EMS Annual Meeting Abstracts
Vol. 16, EMS2019-664, 2019

Observed and Simulated Teleconnections Between the Stratospheric Quasi-Biennial Oscillation and Northern Hemisphere Winter Atmospheric Circulation

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The Quasi-Biennial Oscillation (QBO) is the dominant mode of interannual variability in the tropical stratosphere, with easterly and westerly zonal wind regimes alternating over a period of about 28 months. It appears to influence the Northern Hemisphere winter stratospheric polar vortex and atmospheric circulation near the Earth's surface. However, the short observational record makes unequivocal identification of these surface connections challenging. To overcome this, we use a multicentury control simulation of a climate model with a realistic, spontaneously generated QBO to examine teleconnections with extratropical winter surface pressure patterns. Using a 30-hPa index of the QBO, we demonstrate that the observed teleconnection with the Arctic Oscillation (AO) is likely to be real, and a teleconnection with the North Atlantic Oscillation (NAO) is probable, but not certain. Simulated QBO-AO teleconnections are robust, but appear weaker than in observations. Despite this, inconsistency with the observational record cannot be formally demonstrated. To assess the robustness of our results, we use an alternative measure of the QBO, which selects QBO phases with westerly or easterly winds extending over a wider range of altitudes than phases selected by the single-level index. We find increased strength and significance for both the AO and NAO responses, and better reproduction of the observed surface teleconnection patterns. Further, this QBO metric reveals that the simulated AO response is indeed likely to be weaker than observed. We conclude that the QBO can potentially provide another source of skill for Northern Hemisphere winter prediction, if its surface teleconnections can be accurately simulated.