Figure S1 is the daily distribution of AOD at 550nm at 13:00 from MODIS observations and the corresponding model results from the EXP-CTL case from 6~17 January 2013 over the North China Plain (NCP). In Fig. S1, comparing with MODIS retrievals, the model may underestimate AOD, although there is many missing data from MODIS retrievals. Seen in Fig. 2(a), MODIS tends to overestimates AOD comparing with AERONET. Some previous studies (Ge et al., 2010; Prasad and Singh, 2007, Diner et al., 2005; Li et al., 2009, Wu et al., 2014) also indicated that MODIS retrieved AOD significantly depended on both the aerosol type and the underlying surface type and had large uncertainties. Even though model results could reproduce the more pollutants over the south part of Hebei Province and the evolution of AOD values during the fog-haze period: the event starts from 10 January, when the AOD increases a lot over Beijing, Tianjin and Hebei province. After that, the value of AOD continues to increase during 11 January. Both model results and MODIS retrievals show the decrease of AOD on 12 January and the increase on 13 January. On 14 January, AOD begins to decrease over Beijing but maintains a high value over south of Hebei province.

The Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) onboard the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite

Observations (CALIPSO) provides aerosol vertically resolved extinction and depolarization ratio (Winker et al., 2007; Huang et al., 2007). CALIPSO 532 nm extinction coefficient (Winker et al., 2009) is used to evaluate model results. The horizontal resolution is 5 km and the vertical resolution is 60 m below and 180 m above 20 km, respectively. Figure S2 is the altitude-orbit cross-section of 532 nm aerosol extinction coefficient from CALIPSO and the modeled aerosol extinction coefficient at 532nm from EXP_CTL at 02:00 11 January, 13:00 11 January, 02:00 13 January, 13:00 13 January, 02:00 15 January and 13:00 15 January (local time). The model results are sampled at the time and location of CALIPSO orbit. The simulated aerosol extinction coefficient at 532nm is calculated by using the default output AOD and Angstrom exponent derived from the output AODs at 400nm and 600nm. As seen in Fig. S2, model can capture the vertical distribution and the evolution of aerosol extinction coefficient during the fog-haze period by comparing with CALIPASO retrievals. Both model results and CALIPSO retrievals show that the high value of extinction coefficient is near the surface below 1 km indicating that the particles mainly concentrate below 1 km. Model also reproduces the shift of pollutant from south (between ~32°N and 34°N) to north (between 37°N and 40°N) from 11 January to 13 January.

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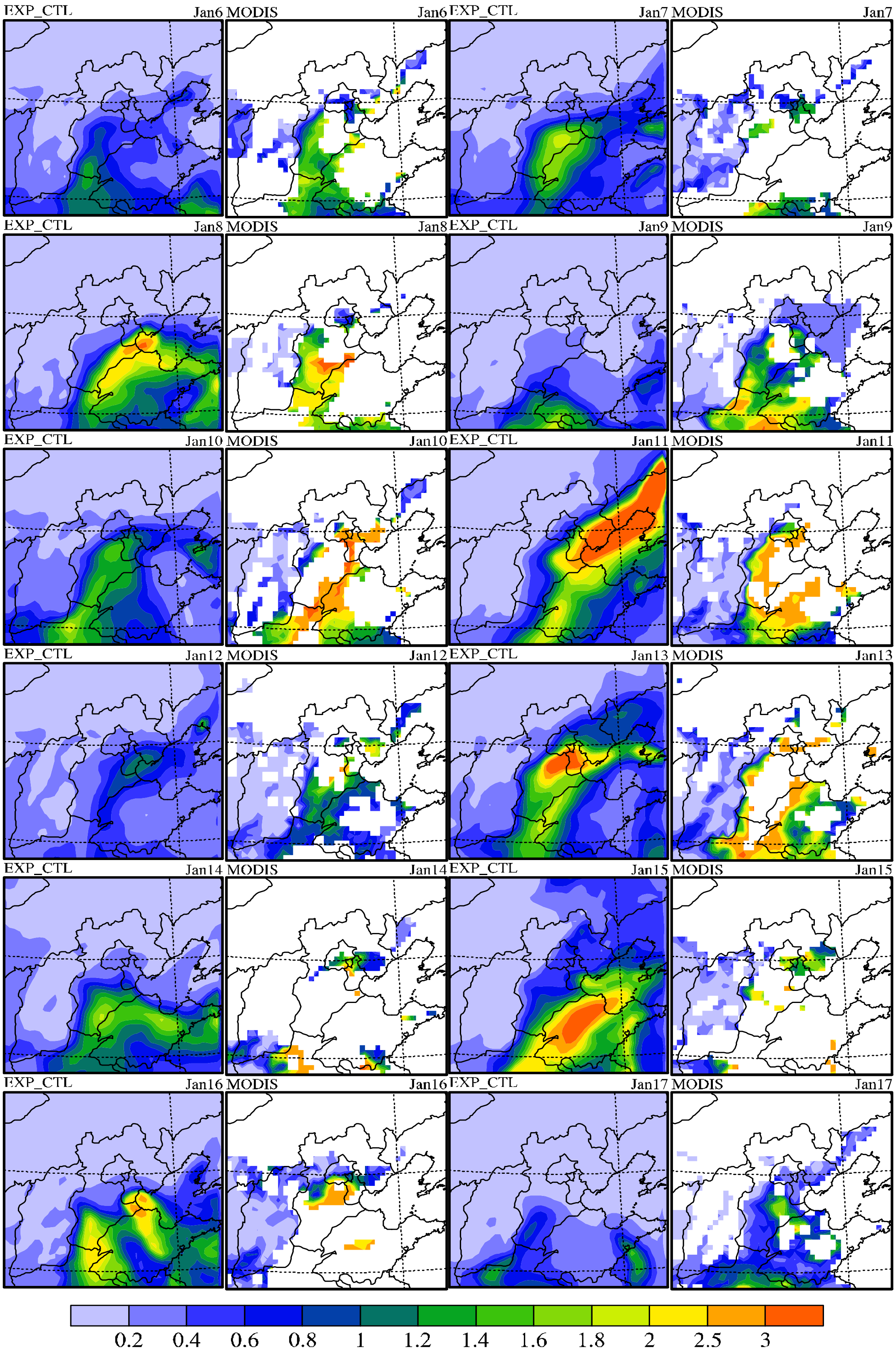

Figure S1. Daily distribution of AOD at 550nm at 13:00 from MODIS observations and the corresponding model results from the EXP-CTL case from 6~17 January 2013 over the North China Plain (NCP).

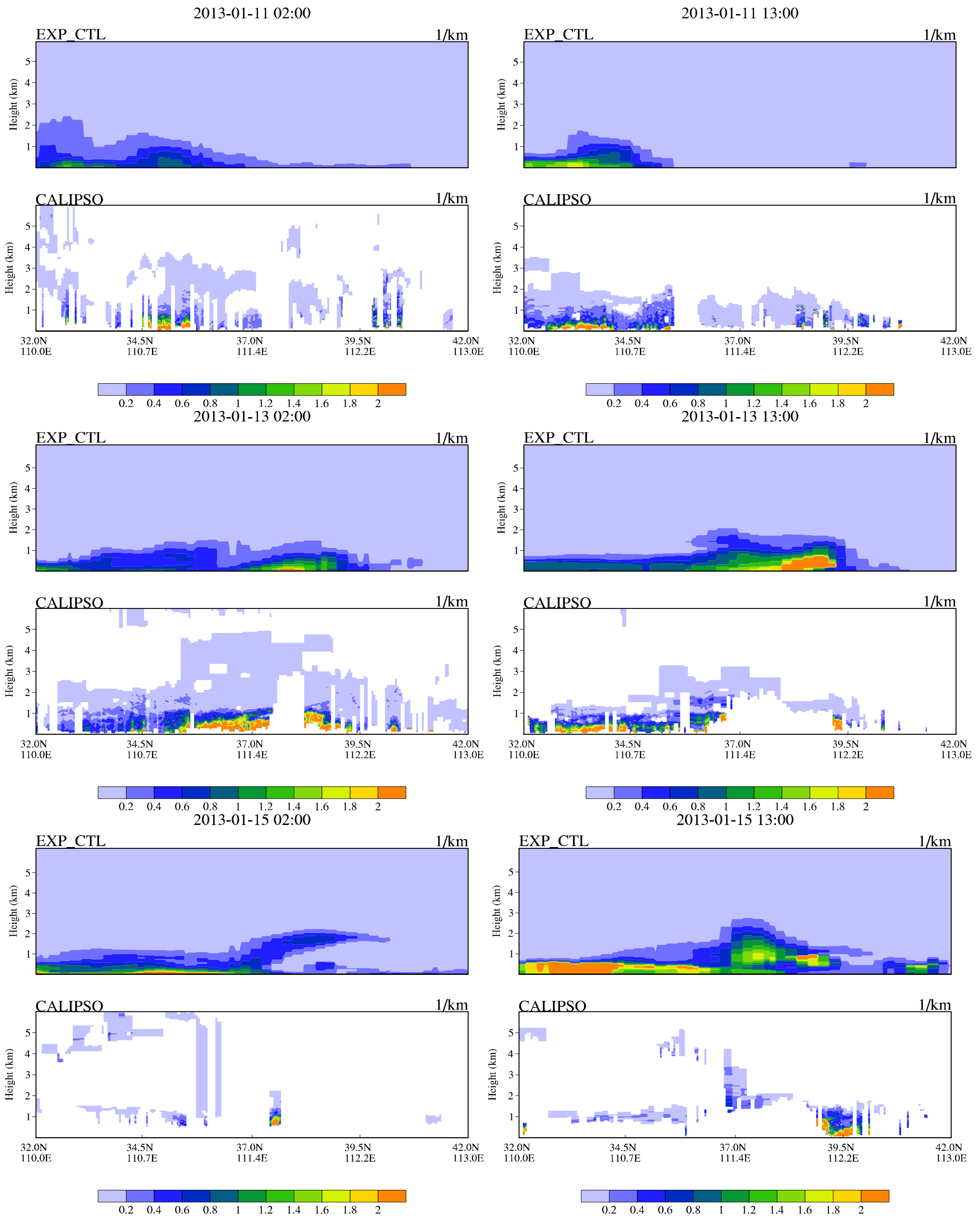

Figure S2. The altitude-orbit cross-section of 532 nm aerosol extinction coefficient from CALIPSO and the modeled aerosol extinction coefficient at 532nm from EXP_CTL at 02:00 11 January, 13:00 11 January, 02:00 13 January, 13:00 13 January, 02:00 15 January and 13:00 15 January (local time). The model results are sampled at the time and location of CALIPSO orbit.