

Sources of tropospheric ozone along the Asian Pacific Rim: An analysis of ozonesonde observations

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Abstract

The sources contributing to tropospheric ozone over the Asian Pacific Rim in different seasons are quantified by analysis of Hong Kong and Japanese ozonesonde observations with a global 3-D chemical transport model (GEOS-CHEM) driven by assimilated meteorological observations. Particular focus is placed on the extensive observations available from Hong Kong in 1996. In the middle/upper troposphere (MT/UT), maximum Asian pollution influence along the Pacific Rim occurs in summer, reflecting rapid convective transport of surface pollution. In the lower troposphere (LT), the season of maximum Asian pollution influence shifts to summer at midlatitudes from fall at low latitudes due to monsoonal influence. The UT ozone minimum and high variability observed over Hong Kong in winter reflects frequent tropical intrusions alternating with stratospheric intrusions. Asian biomass burning makes a major contribution to ozone at $<32^{\circ}\text{N}$ in spring. Maximum European pollution influence ($<5\text{ppbv}$) occurs in spring in the LT. North American pollution influence exceeds European influence in the UT/MT, reflecting the uplift from convection and the warm conveyor belts over the eastern seaboard of North America. African outflow makes a major contribution to ozone in the low-latitude MT/UT over the Pacific Rim during November-April. Lightning influence over the Pacific Rim is minimum in summer due to westward UT transport at low latitudes associated with the Tibetan anticyclone. The Asian outflow flux of ozone to the Pacific is maximum in spring and fall, and includes a major contribution from Asian anthropogenic sources year-round.

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