

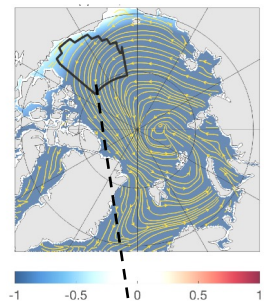
Thinner Beaufort Sea Ice Intensifies Winter Ocean-Surface Stress, Reversing Ekman Pumping

Contact: lyu@whoi.edu

After ~2012, winter sea-ice thinning strengthened wind–ocean momentum transfer in the Beaufort Gyre, intensifying ocean-surface stress and shifting net Ekman pumping from weak upwelling to predominant downwelling, despite little change in wind speed.

Liu, C., and Yu, L. (2025). Satellite-Based Evidence of Winter Intensification of Ocean Surface Stress and Ekman Downwelling in the Beaufort Gyre Since the 2010s. *J. Geophys. Res.: Oceans*, 130, e2025JC022521. <https://doi.org/10.1029/2025JC022521>

Observed Shift



Ice Thinned by ~ -0.4 m

→ Ocean-surface stress $\tau_o \uparrow 44\%$ and variability $\times 2$

→ Ekman flips from weak upwelling to predominant downwelling

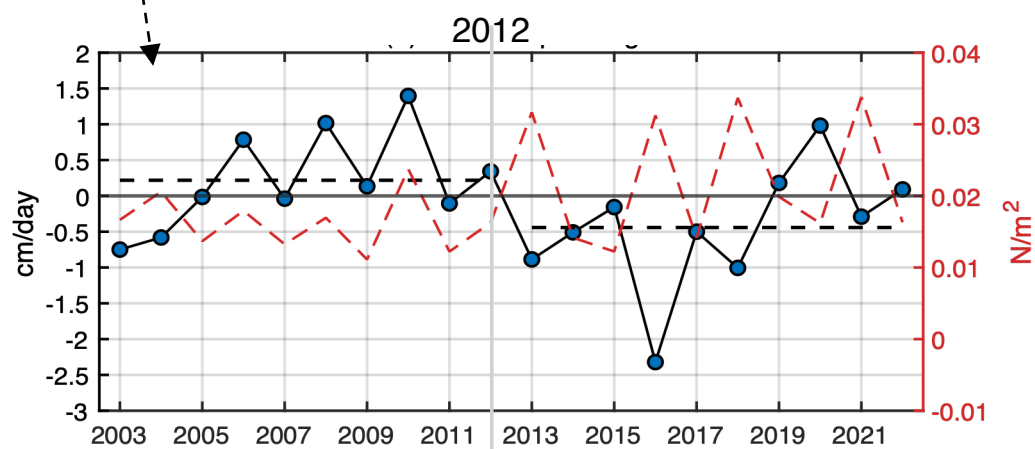
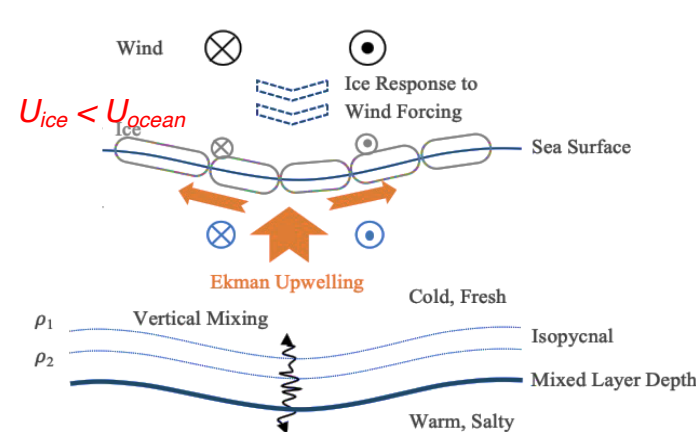


Fig.1. DJFM-mean Beaufort Gyre Ekman pumping (Black: positive = upwelling; negative = downwelling). Red dashed: DJFM-mean ocean-surface stress (right axis).

Physical Explanation

- Pre-2012:** Ice decoupled from wind; weak Ekman upwelling; cold, fresh, stratified.
- Post-2012:** Stronger ice-wind coupling; Ekman downwelling; warmer, saltier, deeper mixed layer.
- Key contrast:** Thinner ice reversed vertical ocean motion and eroded the halocline.

Pre-2012: thicker ice



Post-2012: thinner ice

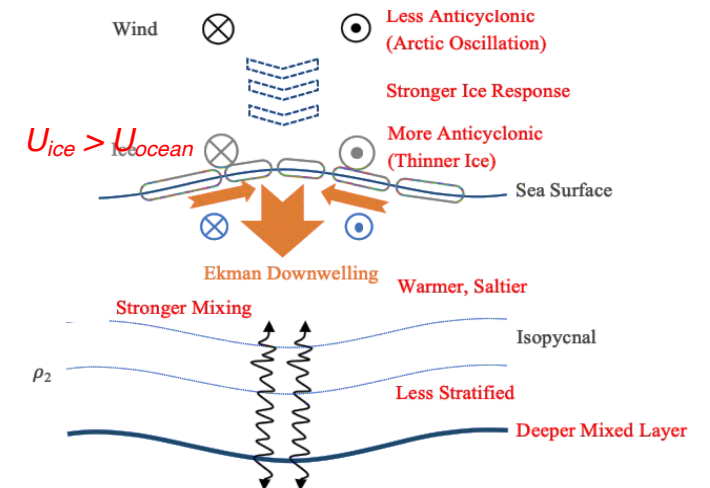


Fig. 2 Schematic of wind-ice-ocean dynamics in the Beaufort Gyre before and after the ~2012 regime shift