

The Quasi-biennial Oscillation in Tropical Ozone as Revealed by Ozonesonde and Satellite Data.

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Abstract

We present an analysis of the quasi-biennial oscillation (QBO) in tropical ozone using recent in-situ measurements made by ozonesondes, supplemented by satellite profile and column data. The first in-situ equatorial ozone profiles reveal the dramatic change in shape of the profile that accompanies the descent of the westerly shear zone. The partial pressure maximum in ozone increases by $\sim 25\%$ in 5-6 months as it descends from 17.5 to 24 hPa. The amplitude of the QBO anomaly which extends from 15 to 80 hPa is found to exceed $\pm 20\%$, larger than indicated by earlier analyses of satellite data. The influence of the QBO on equatorial ozone is dominant between 10 and 45 hPa, but the seasonal cycle is more important below 50 hPa. The equatorial ozone anomalies are influenced by ENSO in the lowest part of the stratosphere. The ozone anomaly in the lower stratosphere at 20 S lags that at the equator by only a few months during the easterlies from 1994 to 1998, contrary to the previous picture of the subtropical and equatorial anomalies being out of phase. There is often a 3-cell structure in ozone anomalies at 20 N and 20 S, with the upper two related to the QBO and that below 50 hPa sometimes related to ENSO. We present an analysis of the contribution of the ozone anomalies as a function of altitude to the subtropical QBO in column ozone. There is a strong subtropical column anomaly (>5 DU) when the anomalies above 20 hPa and from 50 to 20 hPa reinforce. There were four such cases at 20 N and at 20 S in 1985-91, but five at 20 N and only one at 20 S in 1993-99. About 70% of these cases are associated with strong shear at 25-35 hPa in late fall/early winter. There is a weak subtropical anomaly in column ozone when the ozone anomalies above and below 20 hPa are of opposite sign, or one of them is very weak. Over half of these cases are associated with strong wind shear in late fall/early winter in the middle stratosphere at 12.5 hPa. In the southern subtropics, there is strong shear at 12.5 hPa and a weak column ozone anomaly for five of six years from 1994 to 1999.

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