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Simulated ocean mesoscale structures induce air-sea interaction

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The mesoscale activities (or mesoscale structures) in the ocean possess immense energy. Such structures (including oceanic fronts and eddies) can induce mesoscale air-sea interaction (MASI) and then greatly impact oceanic circulation. MASI is distinct from large-scale interaction mainly in terms of the atmospheric forcing, and it can be revealed by high-resolution observations and simulations.

"Mesoscale air-sea interaction can not only affect the atmospheric processes in the boundary layer, but also the cloud and precipitation. Additionally, it can affect the western boundary current," says Dr. Pengfei Lin, an associate researcher at the Institute of Atmospheric Physics, Chinese Academy of Sciences and first author of a paper recently published in *Atmospheric and Oceanic Science Letters*.

"Many global coupled models cannot resolve oceanic mesoscale eddies and fronts because the horizontal oceanic resolutions are too coarse. As such, few simulations had been carried out using very-high-resolution global coupled models. Furthermore, the simulation fidelity of mesoscale air-sea interaction had not been explored in detail in these previous studies," continues Dr. Lin.

Lin and his team developed a high-resolution ocean and atmosphere coupled model and ran six-year simulations using the model. The results indicated that MASI can be captured well by the model (indicated by comparison with observations), especially in regions with high mesoscale activity. The response was described by positive correlations between sea surface temperature and surface wind stress and quantified by the coupling strengths between sea surface temperature anomalies and wind anomalies.

The responses of surface latent and sensible heat fluxes induced by mesoscale structures were also significant. The response was particularly significant over regions with strong oceanic fronts and eddies. Associated with weak wind responses, surface sensible heat flux responses were underestimated slightly, while surface latent heat flux responses were overestimated because of the drier atmospheric boundary layers in the model. The momentum mixing and pressure adjustment mechanisms play important roles.

"Our study provides some suggestions for the study of mesoscale air-sea interaction, as well as advice on improving model simulations," says Lin. "In the future, we intend to use this simulation and further simulations to distinguish the oceanic dynamics and thermal effects on surface wind."

More information: Pengfei Lin et al, Ocean mesoscale structure–induced air–sea interaction in a high-resolution coupled model, *Atmospheric and Oceanic Science Letters* (2019). DOI: 10.1080/16742834.2019.1569454

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