Transport of pollutants from eastern Colorado into the Rocky Mountains via upslope winds

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Abstract. The confluence of mountain meteorology and major pollution sources come together to transport pollutants across the Front Range, especially nitrogen species (NH_3, NH_4^+, orgN, NO_3^-, and HNO_3) from agricultural and urban regions, into the Rocky Mountains. The focus of this study was to examine the meteorological conditions in which atmospheric wet deposition of inorganic nitrogen in the Rocky Mountains was anomalously high. We analyzed 19 years (1994-2013) of precipitation and concentrations of wet inorganic nitrogen data from three National Atmospheric Deposition Program (NAPD) sites in the Rocky Mountains: Beaver Meadows (CO19), Loch Vale (CO98), and Niwot Ridge (CO02). Beaver Meadows (2477 m), Loch Vale (3159 m), and Niwot Ridge (3520 m) are all within 40 km but differ in elevation, resulting in different seasonal precipitation composition and totals. The North American Regional Reanalysis (NARR) was used to observe synoptic conditions that influenced two high wet deposition events from August 18-20, 2006 and July 6-8, 2012. Interestingly, anti-cyclones in southern Canada and high precipitable water values associated with monsoonal flow played significant roles in initiating convection that caused high values of wet deposition of inorganic nitrogen in the Rocky Mountains. The Advanced Research WRF model was then used to simulate the meteorology at a high spatial and temporal resolution for the two time periods to examine the contribution of cloud-scale convection to wet nitrogen deposition in the Rocky Mountains. A mesoscale mountain circulation caused by differential heating between mountains slopes and the plains was the main driver of the slow westward transport towards the mountains while cloud-scale convection contributed greatly to the transport of nitrogen along the Colorado Front Range.