**NASA AQAST Short-Term Project**

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**Project duration:** May 1, 2011 – April 31, 2012  
**Title:** Integration of climate impacts into design of ozone and aerosol control strategies

**Problem to be solved:** In order to account for the effects on climate through changes to short lived climate forcers (SLCFs) incurred by air quality regulations, the US EPA needs to be able to relate emissions changes from individual SLCF precursors within specific US regions to radiative forcing.

**Project Description:** This proposal outlines a project whereby NASA remote sensing observations and Earth System models will be used to help inform decision makers at the US EPA as they work to coordinate their efforts to address greenhouse gases with those focused on particulate matter and ozone. Towards this need, the sensitivity of direct radiative effects of tracer concentrations will be quantified using model estimates of aerosol radiative forcing from GEOS-Chem and observational constraints on tropospheric ozone radiative forcing from the TES remote sensing instrument. These forcings will then be attributed to specific types and locations of emissions using the adjoint of GEOS-Chem. This tool allows quantification of impacts of emissions from each modeled source sector in each model grid cell. This relationship can rapidly be reapplied to estimate the radiative forcing response for numerous emissions scenarios. The project deliverables will be designed for integration with the EPA’s GLIMPSE (GEOS-Chem LIDORT Integrated with MARKAL for the Purpose of Scenario Exploration) project, wherein these sensitivities will be used as constraints in the EPA nine-region MARKAL model for estimating how US energy usage responds to a variety of policy measures. In the longer term, emissions scenarios with demonstrated potential for addressing air quality and climate goals will be tested in the GISS Model-E GCM.

**Deliverables:** Each item below will be delivered to the US EPA in a format (yearly averaged gridded values of W/m² per Kg emissions) suitable for direct implementation with the US EPA 9 region MARKAL model.

- **Deliverable 1:** instantaneous aerosol direct radiative forcing attributions for emissions of SO₂ and black carbon (BC) as calculated in the GEOS-Chem format. 3 months
- **Deliverable 2:** same as deliverable 1, but including organic carbon (OC). 6 months
- **Deliverable 3:** instantaneous tropospheric ozone radiative forcing attributions for emissions of NOₓ and VOCs as constrained by TES remote sensing observations. 12 months

**Expected AQ management outcomes:**

- Quantify the per-country radiative forcing from black carbon to inform EPA involvement in North American strategy for black carbon reduction.
- Allow OAQPS to assess the radiative forcing impacts of emissions scenarios designed for achieving PM NAAQS as part of their Regulatory Impact Analysis (RIA).