Characterizing the Asian Tropopause Aerosol Layer (ATAL) using satellite observations, balloon measurements and a chemical transport model

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Transport of pollution in the Upper Troposphere by Asian Monsoon

ATAL 2015: Balloon-borne measurements of the ATAL

Model comparison with MIPAS SO2 and CALIOP scattering ratio (SR) improved with updated treatment for SO2 scavenging in convective updrafts

Summary

ATAL observations have revealed a seasonal maximum of aerosol in the UTLS associated with the Asian monsoon. The Asian Tropopause Aerosol Layer (ATAL) has been independently validated using backscatter swaths flown out of China and from India.

Limited in situ measurements of composition (CARIBIC) indicate that the ATAL is composed primarily of carbonaceous and sulfate aerosol. Elevated SO2 (~30 ppt) found in monsoon outflow in the UTLS (in HALO EMIS campaign).

Summary continued

Balloon observations (ATAL 2015) reveal ATAL aerosols near the cold point tropopause, often in vicinity of ice cloud and elevated water vapor.

ATAL observations show improved comparison with MIPAS SO2 and CALIOP backscatter with updated treatment of wet scavenging of SO2 in deep convective updrafts.

Model indicates dominant contribution of regional sources of SO2 and OC (~70-80%) in ATAL composition, compared with rest-of-world contributions.

ATAL observations to regions of deep convection (BT<20K from Kalatana);

Map of mean trajectory mapped CALIPSO SR (AOD) sourced to deep convection. 1–5 Aug, 2006, indicates Northern Asia as key deep convective source for elevated aerosol in the ATAL.

Contributions from Indian and Chinese sources, with % contributions (white contours). Model indicates a dominant (>40%) contribution from Indian emissions to ATAL in July 2008; Chinese emissions (20–30%) remain largely outside the anticyclone in this episode; rest-of-world emissions (not shown) found to contribute <20% to ATAL. These contributions change with transeover of the ATAL anticyclone.


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