

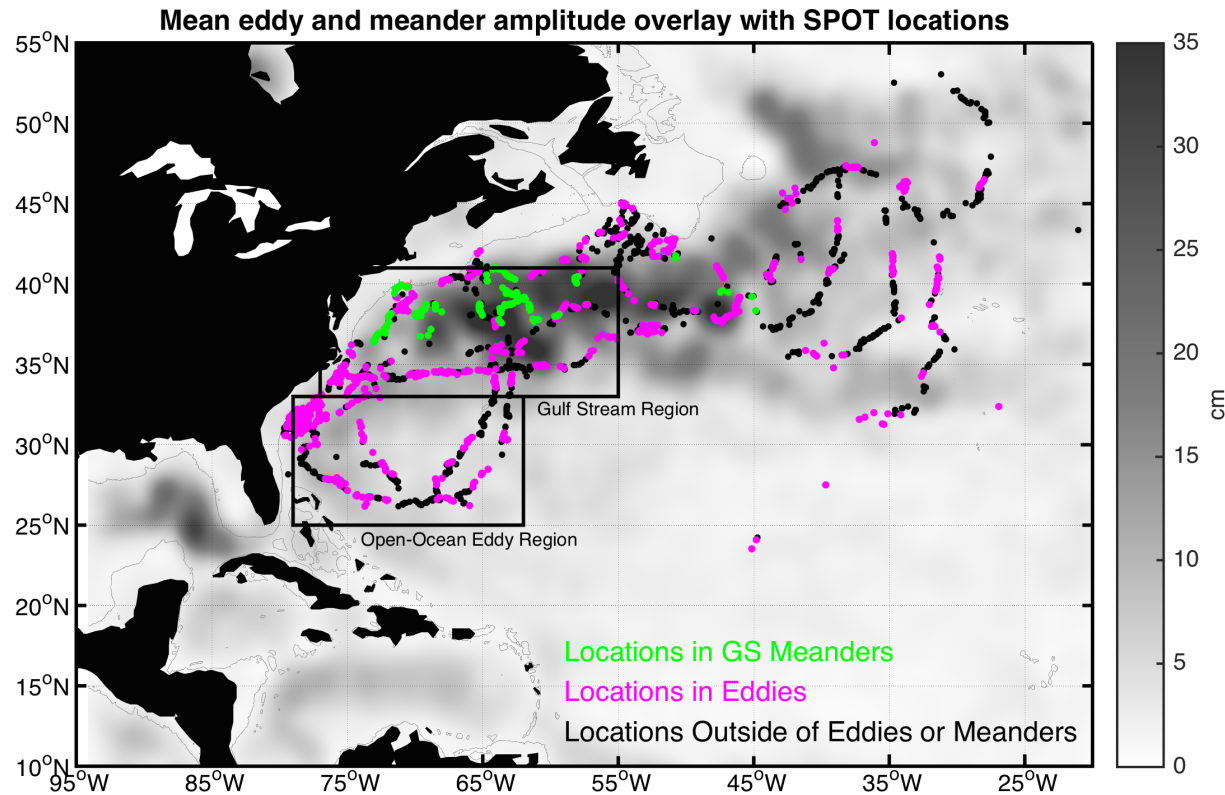
Living and foraging in a fluid-dynamical environment: top predators in a sea of currents

Alice Della Penna, Applied Physics Laboratory, Univ. of Washington, U.S.A.

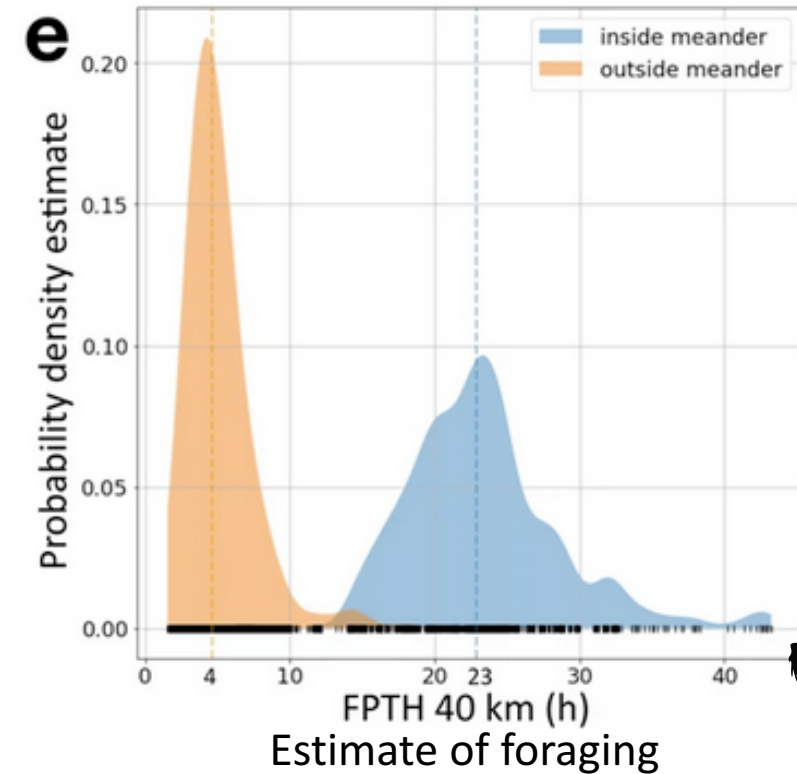
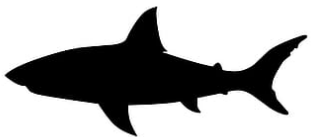
Peter Gaube, Camrin Braun, Francesco d'Ovidio, Christophe Guinet, Charlie Bost,
Cecile Bon, Elodie Kestenare, Silvia De Monte



Animal tracking is revealing a strong link between predators and current patterns



Gaube et al., 2018

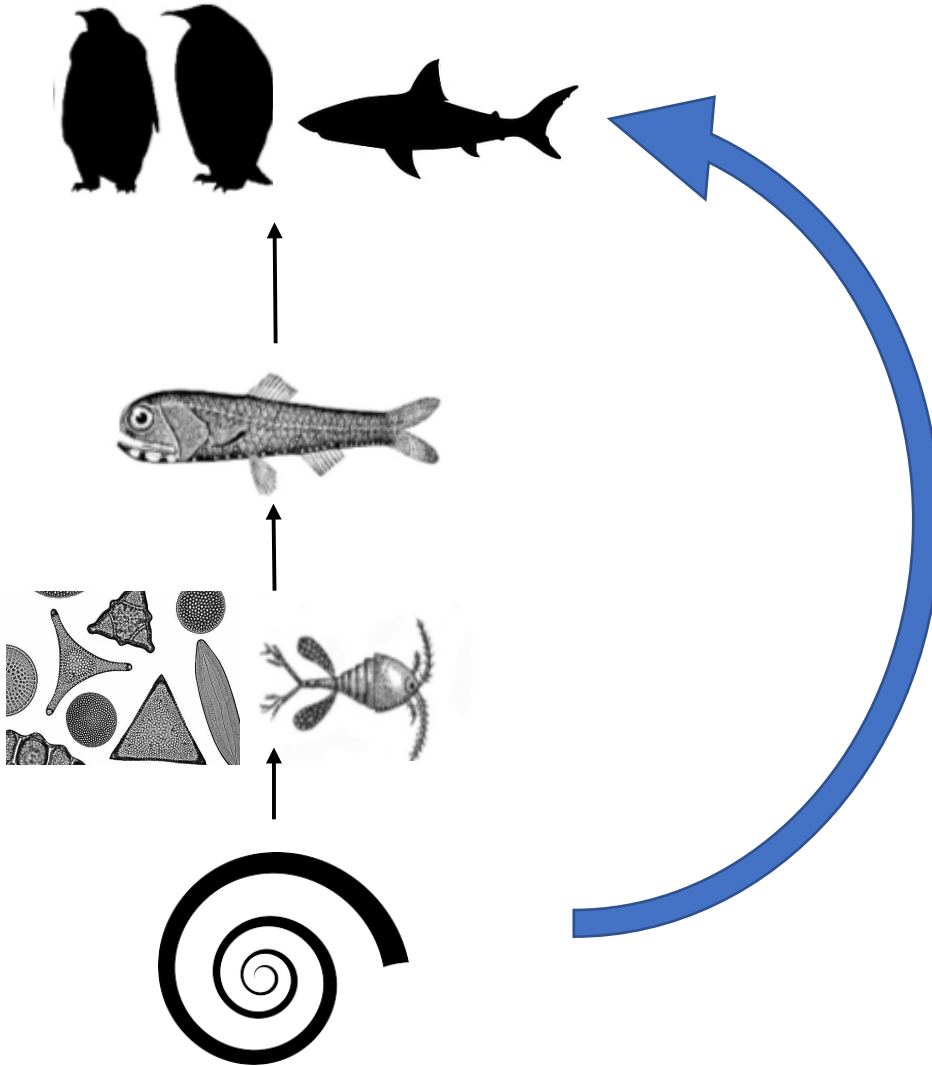


Siegelman et al., 2019

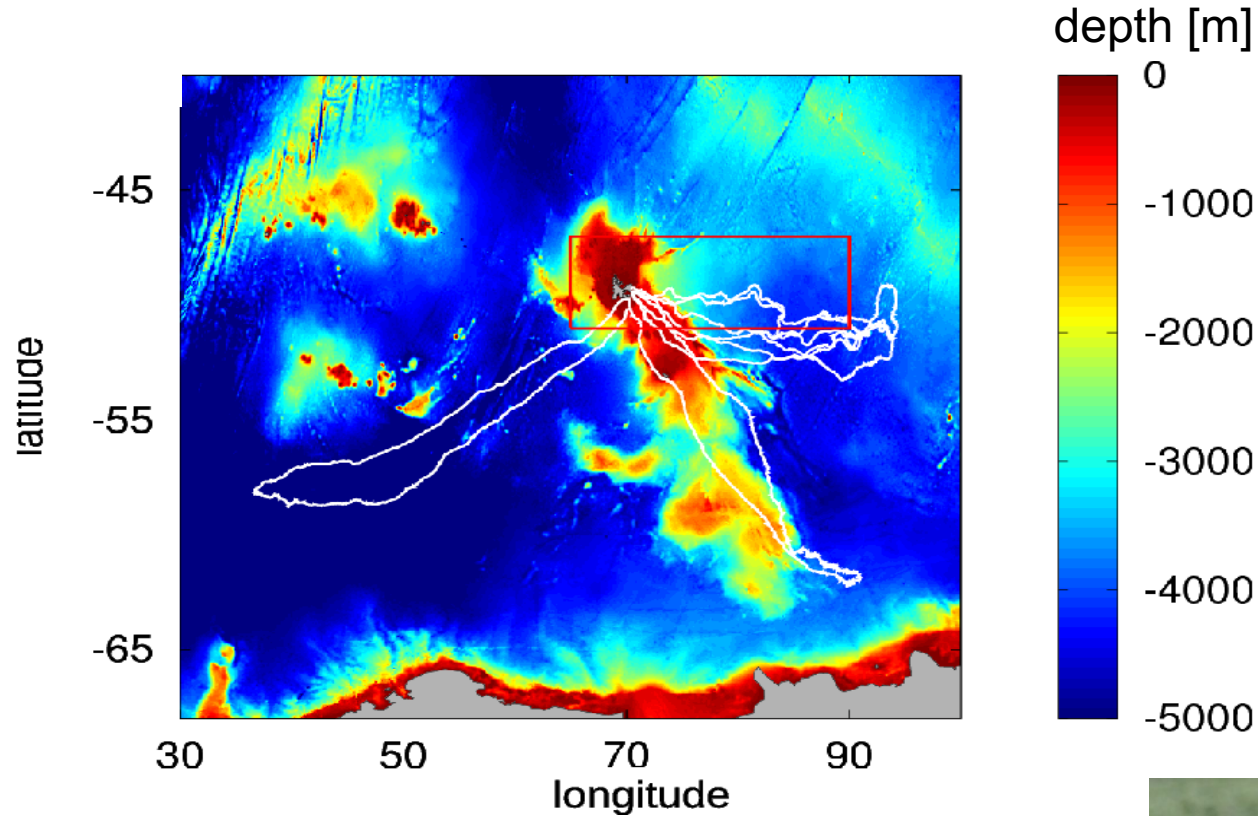
How do currents impact top predators?

1. **Bottom-up effect** current patterns affect the distribution of phytoplankton and this effect is transferred up trophic webs all the way to prey distribution
2. **Patterns in favorable physical properties** for metabolism or prey accessibility
3. **Direct impact** of currents on swimming patterns

Can ocean currents affect large animals' swimming behavior?



An animal tracking study: Southern Elephant Seals from the Kerguelen Islands



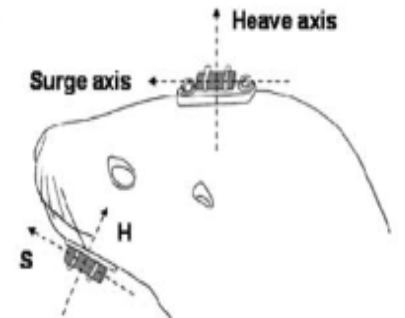
- **GPS** trajectories
- **Accelerometers** as a proxy for foraging
- Altimetry-derived **currents**
- A **Lagrangian approach**: from currents to trajectories



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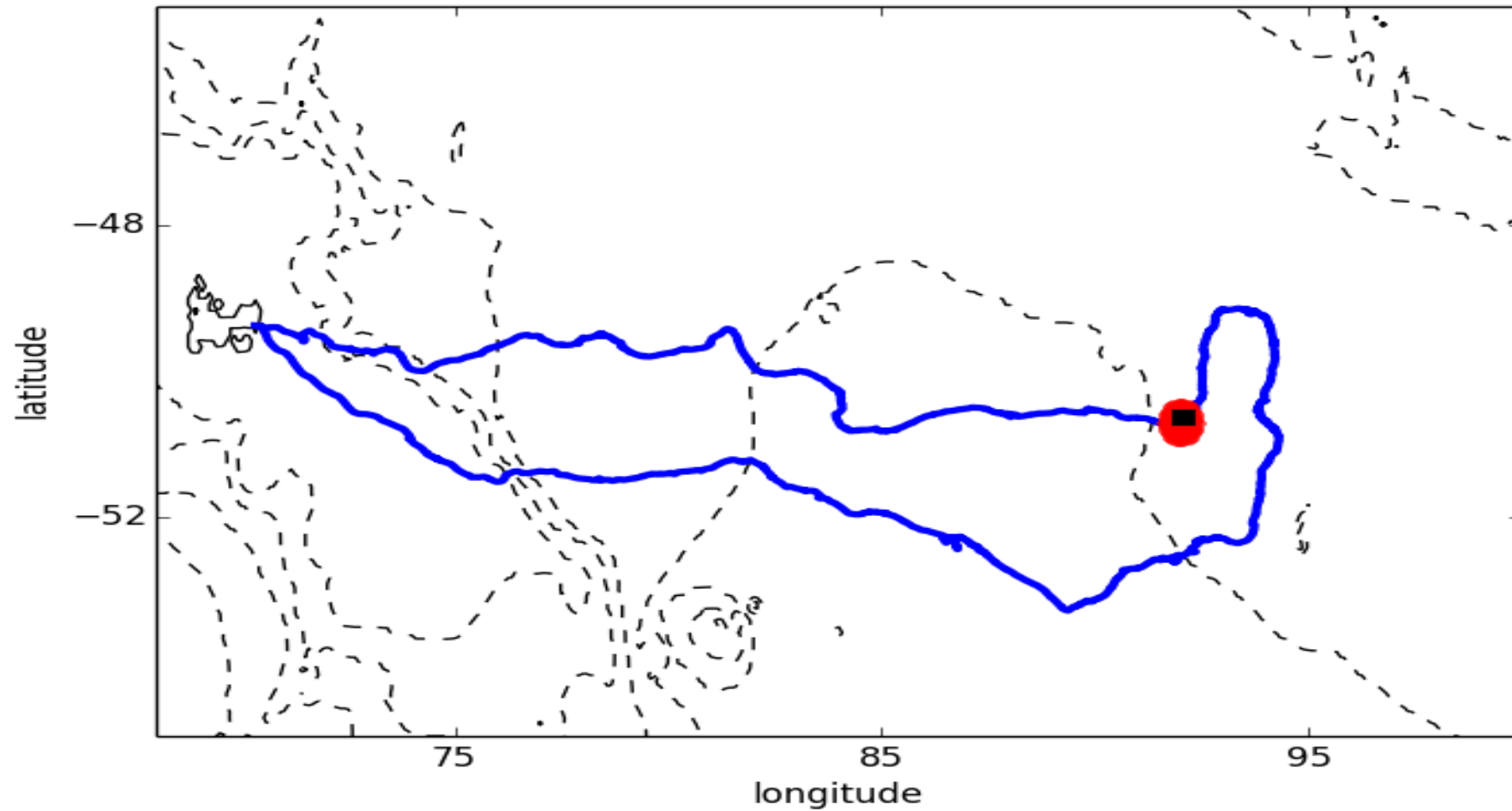
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Viviant et al., 2010

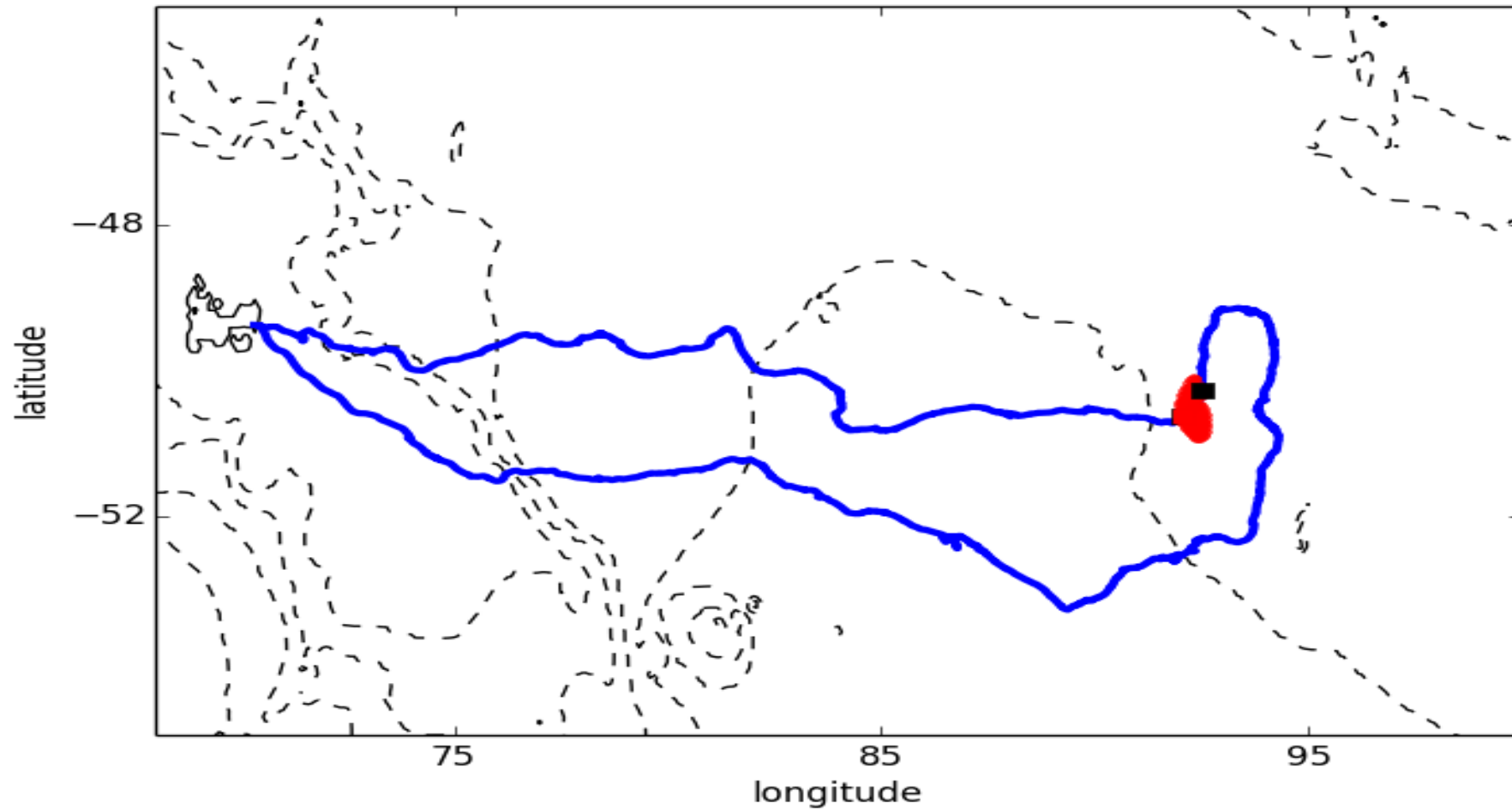
The “planktonic” seal

Day 0



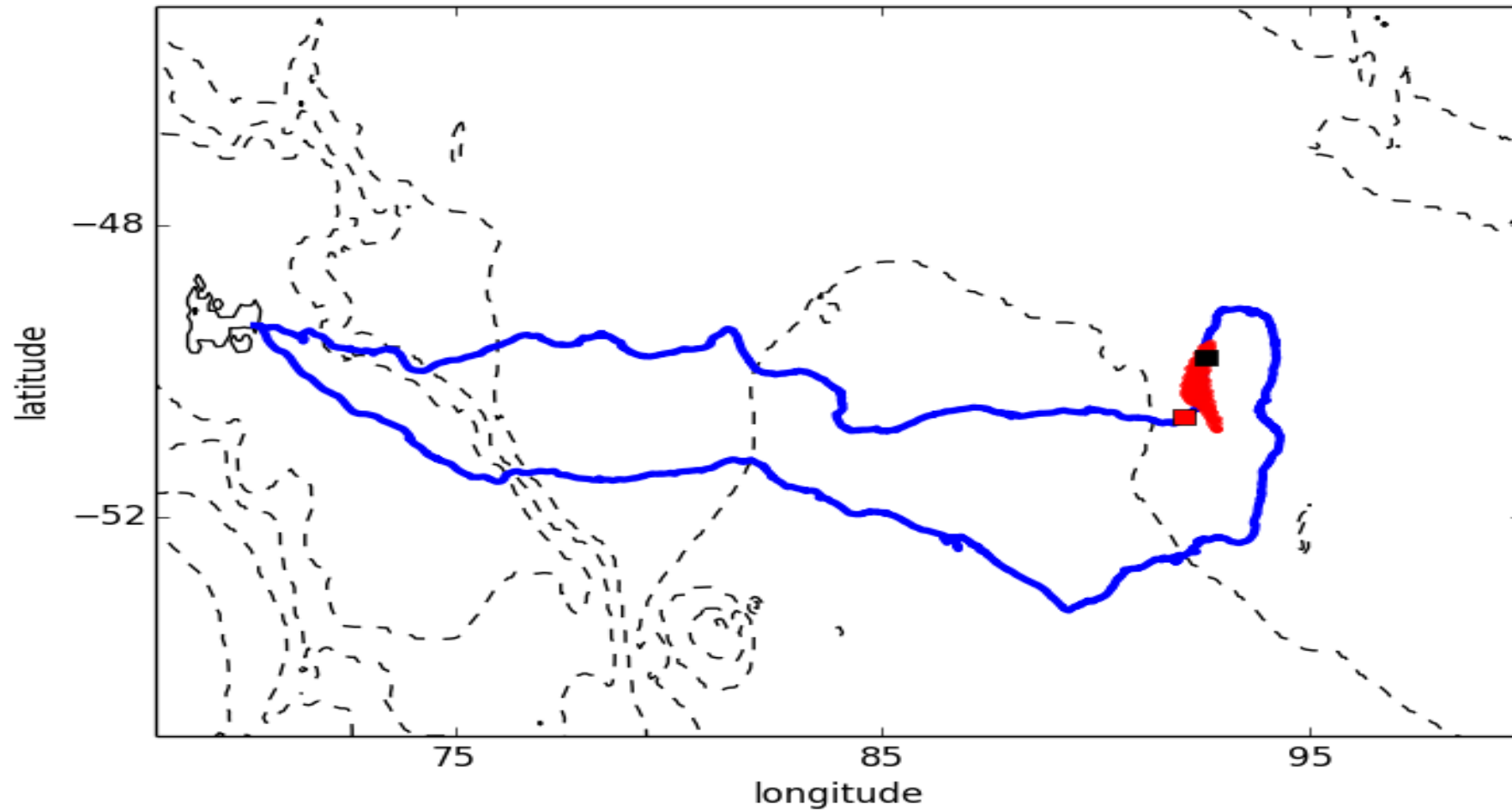
The “planktonic” seal

Day 1



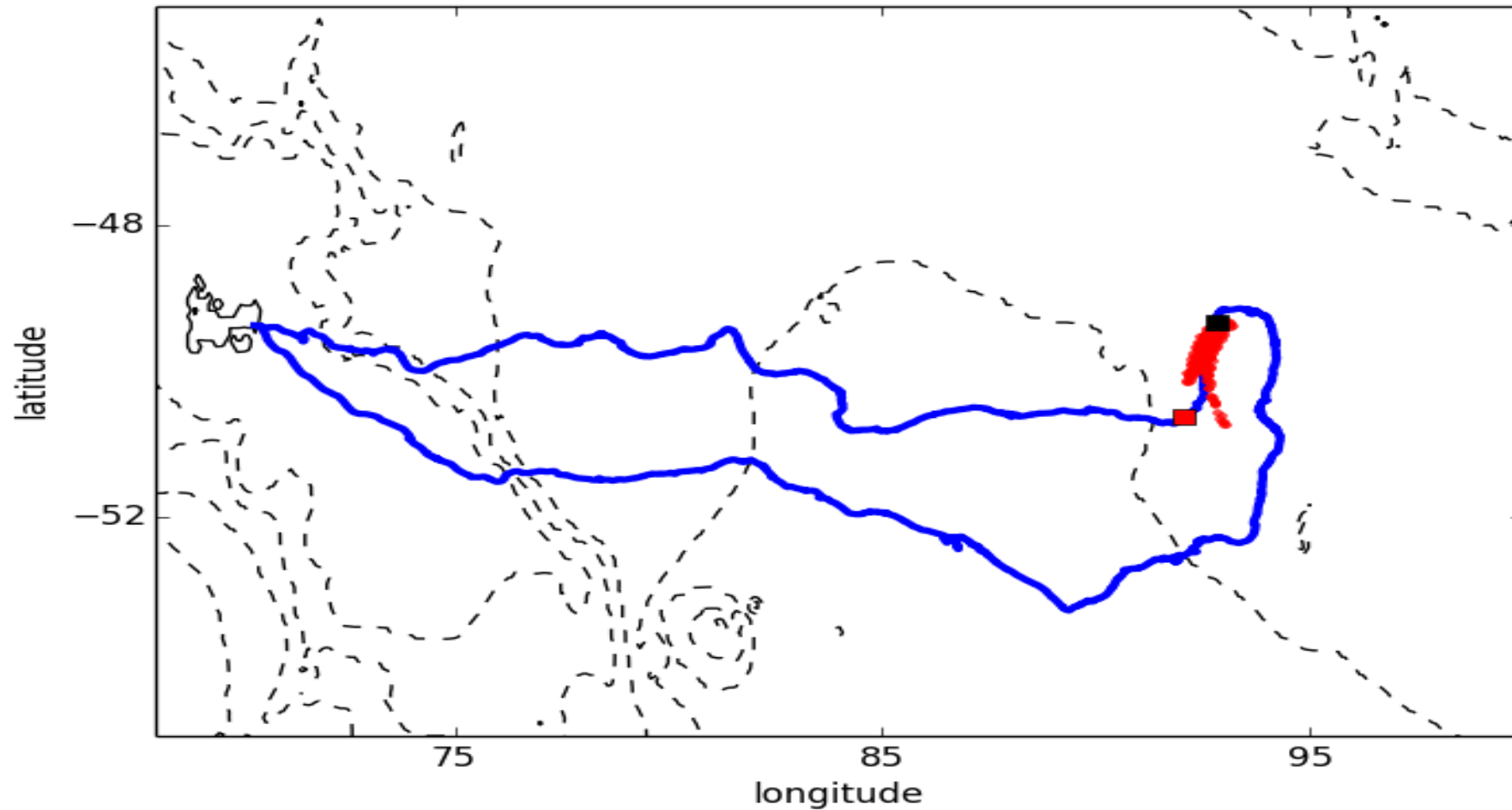
The “planktonic” seal

Day 2



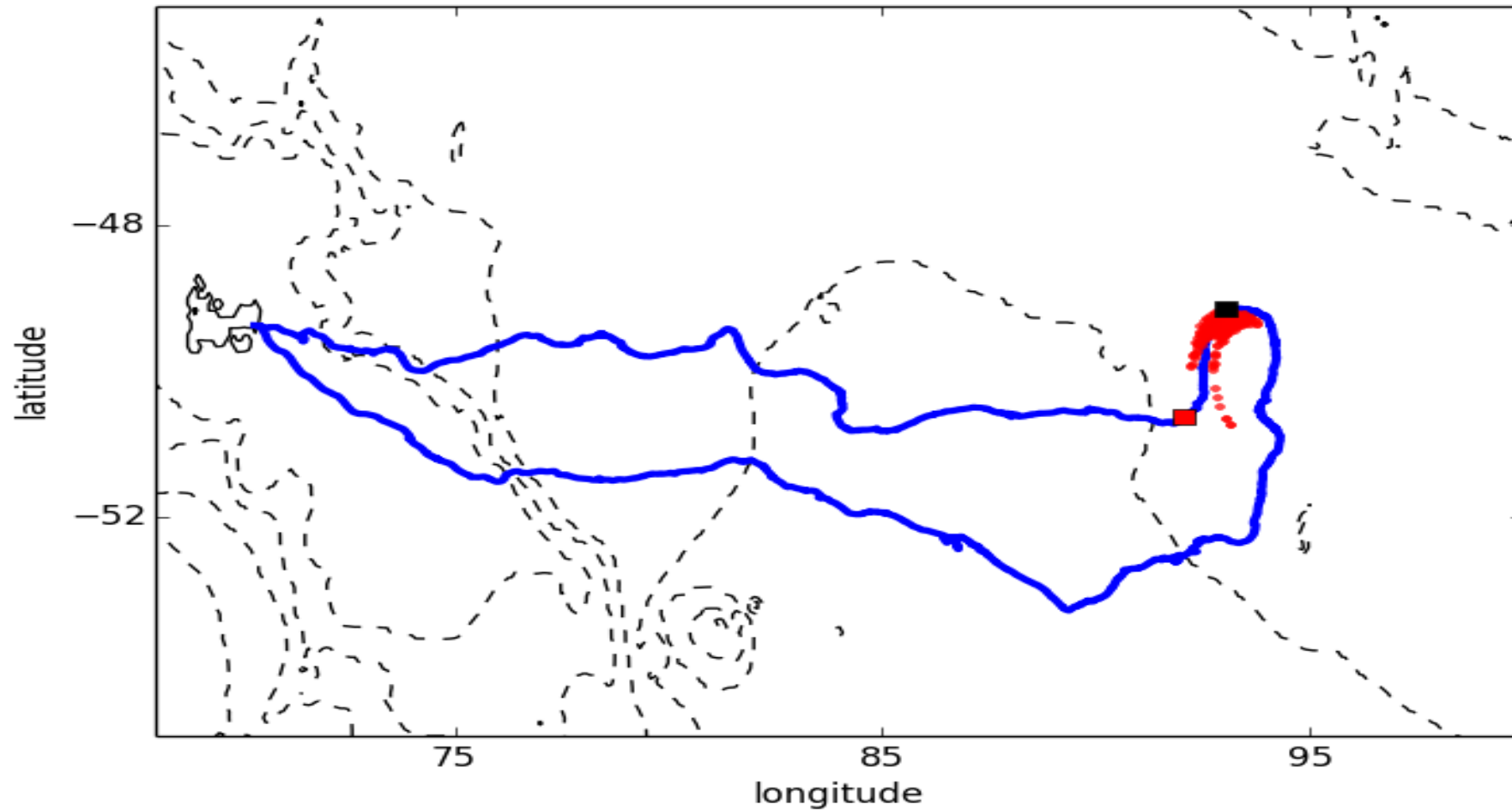
The “planktonic” seal

Day 3



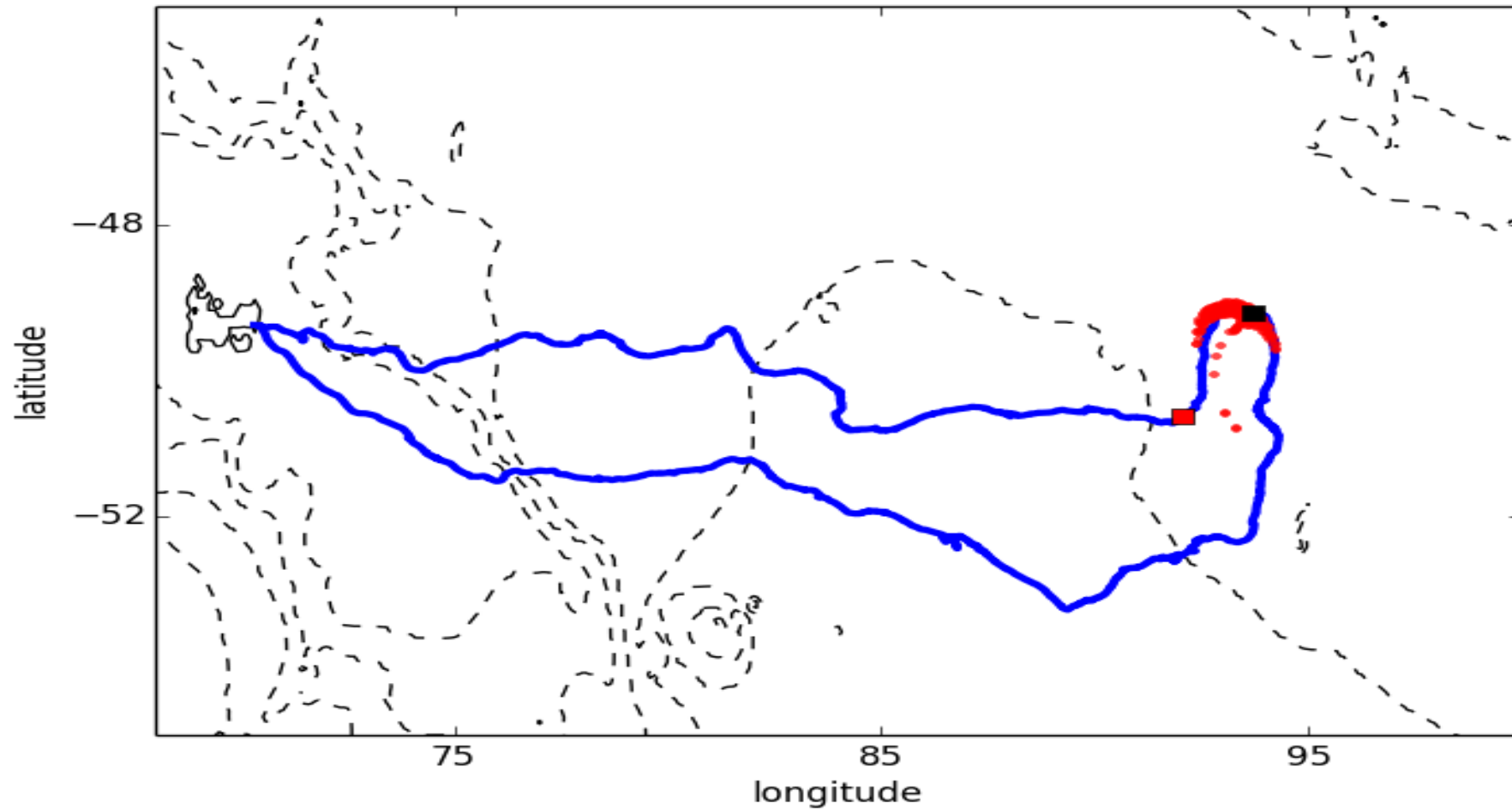
The “planktonic” seal

Day 4



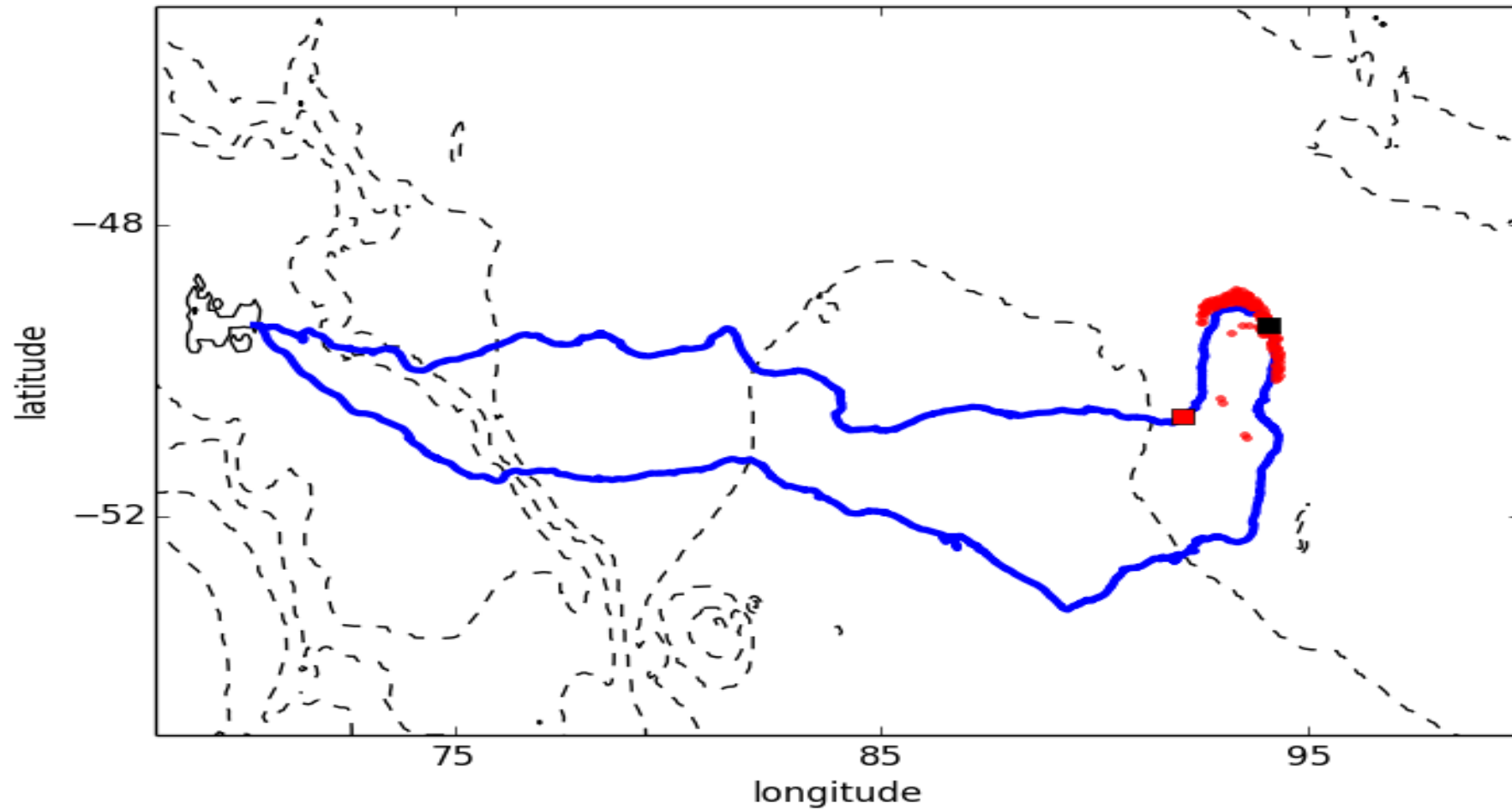
The “planktonic” seal

Day 5



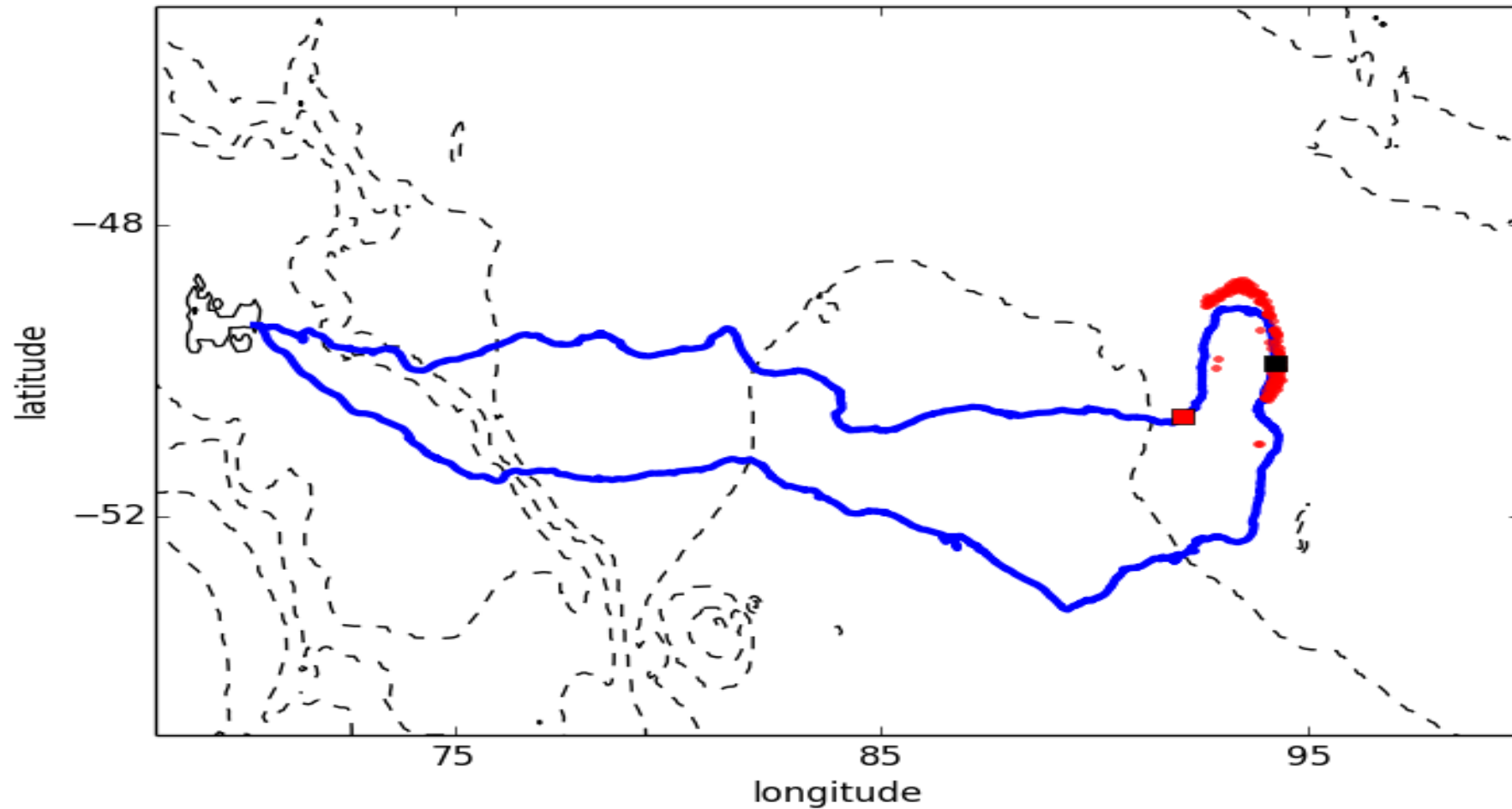
The “planktonic” seal

Day 6



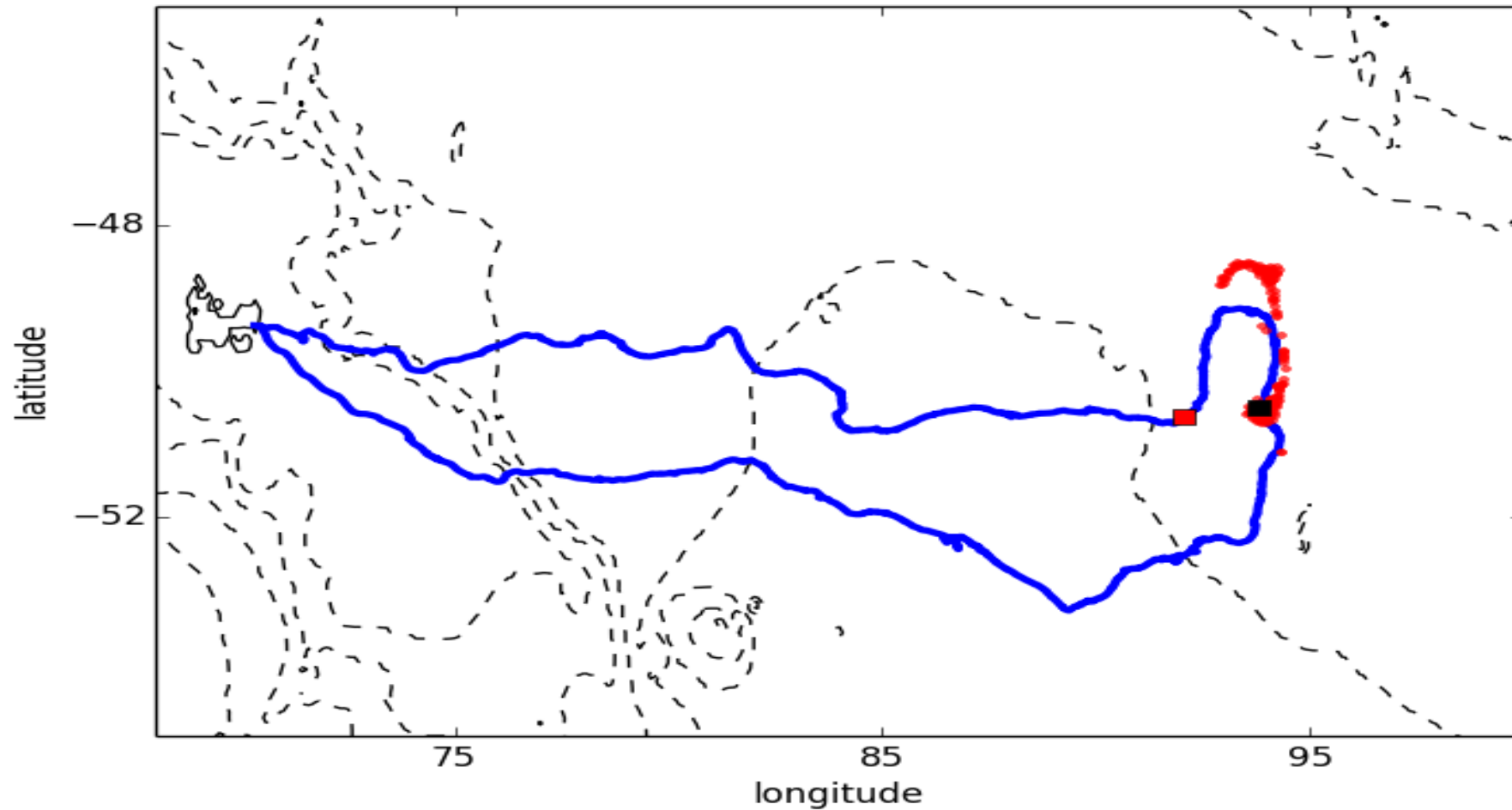
The “planktonic” seal

Day 7



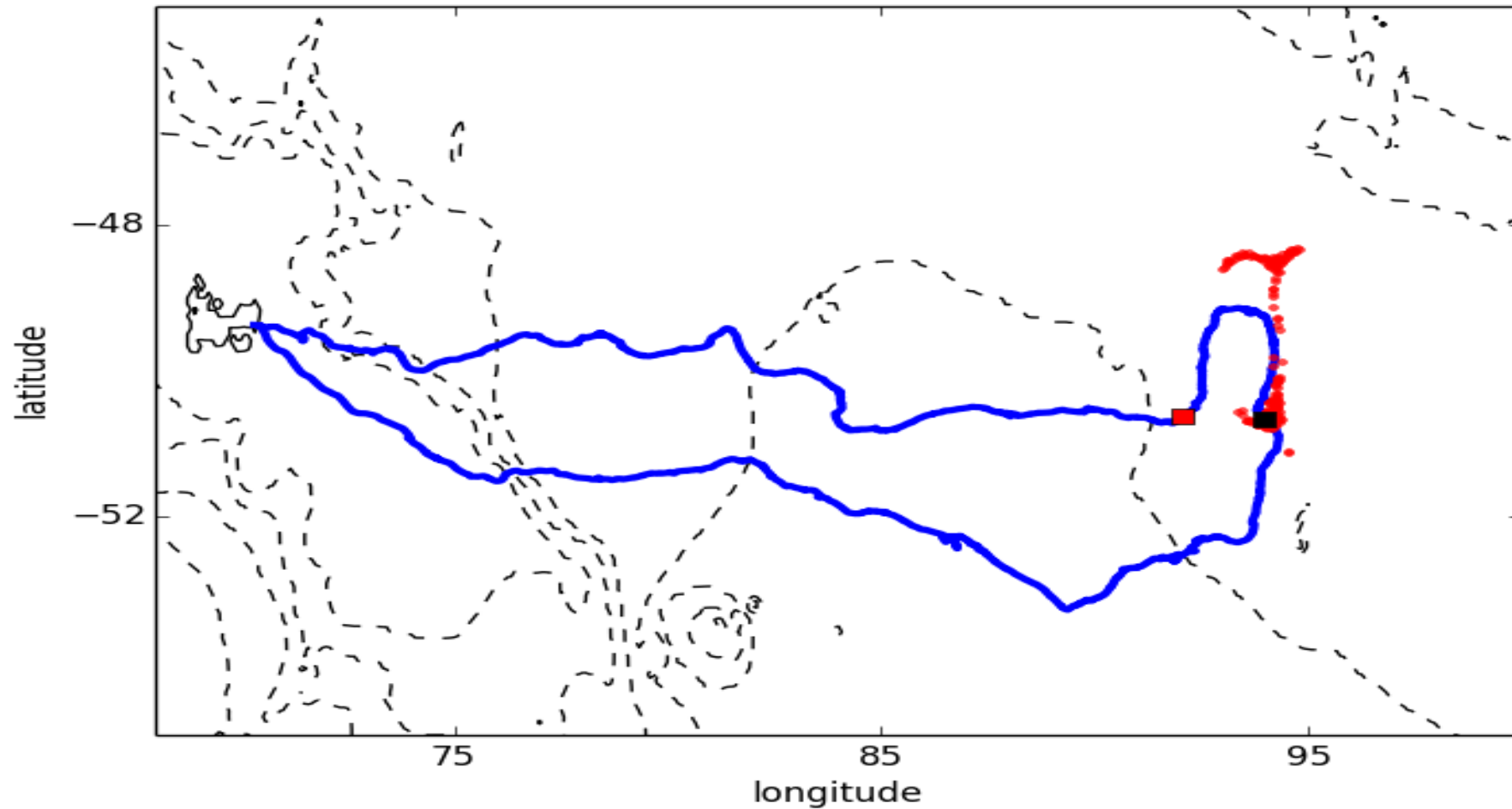
The “planktonic” seal

Day 8

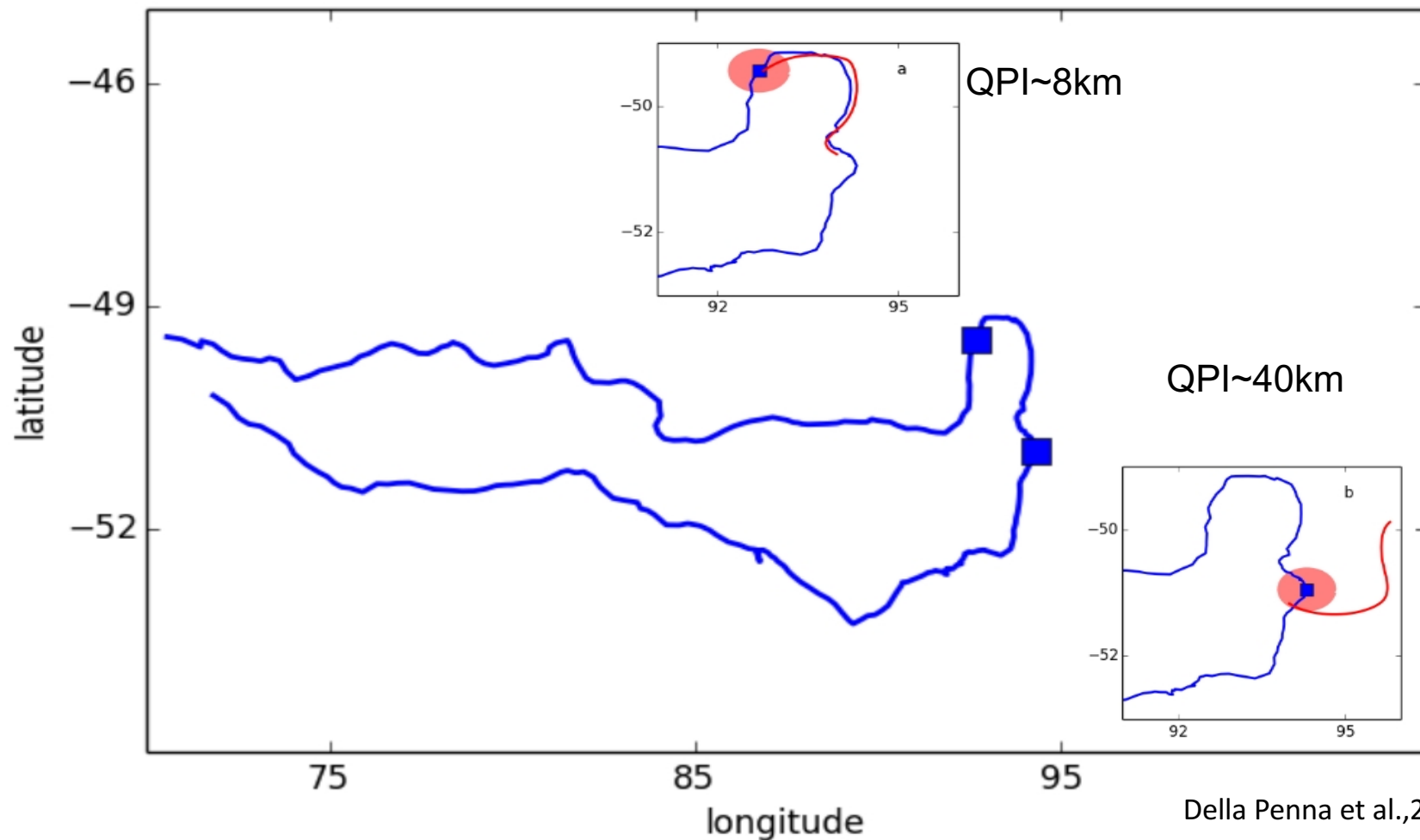


The “planktonic” seal

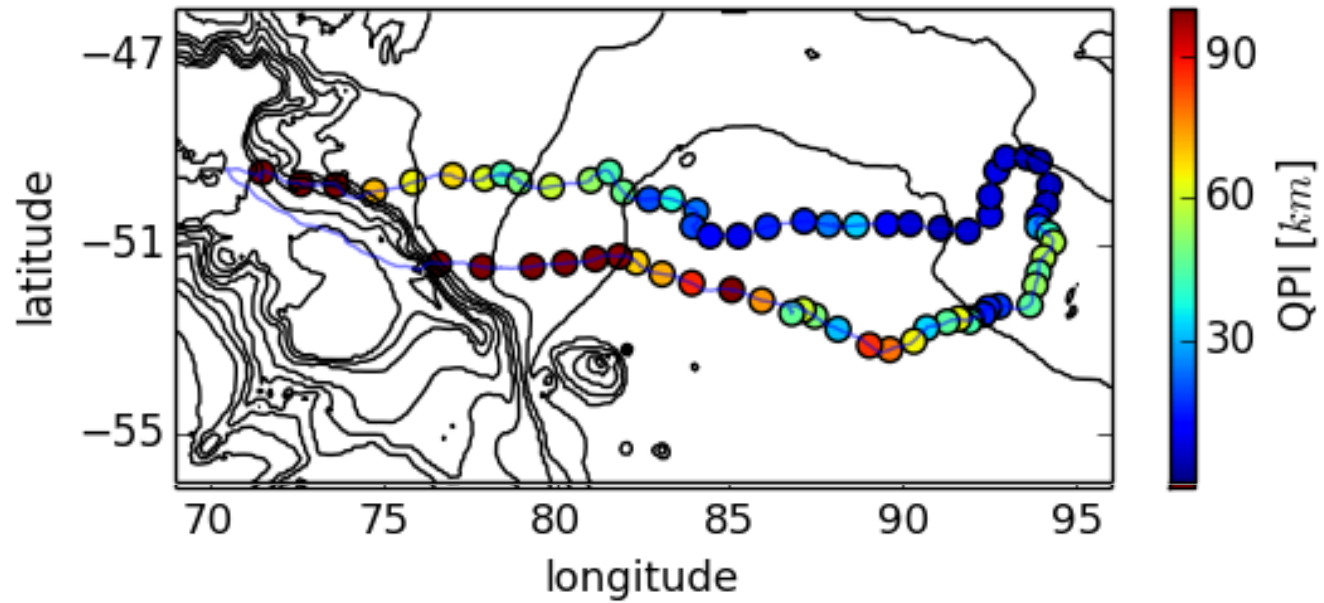
Day 9



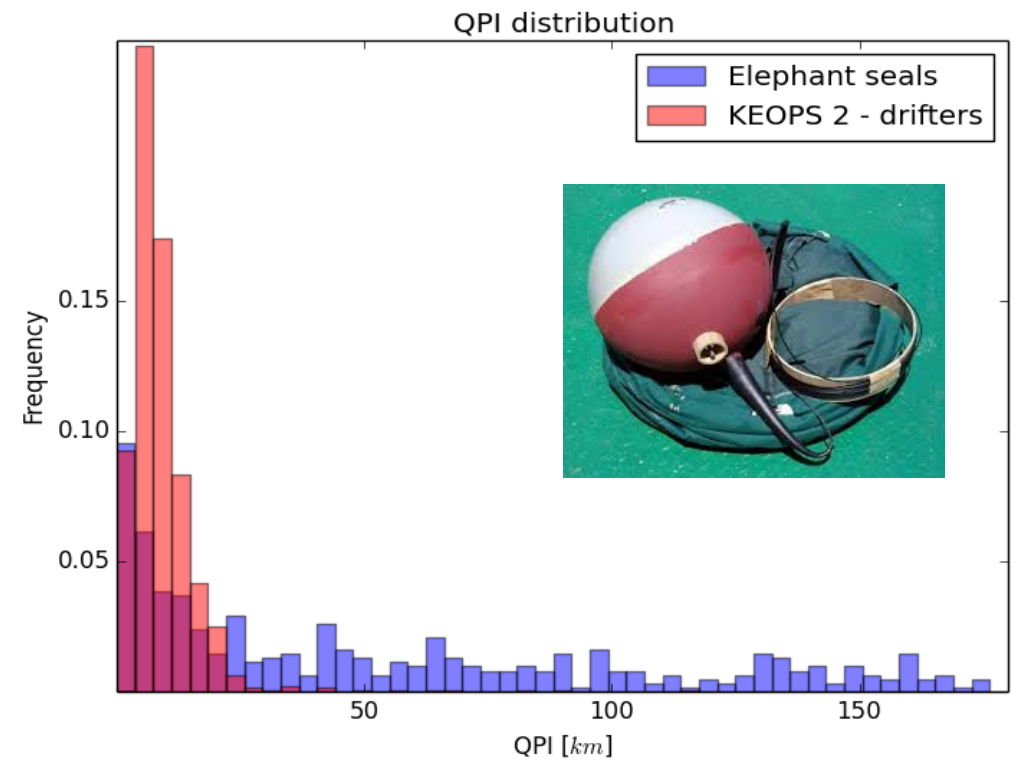
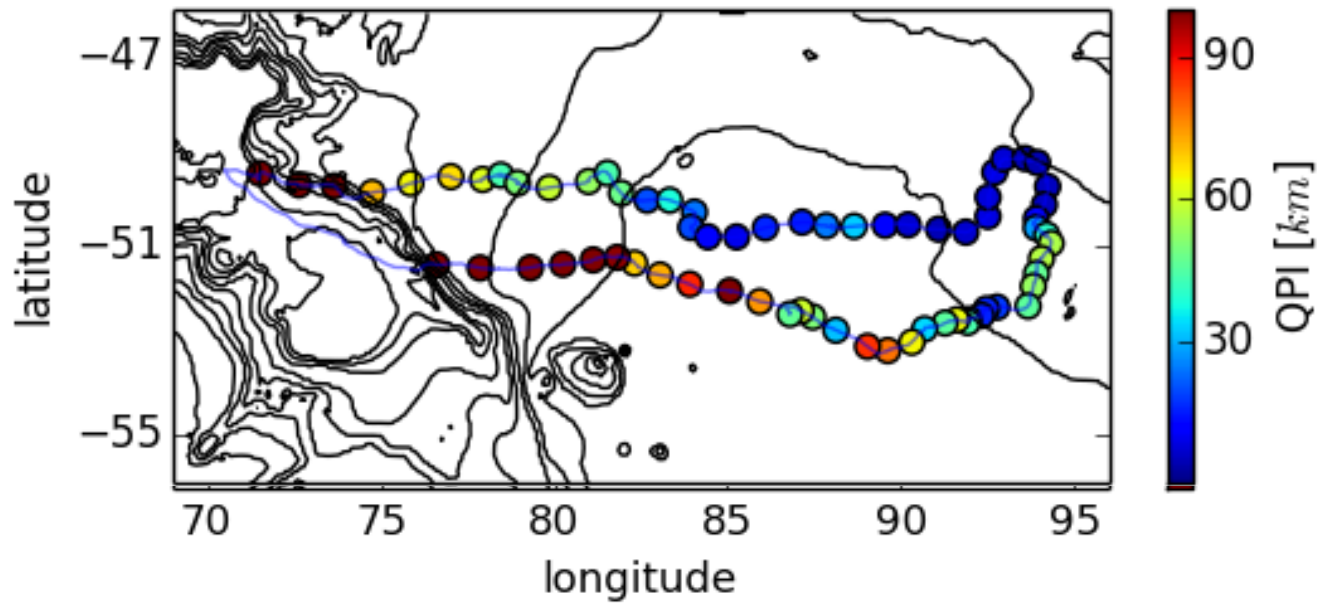
Quantifying the “Quasi-Planktonicity Index” (QPI)



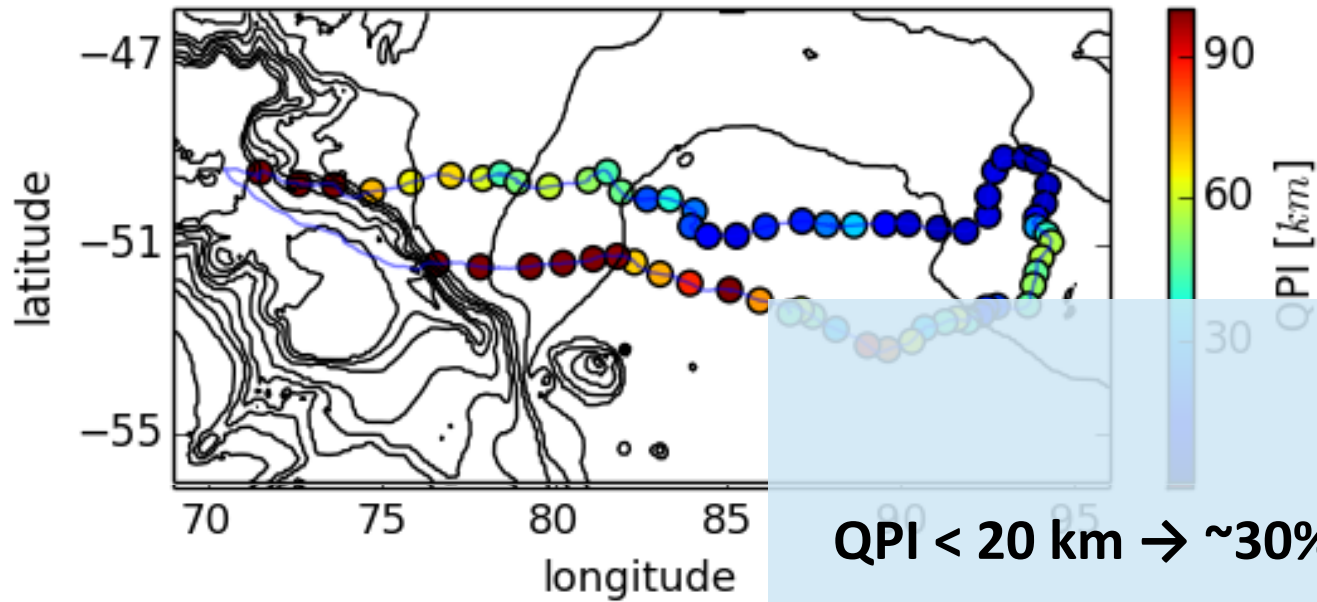
The “Quasi-Planktonicity Index” (QPI)



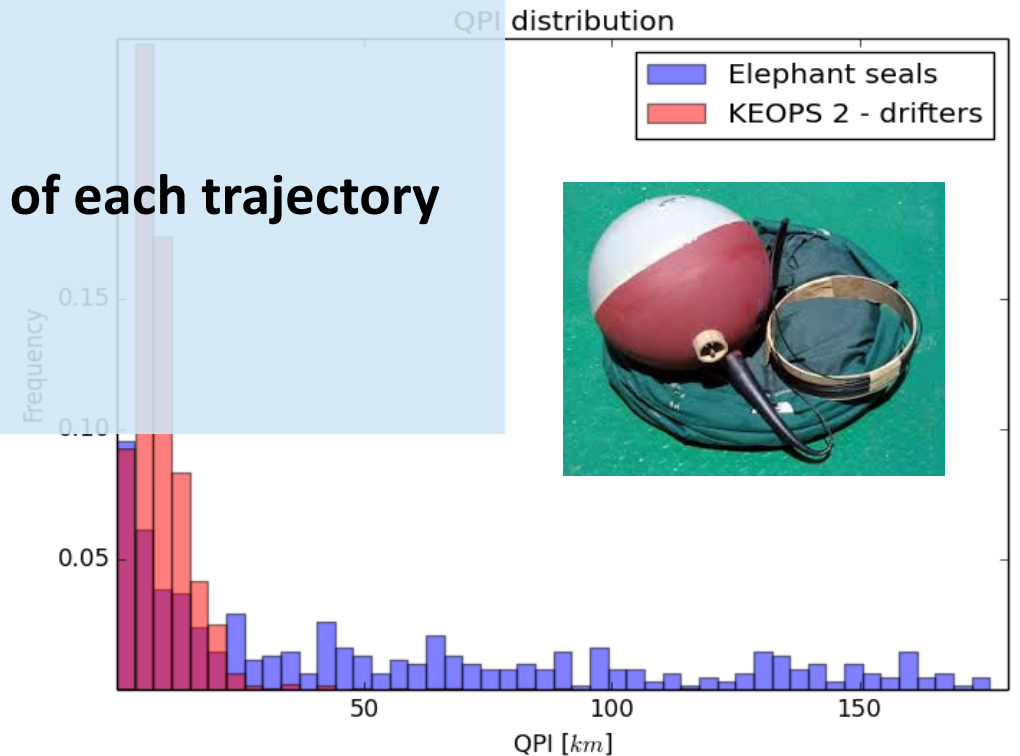
The “Quasi-Planktonicity Index” (QPI)



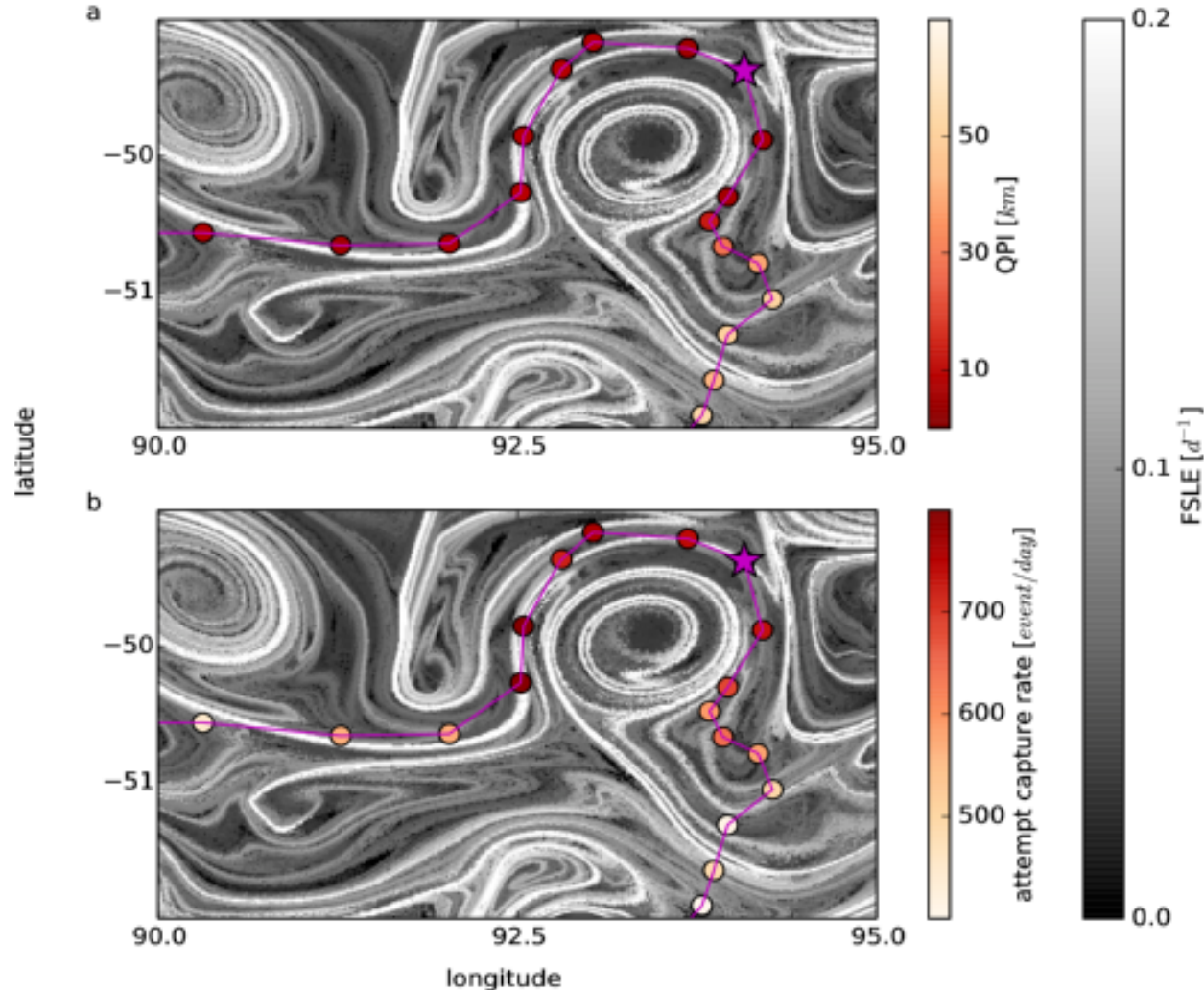
The “Quasi-Planktonicity Index” (QPI)



QPI < 20 km → ~30% of each trajectory



Coherent structures can entrain top predators!

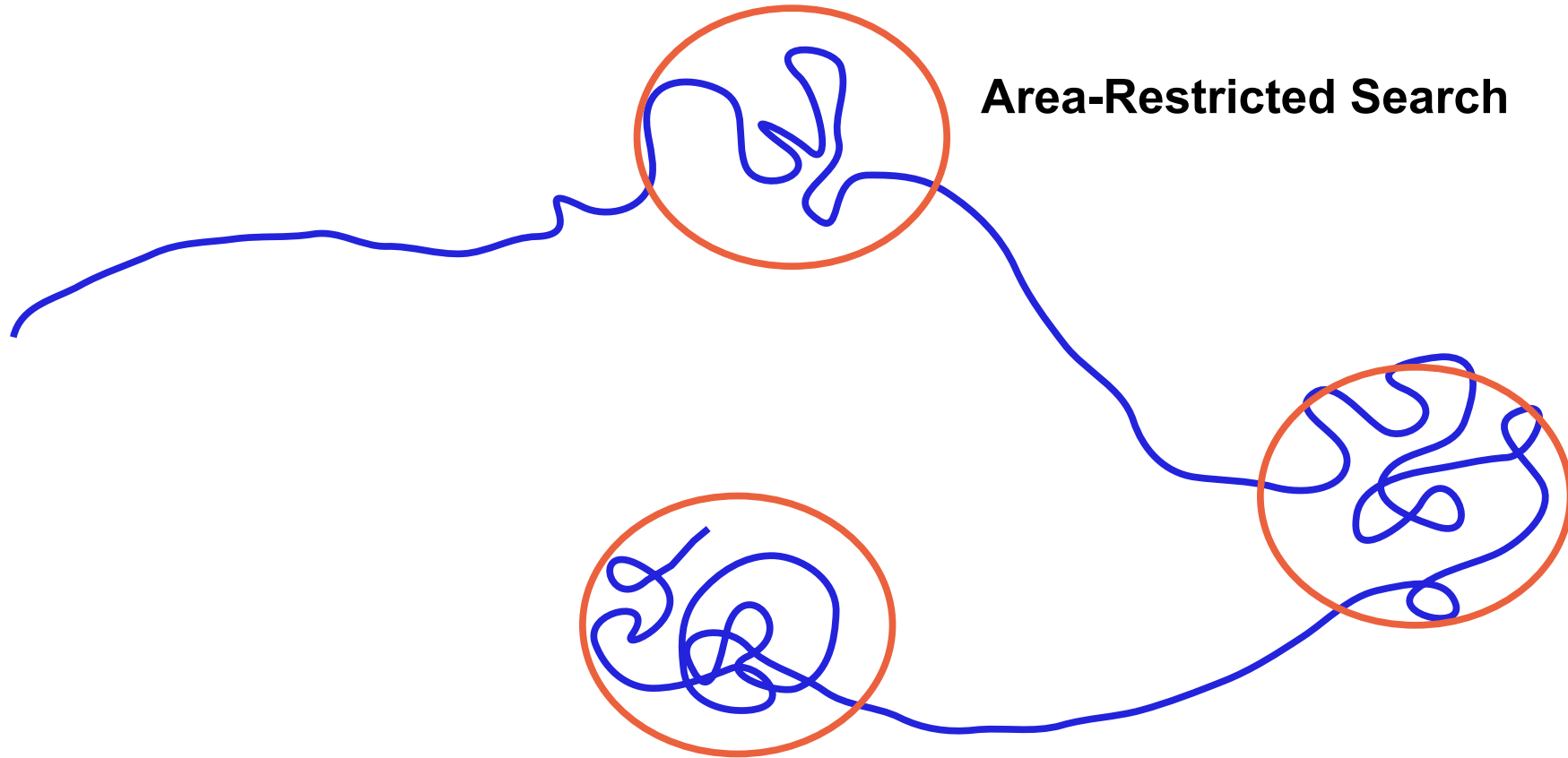


Multivariate analysis

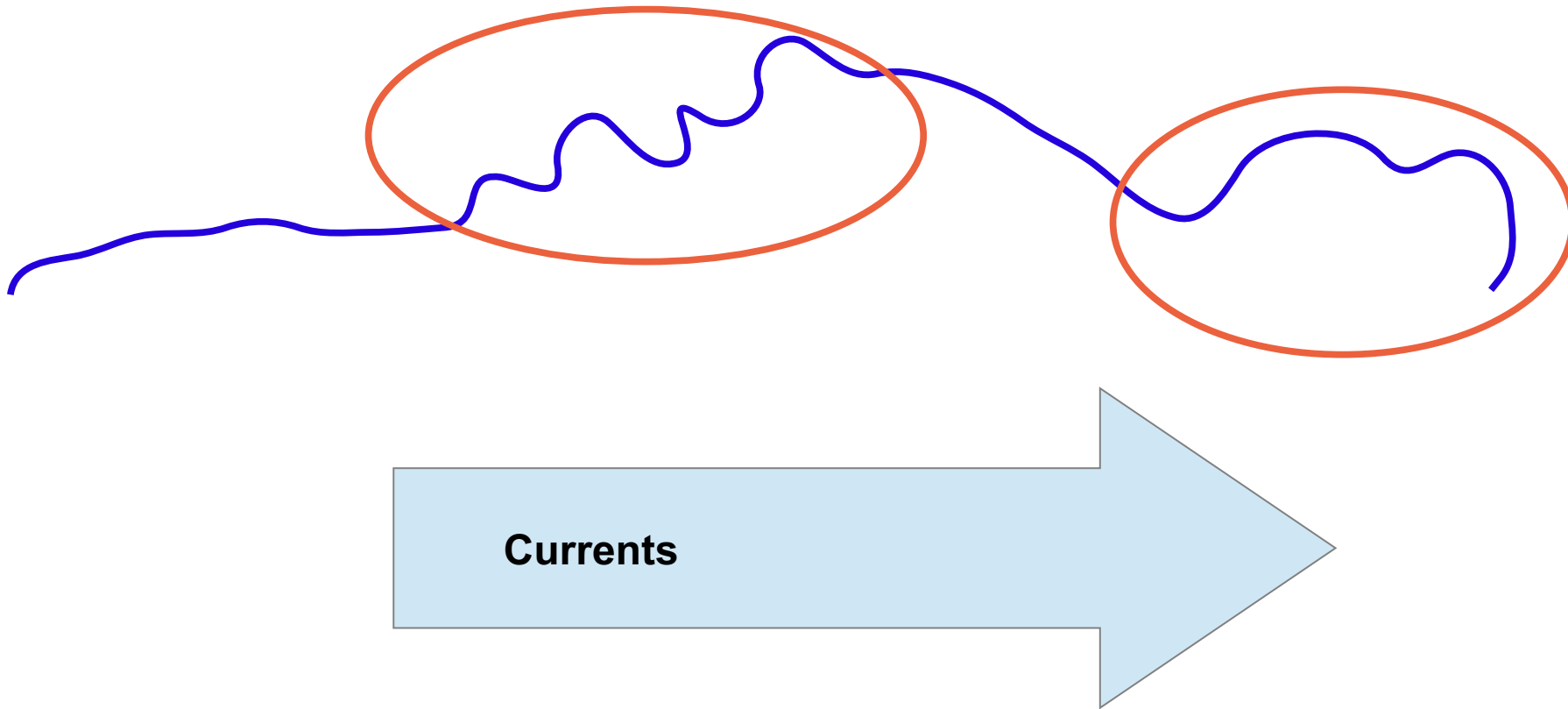


Regions of **low QPI** (“passive” behavior on the horizontal) correspond to (sub)mesoscale **structures** and regions of **intensive foraging**.

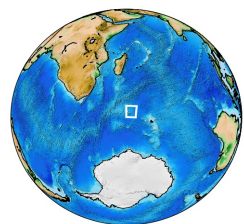
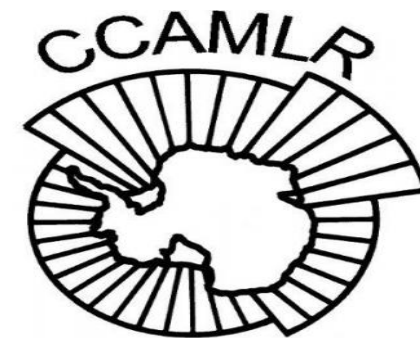
Area restricted search in the open ocean



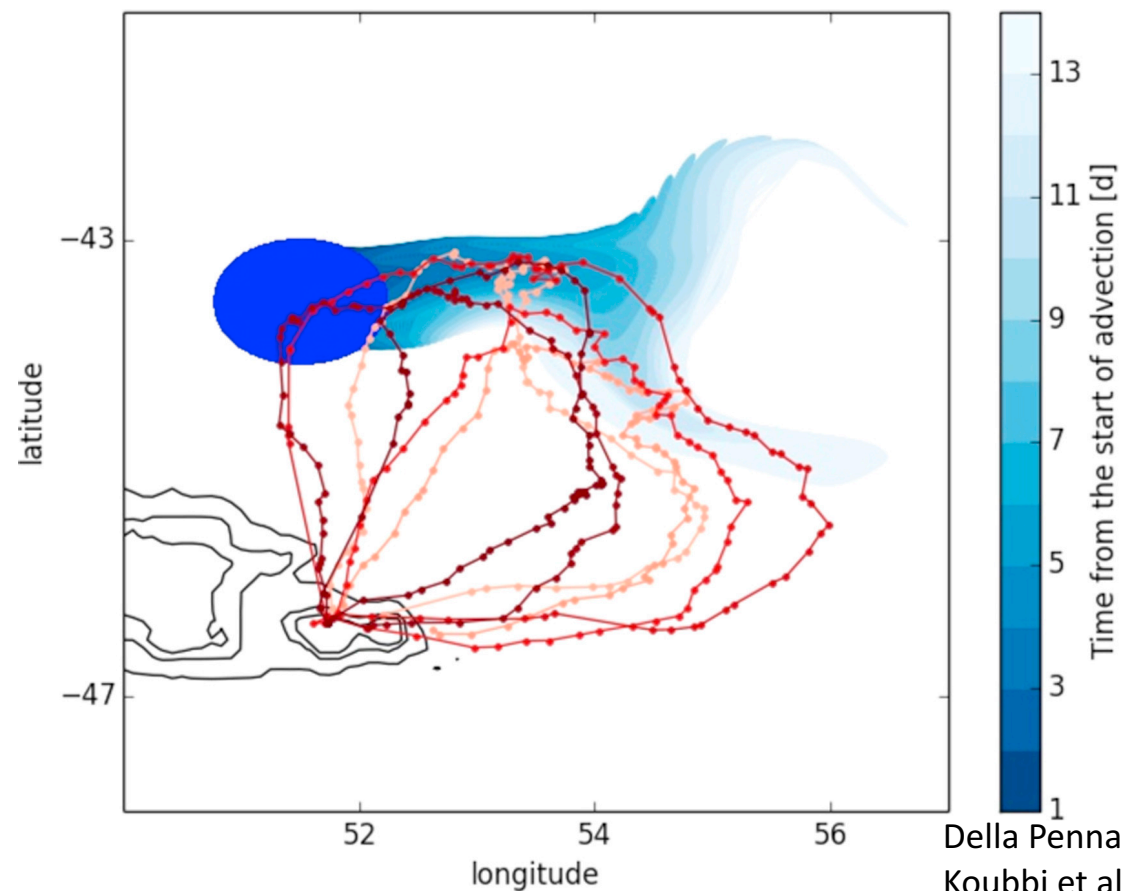
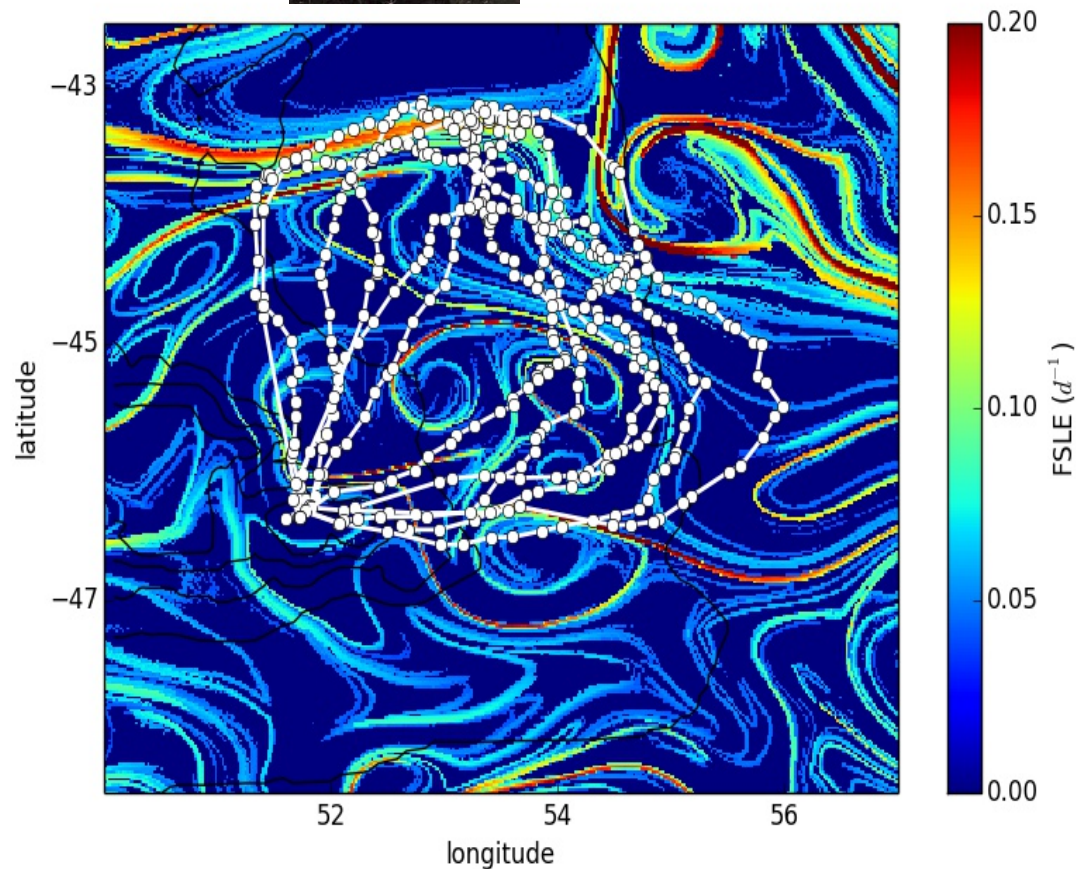
Area restricted search in the open ocean



From a mechanism to conservation

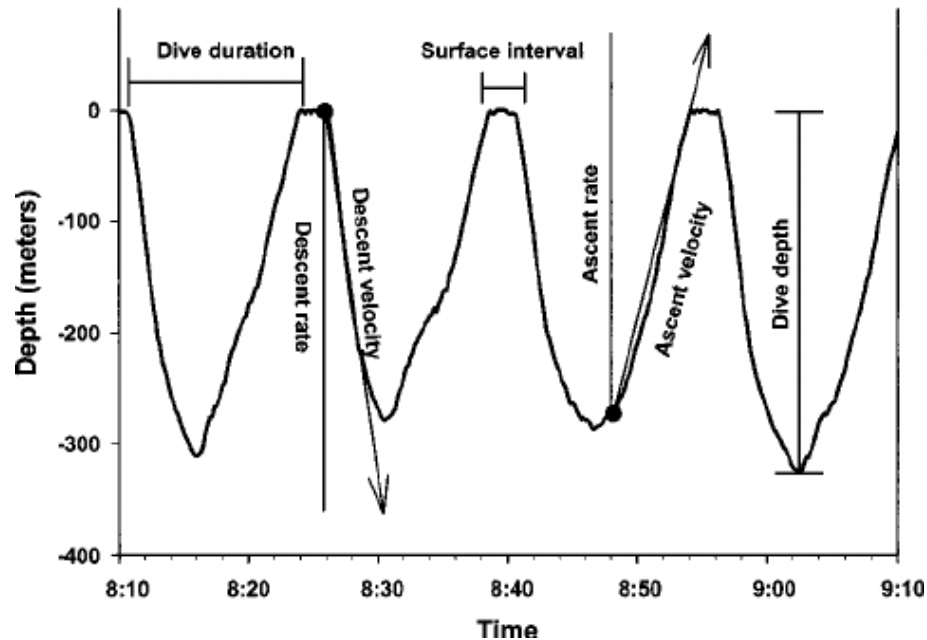


Using transport to identify ecologically significant regions
and design MPAs :
a case study from the Crozet Archipelago

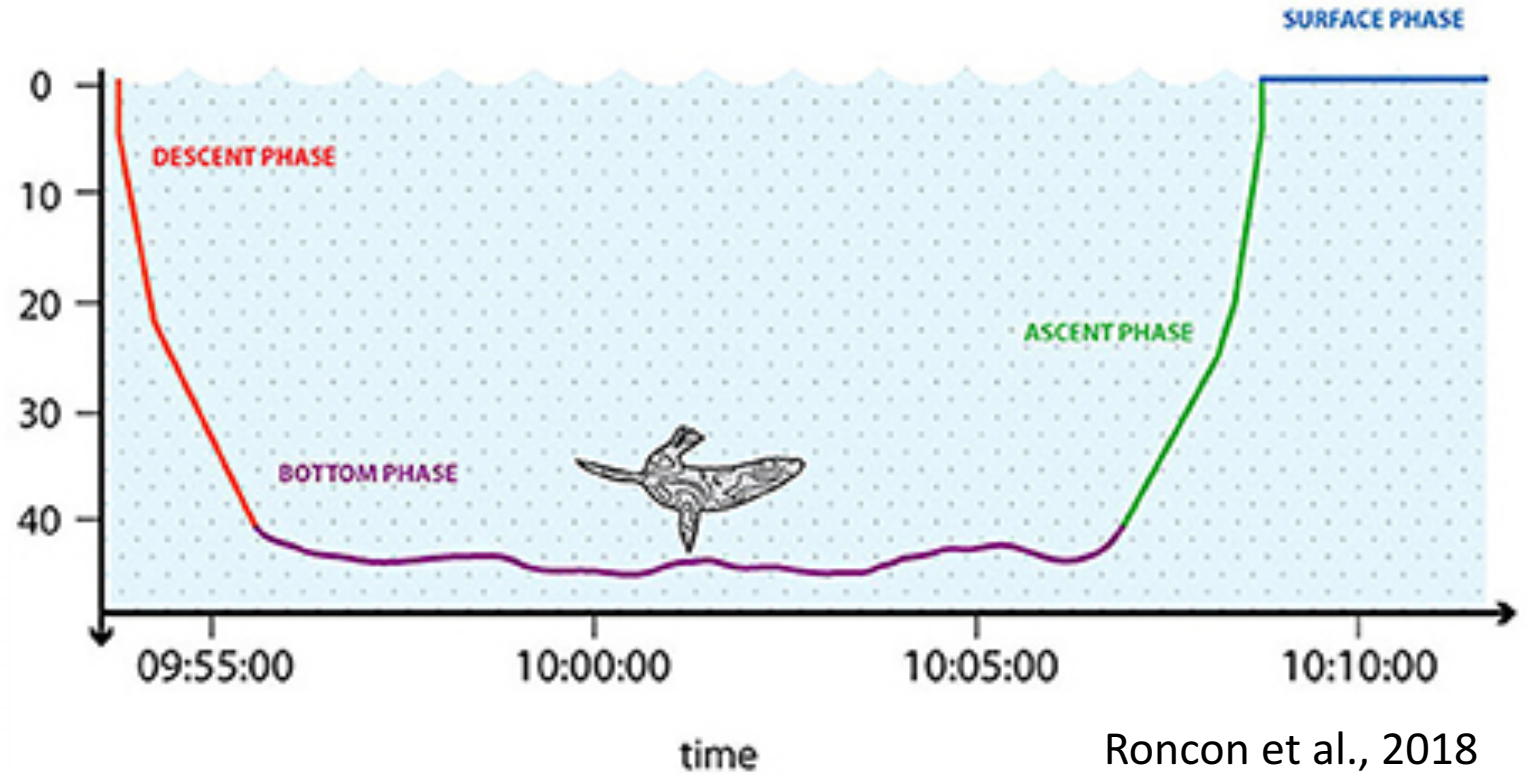


Della Penna et al., 2017;
Koubbi et al., 2017

Describing the currents top predators experience

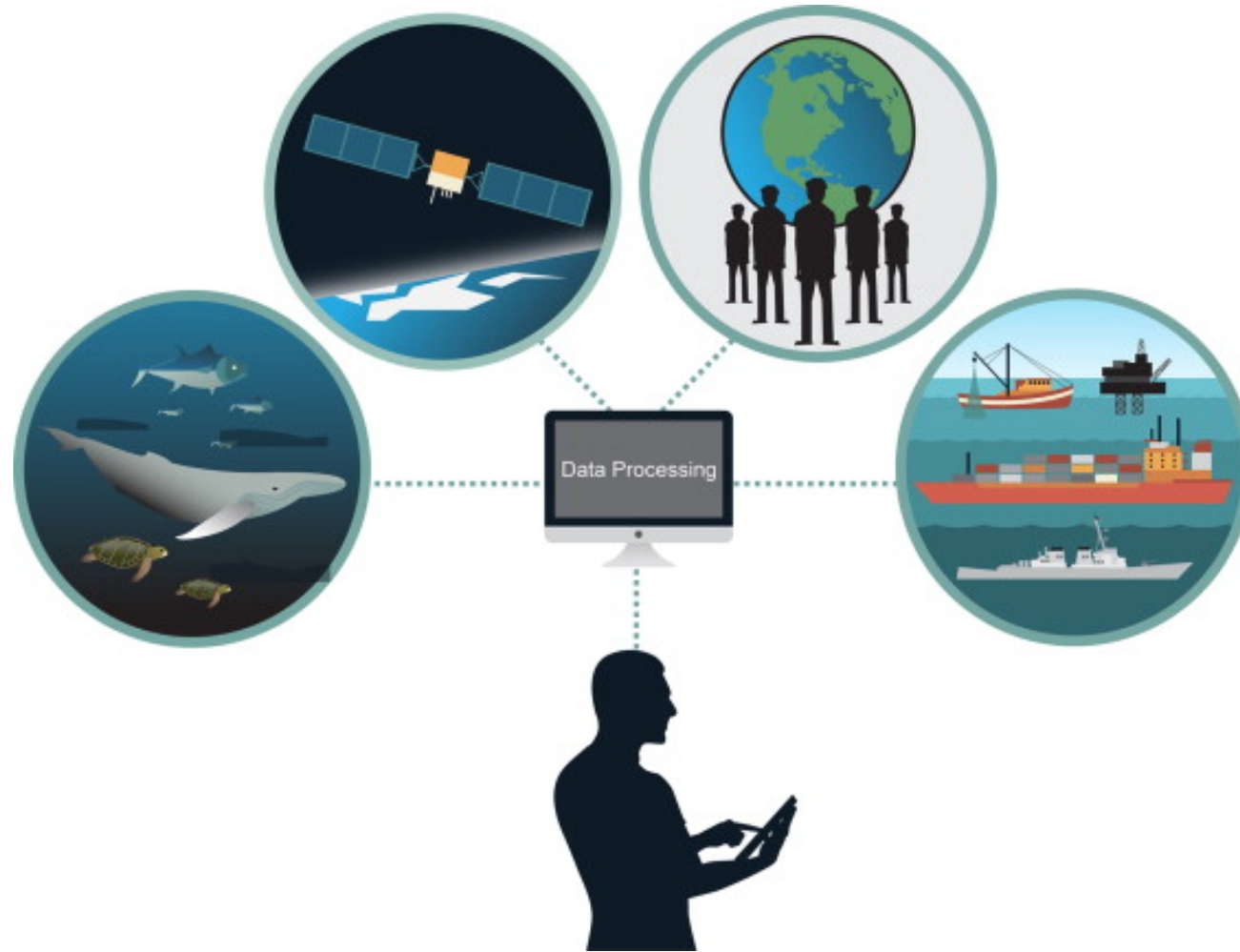


Cocker et al., 2003



Roncon et al., 2018

Towards Dynamic Ocean Management





Thank you for your attention!

Questions?



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WASHINGTON

