Seasonal and spatial distribution of surface ozone over China: contributions from background and domestic pollution

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Topography of China

Observations
4 surface sites
3 mountain sites
TRACE-P
TES O₃ column
Motivation

• Understanding spatial (regional scale) and temporal (seasonal) distribution of surface O$_3$
• Origins of surface O$_3$: relative contributions of background (natural and pollution) and ‘domestic anthropogenic’ ozone over China
• Limited surface observations shows that surface ozone features a distinct summertime trough in East China. Why?

Approach

Use the model to decompose O$_3$ into contributions from different sources and examine their distribution and seasonality

v8-02-01, 0.5x0.667 nested-grid, 2006 meteorology (2001 for TRACE-P)
Model comparison with observations

Mondy site (upwind of China)

(a) Seasonal variations of O₃ at Mondy
(b) Seasonal variations of CO at Mondy

NW Pacific

TES trop. O₃ column

(a) East China TES trop. O₃ column
(b) West China TES trop. O₃ column
**Model comparison with observations**

1. Summertime trough in surface ozone
2. Month of peak ozone differs by region
3. Model reproduces observations
Spatial Distribution

West China (WC) and NEC: Global background dominates in the overall ozone burden.

North China (NC) and South China (SC): Domestic pollution is important.

(above: annual mean model results; note different color scales)
Seasonal distribution by region

**total ozone**  **total background**

**Western China**

**NE China**
Seasonal distribution by region

Summertime trough in surface ozone a regional feature

Background ozone reduced by 15-20 ppbv in summer due to monsoon influence

No summertime trough in domestic ozone; it peaks in Aug in NC, in Sep in SC
Origin of background ozone

Tagged ozone tracers:

- Summer minimum of ozone from Northern middle latitudes
- Summer maximum of ozone from Southeast Asia

Important role of seasonal switch in monsoonal circulation on background ozone
Summary

• Spatial distribution of surface ozone over China is determined by background ozone over West and Northeast China and domestic anthropogenic ozone over East China.

• Summertime O$_3$ trough over East China can be attributed to reduced background rather than reduced domestic O$_3$ production, as southerly summer monsoon reduces long-range transport of O$_3$ from northern mid-latitudes.

Wang et al., Atmos. Chem. Phys., 11, 3511–3525, 2011