Improving Climate Policy Analysis Tools

Project 21

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Motivation

- Aviation accounts for 2% of global CO_2 emissions and up to 5% of global radiative forcing.
- Aviation is projected to grow at about 5% while there is mounting pressure to further regulate aviation emissions.
- Fast, efficient, and up-to-date tools are needed to model the expected impact of aviation on the climate for a variety of future technology and operational scenarios.
- This work looks to improve modeling techniques for long- and short-lived aviation emission species on the global climate to support climate and policy analyses leading to sustainable aviation growth.

Objectives

- Long-term
  - Contribute to the development and application in the aviation context of a more complex model appropriate at finer spatial and temporal scales
  - Improved understanding of climate feedbacks and emissions species interactions over time
  - Alternative fuel projections and modeling capability in policy analysis
- Near term
  - to continue the development of a rapid reduced-order climate model for policy analysis consistent with the latest literature and scientific understanding
  - Improved communication of a greater depth of climate information and trade-offs across researchers and policymakers

Outcomes and Practical Applications

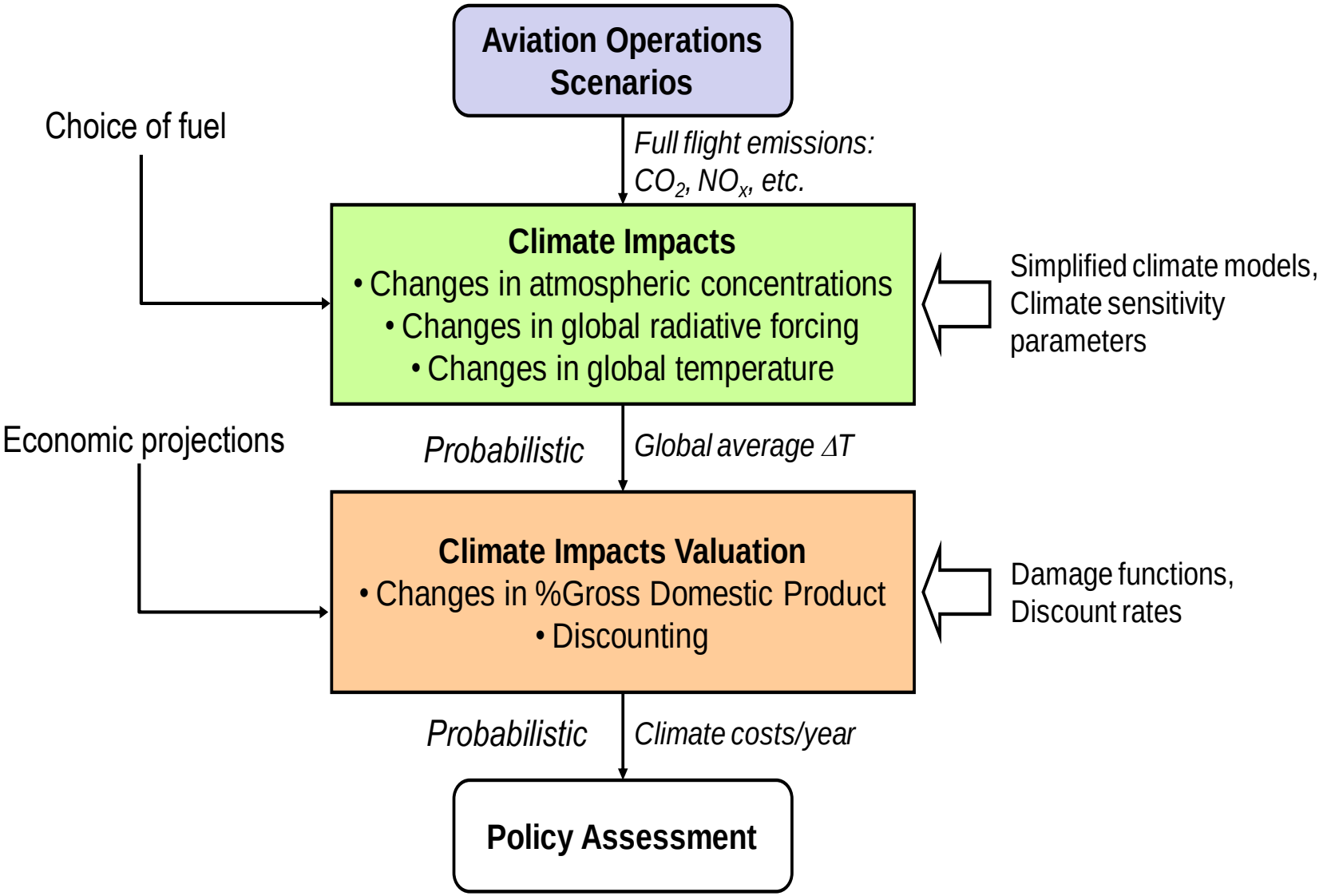
- Outcomes
  - APMT-Impacts Climate Code
    - Continued use and support for FAA domestic and international policy analyses
    - Developmental tool with CH_4 and N_2O modeling capabilities
    - Alternative fuel and well-to-tank modeling of climate impacts
  - Climate system response to short-lived climate forcers
    - climate efficacy of contrail-induced radiative forcing
    - potential of future contrail saturation changing the relationship between fuel burn and radiative forcing
    - Interactions and feedbacks between emission species, radiative forcing, and temperature change to inform policy tools

- Practical applications
  - Codes and frameworks used in domestic and international policy analysis
  - Improved modeling environmental costs of alternative fuel policies and analyses

Schedule and Status

Projected Completion	Task	Status
Spring 2015	Efficacies, non-linearities, and feedbacks for aviation Short-Lived Climate Forcers (SLCFs) using the MIT IGSM	Completed
	Characterize zonal and regional climate characteristics.	Completed
Summer 2015	Expand alternative fuel modeling capability in APMT-Impacts Climate	Completed
	Transfer of APMT-I v23 to Other Research Teams	Completed
Fall 2015	Conduct scoping analysis for APMT-Impacts Project v24	Underway
	Contrail and SLCF non-linearity projections for policy tools	Underway

Recent Accomplishments: APMTv23 Operational Code

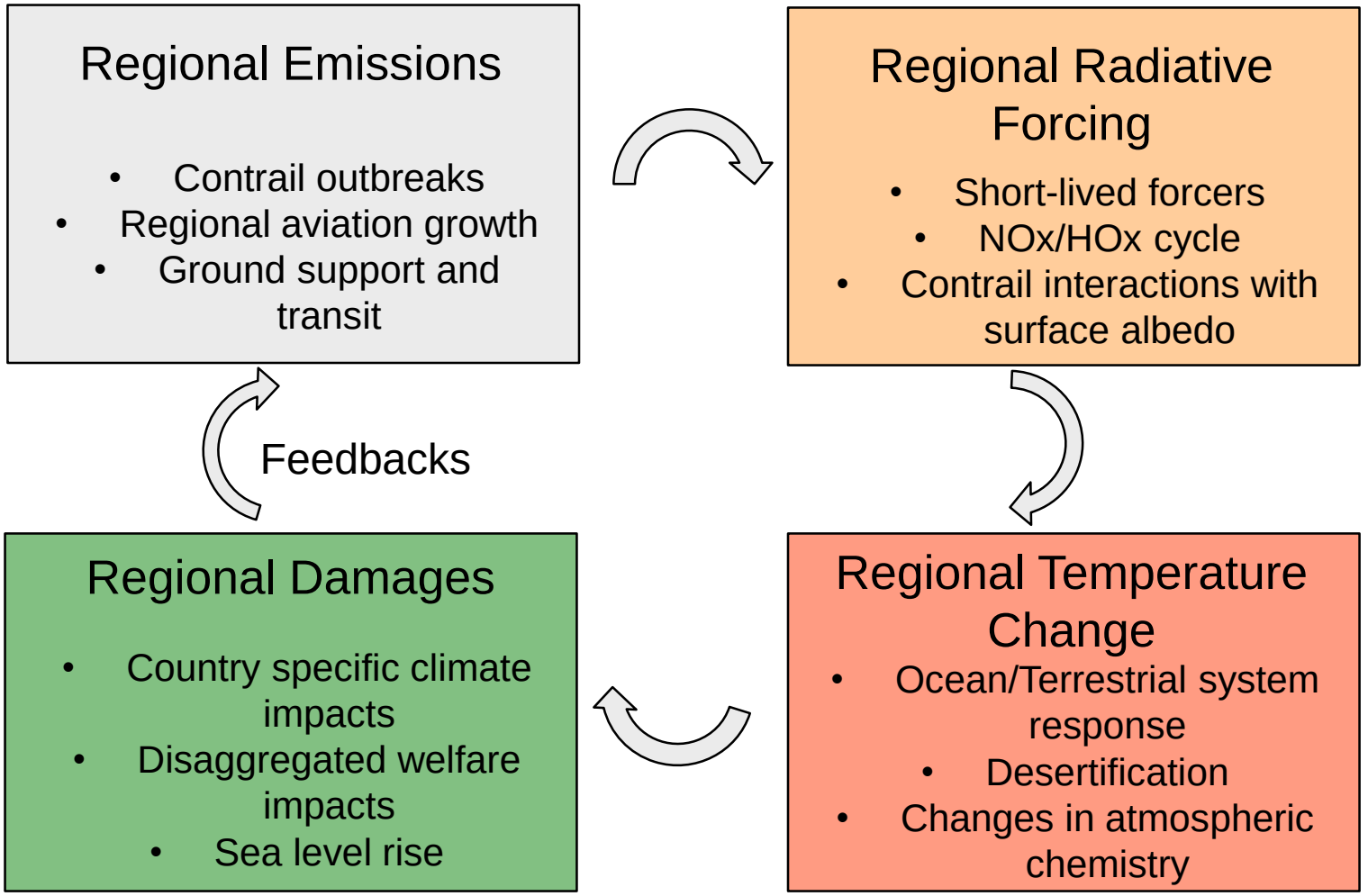


Recent Accomplishments: APMT v23 Operational Code

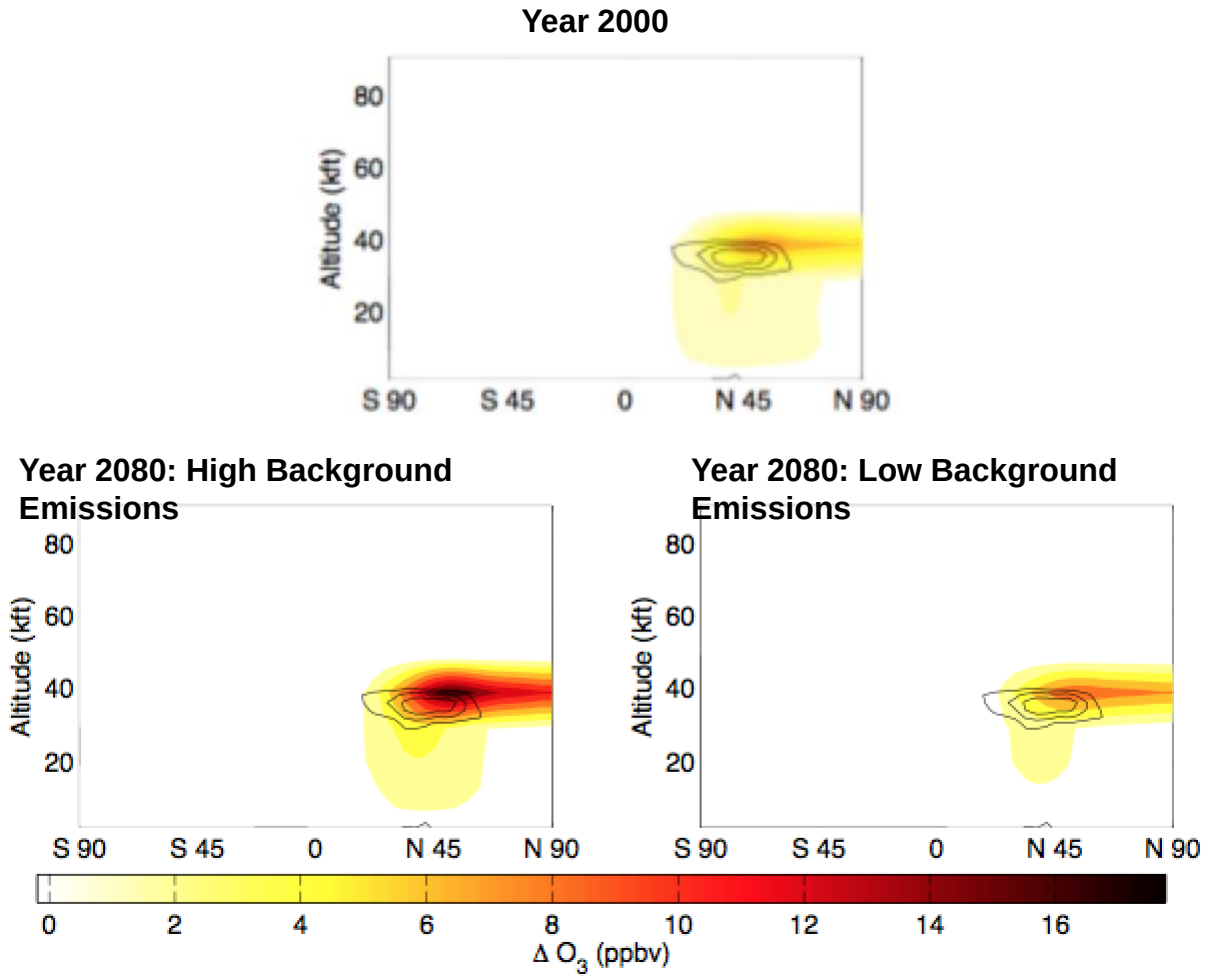
- Short-lived climate forcer impacts and uncertainty updated to match latest scientific consensus from recent ACCRI paper published in BAMS
- Code taught and disseminated to FAA and ASCENT policy analysis teams
- APMT-Impacts Climate currently being used in several domestic and international policy analyses with continued development and operational support from Project 21 team
- Scoping analysis started for capabilities and advancements for APMT-Impacts v24 developmental tool

Recent Accomplishments: Regional impacts requirements

Aviation emissions are spatially heterogeneous and short-lived forcers are not “well-mixed”, thus regional impacts may be important to policymakers.



Recent Accomplishments: NO_X-O_3 Regional Impacts



O_3 concentration change attributed to 1.25 Tg-N aviation NO_x emissions, top row depicts changes in 2000 while the bottom row depicts those in 2080.

Interfaces and Communications

- External
  - Journal publication on spatial heterogeneities in climate response to aviation NOx emissions in preparation
  - Interfaces with ACCRI researchers and project managers
  - v23 review performed by UIUC
  - Collaboration with MIT Joint Program
- Within ASCENT
  - Code transfer and support with A14
  - Alt. Fuel emissions harmonization with A24A
  - Well-to-tank assumptions for lifecycle CO_2 and long-lived greenhouse gas species with A32

Summary

- Summary statement
  - Aviation's impact on climate change is significant and heterogeneous in space and time. Reduced-order assessment tools are necessary to understand the costs and benefits of operational or policy changes. A framework that accounts for interactions, changes in background concentrations, and spatial nonlinearities may be necessary to capture policy-relevant changes on a regional scale.
- Next steps?
  - Investigation of efficacies and fuel impacts on SLCFs
  - Requirements document for APMT-Impacts Climate v24
- Key challenges/barriers
  - Availability of robust research on local and regional climate damage functions
  - As we include greater spatial/temporal disaggregation, the amount of information to communicate increases exponentially

References

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