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The Surface Climate Response to 11-Yr Solar Forcing During Northern Winter: Observational Analyses and Comparisons With GCM Simulations

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The surface climate response to 11-yr solar forcing during northern winter is first re-estimated by applying a multiple linear regression (MLR) statistical model to Hadley Centre sea level pressure (SLP) and sea surface temperature (SST) data over the 1880-2009 period. In addition to a significant positive SLP response in the North Pacific found in previous studies, a positive SST response is obtainedacross the midlatitude North Pacific. Negative but insignificant SLP responses are obtained in the Arctic. The derived SLP response at zero lag therefore resembles a positive phase of the Arctic Oscillation (AO). Evaluation of the SLP and SST responses as a function of phase lag indicates that the response evolves from a negative AO-like mode a few years before solar maximum to a positive AO-like mode at and following solar maximum. For comparison, a similar MLR analysis is applied to model SLP and SST data from a series of simulations using an atmosphere-ocean general circulation model (EGMAM). The simulations differed only in the assumed solar cycle variation of stratospheric ozone. It is found that the simulation that assumed an ozone variation estimated from satellite data produces solar SLP and SST responses that are most consistent with the observational results, especially during a selected centennial period. In particular, a positive SLP response anomaly is obtained in the northeastern Pacific and a corresponding positive SST response anomaly extends across the midlatitude North Pacific. The model response versus phase lag also evolves from a mainly negative AO-like response before solar maximum to a mainly positive AO response at and following solar maximum.