SPARC Workshop SHARP2016

Interannual changes of stratospheric ozone and their relationship to dynamical processes

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Stratospheric ozone is produced through photochemical reactions involving the solar ultra-violet absorption mainly in the tropical upper stratosphere, where ozone is in photochemical equilibrium. In the lower stratosphere, ozone behaves as a tracer because photochemical life time of ozone is sufficiently long compared with the characteristic time scale of air motion. Hence, interannual changes of the distribution of stratospheric ozone is influenced by both photochemistry and transport processes. In this study, we make global gridpoint data for ozone volume mixing ratio values derived from Aura MLS data, to investigate interannual changes of stratospheric ozone since June 2004 to present and their relationship to dynamical processes derived from ERA-Interim reanalysis data as well as Aura MLS data. It is found that stratospheric ozone in the equatorial region, approximately within 15 degrees latitude, is largely influenced by the equatorial quasi-biennial oscillation (QBO), showing positive correlation with the QBO temperature variation below 10 hPa but negative correlation above that level where photochemistry is predominant. On the other hand, ozone changes in mid-latitudes are negatively correlated with them in low latitudes, which seems to be reflected by the existence of mean meridional circulations associated with the QBO. However, such influence is limited within 40-50 degrees latitude and it is strongly contaminated by the Brewer-Dobson circulation driven by planetary waves in the extratropical stratosphere, especially in the Northern Hemisphere. In the polar regions, ozone changes are largely influenced by ozone depletion chemistry along with the dynamical processes.