Abstract Details

AOGS 1st Annual Meeting > Ocean and Atmospheres > Climatology and origin of small-scale vertical structures in stratospheric ozone >

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Title: Climatology and origin of small-scale vertical structures in stratospheric ozone

Abstract:

To understand the small-scale transport and mixing in the stratosphere which are not resolved by assimilated meteorological data, the climatology and origin of vertical structures of stratospheric ozone are investigated with the global data of the routine ozonesonde observation in the lower stratosphere and the optical ozonesonde data obtained in the upper stratosphere at Sanriku (39.16N, 141.83E), Japan. Vertical structures of ozone in the lower stratosphere can be attributed to dynamical processes, i.e. vertical advection and horizontal advection, since ozone lifetime exceeds several months in the lower stratosphere. A powerful method to distinguish between vertical advection and horizontal advection as the cause of ozone laminae is to investigate the correlation between the fluctuations of ozone mixing ratio and potential temperature. Positive correlation indicates that vertical advection is responsible for the ozone fluctuation, while no correlation means tha! t horizontal advection is responsible for the ozone fluctuation. In the midlatitude, there exists a distinct seasonal variation of the correlation with a maximum in late summer and a minimum in late winter. The results of the correlation coefficient, the mixing ratio variability and the gravity wave activity in the midlatitudes suggest that horizontal advection becomes active and overwhelms vertical advection in late winter, thereby lowering the correlation in this season. In the upper stratosphere, the contribution of vertical advection to ozone fluctuations is limited. Photochemical processes also cannot explain the observed ozone laminae. These results suggest that horizontal advection will be the principal process of creating ozone laminae structures in the upper stratosphere.

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