Simulating Total Nitrogen Deposition at Western National Parks with the WestJumpAQMS Modeling Platform

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The western U.S. contains many national parks that are sensitive to elevated nitrogen deposition, with several parks already estimated to be above critical load thresholds for certain nitrogen-sensitive plant communities at 3 kg N ha^{-1} yr^{-1} (e.g., Black Canyon of the Gunnison National Park, Mesa Verde National Park), and many others within 1 kg N ha^{-1} yr^{-1} of this value (e.g., Dinosaur National Monument). To investigate the broad spectrum of nitrogen-containing compounds that contribute to the nitrogen deposition budget at western U.S. national parks, the chemical transport model CAMx (Comprehensive Air Quality with Extensions) was applied. Inputs for CAMx were provided by the West-wide Jump-start Air Quality Modeling Study (WestJumpAQMS). A key component of WestJumpAQMS is the refinement of many of the sources that contribute to nitrogen emissions, including revised estimates for ammonia from livestock operations and fertilizer application, as well as updates to nitrogen oxides from oil and gas development, mobile sources, and large point sources such as coal-fired power plants. Fire emissions were updated to better capture their significant and episodic role as a source of both oxidized and reduced nitrogen. Biogenic emissions were also refined, with new estimates for volatile compounds such as isoprene that can form organic nitrates, as well as revisions to soil nitrogen oxide. This study presents simulated wet and dry nitrogen deposition at a 12 km horizontal resolution for selected national parks in the western U.S. for 2008. All nitrogen-containing compounds within CAMx's chemical mechanism are evaluated, including the reduced nitrogen species of ammonia (NH_3) and particulate ammonium (NH_4+), and the oxidized species of nitric acid (HNO_3), particulate nitrate (NO_3-), peroxyacetyl nitrate (PAN), nitrogen oxides (NO_x), organic nitrates, and 'nighttime' species such as dinitrogen pentoxide (N_2O_5) and nitrate radical (NO_3·). Predicted deposition values are compared to wet and dry deposition measurements at available NADP (National Atmospheric Deposition Program) and CASTNet (Clean Air Speciation and Trends Network) sites. Dry deposition velocities predicted by the older Wesely and newer Zhang models are also compared.

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