

Early warning system for east Colorado ranchers to reduce N deposition in Rocky Mountain National Park

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Abstract. East winds along the Colorado Front Range from both synoptic-scale fronts and mesoscale mountain-valley circulations transport pollutants such as NH_x and NO_x into Rocky Mountain National Park (RMNP). Wet deposition of fixed nitrogen from the Colorado Front Range brings large, unnatural concentrations into the park, altering biogeochemical cycles in the fragile alpine ecosystems. In this study, we focused on mitigating the transport of NH_x from animal feeding operations by developing an early warning system to alert ranchers when a high-deposition day was possible. A forecast favoring high-deposition in RMNP would give ranchers the option to halt manure-stack management because aerobic manure leads to high volatilization of NH_3 .

For the early warning system (EWS), 5 runs of WRF-ARW v3.3.1 with varied physical parameterizations and initial conditions were used. From each run, 6-hour forward trajectories were released from 32 points in close-proximity to 4 municipalities in eastern Colorado. Multivariate kernel density estimation then utilized the endpoints of the 6-hour trajectories to detect high concentrations of advected “particles” released from the Fort Collins, Greeley, Fort Morgan, and Limon vicinities. Because some days with issued warnings did not end with high deposition in RMNP, a metric of success for this EWS was when an issued warning verified with high concentrations of NH_4^+ in RMNP based on reports from the National Atmospheric Deposition Program’s National Trend Network (NADP/NTN). Using meteorology, deposition, and survey-response data, we evaluated the challenges and successes of the EWS during 2014 and 2015.