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Mesoscale Eddies in the Eurasian Basin from FESOM2 simulations at 1-km resolution

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Mesoscale eddies play a crucial role in shaping the dynamics of the Arctic Ocean, making them essential for understanding future Arctic changes and the ongoing 'Atlantification' of the region. To study the Artic mesoscale eddy activity, we use simulations generated by the unstructured-mesh Finite volumE Sea ice-Ocean Model (FESOM2) with a 1-km horizontal resolution in the Arctic Ocean.

The investigation includes multiple simulations, namely a seven-year run forced from reanalysis representing the present-day climate and a slice simulation for the end of the 21st century, forced with future atmospheric conditions from a coupled CMIP6 type run with lower resolution. Through these simulations, we evaluate changes in Eddy Kinetic Energy (EKE) within the Eurasian Basin and analyze their correlation with factors like sea-ice cover, baroclinic conversion rate, and stratification. To deepen our understanding, we combine Eulerian properties like EKE and baroclinic conversion rate with Lagrangian properties obtained from an algorithm that automatically identifies and tracks eddies using vector geometry.

Our findings from the end-of-century slice simulation indicate a significant increase in Arctic eddy activity in the future, accompanied by retreating sea ice. The present-day simulation reveals that the seasonality of EKE is mainly influenced by changes in sea ice, with distinct drivers at different depth levels for monthly anomalies. The mixed layer shows a robust connection to sea ice variability, while deeper levels, protected by stratification, are more significantly influenced by baroclinic conversion.