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One-month lead predictability of the wintertime AO using a realistic initial solar constant for a CGCM

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Recently, anomalous warm events and cold surges have been increasing rapidly during the boreal winter. Many investigations reported that these anomalous temperature variations are closely related with the large-scale disturbance associated with the Arctic Oscillation (AO), thus implying the importance of the AO forecasting during the season. According to previous studies, the AO is caused by various reasons such as the variations of tropical and subtropical sea surface temperature, snow cover and solar activity. This study investigates the impact of solar constant variation on the predictability of the AO in terms of one-month lead predictability of boreal winter season (DJF) AO using Pusan National University (PNU) CGCM, a participant model of APEC Climate Center (APCC) Multi Model Ensemble Seasonal Prediction System. The one-month lead hindcasts produced from a realistic initial solar constant experiment (Solar Run, SR) and from a climatological solar constant experiment (Control run, CR) are comparatively analyzed. The one-month lead hindcasts were initiated from mid-November, -December and -January of each year for the period 1980∼2009. The hindcast of SR showed better skill than that of CR in terms of forecasting not only the AO index but also the atmospheric circulation pattern related with AO. The significantly improved AO forecast skill in SR resulted from the enhanced daily forecast skill of polar vortex by the SR. That is, a more realistic atmospheric response in the upper level to the realistically varying initial solar constant affected all levels of the atmosphere via stratosphere-troposphere coupling, thereby improving the AO forecast. It is worth noting that the model can raise the predictability of the AO forecast by imposing a realistic solar constant as the initial condition.

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