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Regional pollution and long-range transport to the Asia-Pacific region

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Thirty three years (1970-2002) of ozonesonde data from Sapporo, Tsukuba, and Kagoshima and thirteen years (1990-2002) of data from Naha have been analyzed using a sectoral air-mass classification based on back-air trajectories. Air-masses from "Regionally Polluted", "Eurasia", Pacific, and Japan regions were tagged with daily ozone values at each of the four sites. Two major pathways influencing the Asia-Pacific region are identified, one from China and the other from Eurasia. Outflow from China mainly affects the subtropical Pacific region, whereas "Eurasian" air-masses have a major influence in the mid-latitude Pacific region. Both these pathways are weaker in summer, when the Pacific air-masses dominate, than in winter or spring.

Ozone in "Regionally Polluted" air-masses shows a broad maximum in spring and summer due to intense photochemistry in the East Asia and a minimum in winter, while ozone in other air-masses shows a maximum in spring and minimum in summer. In the lower troposphere, "Regionally Polluted" air-masses from northern China show higher ozone levels in summer than those from southern China. Based on this regional analysis, we conclude that Kagoshima is the best ozonesonde site available for studying air-masses from both northern and southern China throughout the year.

Ozone levels in northern Japan are determined mainly by "Eurasian" air-masses and show a broad maximum in spring and summer. The boundary layer ozone levels in the "Regionally Polluted" air-masses are 10-12 ppbv higher throughout the year than in the "Eurasian" air-masses and in winter they are about 8 ppbv higher than over Europe. Ozone levels in the "Regionally Polluted" air-masses show a very large increase (up to 24.2±3.8 ppbv, 64%) in summer and a change in seasonal pattern between 1970-1985 and 1986-2002 over southern Japan (Figure 1) and this is attributed to the large increase in NO_x emissions over China in the 1990s. During the 1990s, the wintertime positive trend (0.2-0.4 ppbv yr^{-1}) in lower tropospheric ozone in the "Eurasian" air-masses at Sapporo is suggested to be due to the intercontinental transport from

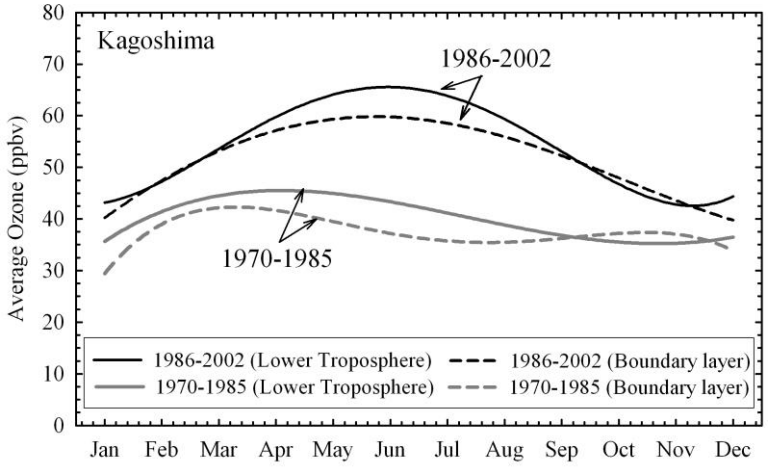

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Figure 1. Changes in ozone levels and seasonal variations between 1970-1985 and 1986-2002 in "Regionally Polluted" air-masses arriving at southern Japan.