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Influence of meteorological variability on interannual variations of springtime boundary layer ozone over Japan during 1981–2005

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Abstract. We investigated the influence of meteorological variability on the interannual variation of springtime boundary layer ozone over Japan during 1981–2005 by multiyear simulations with the Models-3 Community Multiscale Air Quality (CMAQ) modeling system and the Regional Emission Inventory in Asia (REAS). CMAQ/REAS generally reproduced the observed interannual variability of springtime ozone over Japan, showing year-to-year variations larger than the annual rate of increase of the long-term trend. We then analyzed the influence of the interannual variation of meteorology in simulated results by using the fixed emissions for 2000 and meteorological fields for each year. As a reference parameter, we calculated the area-weighted surface pressure anomaly over the Pacific Ocean east of Japan. When the anomaly has a large negative value, polluted air masses from continental Asia tend to be transported directly to Japan by westerly winds. In contrast, when the anomaly has a large positive value, influence of the outflow from continental Asia tends to be small because the westerly components of wind fields around Japan are comparatively weak. Instead, southerly winds are relatively strong and transport clean air masses from the Pacific Ocean to Japan. Consequently, springtime ozone over Japan is higher (lower) than in ordinary years when the anomaly has a large negative (positive) value. In general, the interannual variation of springtime ozone over Japan is sensitive to the outflow from continental Asia. We also found some correlation between springtime ozone over Japan and the El Niño-Southern Oscillation, indicating that higher and lower springtime ozone over Japan are related to La Niña and El Niño, respectively. Differences in the meridional displacement and diversity of cyclone tracks near Japan between El Niño and La Niña years may be responsible for interannual variations in the springtime boundary layer ozone over Japan.

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