## ASCENT Project 58

# Improving Policy Analysis Tools to Evaluate Higher-Altitude Aircraft Operations

**MIT**

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Cost share partner: NuFuels LLC

## Objective:

- Develop the APMT tool to quantify environmental impacts of aircraft operations, consistent with **current understanding of impact mechanisms**
- Extend APMT-IC to cover a **broad range of parameters**, including **high-altitude/ supersonic aviation**

## Project Benefits:

- APMT that includes impacts of **higher altitude emissions** including supersonics
- **Rapid evaluation** of environmental impacts of aviation, including **divergence from currently dominant patterns and technologies**

## Research Approach:

- **Evaluate and assimilate** changes in scientific understanding of aviation's impacts on **climate and air quality**
- Use **atmospheric modeling** to quantify sensitivity of climate and air quality to emissions up to **65 kft**
- **Re-engineer** APMT to support changes in **spatial distribution of emissions** and aircraft **emissions characteristics**
- Provide a **single tool** which can accept **gridded fuel burn and emissions** and return **climate and air quality damages**

## Major Accomplishments (to date):

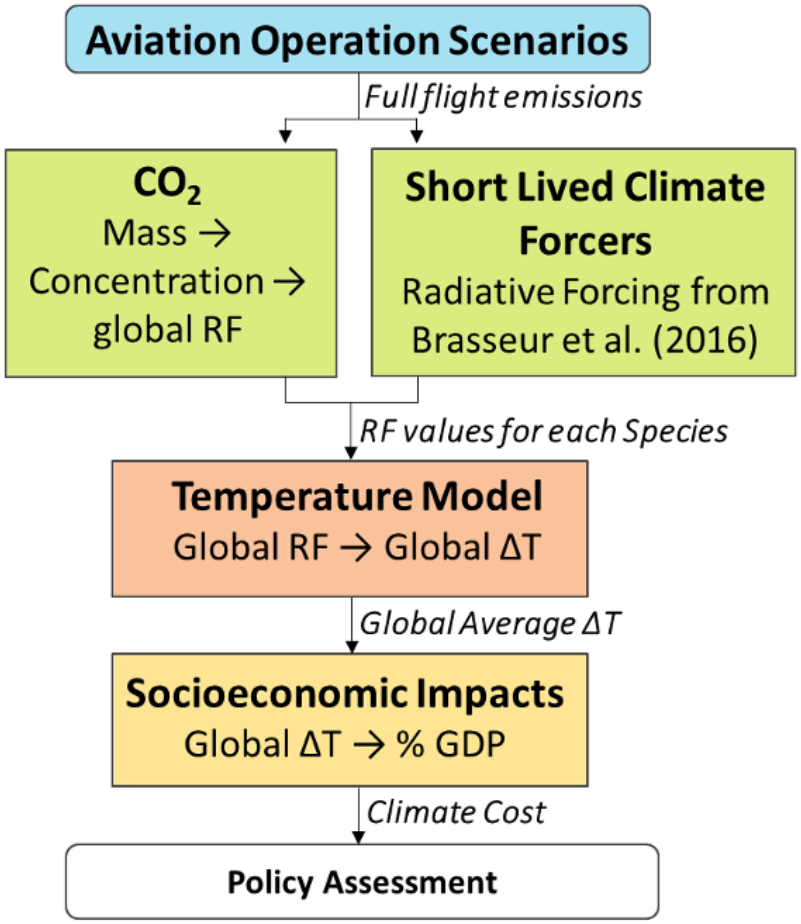
- Updated APMT-IC to **latest standards**
- Established **sensitivity framework** to quantify emissions with altitude change
- Developed **parametric emissions estimator** for representative supersonic aircraft
- Integrated new **RF assessment capability**

## Future Work / Schedule:

- Mid-2021: **architectural plan** for APMT
- End of 2021: **scenario** impact estimates and development of **gridded env. sensitivities**
- Mid-2022: **new version** of APMT

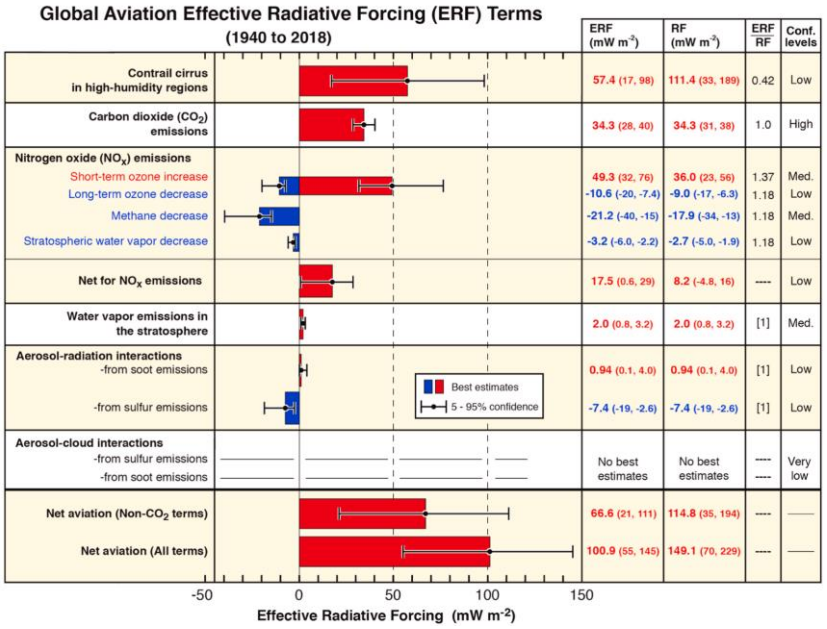
This research was funded by the U.S. Federal Aviation Administration Office of Environment and Energy through ASCENT, the FAA Center of Excellence for Alternative Jet Fuels and the Environment, project 58 through FAA Award Number 13-C-AFJE-MIT under the supervision of Daniel Jacob. Any opinions, findings, conclusions or recommendations expressed in this this material are those of the authors and do not necessarily reflect the views of the FAA.

# APMT: Updates for conventional scenarios and forcers



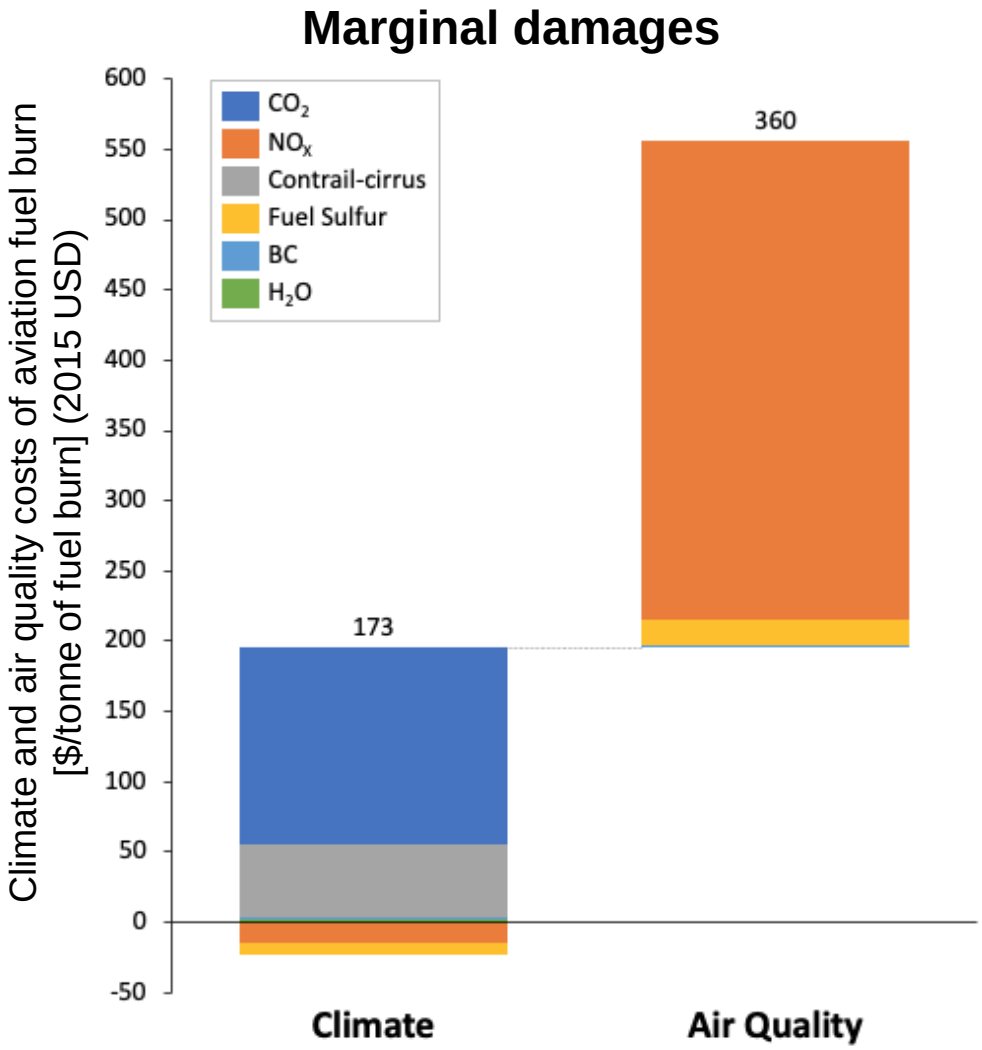

Updated **impact estimates**:

- **Contrail efficacy** ~0.42
- Increase **$CH_4$ RF** by ~20%




(Lee et al. 2020)

# APMT: Current status and recent findings




(Grobler et al. 2019 + APMT updates)

Marginal assessment:

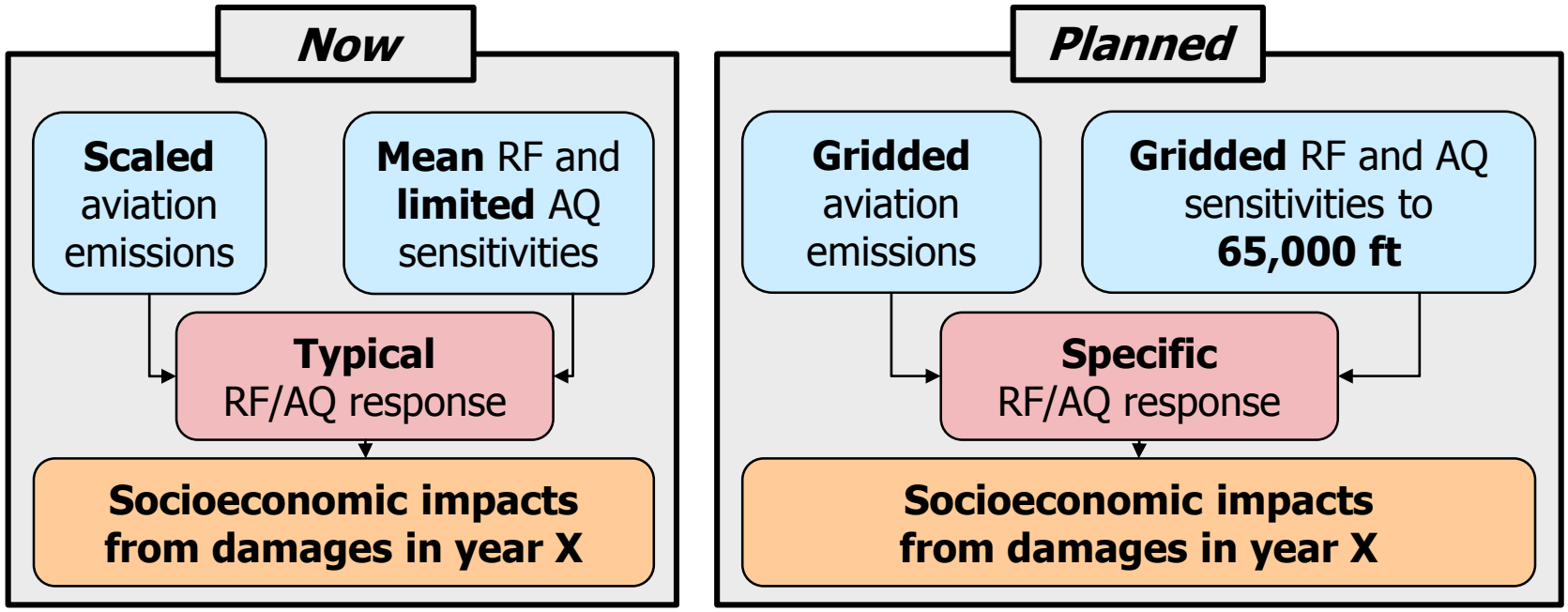
- Climate impacts dominated by **$CO_2$ and contrails**
- Air quality impacts **comparable to climate**, dominated by **cruise $NO_x$**

Next steps:

- Re-structure APMT for:
  - **Location-sensitive** contrails
  - **Higher altitude** aviation
- Incorporate **historical perspective** on $NO_x$

# APMT: Extending to higher-altitude emissions

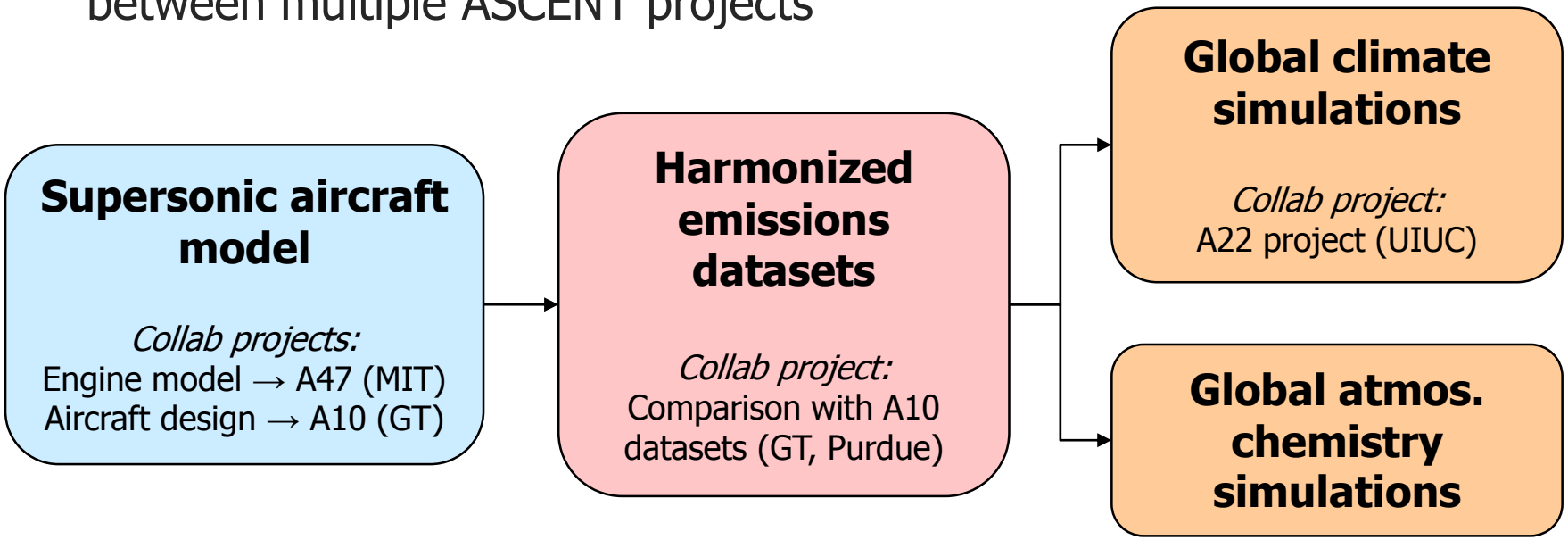
- Current APMT reference RF values represent impacts from emissions at subsonic altitude with current global aviation market distribution
- These do not well represent impacts at higher altitudes due to different **chemical regimes** and **atmospheric lifetimes** - as seen for supersonic emissions (e.g. Kawa et al, 1999; Speth et al, 2020)



# Planned work on impacts of supersonic aviation

- Spatially-discretized climate and air quality sensitivities will be defined based on results from chemistry-transport modeling and integrated into APMT

- APMT will be tested and calibrated with **representative supersonic emissions datasets**, generated through collaboration between multiple ASCENT projects



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