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EOF analysis of global tropospheric ozone fields: ENSO/PNA impact on atmospheric transport

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We investigate impacts of El Nino Southern Oscillation (ENSO) and Pacific/North American (PNA) pattern on distribution and transport of global tropospheric ozone. In this study, we determine major mode of interannual variability of tropospheric ozone using an EOF analysis of global ozone field for 1970-2006 simulated by a chemical transport model. We assess first mode of EOF spatial patterns (EOF1), corresponding principal component time series (PC1), and composite pattern based on PC1.

Leading mode of the interannual variability of global tropospheric column ozone (TCO) correlates with Nino3 index well. EOF1 pattern of global TCO shows positive anomalies (1-3 DU) in the tropical western Pacific including Indonesia and in the subtropics over the central to eastern Pacific. In the tropical western Pacific, most of the TCO change is explained by the change in O₃ transport in response to the Walker circulation and convective changes. On the other hand, changes in tropopause height and O₃ transport both contribute to the TCO changes (about 50% and 50%, respectively) in the subtropics over the central to eastern Pacific. The changes in tropopause height and O₃ transport are associated with changes in local Hadley cell and subtropical jet stream in this region.

Focusing on the vicinity of North America, PNA dominates interannual variability of tropospheric ozone. TCO increases by about 2-3 DU in the south part of America, and decreases by about 1 DU in the North East Pacific during positive phase of PNA. While the TCO increase is attributed to the combination of changes in tropopause height and O₃ transport (contributions are about 50% and 50%, respectively), the TCO decrease is caused by the change in tropopause height.

Keywords: tropospheric chemistry, transport process, El Nino-Southern Oscillation, teleconnection