Premature deaths in Brazil associated with long-term exposure to $PM_{2.5}$ from Amazon fires and development of a nested South American domain for the GEOS-Chem Adjoint

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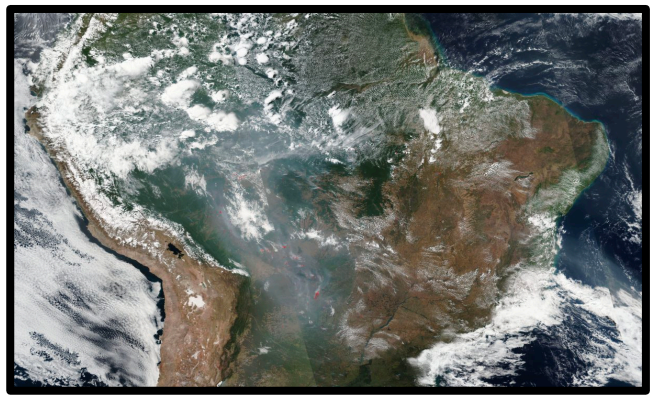
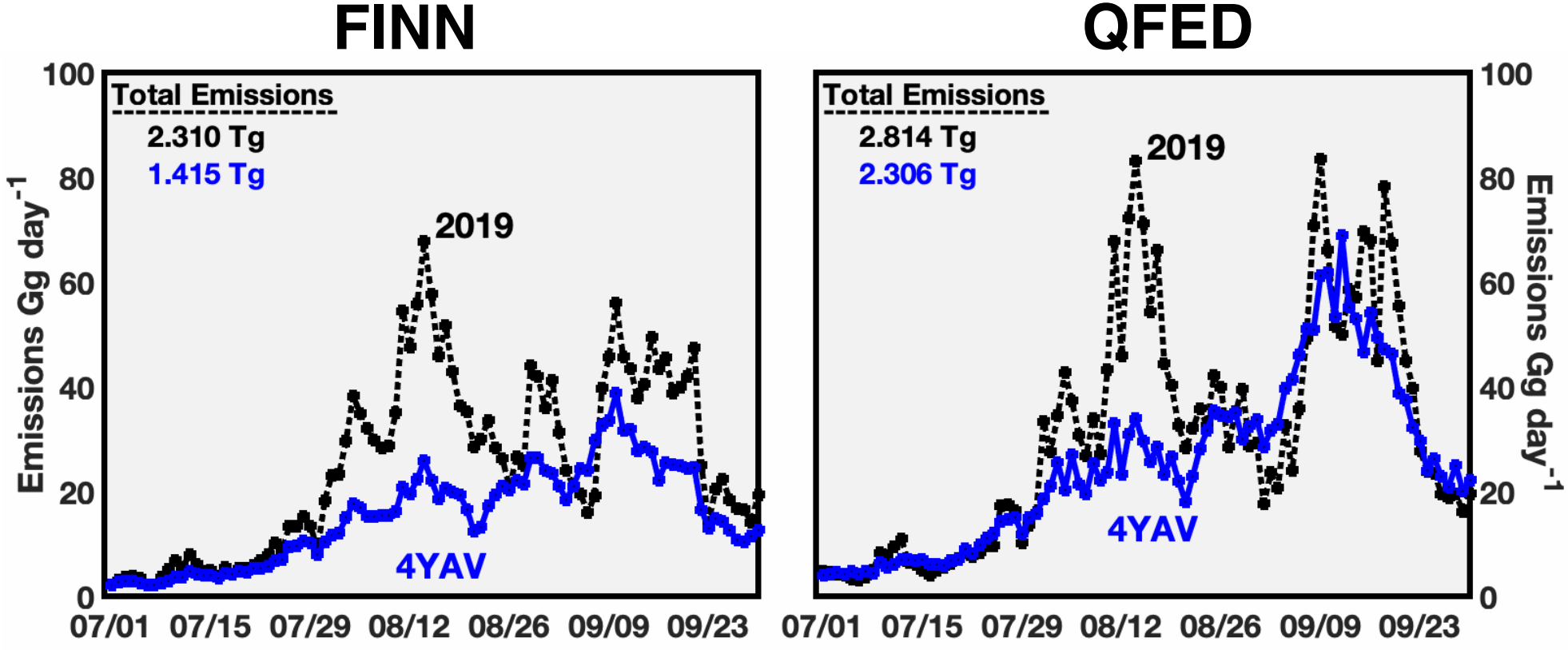


HAQAST Final Showcase
Web Presentation

GEOS-Chem

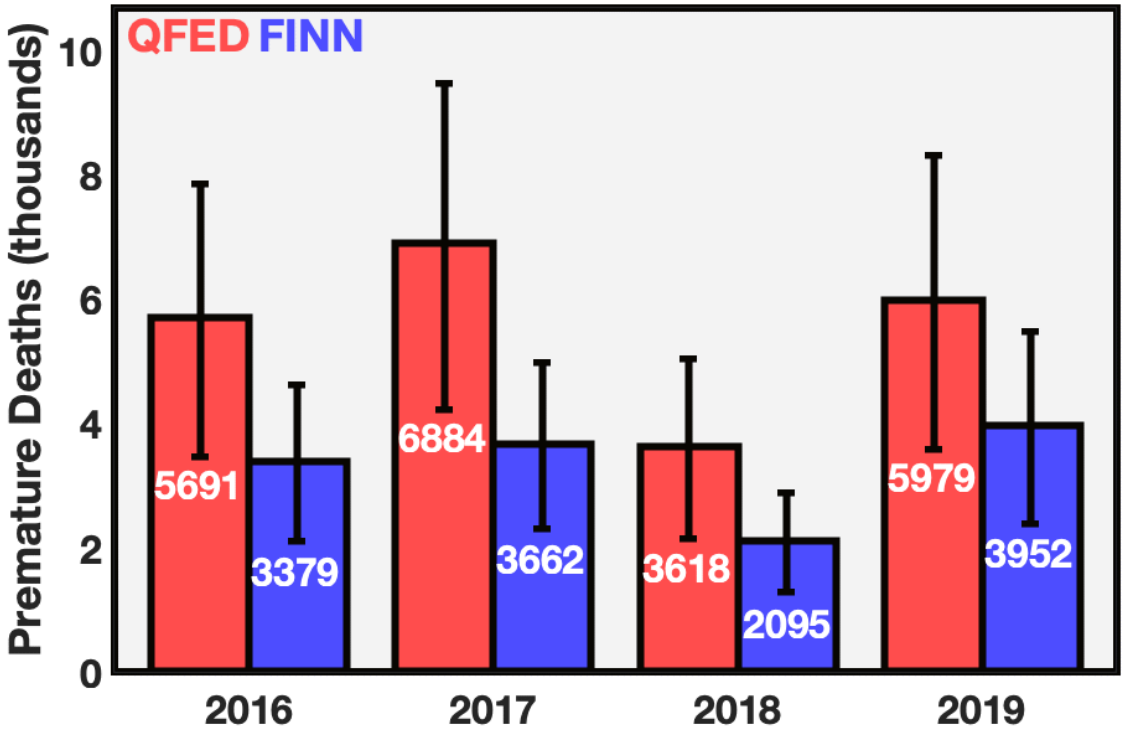
https://www.ibtimes.com/santiago-smog-chile-declares-environmental-emergency-over-air-pollution-1976819 / https://towardsdatascience.com/an-analysis-of-amazonian-forest-fires-8facca63ba69 / https://www.businessinsider.com/amazon-fires-satellite-images-map-of-rainforest-blazes-2019-8 /

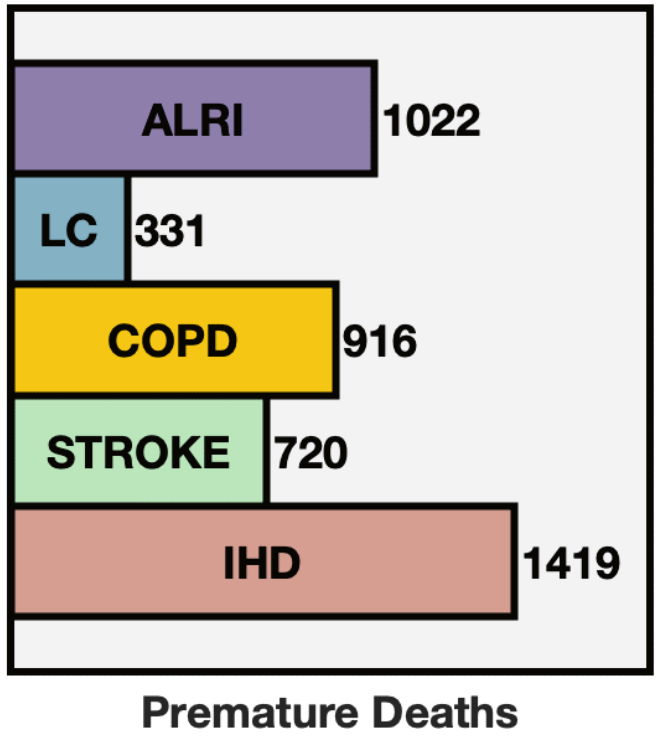
Health Impacts in Brazil: Amazon Fire Emissions



- In this study we quantify health impacts from fires in Brazil over the last four years
- We also consider the significance of emissions magnitude versus transport in our analysis
- Make use of an adjoint modeling approach to estimate changes in health impacts
- Here we present total primary carbonaceous aerosol emissions from FINN and QFED

Health Impacts in Brazil: Total Health Impacts





ALRI: Acute Lower Respiratory Illness

LC: Lung Cancer

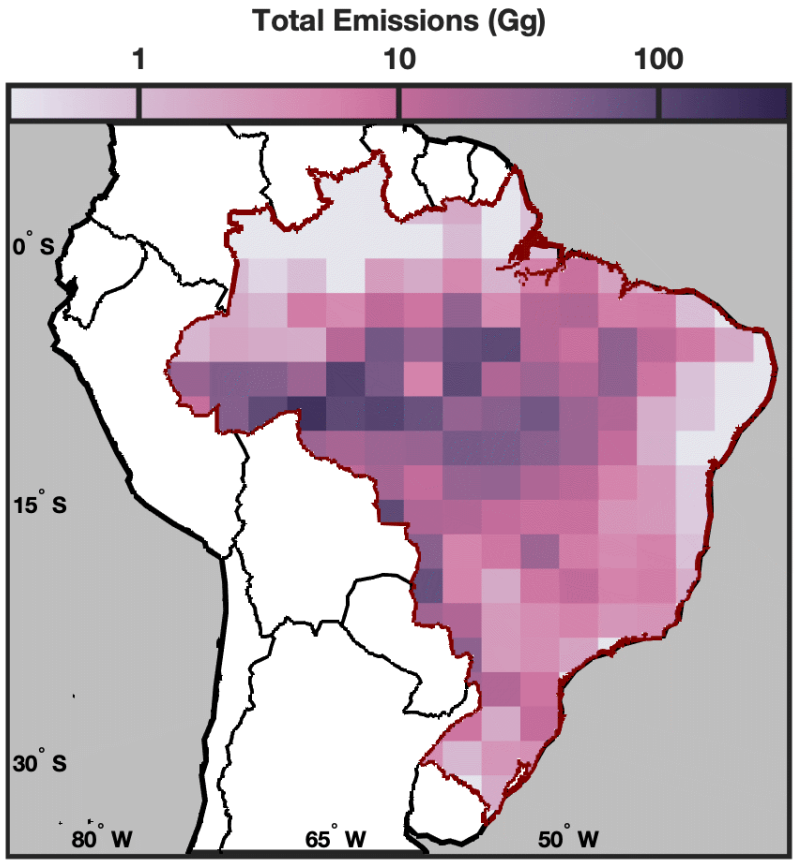
COPD: Chronic Obstructive Pulmonary Disorder

IHD: Ischemic Heart Disease

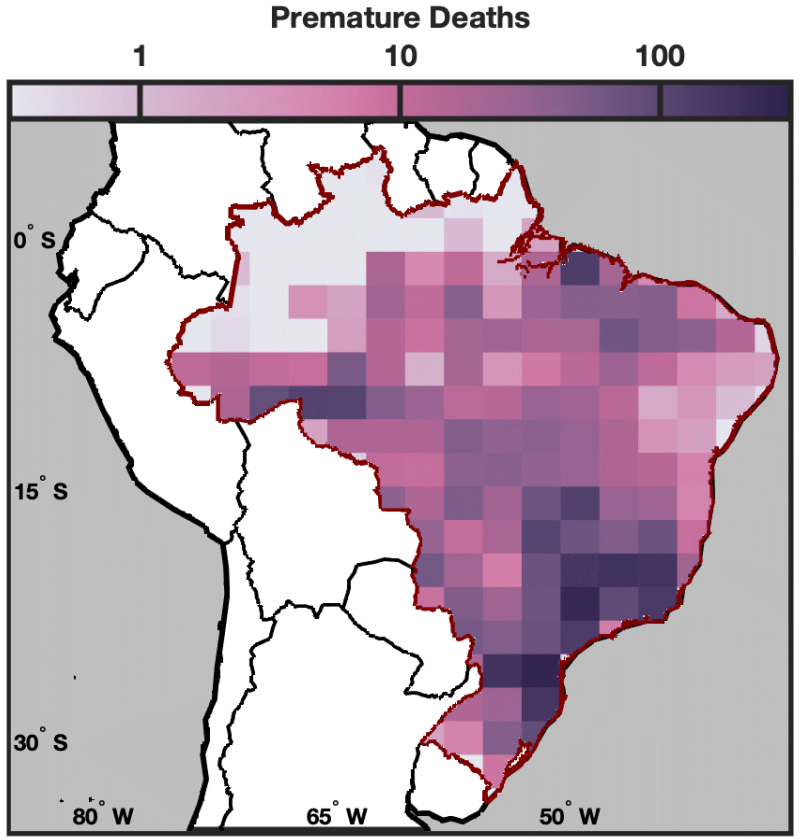
- By combining adjoint sensitivities with biomass burning emissions and integrated exposure response functions we estimate health impacts
- The 2019 fire season had significant biomass burning health impacts
  - Health impacts increased by 75% between 2018 and 2019

Health Impacts in Brazil: Spatial Comparison

Emissions



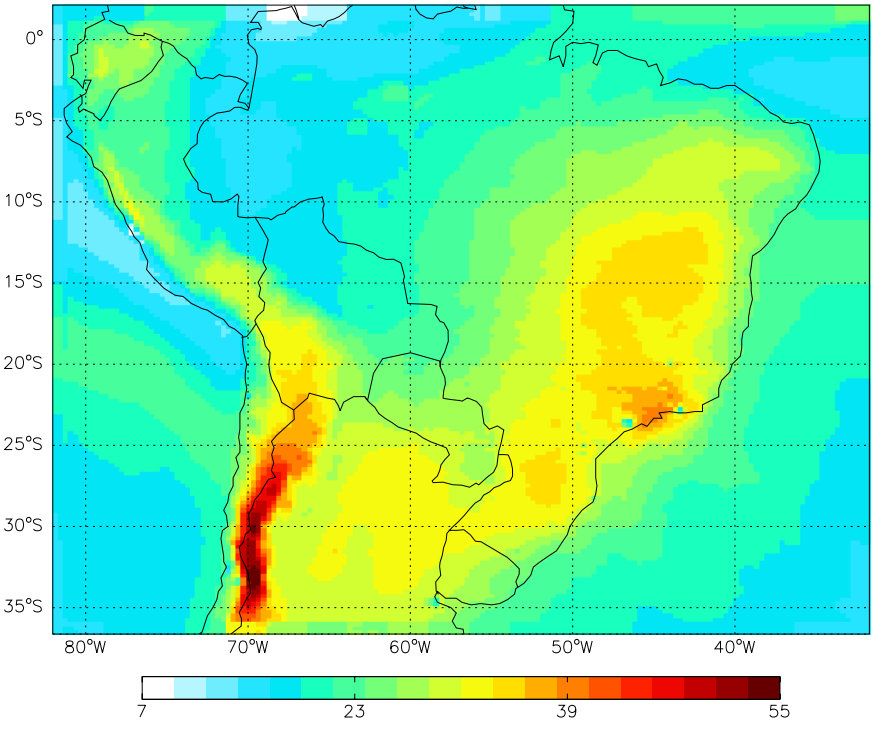
Biomass Burning Associated Premature Deaths Contributions



- We find the largest fires were localized in north-western Brazil in 2019
- The highest health impact contributions were in south eastern Brazil
- Considering emissions magnitude exclusively does not fully characterize health impacts

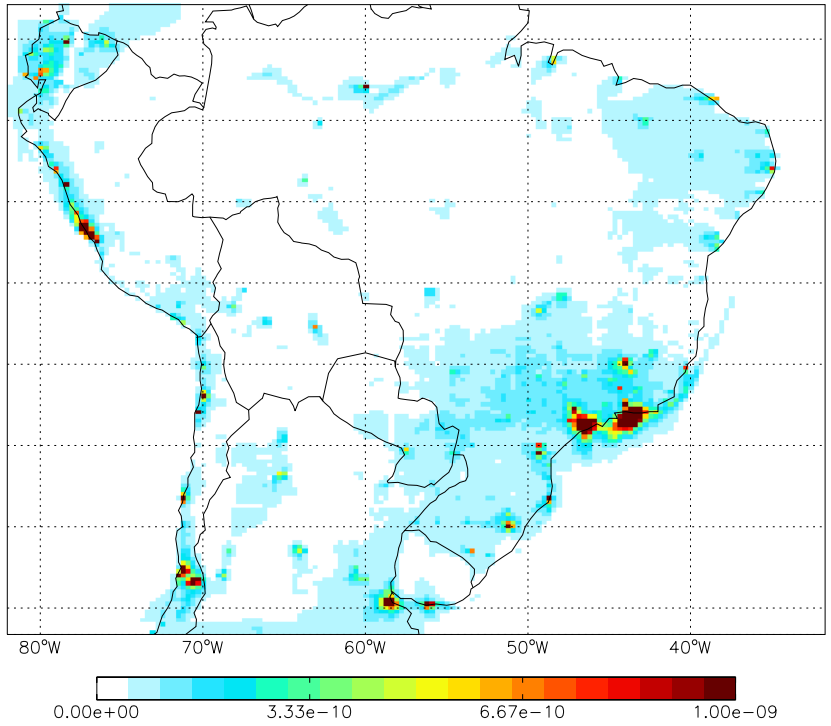
GEOS-Chem South America: 1 Month Forward Model

Ozone Concentration



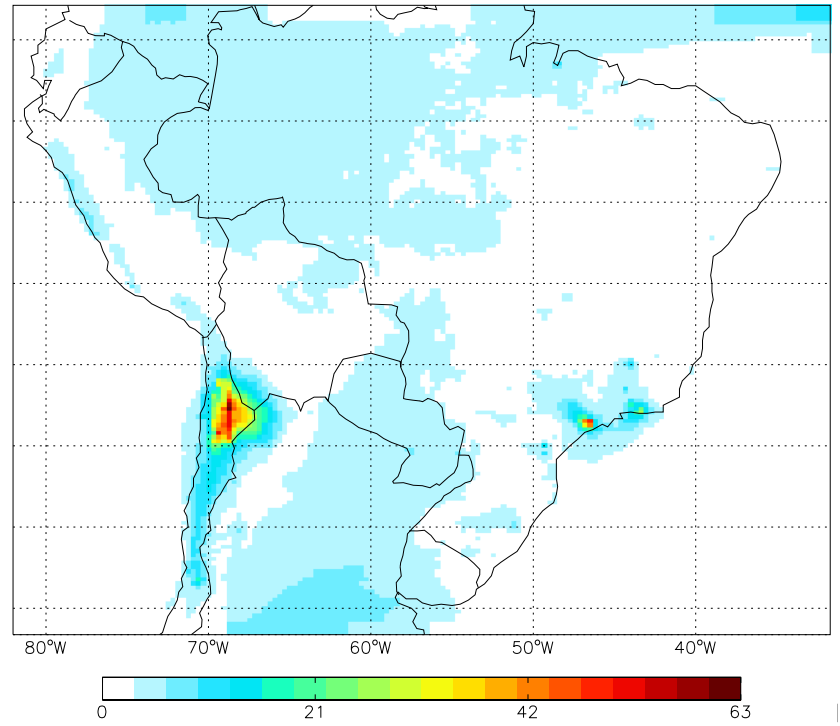
$(ppbv)$

Nitrogen Dioxide Concentration



$(mixing\ ratio)$

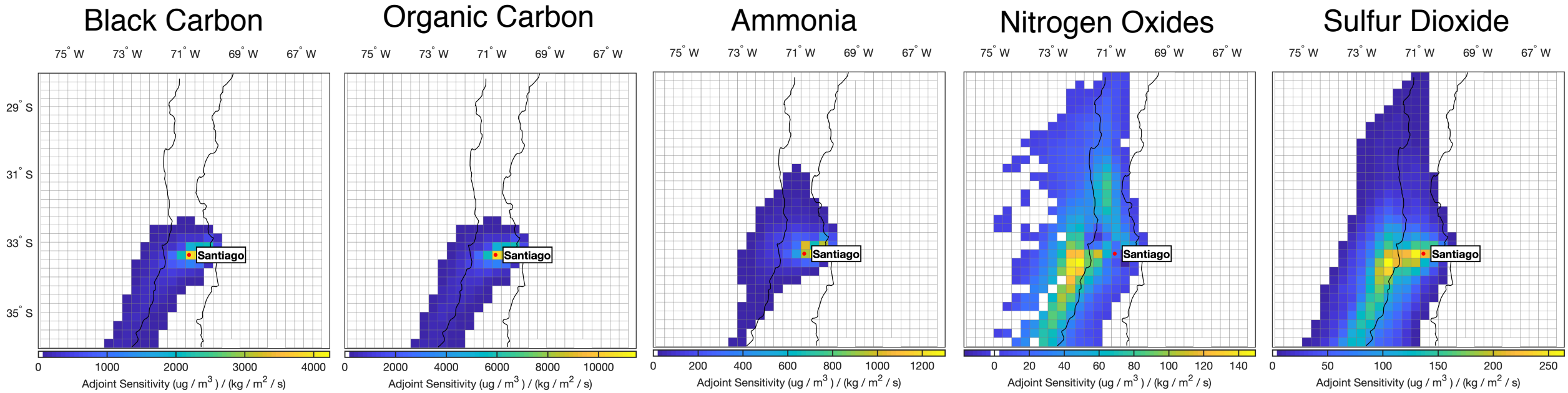
$PM_{2.5}$ Concentration



$(\mu g/m^3)$

- To more accurately represent urban environments in South America we've begun developing a new 0.25° x 0.3125° nested domain for GEOS-Chem
- Here we show one month simulations for January
- We are looking for more accurate anthropogenic and natural emission inventories for this domain

GEOS-Chem South America: 1 Month Adjoint Model



- Additionally, we have begun the development of the adjoint component in this domain
- Here we present sensitivity of Santiago $PM_{2.5}$ exposure to precursor emissions
- We see that Santiago appears to have a relatively small airshed