Analysis of Modeled Atmospheric Deposition of Pollutant into Watersheds

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Objective

The deposition of pollutants from the atmosphere can be important contributors to total pollutant loadings to water bodies, by direct depositions to the water bodies and by deposition to watersheds with subsequent transport into to the water bodies. Atmospheric deposition of sulfur and reactive nitrogen leads to acidification of lakes, causing adverse effects in the ecosystem. Atmospheric deposition of mercury also adversely affects the ecosystem and can seriously impact human health when humans consume contaminated fish.

Across the nation there are several monitoring networks for measuring depositions from the atmosphere. These measurements provide very valuable information shedding light on the impact of deposition on water quality, but they do not provide a complete picture of spatial and temporal distributions for all chemicals. Modeling provides a powerful tool to complement measurements in evaluating current understanding of pollutant cycles from emissions into the atmosphere to deposition into water bodies and in determining critical loads for pollutant deposition into watersheds. Modeling also has the capability to predict the potential change in future deposition rates due to global changes, such as climate and emissions changes.

The CMAQ (Community Multiscale Air Quality) chemical transport model (Byun and Schere, 2006) is a model typically used for modeling regional air quality. It has been used to forecast air quality, do retrospective analysis of air pollution events, and to study the impact of future global changes on air quality. In addition to determining pollutant concentrations in the atmosphere, the model also computes deposition rates for a suite of chemical species, including sulfur, reactive nitrogen, and mercury. CMAQ is a useful tool for providing spatially and temporally distribution of deposition rates.

There are two components to this project. The first part is to use CMAQ results from the AIRPACT3 air quality forecasting system for the Pacific Northwest (http://lar.wsu.edu/airpact-3/introduction.html) to analyze pollutant deposition into major watersheds in the Pacific Northwest. The objective of the second component is to analyze results from current- and future-decade (2045-2054) CMAQ simulations to investigate the impact of climate and emissions changes on deposition of nitrogen into the major water basins in the continental US.

Preliminary Training

This project will involve the analyzing, extracting, and plotting wet deposition results from the chemical transport model CMAQ. Various existing shell scripts and Fortran programming tools in the Linux environment will be used. The student will use VERDI (www.verdi-tool.org) to interpolate, plot, and analyze CMAQ results at the watershed-scale. All REU students will receive introduction on working in the Linux environment; more training will be provided as needed to perform this project.

Project Tasks

1. Extract deposition results from AIRPACT3's CMAQ output .
2. Performing literature review on identifying major watersheds of interest in the Pacific Northwest.

3. Evaluate annual and monthly mean deposition rates of sulfur, nitrogen, and mercury into the watersheds.
4. Extract depositions results from current- and future-decade CMAQ simulations.
5. Evaluate the impact of climate change versus emissions changes on deposition of nitrogen in the future.
6. The student will prepare a poster for the end-of-summer symposium.

References

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