Ensemble Analysis on the Effects of Climate Change on Wildfire Atmospheric Emissions

REU Mentors: Brian Lamb, Serena Chung, Rodrigo Gonzalez

Objective

Poor air quality usually results from the accumulation of several pollutants emitted into the atmosphere; sometimes local weather patterns can worsen this problem by reducing atmospheric mixing and transport of these pollutants. To protect human health air pollution managers are constantly looking for ways to reduce and manage air pollution. There is strong relationship between weather and air pollutions and therefore with the projected change in global weather patterns air quality is also expected to change or even worsen in the future. In order to better understand the impact of climate change on air quality is necessary to first evaluate the influence of climate change on the emission of pollutants injected into the atmosphere.

As wildfires burn, large amounts of particulate matter (PM), carbon monoxide (CO), non- methane hydrocarbons (NMHCs), nitrogen oxides (NOx) and ammonia (NH3) are emitted and injected into the atmosphere. As we enter in an era of rapid climate change, the contribution of wildfire emissions and their dependence on future weather needs to be better understood.

This REU project is intended to contribute to the understanding on the effects of climate change in wildfire emissions by analyzing historical data from US wildfires processed by the Sparse Matrix Operator Kernel Emission Model (SMOKE). If the time allows, this project will include air quality simulations from the CMAQ (Community Multiscale Air Quality) chemical transport model. In both models, four sets of meteorological data downscaled from two different global circulation climate models (ECHAM5 and CCSM3) each of which provide Current (1995 to 2004) and Future Climate (2045 to 2054) simulations were used to provide the meteorological information.

Preliminary Training

This project will involve analyzing, extracting, and plotting anthropogenic, biogenic and wildfire emissions resulting from the SMOKE model. If the time permits, the project will also involve extracting and analyzing Ozone and PM atmospheric concentrations from the CMAQ model simulations. 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. Performing literature review on climate change impacts on wildfire atmospheric emissions

2. Extract existing anthropogenic, biogenic and wildfire emissions from SMOKE simulations for the summers of 1995 to 2004 (Current Decade scenario). This process includes the extraction of emissions processed with both global climate circulation models ECHAM5 and CCSM3

3. Extract existing anthropogenic, biogenic and wildfire emissions from SMOKE simulations for the summers of 2045 to 2054 (Future Decade scenario). This process includes the extraction of emissions processed with both global climate circulation models ECHAM 5 and CCSM3

4. Evaluate decadal means, maximums and minimums of PM, CO, NMHCs, NOx and NH3 emitted by each sector for each scenario.

5. Evaluate the impact of climate change on US wildfire emissions by comparing current to future Decade decadal means, maximums and minimums.

6. If time permits, extract PM and Ozone from CMAQ current and future decade simulations and evaluate the decadal mean, maximums, minimums to evaluate the impact of future wildfire atmospheric emissions on US air quality.

References

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