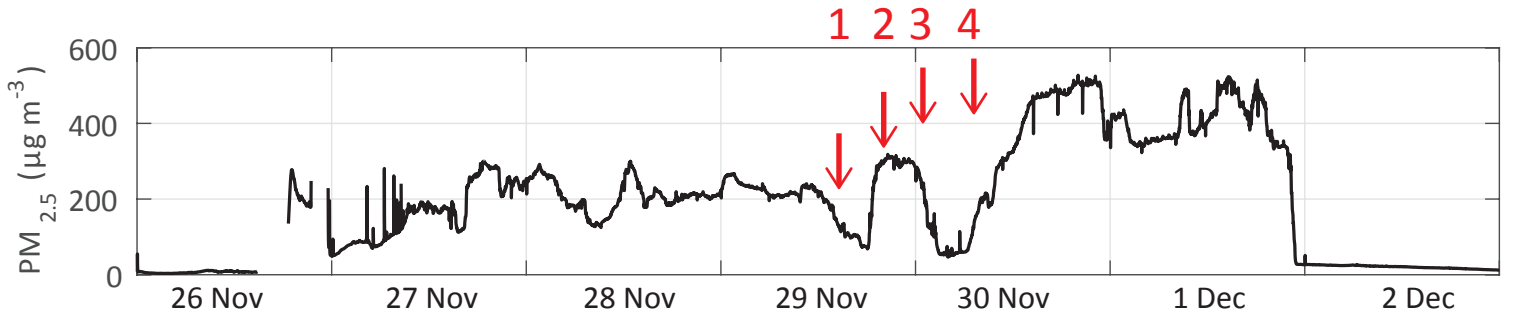
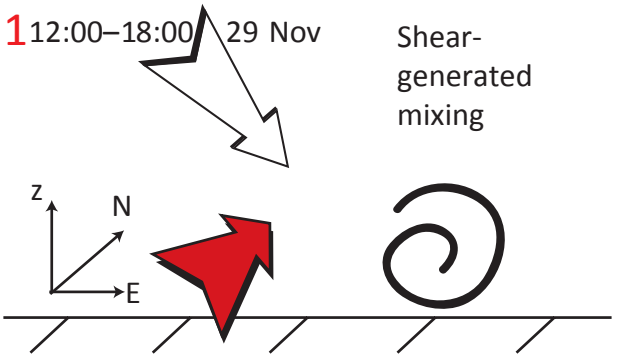
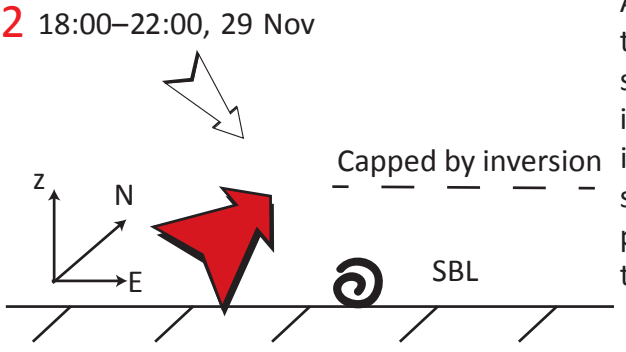
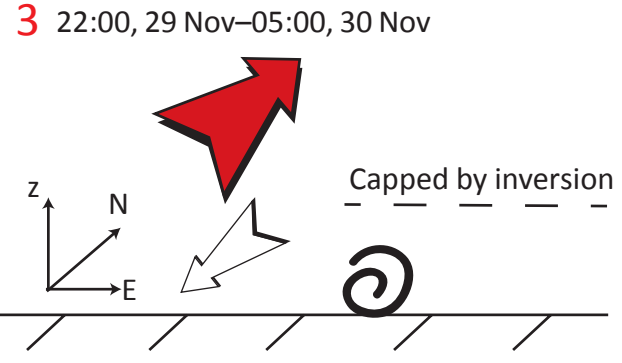




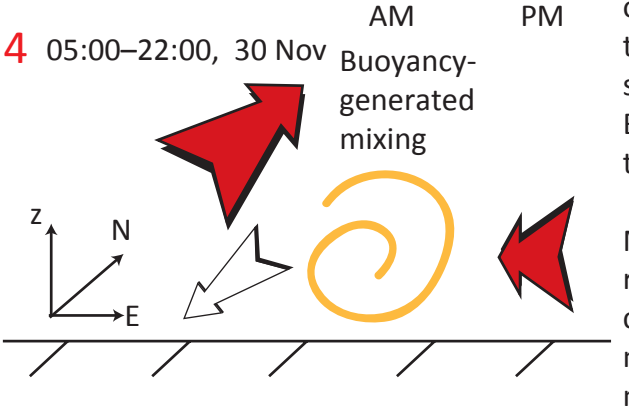
Around noon, the upper-level northwesterly wind speed increased. The shear-generated turbulent mixing transported the local polluted air upward and the less polluted air from northwest downward, leading to the decrease in $PM_{2.5}$.



After sunset, the near-surface layer became very stable after the relatively strong heating during the daytime. As a result of the stable stratification, the reduced wind led to the reduced turbulence in the SBL. Meanwhile the surface northwesterly wind under the influence of the northwest downslope wind started to change to southwesterly. The southwesterly surface wind transported the polluted air into Beijing. The weak turbulent mixing in the SBL limited the vertical dilution of the pollutant, leading to the $PM_{2.5}$ increase.



Around midnight on 29 Nov., the downslope surface wind became stronger; the surface wind became northeasterly in the early morning. Both brought relatively clean air to the SBL. Meanwhile, the wind above ~ 500 m switched to southwesterly. Because the SBL decoupled the rough surface from the air above the SBL, the accelerated air flow advected the polluted air over Beijing. The SBL prevented the polluted air from reaching to the surface.



After sunrise, buoyancy-generated turbulent mixing transported the elevated high aerosol air downward, leading to the large initial increase of $PM_{2.5}$ in the morning. Meanwhile, the convective mixing kept transporting the heavily polluted air south of Beijing upward, the southwesterly above the PBL kept transporting the polluted air over Beijing, and the convective mixing kept mixing the polluted air downward to the surface, leading the continuous increase of the surface $PM_{2.5}$.

Meanwhile the $PM_{2.5}$ east of Beijing, where the surface $PM_{2.5}$ was not reduced by the nighttime downslope flow, was also enhanced by the convective mixing from the polluted air above. As the high $PM_{2.5}$ air northeast of Beijing was enhanced higher than that in Beijing, the surface northeasterly also contributed to the $PM_{2.5}$ increase in Beijing.