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Potential feedback between aerosols and meteorological conditions in a heavy pollution event over the Tibetan Plateau and Indo-Gangetic Plain

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A regional climate model WRF-Chem was used to investigate the feedback between aerosols and meteorological conditions in atmospheric boundary layer over the Tibetan Plateau (TP) and Indo-Gangetic Plain (IGP). The numerical experiments with and without the aerosol effects are driven by reanalysis from March 1-31, 2009, when a heavy pollution event (March 13-19) occurred. Results showed that the model can capture the spatial and temporal meteorological conditions and aerosols optical characteristics during the heavy pollution days. Aerosols induce cooling at the surface and warming in the middle of troposphere due to their radiative effects, and result in the atmospheric boundary layer (ABL) trend to more stable over the IGP. Aerosols-induced 2-meter relative humidity (RH2) is increased, which superposes the stable ABL lead to the surface PM2.5 concentration increases by up to 21 ug m-3 (15%) over the IGP. For the TP, the atmospheric profile does not change too much due to the fewer aerosols' radiative effects in the ABL comparing to those over the IGP. The aerosols-induced RH2 decreases because of the cloud albedo and cloud lifetime effect and leads to the surface PM2.5 concentration reduce up to 17 ug m-3 (13%). It is implicated that a negative/positive feedback between aerosols concentration and changes of aerosol-induced meteorological conditions over the TP/IGP, which is like/unlike the situations in other heavy polluted regions (e.g., the North China Plain). The results have a potential implication of air pollution on weather and environment over the TP and IGP.