Background

The increasing frequency and intensity of wildfires over the past few decades has greatly concerned land and air quality managers, due to the environmental and health impacts, as well as the potential impacts on the radiation budget due to the short-lived climate forcing pollutants produced in these fires, and climate change is increasingly seen as a driver. The U.S. Forest Service (USFS), in its current projections of the condition of rangelands and forests required by the Resources Planning Act (RPA) of 1974, has included the impacts of climate change on wildfires in its current assessment. USFS has developed statistical models of annual burns (AAB) over the Southeast at the county level, to project their trends from 2010-2060. These projections account not only for changes in regional meteorology, downscaled from an ensemble of nine climate simulations, but also changes in land use, population and economic growth patterns over the region, consistent with the greenhouse gas (GHG) emission scenarios used in those simulations. This study used these AAB projections in a stochastic model of fire generation that disaggregates them into daily area burned to estimate fire emissions needed to drive air quality simulations in the present (2010), and in selected future years, and analyzed the regional air quality impacts for the 2010 baseline and future years. This work is supported by USFS Joint Venture Agreement # J-11-JV-1130143-080.

Project Goal and Objectives

Goal: To assess the impact of climate change on wildfire activity, emissions and air quality in the Southeast.

Objectives

- Examine the impacts of changes in climate and socioeconomic variables relevant for fire activity on annual burned in the next five decades over the Southeast.
- Use the downscaled meteorology to project daily fire activity, and estimate fire emissions in selected years.
- Examine the trends in fire emissions and air quality over the Southeastern U.S. in modeled years.

Climate Model Ensemble

Statistical models of AAB projections are built on original models of Mercer and Prestemon (2005) and related work. Statistically downscaled meteorological inputs to these models come from a nine-member ensemble of Climate Research 22 model runs (GCMs) with each run with 3 GHG emission scenarios from the PRISM models of Mercer and Prestemon (2005) and related work.

AAB Projections 2010-2060

Lightning-caused

Human-caused

Wildfire PM2.5 Emission Trends

PM2.5 model performance for IMPROVE is nearly identical for the ST and DY-based fire emissions relative to simulations with the NEI wildfire inventory, with slightly better summertime performance, and slightly worse performance in the fall. Wintertime performance (when there are no fires) is identical.

Annual PM2.5 Composition Trends (DY)

Total PM2.5 shows a slight decrease in the 2040-2060 period relative to 2010. The decrease in SO2 is mainly from reductions in the energy sector.

Conclusions

- Socioeconomic factors play a major role in decreasing future wildfires
- Projected PM2.5 emissions track AAB trends well, showing a slight decrease in future for all three methods of calculating daily fires
- Projected emissions significantly differ from 2010 NEI in all seasons
- DY estimates of daily AB produce lower fire emissions in all seasons and years compared to the other methods
- 2010 PM2.5 performance is very similar for all methods, implying that the fire emissions projection methodology is reasonably robust; however, more in-depth evaluation is needed for all pollutants

References