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Seasonal Predictability of wintertime North Atlantic cyclonic activity through the NAO and the eddy-driven jet stream

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We investigate the potential for enhancing the seasonal prediction skill of mid-latitude cyclonic activity, represented by eddy kinetic energy (EKE) at 250 hPa over the North Atlantic and Europe, in hindcast simulations with the Max Planck Institute Earth System Model (MPI-ESM) against the ECMWF ERA5 reanalysis. Our analysis focuses on wintertime months (December-March) from 1982 to 2019, with a 30-member seasonal hindcast ensemble initialized every November 1st. Based on the initial confirmation that in both ERA5 reanalysis and MPI-ESM hindcasts, the eddy-driven jet stream and the wintertime North Atlantic Oscillation (NAO) play a significant role in wintertime's spatial and temporal distribution of mid-latitude cyclonic activity, we perform ensemble subsampling.

Specifically, we sample each winter so that a northern position of the jet stream is consistent with a positive phase of the NAO and represents poleward enhanced EKE activity. In contrast, a southern position of the jet stream is consistent with a negative phase of the NAO and represents equatorward enhanced EKE activity. Preliminary analysis of the predictive skill of MPI-ESM hindcasts with respect to ERA5 shows that such subsampling with respect to a consistent representation of the jet stream position and the NAO phase leads to improvements over the skill from the 30-member ensemble mean, with significant correlations concentrated over areas of major frequency of storm tracks. Our results put into practical use that an enhanced representation of the large-scale climate variability plays a crucial role in the long-term prediction of high-frequency events such as mid-latitude cyclones.