

A Decade of Polar Ocean-Surface Stress, Seen from Space

Contact: lyu@whoi.edu



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A satellite-based ocean-surface stress dataset that incorporates satellite-observed sea ice drift and concentration into the stress calculation, providing a physically consistent, two-decade record of wind-driven forcing across ice-covered and open-water regimes in both polar oceans. It addresses a long-standing observational gap in polar ocean surface forcing, supporting process-oriented studies of ice-ocean coupling and wind-driven circulation.

Liu, C., and Yu, L. (2025). Satellite-based analysis of ocean-surface stress across the ice-free and ice-covered polar oceans. *Earth System Science Data*, 17, 4159–4184. <https://doi.org/10.5194/essd-17-4159-2025>

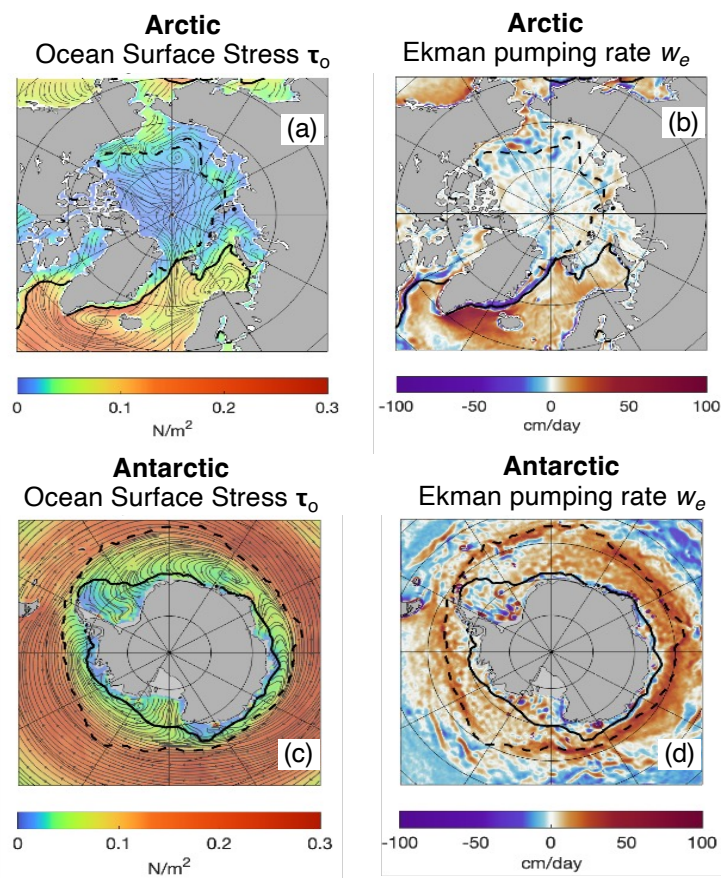


Fig.1 Mean ocean-surface stress (τ_o) and Ekman pumping rate (w_e) in the Arctic (a)&(b) and Antarctic (c)&(d).

Dataset coverage

Arctic

2011-2021

Antarctic

2013-2021

Both poles at 25 km spatial resolution and daily temporal resolution, publicly available under a CC-BY license.

What Makes This Dataset Unique

- **Sea-ice-mediated stress formulation.** Ocean surface stress is computed as a weighted combination of ice–water and air–water stress, incorporating satellite-observed sea ice drift, ocean geostrophic currents, and ice concentration: $\tau_o = \alpha\tau_{iw} + (1 - \alpha)\tau_{aw}$. Input data include NSIDC Polar Pathfinder ice drift, CLS/PML multi-altimeter combined sea surface height, and OAFflux2 wind stress.
- **Unified polar domain.** Ice-covered and open-water stress fields are integrated into a single, physically consistent analysis across both the Arctic and Antarctic at 25 km daily resolution.
- **Two decades of change captured.** The record spans the period of accelerated sea ice decline, providing an observational basis for quantifying how ice changes have altered surface stress, stress curl, and Ekman pumping across both hemispheres.
- **Ready-to-use, openly archived.** Validated against Ice-Tethered Profiler drifting buoy observations and freely accessible at Zenodo (zenodo.org/records/15534576).