# Analysis of Arctic spring ozone anomaly in the phases of QBO and 11-year solar cycle for 1979–2011

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This study investigates Arctic spring ozone in relation to the phase of quasi-biennial oscillation (QBO)/the 11-year solar cycle, using satellite observations, reanalysis data, and outputs of a chemistry climate model (CCM) during the period of 1979–2011. For this duration, we found that the composite mean of the Northern Hemisphere high-latitude total ozone in the QBO-westerly (QBO-W)/solar minimum ($S_{min}$) phase is slightly smaller than those averaged for the QBO-W/$S_{max}$ and QBO-E/$S_{max}$ years in March. An analysis of the passive ozone tracer defined at the pressure levels between 220 hPa and 12 hPa in the CCM simulation indicates that this negative anomaly is primarily caused by transport. The negative anomaly is consistent with a weakening of the residual mean downward motion in the polar lower stratosphere. The contribution of chemical processes estimated using the column amount difference between ozone and the passive ozone tracer is less than 6% of the total anomaly in February and between 10–20% in March. The lower ozone levels in the Arctic spring during the QBO-W/$S_{min}$ years are associated with a stronger Arctic polar vortex from late winter to early spring, which is linked to the reduced occurrence of sudden stratospheric warming in the winter during the QBO-W/$S_{min}$ years.

Keywords: Arctic, ozone, QBO, 11-year solar cycle, CCM, sudden stratospheric warming

 