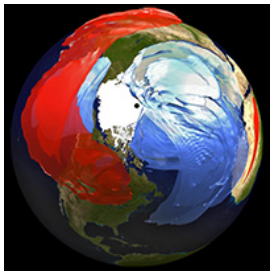

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Subseasonal Forecasting of Sudden Stratospheric Warming Events and their Influence on the Troposphere in the NASA-GEOS-S2S Forecast System

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Sudden stratospheric warming (SSW) events significantly disrupt the stratospheric circulation, and are a major mode of subseasonal variability in the winter atmosphere. Major SSWs appear as dramatic polar-cap warmings of 20K or more, accompanied by weakening of the circumpolar zonal wind and reversal from the normal westerly to easterly wind. SSW anomalies can develop rapidly over days, descend in time over 1-2 weeks, and persist at the tropopause for 1-2 months. These stratospheric wind changes affect the vertical and latitudinal propagation of planetary waves throughout the atmosphere and are statistically associated with anomalous southward shifts in the storm tracks and associated changes in surface temperature and precipitation patterns. Previous work has suggested enhanced prediction skill at 16-60 day forecast range when forecasts are initialized during SSW events. However, prediction of the onset of SSWs themselves has been poor beyond ˜10-day lead times.

We examine historical SSW events as forecasts of opportunity in NASA's seasonal-to-subseasonal (S2S) forecasting system. The work examines GEOS-S2S Version 2 (V2) developed in NASA's Global Modeling and Assimilation Office (GMAO) at Goddard Space Flight Center. Compared to GMAO's previous S2S system, V2 runs at higher atmospheric resolution (approximately 1/2-deg globally), contains a substantially improved model of the cryosphere, includes additional interactive aerosol model components, and the ocean data assimilation system has been replaced with a Local Ensemble Transform Kalman Filter. A set of retrospective 45-day forecasts was initialized based on the MERRA-2 reanalysis at 5-day intervals throughout years 1999 to present, with four ensemble members per initialization date. Our analysis of these retrospective forecasts reveals surface anomaly patterns in the ˜30-day period following the onset of SSW events, and compares skill in forecasts initialized during an SSW to those initialized during normal winter conditions. We investigate how far in advance the GEOS-S2S-V2 system can forecast major SSW events themselves. We also examine the roles of extratropical wave activity, stratospheric wind biases, and parameterized gravity wave drag on forecast skill.

Primary author: ALEXANDER, Joan (NWRA)

Co-authors: COY, Lawrence (NASA/GMAO); HOLT, Laura (NWRA); LI, Zhao (NASA/GMAO); MOLOD, Andrea (NASA/GMAO); PAWSON, Steven (NASA/GMAO); PUTMAN, William (NASA/GMAO)

Presenter: ALEXANDER, Joan (NWRA)

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