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Meteorological impacts on eastern Asia surface ozone during 1996-1998

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1. Introduction

Many observations show that the seasonal cycle of surface ozone has a spring maximum and summer minimum at many remote sites in East Asia. But in the northwest of china (eg. Waliguan station, 100.9°E 36.3°N), measurement shows ozone has summer maximum and winter minimum. In this study, The East Asia surface ozone seasoanl variations is researched by a regional scale chemical transport model (RAPMS), which initial and boundary condition of chemical species (O3, CO, and some long life VOCs) obtained from a coupled global chemistry-climate model CHASER. Also, the El Nino event (1997-1998) impacts on the surface ozone interannual variations are evaluated.

2. Model Validation

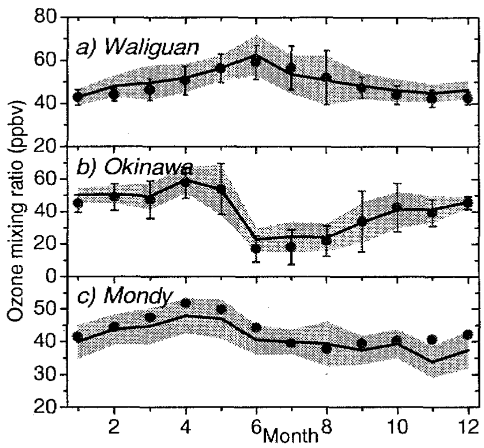

Figure 1. Monthly-averaged surface ozone at several sites.

In general, our RAPMS reproduces well the O3, CO daily and seasonal variations caused by large scale atmospheric transport and photochemical reactions

3. Surface ozone seasonal cycles

In the most rural and remote East Asian Pacific rim regions, O3 has a spring maximum and summer minimum. High O3 in spring comes from continental outflow and active photochemistry. In contrast with other observational sites, the seasonal variation of ozone has a summer maximum and winter minimum at Waliguan station, northeast of the Tibetan Plateau. It is concluded that the seasonal conversions associated with the Asian monsoon system and transport from eastern/central China, southern/central Asia and even Europe are significantly responsible for the distinct ozone seasonal cycles.

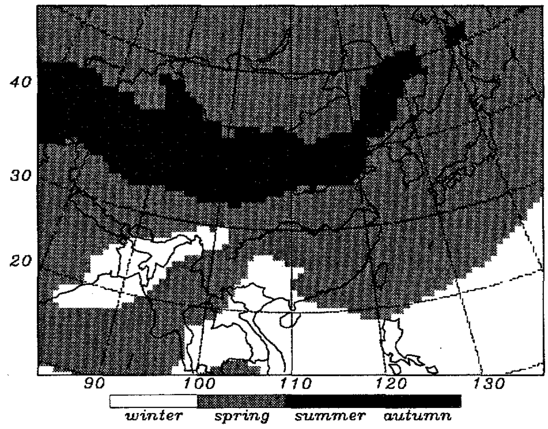

Figure 2. the appearing season of maximum monthly-averaged ozone in 1996.

4. Surface ozone interannual variations: 1997-1998

Although mid-latitude climate has weaker responds to ENSO events in contrast to tropic zone, some researches indicate that the cycles of the East Asia winter and summer monsoons are significantly influended by the El Niño (La Niña) events. In the winter preceding an El Niño (Jan. 1997), there are anomalies northlies over East Asia, which result in higher ozone than Jan. 1998 over south of 30oN by increasing continent outflow. In the summer during the developing phase of an El Niño (Jun. 1997), the western subtropical Pacific high and southwesterlies tend to be weak, which result in higher ozone by decreasing marine air masses intrude with low background ozone. Compare with summer 1998, the total cloud cover ratios are much lower in some regions in 1997, corresponding well with the higher net ozone photochemical production in these regions.

5. Concluding remarks

These ozone seasonal cycles features can be well explained by the seasonal change of atmospheric circles (Asia monsoon) and photochemistry.

The differences of ozone distribution and transport patterns year to year are significantly controlled by meteorology and meteorological factors combined with atmospheric chemistry processes, e.g., Asia monsoon interannual variations, El Nino event impacts, cloud effects on photochemistry.