EXPLORING AIR-CLIMATE-ENERGY IMPACTS WITH GCAM-USA

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OBJECTIVES

The Global Climate Assessment Model (GCAM) is a global integrated assessment model used for exploring future scenarios and examining strategies that address air pollution, climate change and energy (ACE) goals. My research focuses on integration of impact factors in GCAM-USA and application to multi-pollutant/multi-media impact analyses, including:

- human health (PM and ozone mortality),
- water demands, and,
- climate-related damages (health, environment, e.g., acidification, and eutrophication)

WHAT IS AN IAM?

Integrated Assessment Models (IAMs) have a long history in climate change mitigation studies. Unlike traditional Chemical Transport Models (e.g., CMAQ), IAMs feature a comprehensive computation framework to reveal the interaction across multiple sectors.

INTEGRATING IMPACT FACTORS INTO GCAM-USA DATA SYSTEM

METHOD

Integration of impact factors in GCAM-USA uses a first-order approximation to relate changes in emissions to marginal damages. Such reduction technique relies on a limited number of full-scale photochemical modeling scenarios yet focuses on a more computationally efficient representation.

\[ \Delta \text{Emission (ton)} \times \text{Marginal Damage ($/ton)} = \text{Total Damages ($)} \]

Integrated Assessment Tools

GCAM-USA is a fully global integrated assessment model with additional detail for the fifty U.S. states. Thus,

- State-level resolution
- Within a consistent global modeling framework
- Higher level of detail in electricity, transportation, etc.
- State-level policy representation, e.g. CPP, CSAPR

WHY GCAM-USA?

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ILLUSTRATIVE STATE-LEVEL RESULTS (NORTH CAROLINA)

Scenario Description

BASE Model default (GCAM reference)

POLICY Global CO₂ emissions are constrained to meet a trajectory consistent with a 450 ppm CO₂ concentration in 2100

+ NC only

Findings:

- Under a comprehensive climate policy (policy case), CO₂ and other non-GHG emissions in NC show significant decreasing among all sectors;
- The decreasing PM and its precursors lead to an increasing overall health benefit, among which the emission reduction in the industry sector obtains the largest health benefits.

+ Results provided for illustrative purposes only

FUTURE RESEARCH

This work is part of the EPA’s ongoing GLIMPSE project[1]. Future work includes integrating other impact factors into GCAM-USA, like ozone-related mortalities, life-cycle impacts and climate impacts, so that we are able to better understand more comprehensive co-benefits related to ACM policies in the U.S. in the future.

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REFERENCES