

Analysis of climate drivers and mitigation options within the Energy, Transportation and Agriculture sectors using GISS ModelE2

Drew Shindell, PI

with

Yunha Lee, Greg Faluvegi & George Milly (GISS)

Rob Pinder, Farhan Akhtar (US EPA)

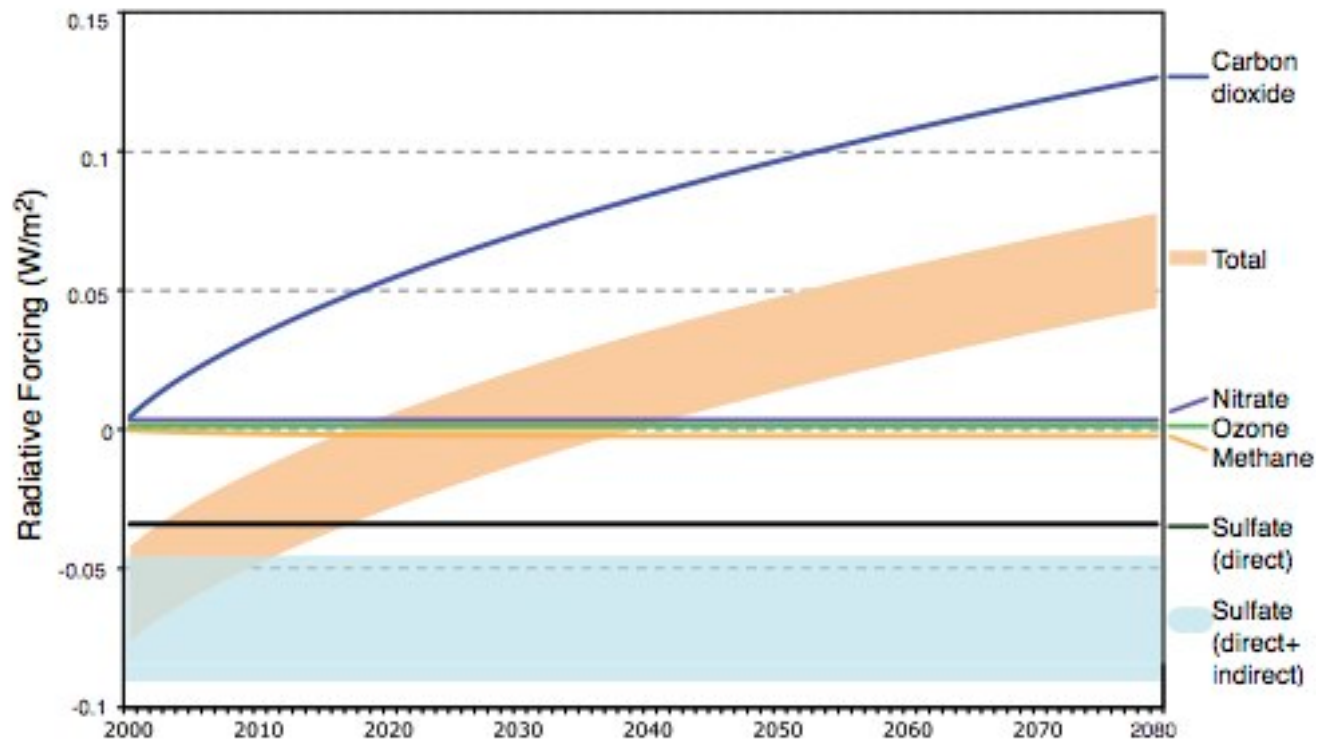
David Streets (ANL)

National Climate Assessment

Context

Prior work showed balance between various pollutants time-dependent, impacts of emissions changes not always obvious

Radiative forcing due to coal-fired power plants



Project Goals

First phase:

- Study effects of US emissions by sector on climate, human health and agriculture.
- Use same GISS model as in runs supporting IPCC AR5 (a well characterized model, both in terms of its own performance and context among other models).

Later in proposal period:

- High-resolution simulations using WRF (with US EPA) and/or GISS cubed-sphere.
- Analysis using alternate version of aerosol model (TOMAS microphysics)
- Exploration of emissions mitigation options (Obama Administration plans)

Progress

Simulations completed:

2050 conditions under RCP8.5 (control run)

2050 conditions under RCP8.5 except 2010 US energy sector emissions

2050 conditions under RCP8.5 except 2010 US transportation sector emissions

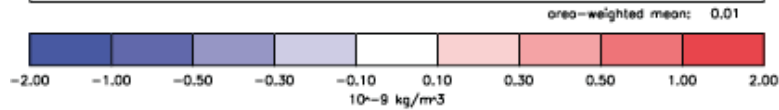
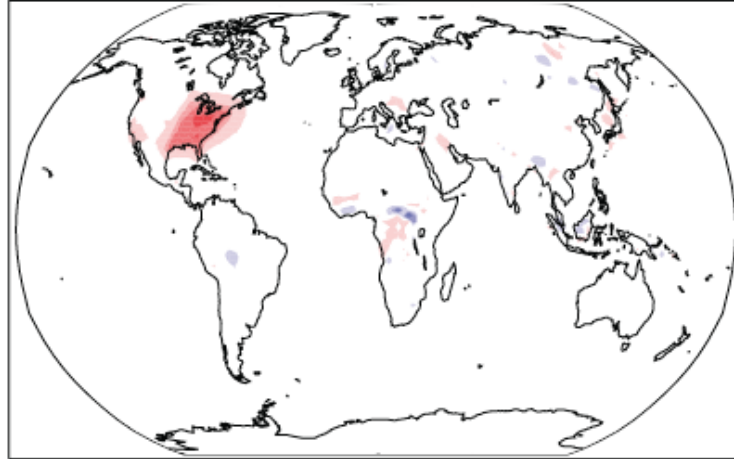
2050 conditions under RCP8.5 except 2010 US agricultural sector emissions

Each 40 years to allow diagnosis of aerosol indirect effects

Project received no FY12 funding, so ceased to function. One participating scientist forced to leave GISS for lack of funding, further disrupting progress. Hence minimal analysis to date, but FY13 funds recently arrived.

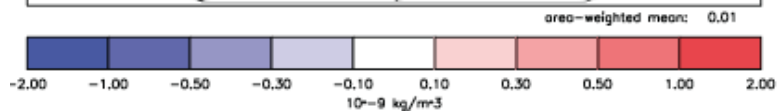
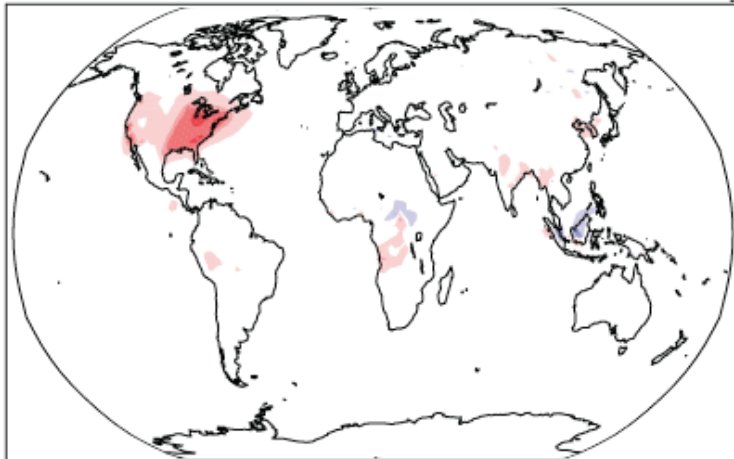
PM2.5 change by sector; US 2010 vs 2050

Energy sector

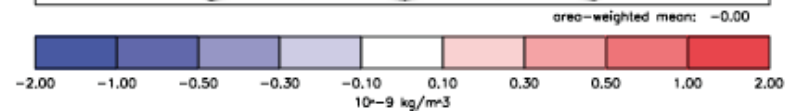
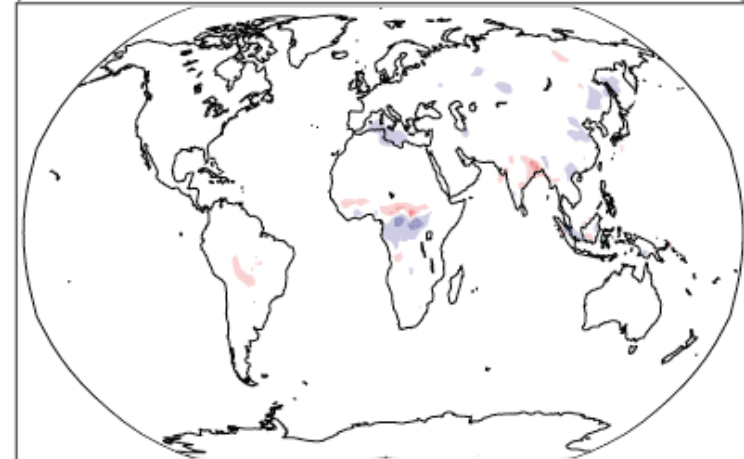


Similar impacts of
Energy & Transport
sectors, Ag small

Transportation sector

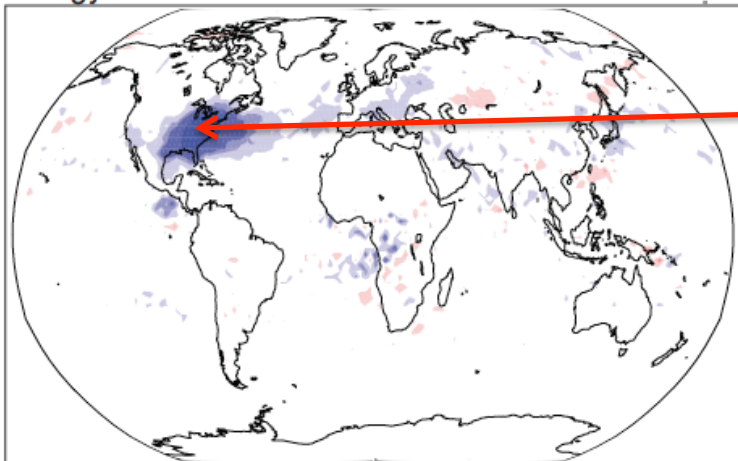


Agriculture sector



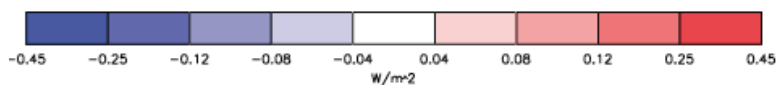
Aerosol Forcing (direct) by sector; US 2010 vs 2050 emissions (i.e. without projected trends)

Energy sector

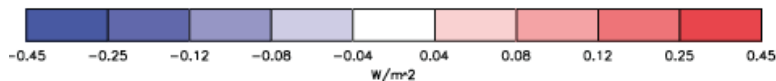
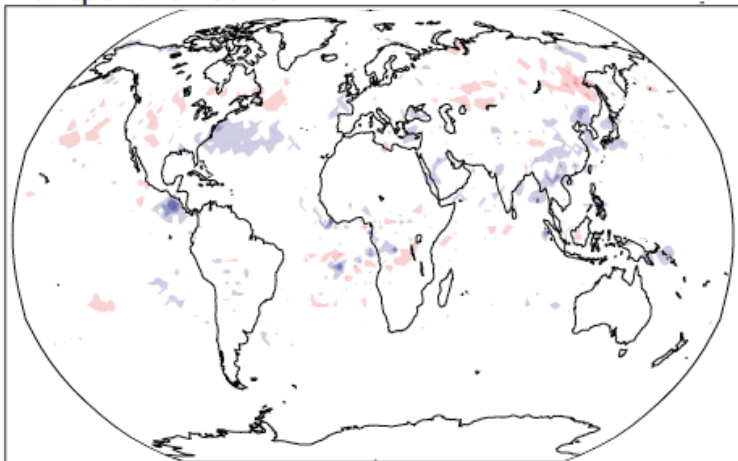


Negative primarily due to more SO₂ in 2010, centered in Northeast

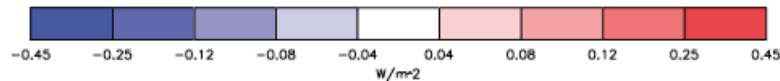
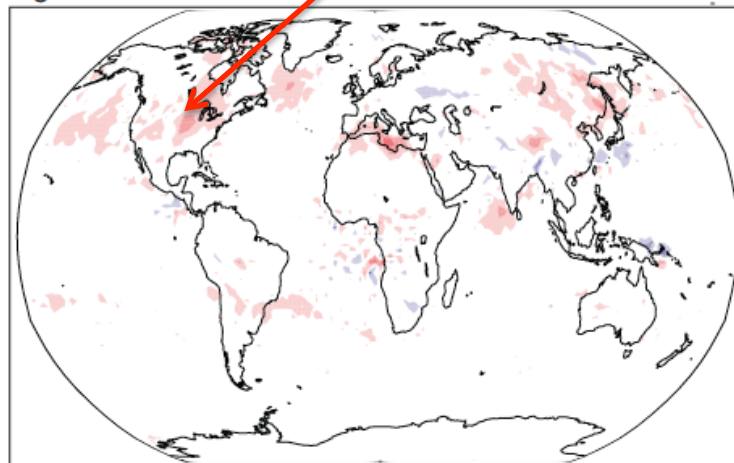
Positive due to more NH₃ in 2050, centered in Midwest



Transportation sector



Agriculture sector



Aerosol Forcing by sector; US 2010 vs 2050

Indirect aerosol effects:

- Energy : 0.07 W m⁻²
- Transportation : -0.04 W m⁻²
- Agriculture : 0.06 W m⁻²

Indirect dominates over direct effect (net of positive and negative components) or ozone.

Agricultural result attributable to nitrate, other sectors less clear. Sea-salt and dust changing too.

Needs further study...

Next Steps (FY13)

Need to unravel aerosol indirect responses

Examine key cases with microphysics model (TOMAS)

Need to also calculate long-lived greenhouse gas forcings next. Then determine if full climate simulations warranted.

Explore difference in other RCPs (start with 2.6)

Explore impact of Obama Administration's vehicle and energy policies