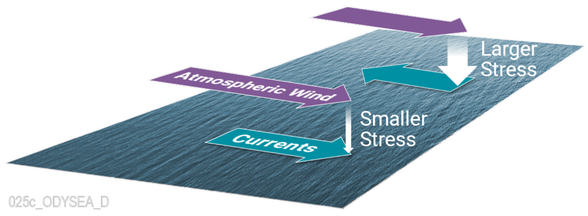
Simultaneous Measurements of Winds and Surface Currents from Space: ODYSEA (Ocean Dynamics and Surface Exchange with the Atmosphere)

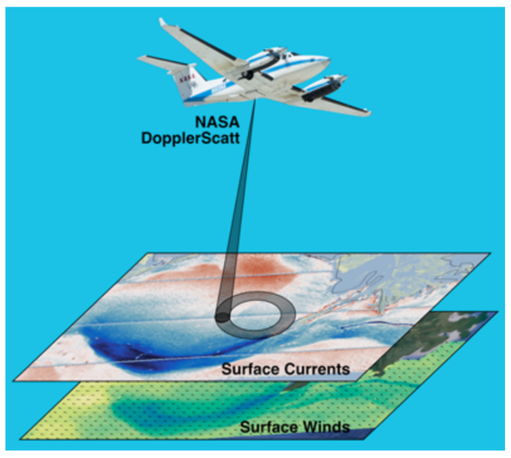
Sarah T. Gille, Tong Lee, Fabrice Ardhuin, Mark A. Bourassa, Paul Chang, Sophie E. Cravatte, J. Thomas Farrar, Melanie R. Fewings, Fanny Girard-Ardhuin, Gregg A. Jacobs, Zorana Jelenak, Florent Lyard, Jackie C May, Elisabeth D Rémy, Lionel Renault, Ernesto Rodriguez, Clément Ubelmann, Ana Beatriz Villas Bôas, and Alexander G. Wineteer

BACKGROUND: Interactions between winds and currents are critical for the Earth system but remain poorly sampled. ODYSEA, a proposed satellite-based Doppler scatterometer will provide global daily speed and direction for both winds and total currents, with unprecedented 5 km postings.



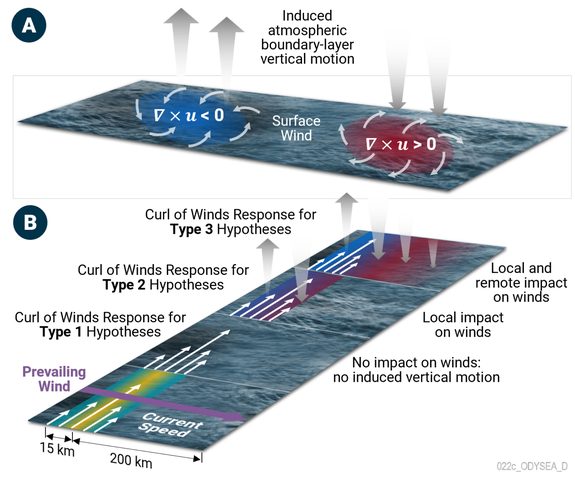
Wind stress ($\vec{\tau}$) that drives the ocean depends on the difference between atmospheric wind and total surface current.

FOUNDATION: ODYSEA employs a tested measurement technique, demonstrated with DopplerScatt in the airborne S-MODE program to study sub-mesoscale frontal features**.**



SCIENCE OPPORTUNITIES: Advancing understanding of coupled air-sea interaction:

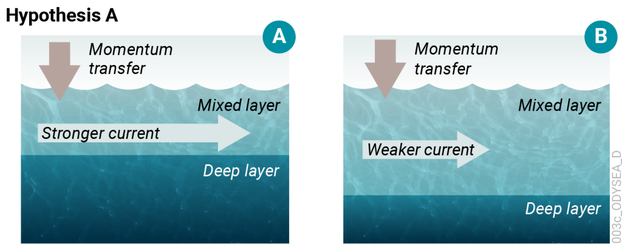
- How do ocean currents influence the atmosphere? *Is the atmospheric response to ocean currents localized or geographically distributed?*



(A) Weather responds to upward and downward motion in the atmosphere, determined by direction of wind rotation (the sign of ∇x u, wind curl).

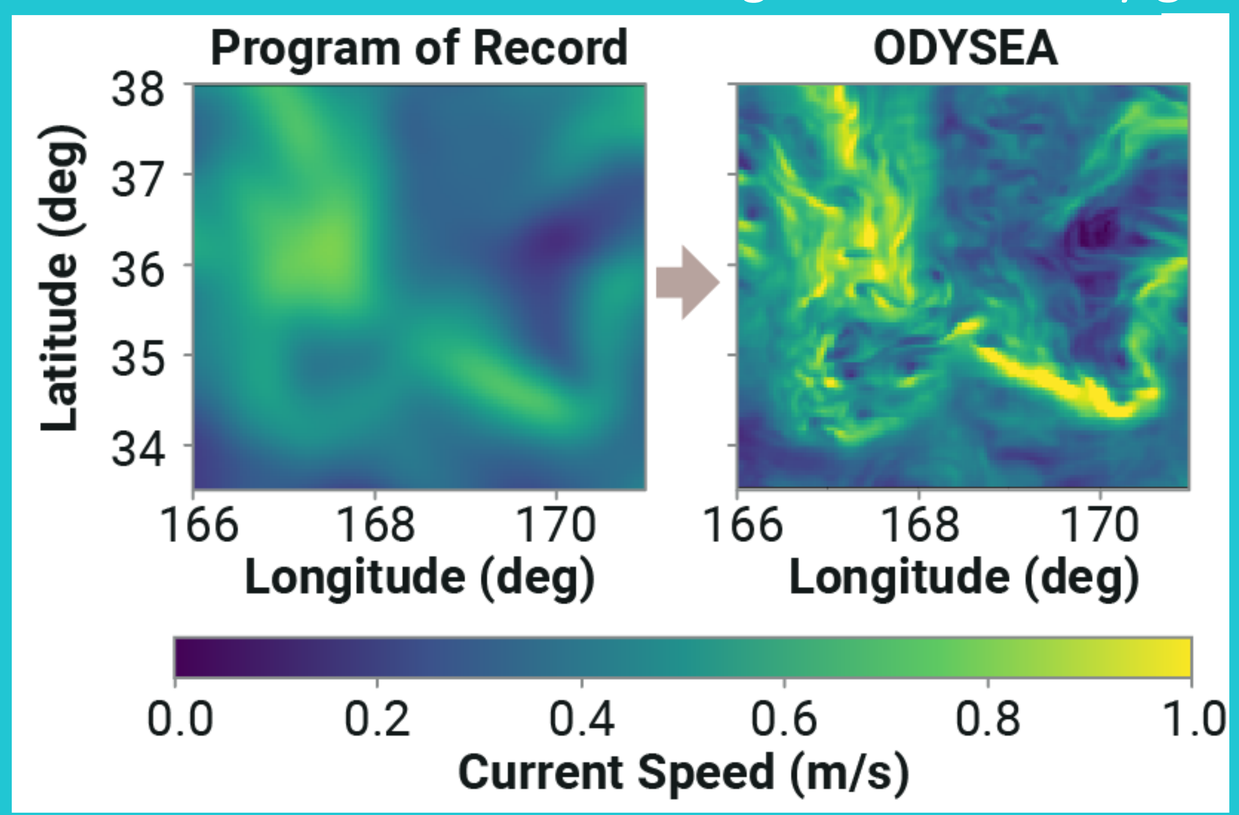
(B) Given a prevailing wind blowing across a strong, narrow current, hypothesized responses range from no vertical motion (Type 1), local impact (Type 2), to local and remote impact (Type 3). ODYSEA will collect evidence needed to show the strength and scale of the response.

- How do ocean currents vary on small and rapid scales? What controls these changes?

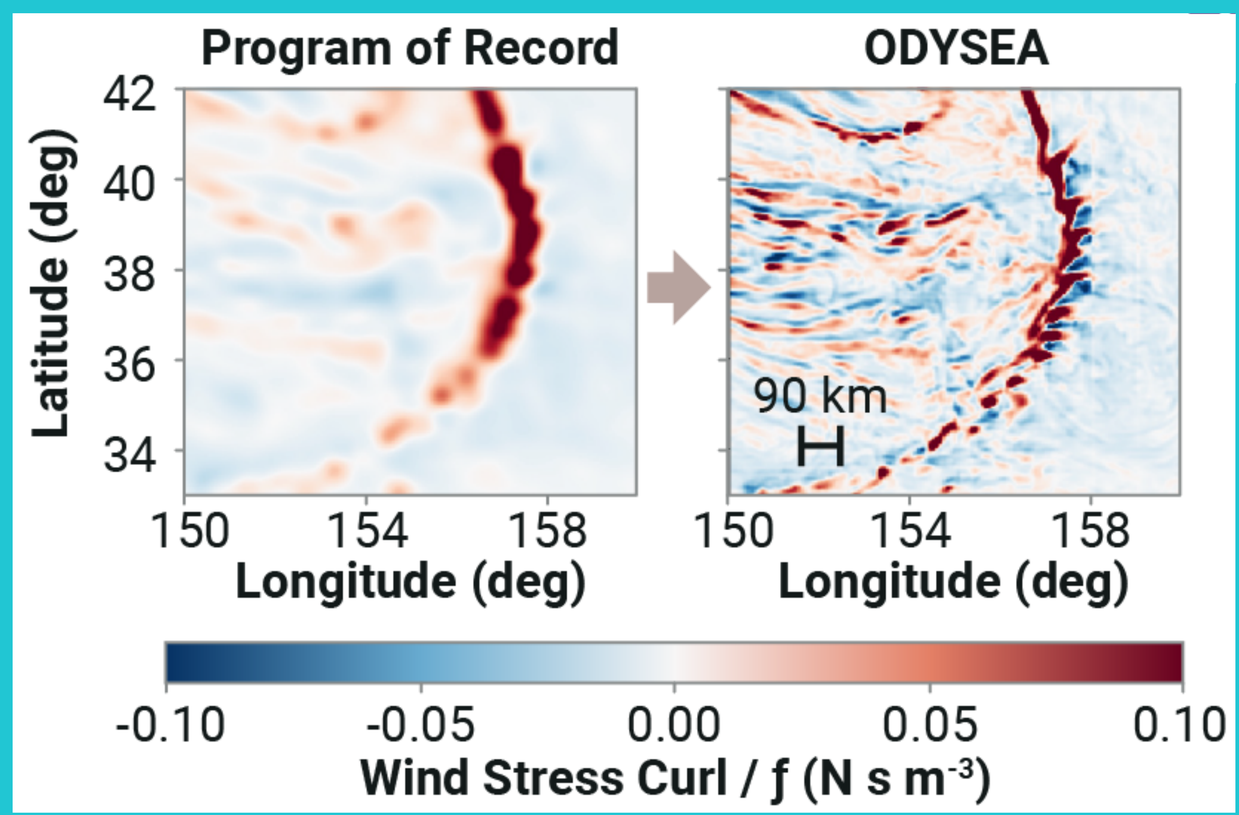


Some modeling studies suggest that surface currents accelerate more easily when mixed layers are shallower. Other studies suggest deeper mixed layers store more potential energy which can convert to greater eddy kinetic energy.

The ODYSEA satellite will bring into focus **daily global surface currents** and their interactions with **winds**



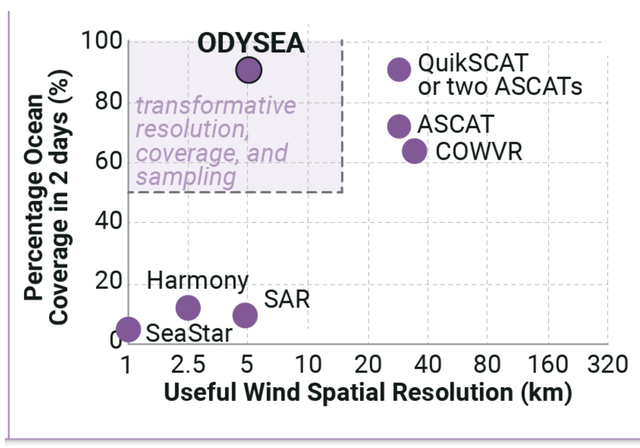
Frontal-scale currents

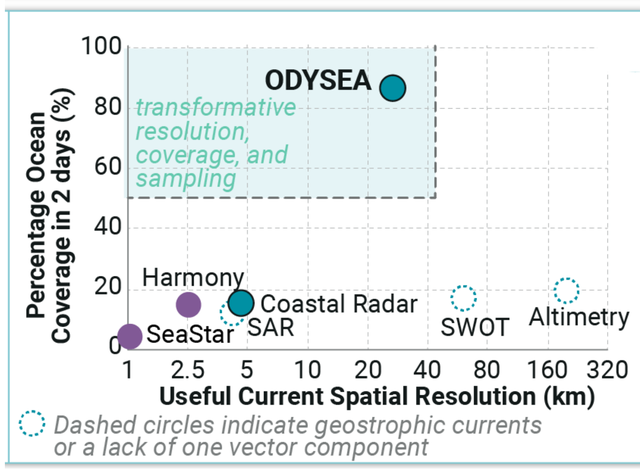


Structure in wind gradients

APPLICATIONS: ODYSEA's wind and current observations will constrain models of ocean circulation, weather, and climate, helping with critical operations and providing key information for biology and biogeochemistry:

- Search and rescue at sea requires frequent and high-resolution currents on 24—48 hour time scales.
- The global constellation of wind satellites lacks observations around 4:30 am/pm local time. ODYSEA will fill this gap to track the evolution of diurnal winds and fast-moving storm systems.





Dashed circles indicate geostrophic currents or a lack of one vector component

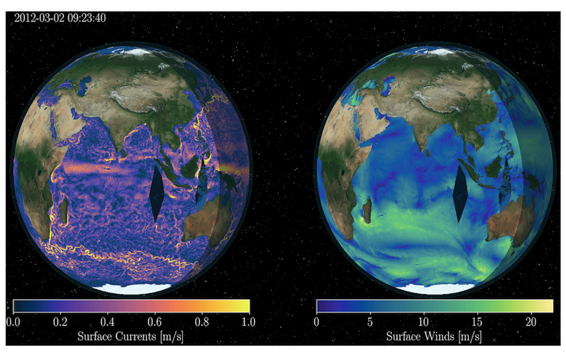
For both **winds** and **currents**, ODYSEA will provide notable improvements in spatial and temporal resolution relative to existing satellite missions and gridded products.

ODYSEA will improve on altimeter products by providing **ageostrophic plus geostrophic** currents.

TIMELINE: ODYSEA was identified as a potential Earth System Explorer mission in the 2017 Decadal Survey. **It has been proposed to NASA as a joint mission with the French Centre National d'Etudes Spatiales (CNES) .** If selected, ODYSEA will launch in 2030 or 2032.

SPECIFICATIONS:

- Orbit: 4:30 am sun synchronous
- Swath width: 1700 km
- Resolution: 5 km for wind, ~10 km for currents
- Effective revisit time: ~daily (and 2/day in many places)



LEARN MORE: https://odysea.ucsd.edu