Deposition of reactive nitrogen in the U.S. Rocky Mountain region

J. L. COLLETT, JR.[1*], K. BENEDICT[1], Y. LI[1], A. EVANOSKI-COLE[1], A. SULLIVAN[1], Y. ZHOU[1], D. DAY[2], A. PRENNI[3], B. A. SCHICHTEL[23], B. SIVE[3], K. GEBHART[23] AND W. MALM[2]

[1]Department of Atmospheric Science, Colorado State University, Fort Collins, CO 80523 USA
(*correspondence: collett@atmos.colostate.edu)
[2]CIRA, Colorado State University, Fort Collins, CO 80523 USA
[3]National Park Service Air Resources Division, Lakewood, CO USA

Increases in reactive nitrogen deposition are a growing concern in the U.S. Rocky Mountain west where alpine and subalpine ecosystems evolved under low nitrogen conditions. Current inputs of reactive nitrogen in many environments exceed the critical load, the deposition flux at which irreversible changes occur to the ecosystem. For the past decade we have been actively examining the sources, transport and deposition of reactive nitrogen in Rocky Mountain National Park (RMNP) and Grand Teton National Park (GTNP). Both parks are located at high elevation, but experience periodic, polluted conditions associated with transport of emissions from a variety of regional sources, including urban centers, power plants, agricultural regions, and areas of active oil and gas development. While wet deposition of nitrate and ammonium, on which the critical loads for nitrogen deposition are based, are important, dry deposition of gaseous ammonia and wet deposition of organic nitrogen are both major contributors to regional reactive nitrogen deposition budgets. Neither of these forms of reactive nitrogen has historically been measured in U.S. air quality or deposition monitoring networks. Prevailing winds in RMNP are from the west, where fewer large sources are located; however, study findings clearly indicate the importance of less frequent flow from the east in transporting major urban and agricultural emissions into the park. Because easterly flow pushes air up the east slope of the mountains, these transport periods are often accompanied by heavy precipitation which scavenges and effectively deposits transported pollutants into RMNP ecosystems. GTNP, by contrast, more frequently lies downwind of major ammonia source regions and ammonia is an even larger part of the reactive N deposition budget there. In both parks and across the nation, recent and planned regulatory reductions in NO_x emissions are expected to drive down nitrate deposition. Ammonia emissions, currently unregulated, are projected to continue growing and to comprise an increasingly large component of reactive N deposition.