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Atmospheric Weather Noise Characteristics in 20th Century Coupled Atmosphere-Ocean Model Simulations

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The statistical characteristics of the atmospheric internal variability (hereafter weather noise) for surface pressure (PS) in 20th century simulations of a coupled general circulation model are documented. The weather noise is determined from post-industrial (1871-1998) Community Climate System Model 3 simulations by removing the SST and externally forced responses from the total fields.The forced responses are found from atmosphere-only simulations forced by the SST and external forcing of the coupled runs.
The spatial patterns of the main modes of weather noise variability of the noise are found for boreal winter and summer from empirical orthogonal function (EOF) analyses performed globally, and for various regions, including the North Atlantic, the North Pacific, and the equatorial Pacific. The temporal characteristics of the modes are illustrated by power spectra and probability density functions (PDF) of the principal components (PC).
Our findings show that, for two different realizations of weather noise, the variability is dominated by large scale spatial structures of the weather noise that resemble observed patterns, and that their relative amplitudes in the CGCM and AGCM simulations are very similar. The regional expression of the seasonally dependent AO-like or AAO-like dominant global pattern is also found in the regional analyses, giving similar PCs. The PCs in the CGCM and the corresponding SST forced AGCM simulations are uncorrelated, but the spectra and PDFs of the CGCM and AGCM PCs are similar.
The temporal structures of the PCs are white at timescales larger than few months, so that these modes can be thought of as stochastic forcings (in time) for the climate system. The PDFs of the weather noise PCs are not statistically distinguishable from Gaussian distributions with the same standard deviation. The PDFs do not change substantially between the first and second half of the 20th century.