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The effect of SST anomalies on planetary waves dynamics: numerical experiments with ISCA

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Stratospheric dynamics have predictive skills on a subseasonal timescale for troposphere synoptic processes, which plays a crucial role in the “seamless” forecasting approach. Therefore, predicting the state of the stratospheric polar vortex (SPV) is one of the top priority tasks for modern meteorology.

Early research showed that the intensity of the vertical propagation of wave 1 over Eastern Siberia could be a predictor for an extremely strong/weak SPV in the next month during the winter season. However, this connection does not always exist. During the negative phase of the Pacific Decadal Oscillation (PDO), 70% of the variability of the SPV intensity is explained by the dynamics of wave 1 in the previous month, and during the positive phase of the PDO, there is no statistically significant connection between them. It can be concluded that the nature of the spatial propagation of planetary waves differs in different phases of the PDO.

The work aimed to confirm the effect of large-scale SST anomalies on planetary waves propagation using numerical experiments with ISCA model and to prove results of observational analysis based on JRA-55 data that showed that wave 1 is more “stationary” during the negative PDO phases than during the positive ones. Distributions of the wave 1 ridges’ location for different PDO phases are significantly different at the 8% level according to Student’s t-test.

We analyzed the differences in the vertical components of the Plumb flux for isolated large-scale SST anomalies condition corresponding to the main modes of SST variability, such as PDO, El-Nino Southern Oscillation (ENSO), and for SST anomalies in the Kara-Barents Seas region. The experiments with combined conditions were carried out as well.