

Interannual variations of tropospheric ozone in eastern China: the key role of transport

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We quantify the interannual variations (IAVs) of tropospheric O₃ over China for years 1986-2012 by using the global three-dimensional Goddard Earth Observing System chemical transport model (GEOS-Chem). With variations in both meteorological parameters and emissions, simulated seasonal mean surface-layer O₃ concentrations over North China (NC, 110-120°E, 32-42°N), South China (SC, 110-120°E, 22-32°N), and Sichuan Basin (SCB, 102-110°E, 27-33°N) show large IAVs; the deviations from the mean are in the range of -7.0% to +7.5%, -6.0% to +6.0%, and -9.6% to +7.0% over NC, SC, and SCB, respectively. The IAVs in surface-layer O₃ by variations in meteorological fields are simulated to be larger than those by variations in anthropogenic emissions. Process analyses are performed to identify key meteorological parameters that influence the IAVs of O₃. Over NC and SC, transport flux and chemical production are found to be the first and second important processes that drive the IAVs of O₃ throughout the year, with relative contributions of, respectively, 46-52% and 28-34% over NC and 59-63% and 16-21% in SC. Over SCB, transport is the most dominant process that leads to the IAVs of O₃, with high relative contributions of 58-87% throughout the year. Our results have important implications for the effectiveness of short-term air quality control strategies in China.

Keywords: Tropospheric ozone, Transport, Interannual variations, Eastern China, Process analysis