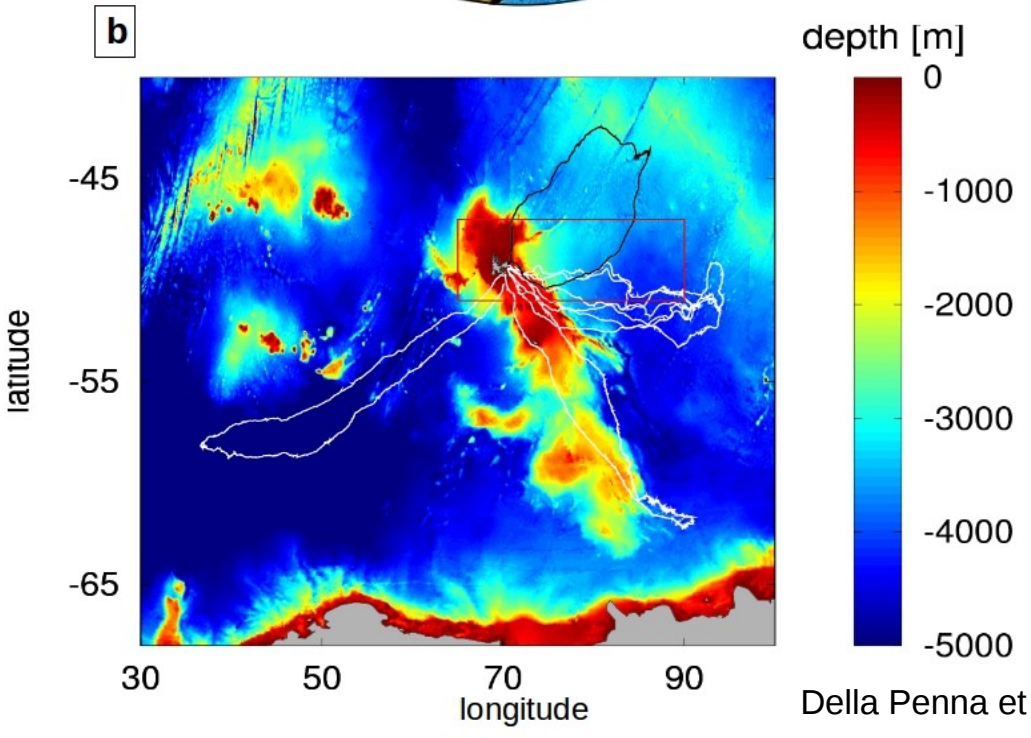


Block et al., 2011

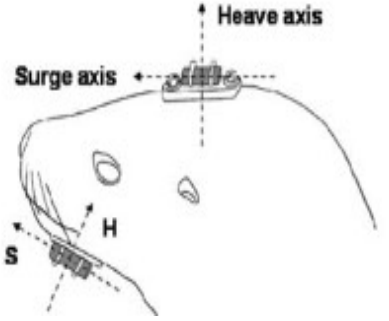
Question: Are large marine animals affected by mesoscale currents?

Example # 1: Kerguelen's Southern Elephant Seals





- GPS trajectories
- Accelerometry as a proxy for foraging
- Altimetry-derived velocity field (AVISO / CNES CLS regional product)
- Lagrangian advection scheme (Lamta by F. d'Ovidio)



Della Penna et al., *in review*

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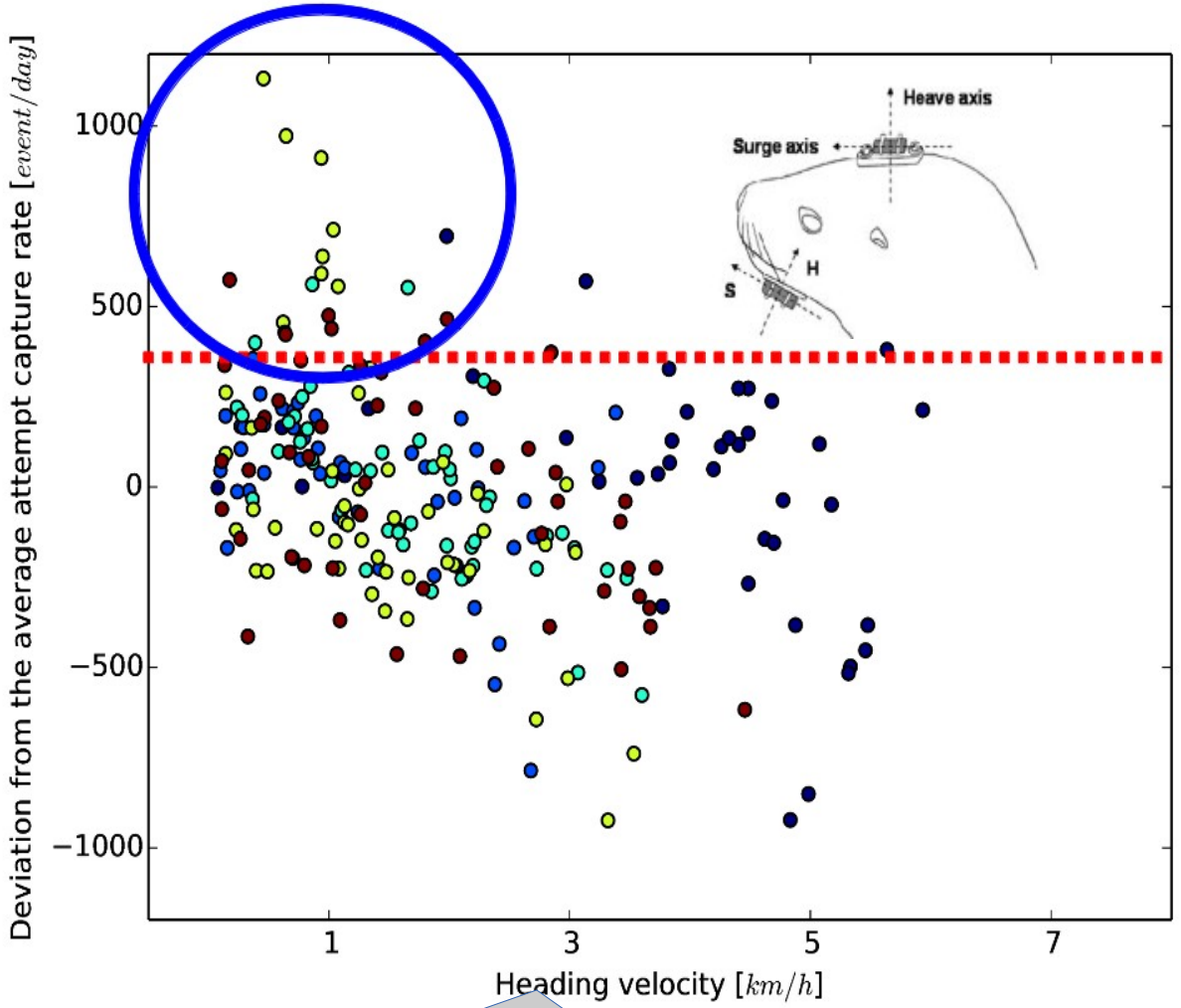
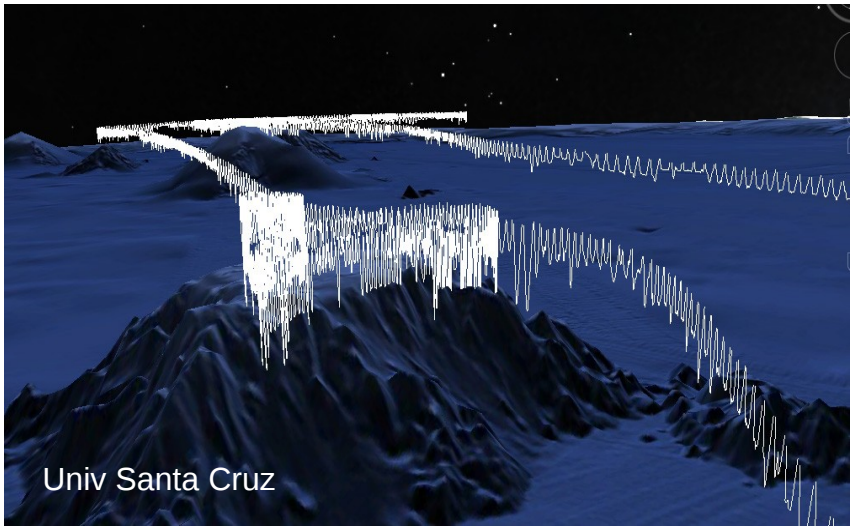


- Intensively foraging elephant seals tend to have slower horizontal heading velocities



Tracking velocity – geostrophic velocity

Della Penna et al., *in review*

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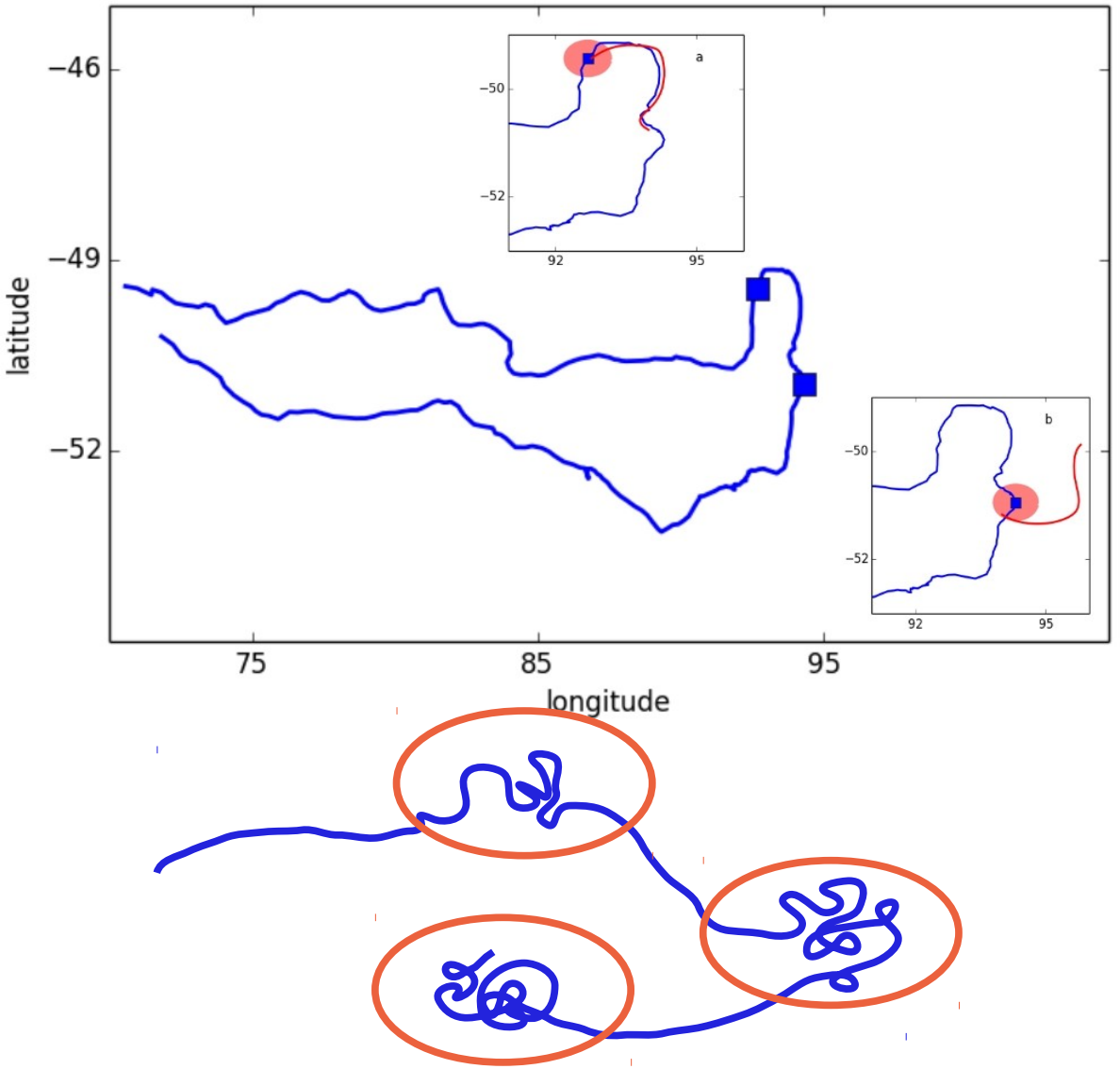

- QPI → a diagnostic to quantify the effect of mesoscale horizontal transport on animal trajectories
- Comparison between observed and simulated trajectories
- Correlation with heading velocity, intensive foraging and front presence

Della Penna et al., *in review*

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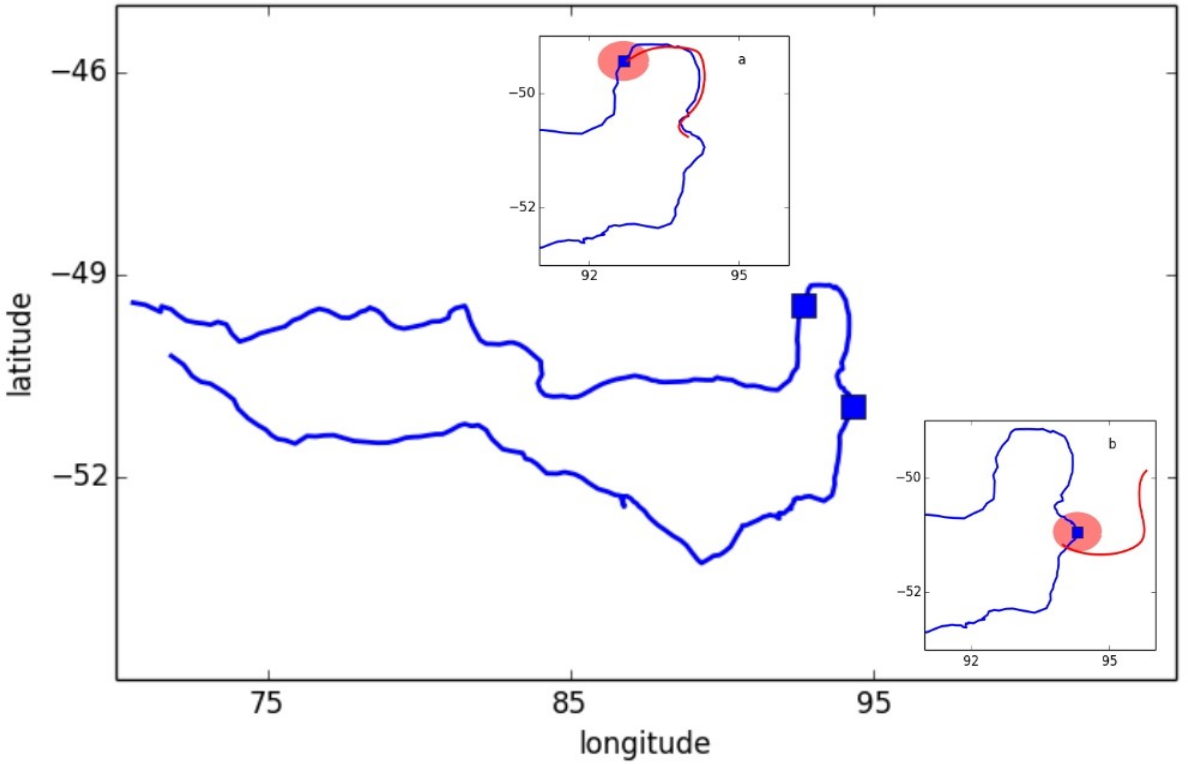

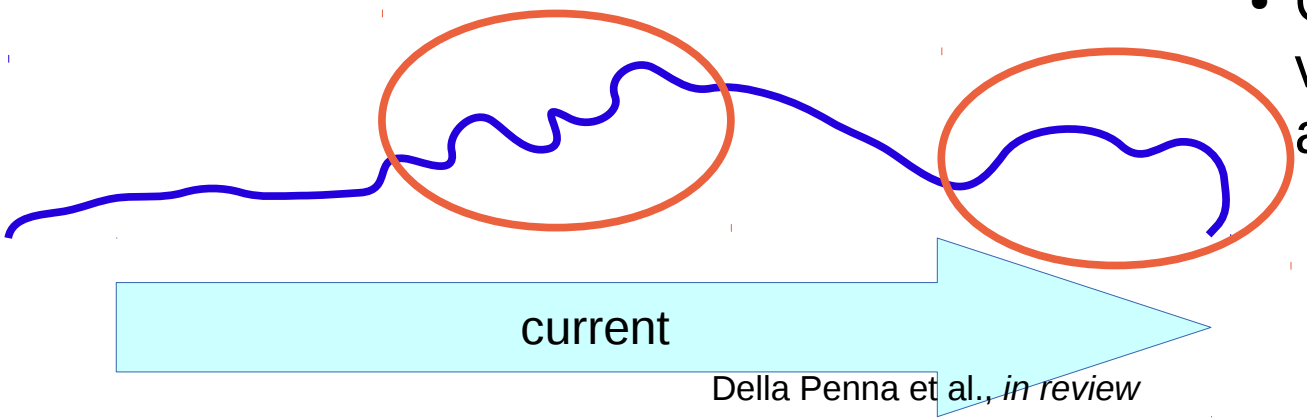

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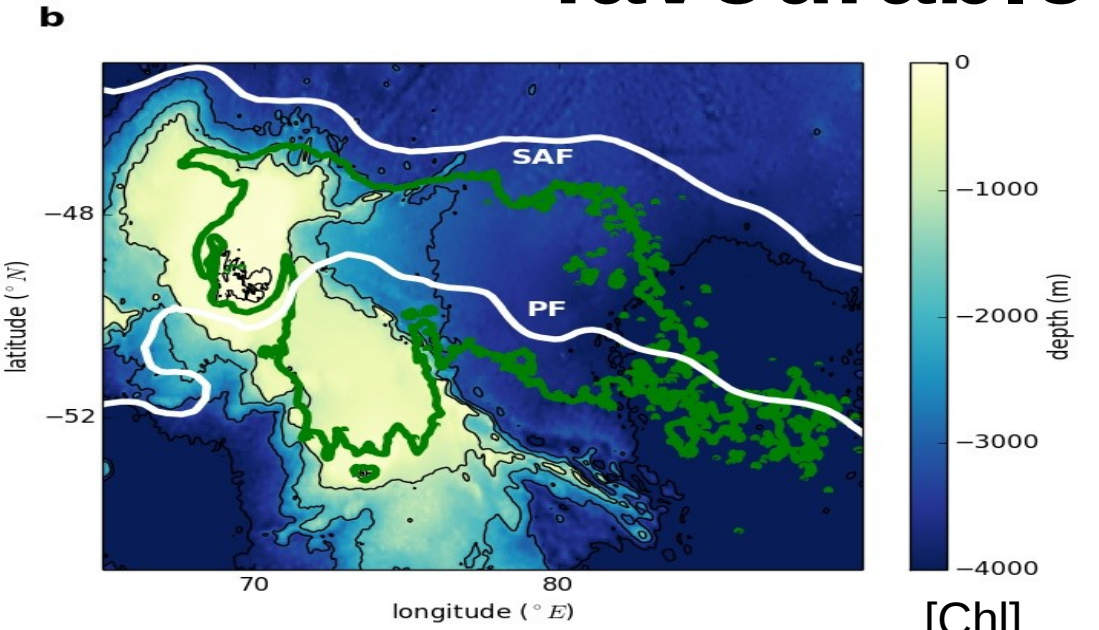
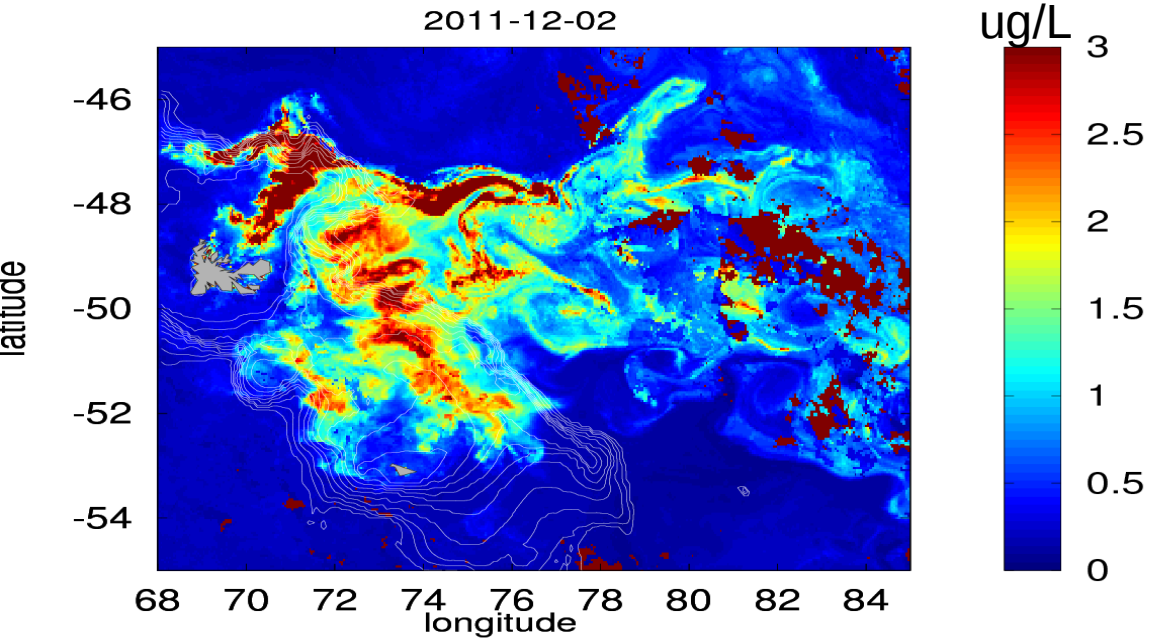
Example # 2: biogeography of diatom favourable niches





Motivation:

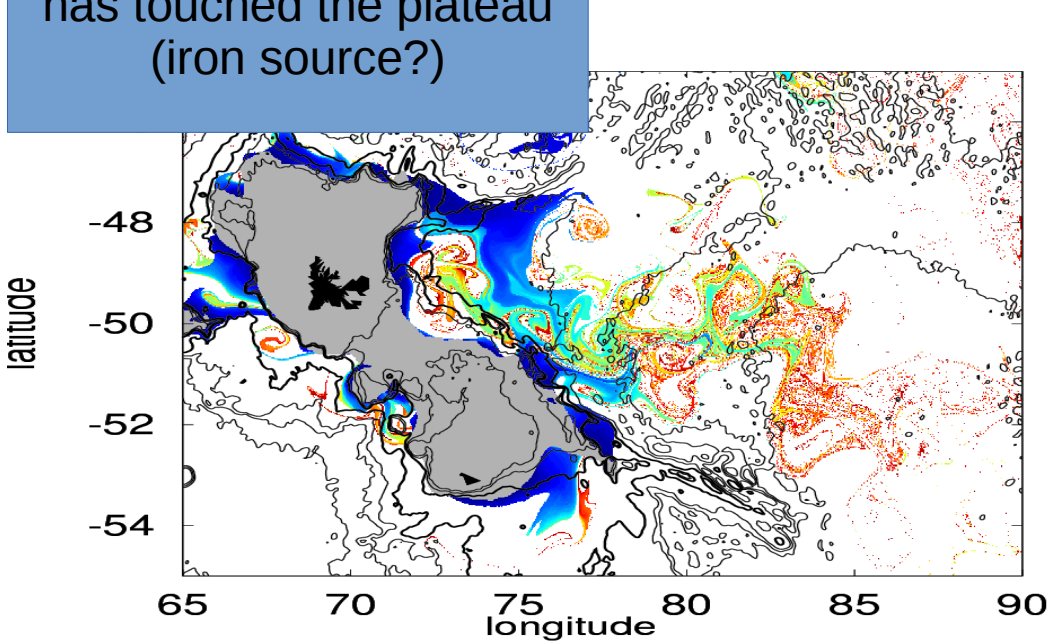
- Different phytoplanktonic communities play different biogeochemical roles and sustain different ecosystems

- Diatoms are responsible for blooms in the Southern Ocean (otherwise HNLC)

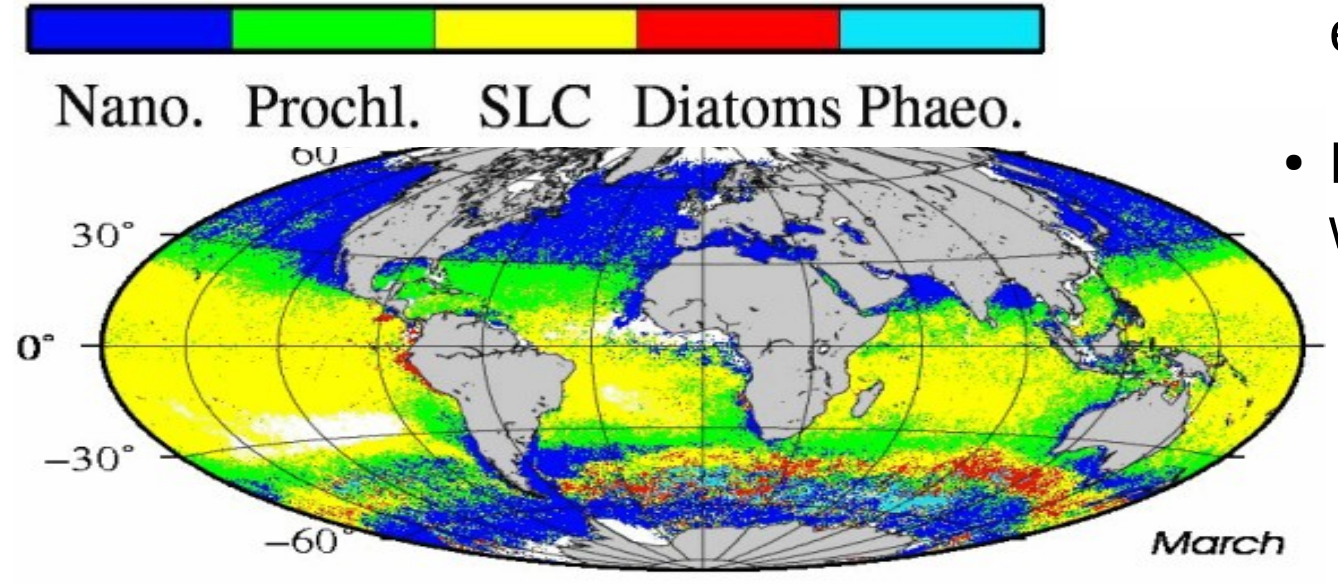
Objective: Relate the spatial distribution of diatoms with iron-enriched waters from the plateau

Example # 2: biogeography of diatom favourable niches

Time since a water parcel has touched the plateau (iron source?)



- Altimetry-derived velocity field (AVISO + CNES CLS)
- Lagrangian advection scheme
- The “water age” diagnostic [d'Ovidio et al. 2015, Mongin et al. 2009)



- PHYSAT (from physat's website) [Alvain et al., 2005]

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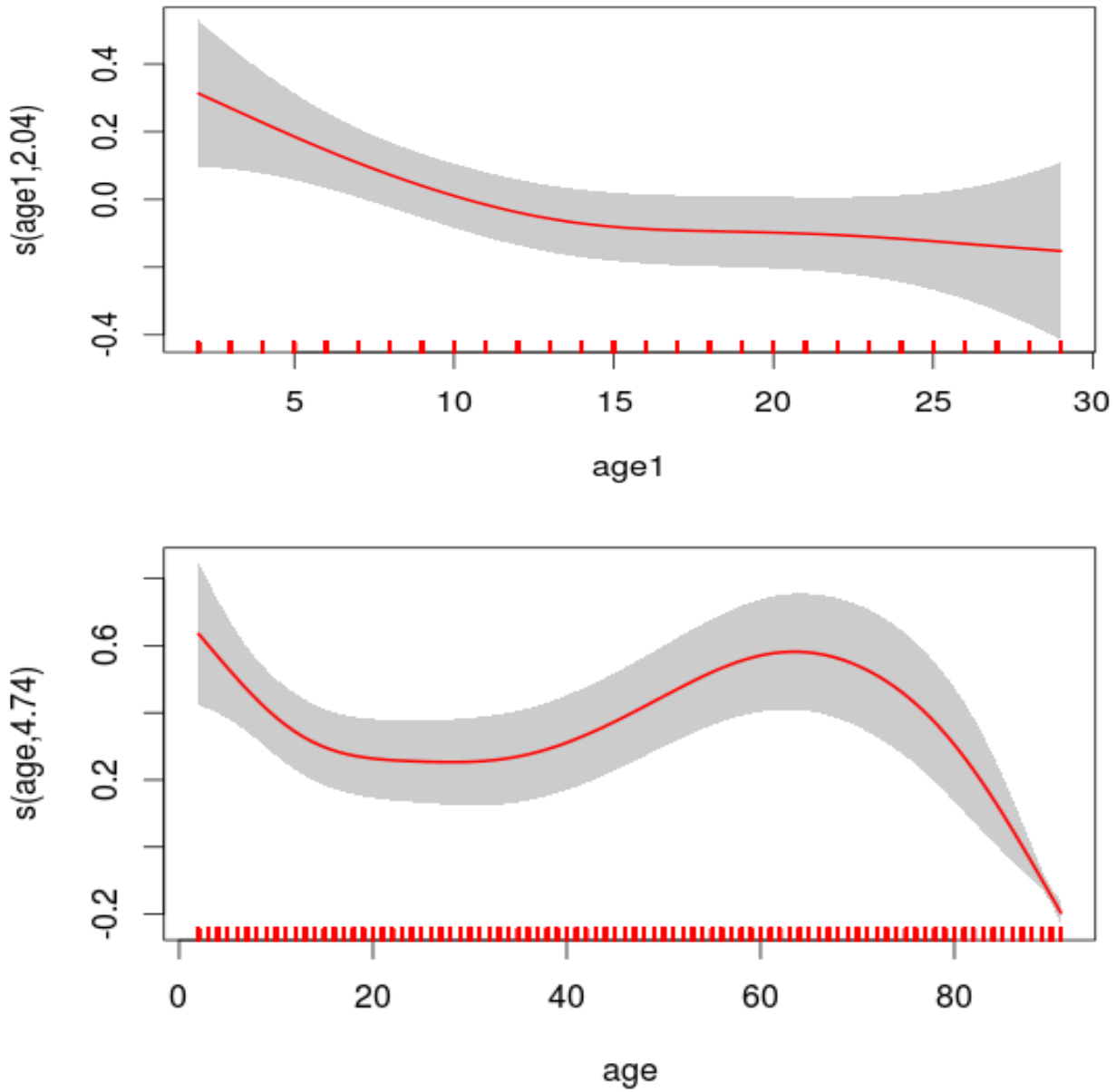
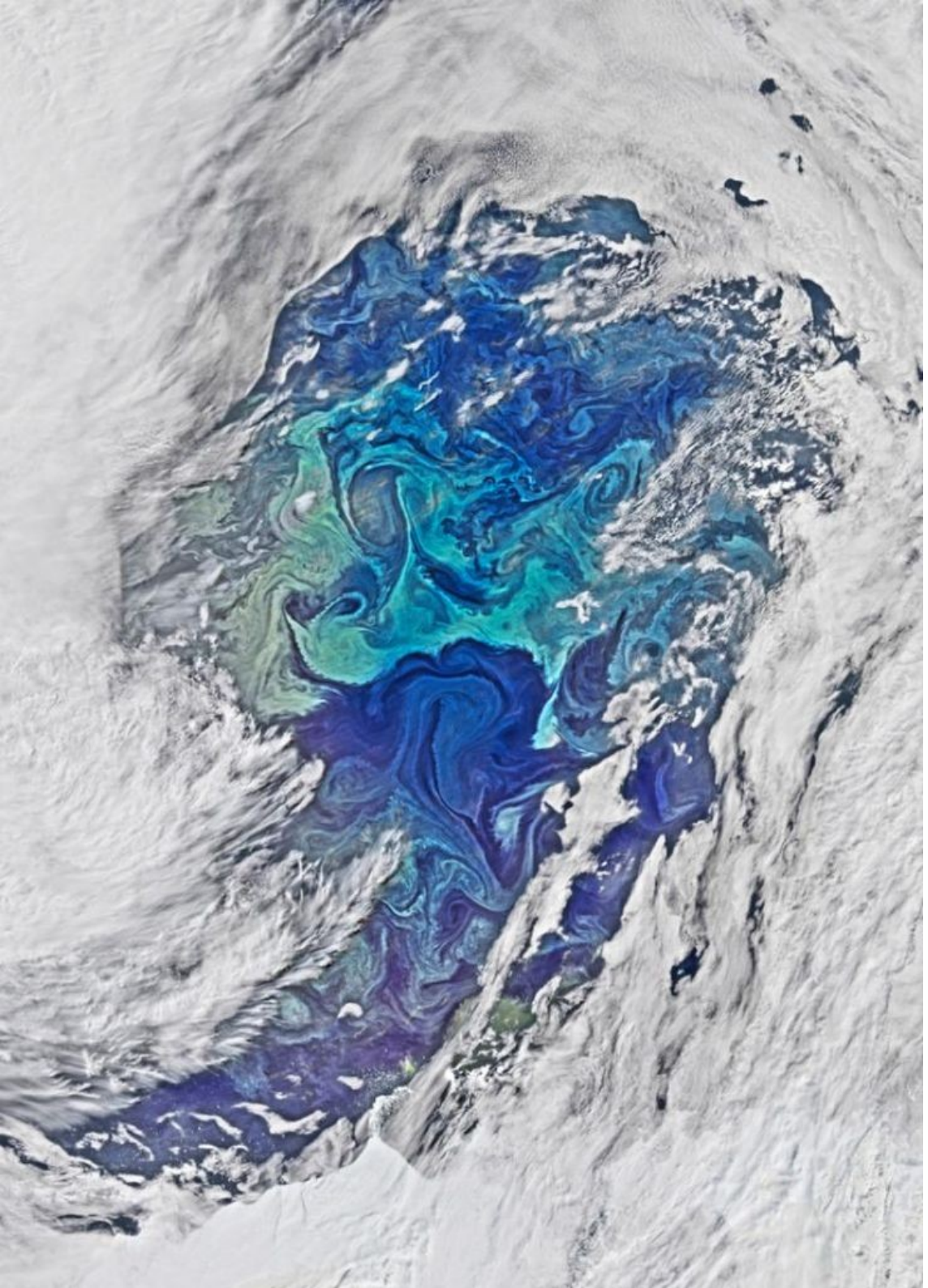


- Pixel by pixel, day by day comparison (2007-2010)
- General Additive Model (GAM) comparison between water age and diatom dominance
- Expected decreasing trend for the first month of advection
- Unexpected trend for “older” water parcels

Conclusions

- Altimetry is a key part of the Lagrangian approach that can address a variety of ecological questions at the mesoscale
- Importance of accuracy on the geolocation (biologging applications, comparisons)
- Mostly regional studies: what should we do to go global?
- A standardised way to look at error?



Thank you!