Atmospheric Deposition Comparisons Between Photochemical Grid Model Estimates and Measurements in the Western U.S.

Tiffany Samuelson[1], Zion Wang[1], Courtney Taylor[1] & Marco Rodriguez[1]

Recent studies have highlighted the discrepancies between measured and model-predicted estimates of nitrogen and sulfur deposition fluxes using various models including photochemical grid models (PGMs). These modeling discrepancies, importantly, could lead to an inaccurate assessment of the impacts of atmospheric deposition, especially on sensitive ecosystems. This analysis focuses on the comparison of PGM estimated atmospheric deposition fluxes to measured data products from the National Atmospheric Deposition Program National Trends Network (NADP/NTN) and Clean Air Status and Trends Network (CASTNET) in the Western U.S. Atmospheric deposition in the Western U.S. is often dominated by nitrogen deposition that has demonstrated an increasing trend in recent years; furthermore, deposition in the Western U.S. is characterized by low deposition levels, relative to the Eastern U.S., with localized hotspots downwind of urban areas and agro-industrial activities. Atmospheric deposition measurements, however, are sparse throughout the region. In unmonitored areas, modeled values are an important source of deposition estimates.

In this work, modeled wet and dry deposition fluxes are derived from a PGM, the Comprehensive Air Quality Model with extensions (CAMx). For comparison with NADP/NTN data products, modeled wet atmospheric deposition contributions from ammonium (NH4+), nitrate (NO3-), and sulfate (SO42-) are considered. For comparison with CASTNET data products, modeled dry atmospheric deposition contributions from gas and particle-phase species, including NH4+, NO3-, nitric acid (HNO3), SO42-, and sulfur dioxide (SO2), are considered. Model performance is evaluated by comparing the speciated, wet, and dry deposition values to NADP/NTN and CASTNET data products. Further comparisons were made in evaluating the model's ability to reproduce spatial and temporal deposition features over the Western U.S. Additionally, the modeled, speciated nitrogen budget is analyzed including the aforementioned monitored deposition components and additional unmonitored deposition components such as ammonia (NH3), nitric oxide (NO), nitrogen dioxide (NO2), dinitrogen pentoxide (N2O5), nitrous acid (HONO), peroxyacetyl nitrate (PAN), and organic nitrogen. An emphasis was placed on model evaluations of atmospheric deposition in Class I areas, sensitive Class II areas, and high elevation sensitive lakes. These analyses are intended to inform the development of more extensive and inclusive nitrogen deposition monitoring.

Tiffany Samuelson[1], Tiffany.Samuelson@aecom.com
Zion Wang[1], Zion.Wang@aecom.com
Courtney Taylor[1], Courtney.Taylor@aecom.com
Marco Rodriguez[1], Marco.Rodriguez@aecom.com
[1] AECOM Inc., (970) 493-8878, 1601 Prospect Parkway, Fort Collins, CO 80525