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Ocean Eddies and Climate Predictability

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A suite of coupled climate model simulations and experiments are used to examine how resolved mesoscale ocean features affect aspects of climate variability, air-sea interactions and predictability. In combination with control simulations, experiments with the interactive ensemble coupling strategy are used to further amplify the role of the oceanic mesoscale field, and the associated air-sea feedbacks and predictability. The basic intent of the interactive ensemble coupling strategy, a forerunner of multi-model supermodeling, is to reduce the atmospheric noise at the air-sea interface, allowing an assessment of how noise affects the variability, and in this case, is also used to diagnose predictability from the perspective of signal-to-noise ratios. The climate variability is assessed from the perspective of SST variance ratios and it is shown that, unsurprisingly, mesoscale variability significantly increase SST variance. Perhaps surprising, is the fact that the presence of mesoscale ocean features even further enhances the SST variance in the interactive ensemble simulation beyond what would be expected from simple linear arguments. Changes in the air-sea coupling between simulations are assessed using pointwise convective rainfall-SST and convective rainfall-SST tendency correlations, and again emphasizes how the oceanic mesoscale alters the local association between convective rainfall and SST.

Understanding the possible relationships between the SST-forced signal and the weather noise is critically important in climate predictability. We use the interactive ensemble simulations to diagnose this relationship and we find that the presence of mesoscale ocean features significantly enhances this link particularly in ocean eddy rich regions. Finally, we use signal-to-noise ratios to show that the ocean mesoscale activity increases model estimated predictability in terms of convective precipitation and atmospheric upper tropospheric circulation.