Supporting information

Lidar vertical observation network and data assimilation reveal key processes driving the 3-D dynamic evolution of $PM_{2.5}$ concentrations over the North China Plain

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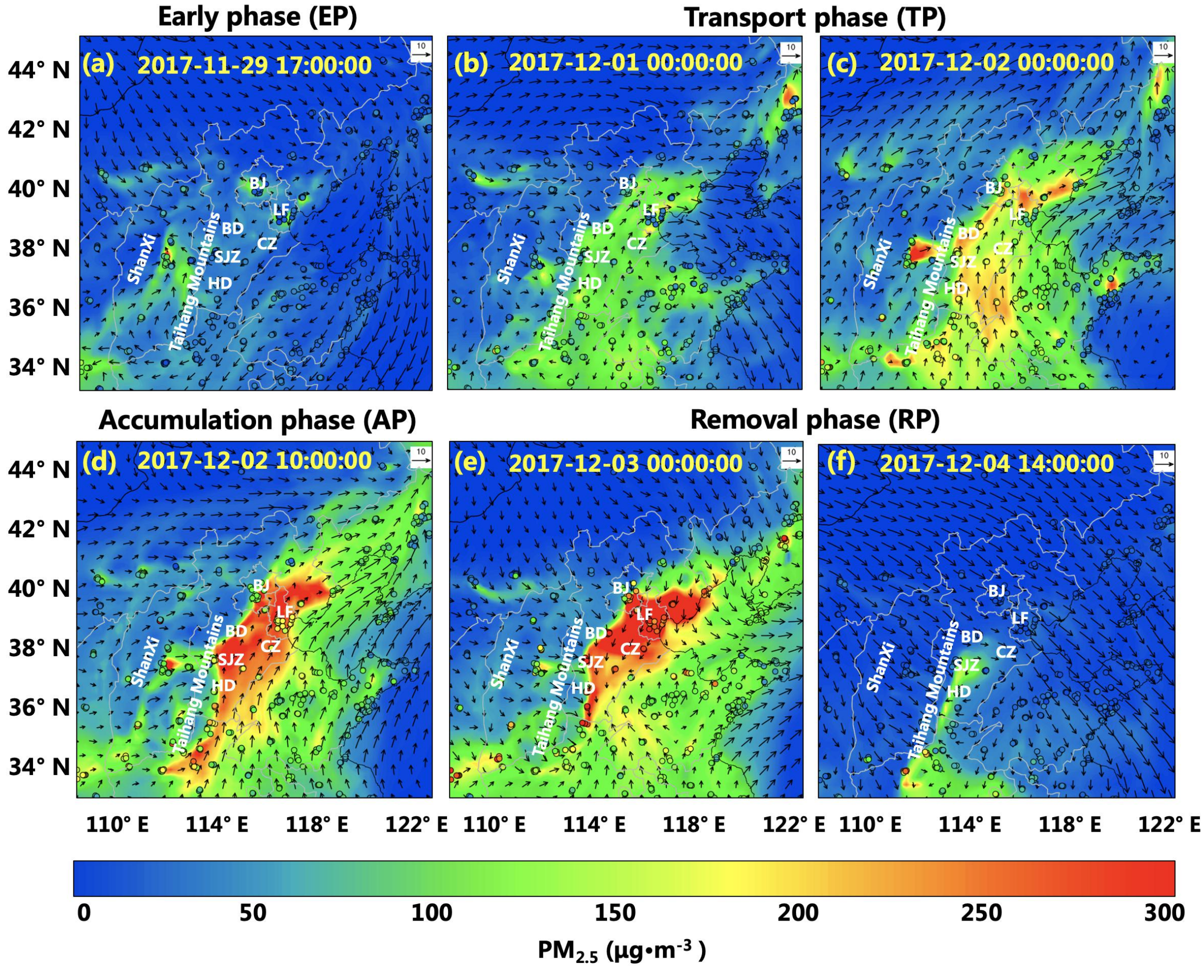

Figure S1. Spatial distribution of $PM_{2.5}$ in the surface layer during different phases without assimilation. The black arrows indicate the wind direction. The circles represent the *in-situ* surface observations.

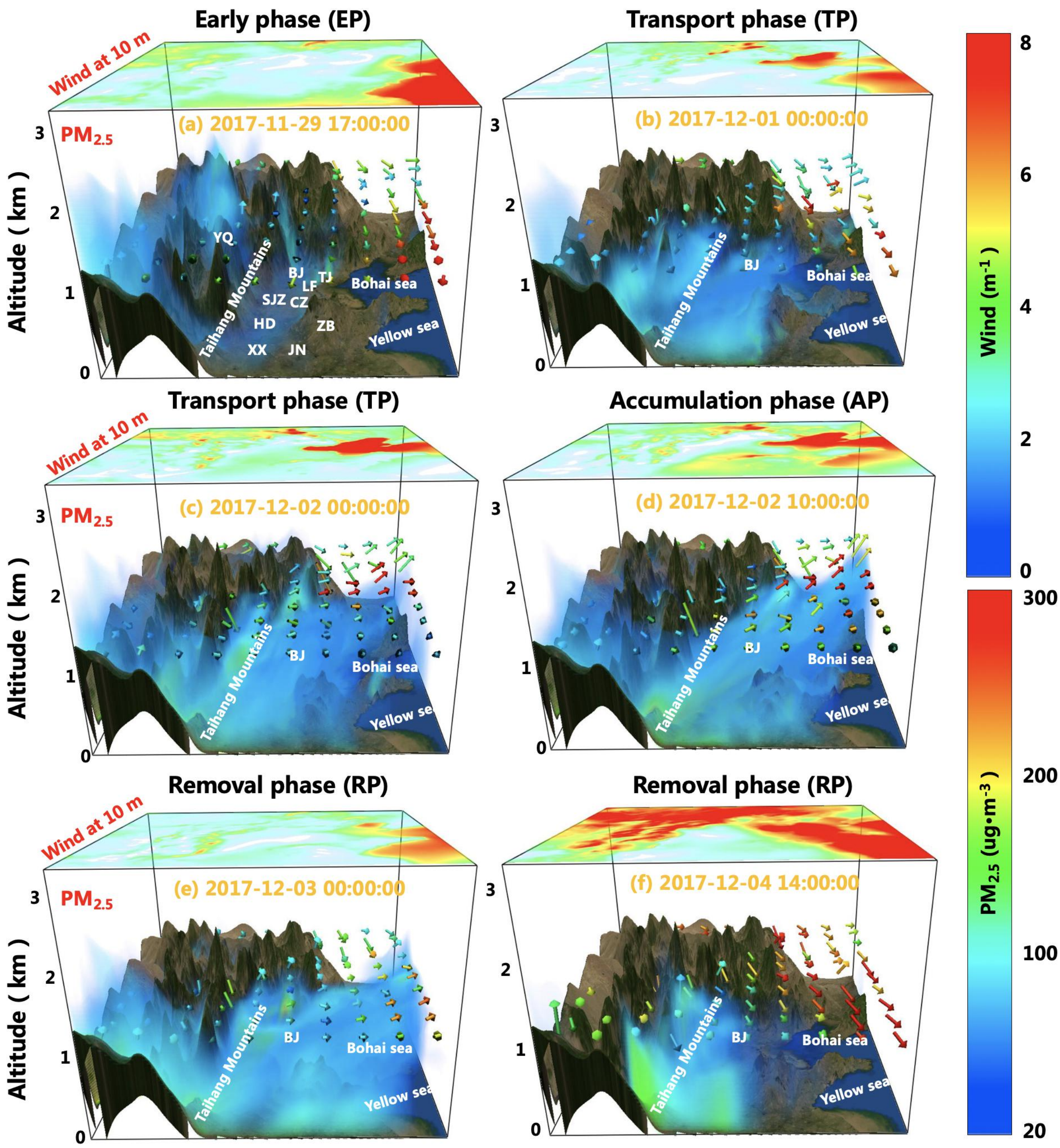

Figure 2. Three-dimensional distribution of $PM_{2.5}$ during different phases without assimilation. Colors within the boxes depict the $PM_{2.5}$ concentrations. The color-coded arrows represent the wind direction and speed at 1 km. On the tops of the boxes, the spatial distributions of wind speed at 10 m are plotted.

Table S1. Configurations of WRF-Chem

Physics	WRF options
Microphysics	Lin scheme (Lin et al., 1983)
Longwave radiation Shortwave radiation	RRTMG scheme (Mlawer et al., 1997)
Land surface	Noah land surface scheme (Ek, 2003)
Boundary layer scheme	Yonsei University scheme (Hong, 2010)
Cumulus parameterization	Grell-Freitas ensemble scheme (Grell and Dévényi, 2002)
Chemistry and aerosol	**Chem options**
Aerosol module	MOSAIC (Zaveri et al., 2008)
Gas-phase mechanism	CBM-Z (Zaveri and Peters, 1999)

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