# A novel Lagrangian index to compare altimetry-derived and measured trajectories

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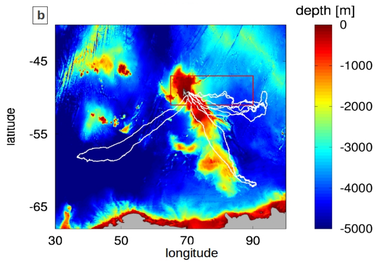



## Abstract

The tracking of passive and (quasi-passive) **tracers** at the mesoscale (10-100 km, weeks to months) is one of the most challenging uses of **altimetry**. This approach provides insights for marine biogeochemistry, analysis of transport of pollutant and radionuclids and **ecological studies** that go from larval dispersal to top predators' behaviour. The accuracy and the robustness of these studies are affected by how much the **trajectories** we can infer from **altimetry-defined current fields** are realistic and similar to the ones that an actual passive tracer would have at specific times and locations.

In this study we define a **novel Lagrangian diagnostic**, the quasi-planktonicity index (QPI) that compares the trajectories of drifting floats with the ones we can simulate from the altimetry horizontal velocity field. We use the QPI and a dataset of more than 40 **drifters** released in the Kerguelen region during the research cruise KEOPS2 to compare Near-Real Time and Delayed Time AVISO products, global and experimental regional ones and purely geostrophic and Ekman-corrected (provided by CLS). Futhermore we apply this diagnostic to **animal tracking** information to infer information about southern elephant seals' foraging behaviour from a measure of how close their trajectories are to the ones of passive tracer simulated from altimetry.

## Objectives

### Altimetry validation

- Compare drifting buoys' measured and simulated trajectories

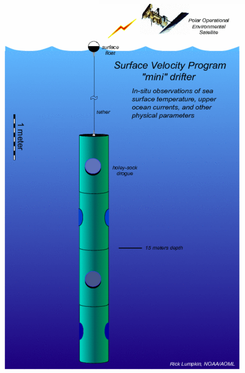
### Ecological exploitation

- Compare the movement of active swimmers (southern elephant seals) and simulated trajectories
- Infer information about elephant seals behaviour from their movement pattern

## Multiplatform approach

**Altimetry**
To define the horizontal geostrophic velocity field

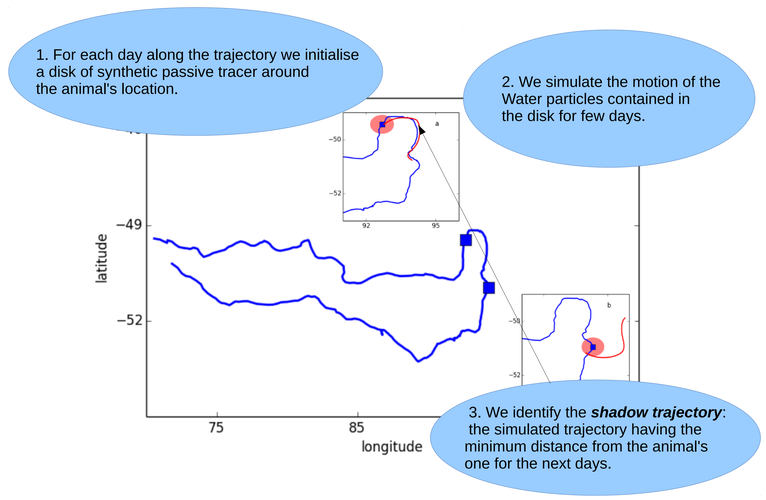
**5 GPS tracking & accelerometry**
To measure trajectories and quantify the attempt capture rate


**47 Drifting buoys**
To measure trajectories

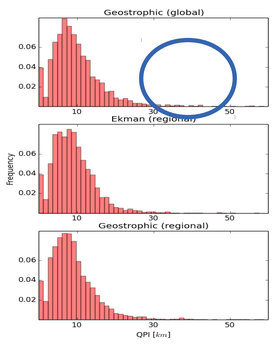
| Seal trajectory | = | Ocean current | + | Active swimming |
|---|---|---|---|---|

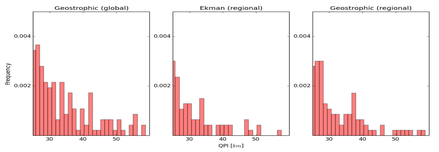
## A novel method to measure active movement: The *Quasi-planktonicity index* (QPI)




The value of the QPI is the distance between the animal's and the shadow trajectories. In this example we compare daily an elephant seal's trajectory (in blue) with sets of simulated trajectories.

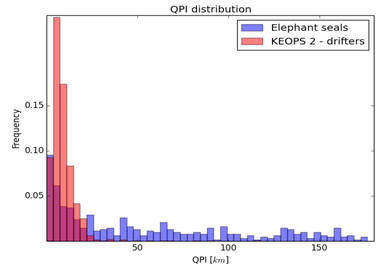
## Drifting buoys and swimming elephant seals: validation of different altimetry products




Regional and Ekman-corrected altimetry products allow to simulate trajectories that are more similar to the ones observed for drifting buoys.

The distribution of QPI for drifters and southern elephant seals present a consistent overlap.
Elephant seals can be affected by the horizontal dynamics as much as drifting buoys.

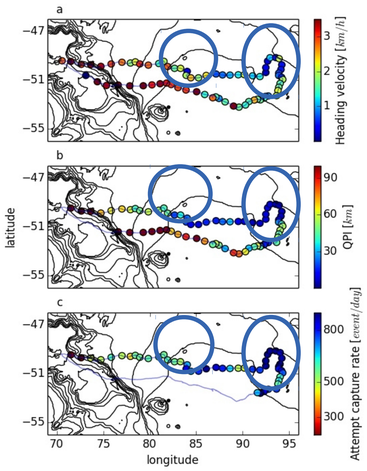


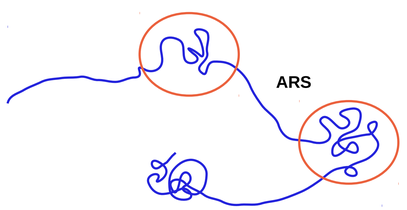

## From altimetry to animal behaviour

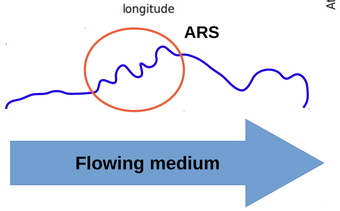
Example of one elephant seal's trajectory (out of 5): the locations with low QPI (and small differences between geostrophic and measured velocity) correspond to high attempt capture rate (p-value < 0.01).

In profitable regions elephant seals concentrate their movement in Area-Restricted Search (ARS) and invest their energy in deep diving rather than large scale displacements.

In a flowing medium this pattern corresponds to parts of the trajectory that are close to the ones of passive tracers.




## Conclusions

Regional and Ekman-corrected altimetry products perform better than global product when simulating drifting buoys' trajectories.

Elephant seals can present *quasi-planktonic* horizontal behaviour when foraging more intensively → *quasi-planktonicity* as a proxy for foraging.