温室効果気体(GHG)増加とオゾン回復に伴うCCMI将来実験から得られたオゾンQBOの将来変化
Future changes in quasi-biennial oscillation of ozone with increasing GHS and ozone recovery in CCMI simulation

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The future quasi-biennial oscillation (QBO) in ozone in the equatorial stratosphere is examined by analyzing future transient reference simulation (REF-C2) for the period from 1960 to 2100 in a climate change due to increasing GHGs and decreasing ODSs under the Chemistry-Climate Model Initiative (CCMI) activities. The REF-C2 simulation is conducted using the Meteorological Research Institute Earth System Model (MRI-ESM), which constitutes a core component of the atmosphere-ocean coupled global climate model and components of sea-ice, aerosol, and ozone models. We have conducted the wavelet analysis to provide inter-annual variability of amplitude and phase of the ozone QBO in the vertical structure of tropical stratosphere.
In the simulation the power spectra of the equatorial zonal-mean ozone mixing ratio shows a double peak structure with maximum amplitude at two pressure levels of around 30 hPa and 10 hPa and a node at 15 hPa. The vertical residual-velocity anomalies are in phase with the ozone anomalies in the upper stratosphere with the abrupt phase change at around 15 hPa. Below this level, the phase is almost reversed from what it is above. Quantitatively, the amplitude of the ozone QBO in the model-free simulation (REF-C2) is reduced to 0.25 ppmv at 10 hPa, which is about half of that in the simulation forced by the meteorological reanalysis data (REF-C1sd).
Compared with the past climatology of 1960-1980 at the time before the severe ozone destruction, the amplitude of the future equatorial ozone QBO during the period of 2040-2070 at the time of the ozone recovery is characterized by the decrease by 20-30% at 30 hPa and the increase by around 20% at 5-10 hPa. This can be explained by the fact that the dominant role of future ozone decrease in the lower stratosphere is due to the changes in tropical upwelling. In addition, it is found that chemical ozone production and destruction do contribute to the ozone changes in the tropical upper stratosphere.

キーワード：オゾンQBO、準二年周期振動、オゾン破壊と回復
Keywords: ozone QBO, quasi-biennial oscillation, ozone depletion and recovery

