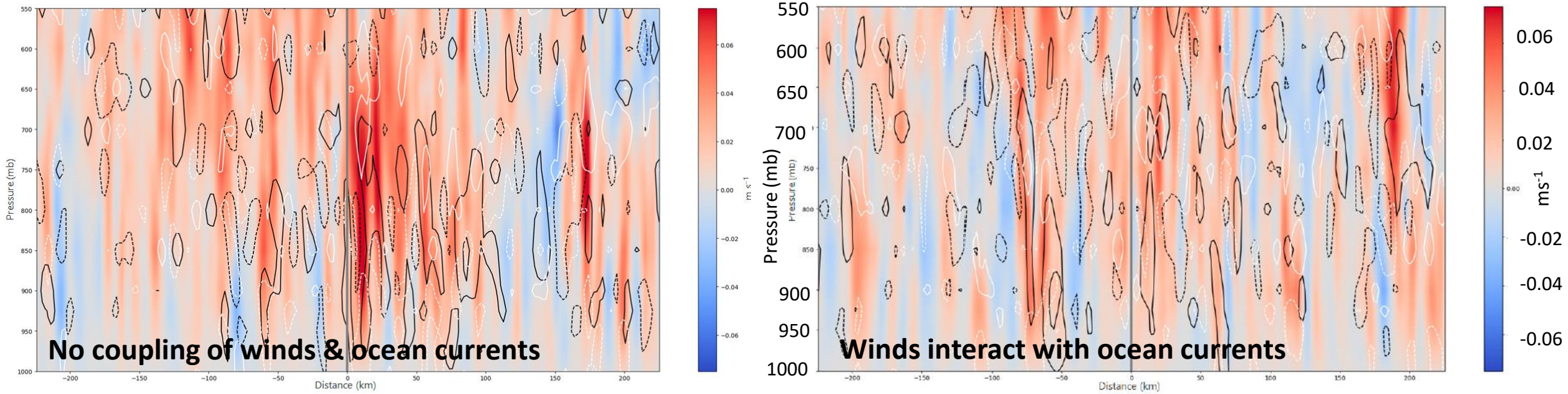
Ocean Surface Currents Influence Winds Well Above the Surface

A key question among climate scientists is whether ocean surface currents modify atmospheric winds well above the sea surface. This is important because the curl and divergence of surface horizontal winds and stress are tied to atmospheric vertical motion through known processes (e.g., Ekman). For example, in the northern hemisphere, horizontal surface winds flowing counterclockwise are associated with convergence and upward motion in the atmosphere. The magnitude and extent of the impacts due to currents are unknown.

In the figures below, blues indicate (downward) motion and and reds indicate (upward) motion. Contours of divergence are white (solid is positive) and curl is black. **Model data indicate that gradients of surface currents *suppress* upward vertical motion to the right of current vector; and they *enhance* upward vertical motion to the left of the current vector.** Atmospheric fronts and cyclones help these impacts penetrate the top of the atmospheric boundary-layer (around 800 to 850 mb). These relatively rare events are high impact, with much stronger current-induced vertical motions than seen in these averages.



Winter-averaged vertical sections at 70°W, roughly perpendicular the mean current. Data are centered about the strongest surface current (vertical line at distance = 0). The data from 00:00 UTC averaging over December, January and February.

May, J.C., and M. A. Bourassa, 2023: Atmospheric dynamic response to coupling currents to wind stress over the Gulf Stream. Atmosphere, 14(8), DOI: 10.3390/atmos14081216

Funded through NASA OVWST

Jet Propulsion Laboratory
California Institute of Technology