

Supplement of Atmos. Chem. Phys., 20, 1507–1529, 2020  
<https://doi.org/10.5194/acp-20-1507-2020-supplement>  
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*Supplement of*

## **Modeling dust sources, transport, and radiative effects at different altitudes over the Tibetan Plateau**

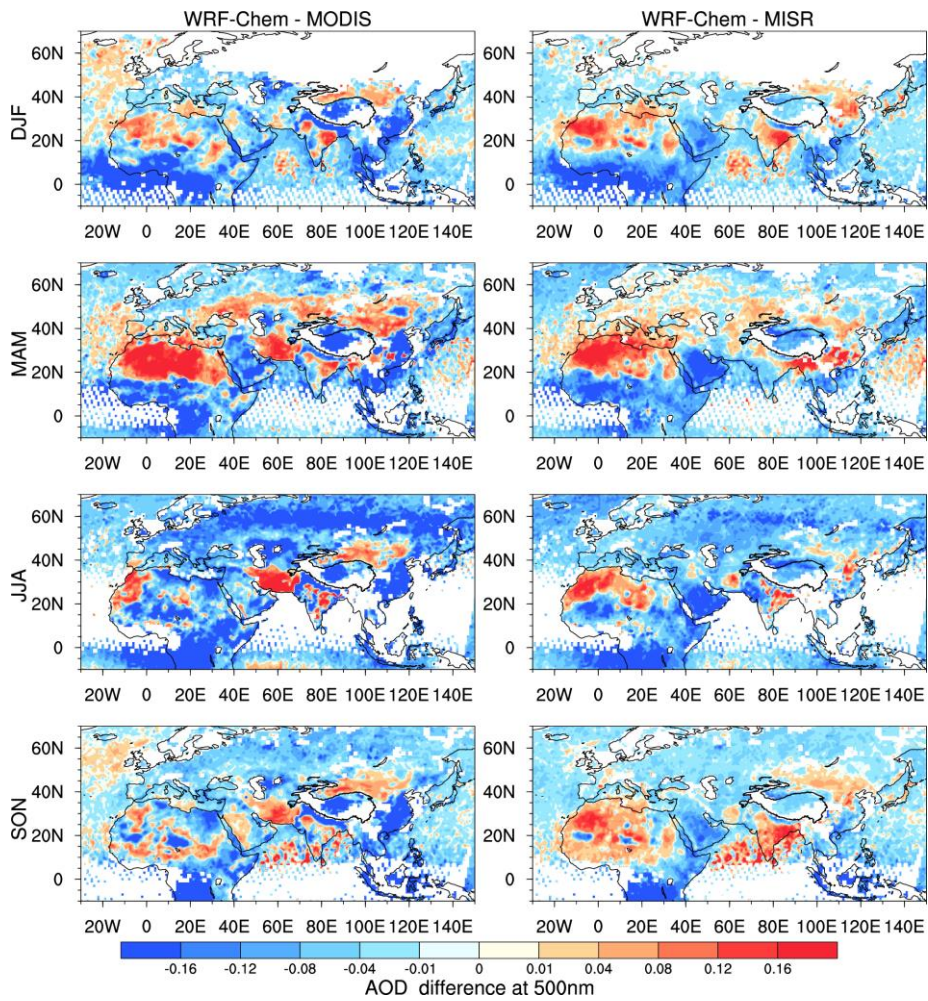
**Zhiyuan Hu et al.**

*Correspondence to:* Jianping Huang ([hjp@lzu.edu.cn](mailto:hjp@lzu.edu.cn))

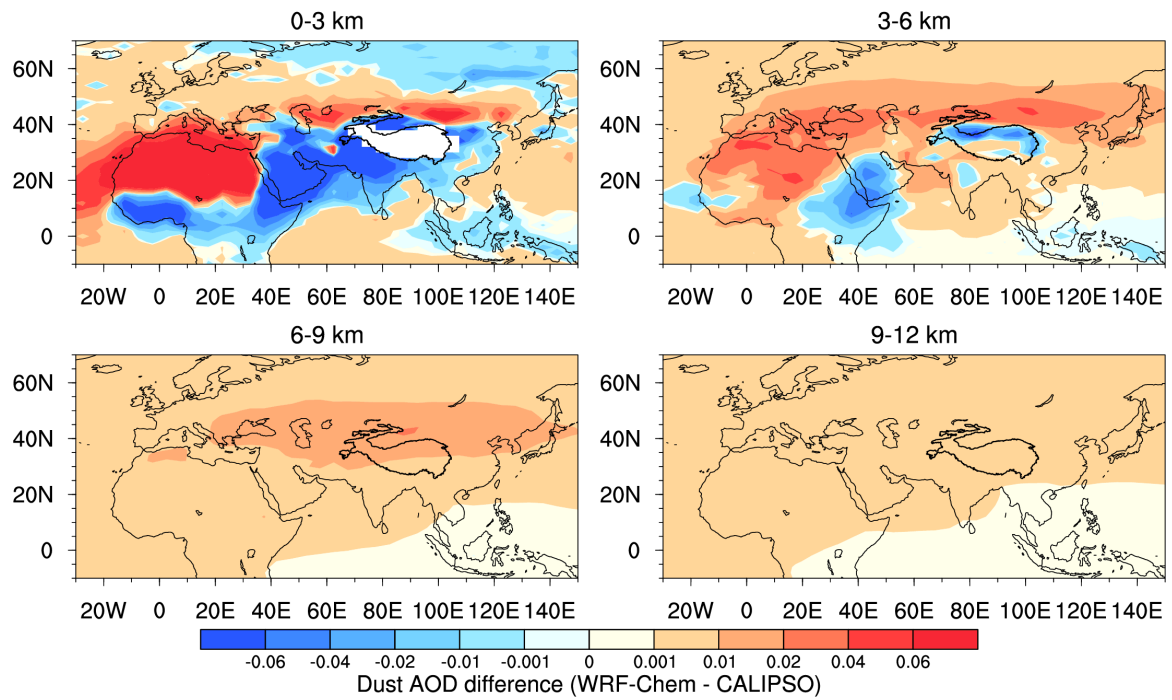
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## **Emissions:**

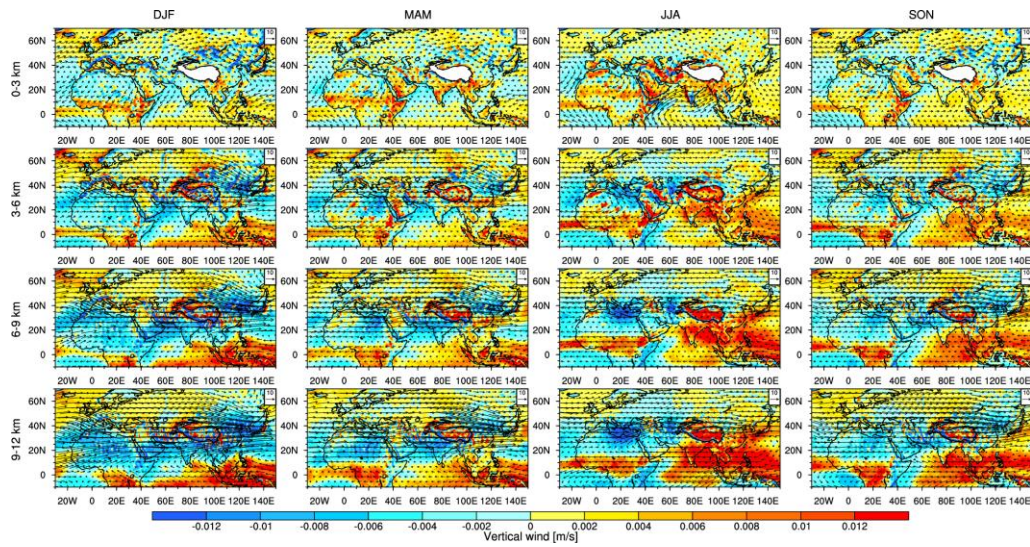
The HTAP\_V2 dataset consists of CH<sub>4</sub>, CO, SO<sub>2</sub>, NO<sub>x</sub>, NMVOC, NH<sub>3</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, BC and OC. The anthropogenic gases are CH<sub>4</sub>, CO, SO<sub>2</sub>, NO<sub>x</sub>, NMVOC and NH<sub>3</sub>, and the aerosol particles are PM<sub>10</sub>, PM<sub>2.5</sub>, BC and OC. For the anthropogenic gases, the CH<sub>4</sub>, CO, SO<sub>2</sub>, NO<sub>x</sub> and NH<sub>3</sub> can be mapped directly to the CBMZ-MOSAIC species. However, the NMVOC emissions are calculated for 23 VOCs species, using the VOCs breakdown that was generated by the TNO (boxlat1). Also, The RETRO ratios are applied to HTAPv2 total NMVOC emissions files for the five HTAPv2 sectors (Power, Industry, Transport, Residential, Agriculture), for which individual VOC can be calculated. More details on the HTAPv2 VOCs breakdown are available online at: <http://iek8wikis.iek.fzjuelich.de/HTAPWiki/WP1.1?highlight=%28%28WP1.1%29%29>. Moreover, the aerosol particles (include PM<sub>10</sub>, PM<sub>2.5</sub>, BC and OC) can be mapped directly to the MOSAIC species.



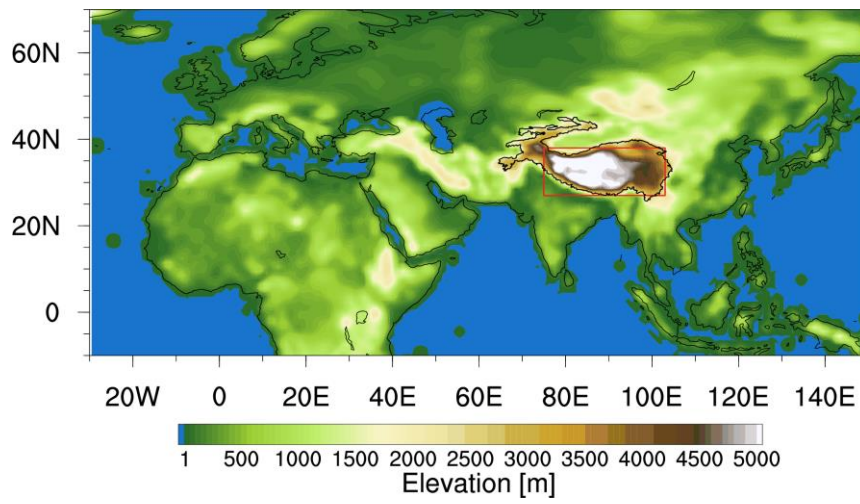
**Figure S1.** Spatial distributions of seasonal mean AOD difference at 550 nm from the retrievals of MODIS and MISR onboard Terra and the WRF-Chem simulation for the period of 2010–2015. The daily results from MISR, MODIS, and WRF-Chem are only sampled for averaging when all of them have valid values at the same location and time.



**Figure S2.** Spatial distributions of annual mean dust AOD difference from CALIPSO and WRF-Chem between 0–3 km, 3–6 km, 6–9 km, and 9–12 km for the period of 2010–2015.



**Figure S3.** Seasonal mean wind field between 0–3 km, 3–6 km, 6–9 km, and 9–12 km from WRF-Chem simulations for the period of 2010–2015. The arrows indicate the horizontal wind (m/s). The colors indicate the vertical wind velocity (m/s) and positive values are for updrafts and negative values are for downdrafts.



**Figure S4.** Spatial distribution of annual elevation (m) simulated in WRF-Chem for the period of 2010–2015.