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Long-term evolution of eddying oceans in a warming world

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Mesoscale ocean eddies impact atmosphere-ocean gas exchange, carbon sequestration, and nutrient transport. Studies have attempted to identify trends in eddy activity using satellite altimetry; however, it is difficult to distinguish between robust trends and natural variability within the short observational record. Using a novel climate model that exploits the variable-resolution capabilities of unstructured meshes in the ocean component to concentrate computational resources in eddy-rich regions, we assess global mesoscale eddies and their long-term response to climate change at an unprecedented scale. The modeled results challenge the significance of some trends identified by observational studies, as well as the effectiveness of linear trends in assessing eddy kinetic energy (EKE) change. Some anticipated changes to ocean circulation, such as a poleward shift of major ocean currents and eddy saturation in the Southern Ocean, are reinforced by the modeled EKE changes. Several novel insights regarding the evolution of EKE in a warming world are also proposed, such as a decrease of EKE along the Gulf Stream in unison with weakening Atlantic meridional overturning circulation (AMOC); increasing Agulhas leakage; and accelerating, non-linear increases of EKE in the basins of the Kuroshio Current, Brazil and Malvinas Currents, and the Antarctic Circumpolar Current (ACC).