Partnership for AiR Transportation Noise and Emission Reduction

An FAA/NASA/TC-sponsored Center of Excellence

PARTNER Research on Air Quality and Health Impacts due to Aviation-Related Air Pollutants

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Acknowledgement

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Research Sponsor

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Outline

- Introduction
- Key Questions Identified
- Research Motivation
- Present Gaps and Needs
- Approach
- Current Focus
- Summary

Background

- There are known direct emissions of hydrocarbons, CO, NOx, SOx, particulate matter (PM) and hazardous air pollutants (HAPs) from aviation activities
- These emissions interact among themselves and with background air to form other air pollutants such as ozone, PM, etc.
- There are growing concerns about potential health impacts of aviation emissions
- Aviation emissions are small but are growing against the generally decreasing emissions from other sources

Must deal with these emissions both to enable growth and to protect our environment

Background

Known health impacts of key pollutants

Ozone – causes acute respiratory problems, aggravates asthma, impairs the immune system defenses, damages lungs

PM – causes reduced lung function, development of chronic bronchitis, premature death, asthma attacks and acute bronchitis. May increase susceptibility to respiratory infections. PM have also been linked to heart attacks.

HAPs – cause cancer and potentially non-cancer (reproductive, immune, neurological and respiratory) health problems

NO2 - may decrease lung function and increase the risk of respiratory problems, particularly in children and persons.

Note that these pollutants are regulated at varying levels across the world.

Research Motivation

- **Quantify and isolate 'incremental' impacts of aviation emissions on:**
  - **local/urban/regional air quality**
  - **human health**
- **Develop simulation and analysis capabilities, and metrics to quantify these impacts**
- **Incorporate findings in impact analysis tools to**
  - **inform policy-making decisions**
  - **guide impact mitigation**

Key issues to be addressed

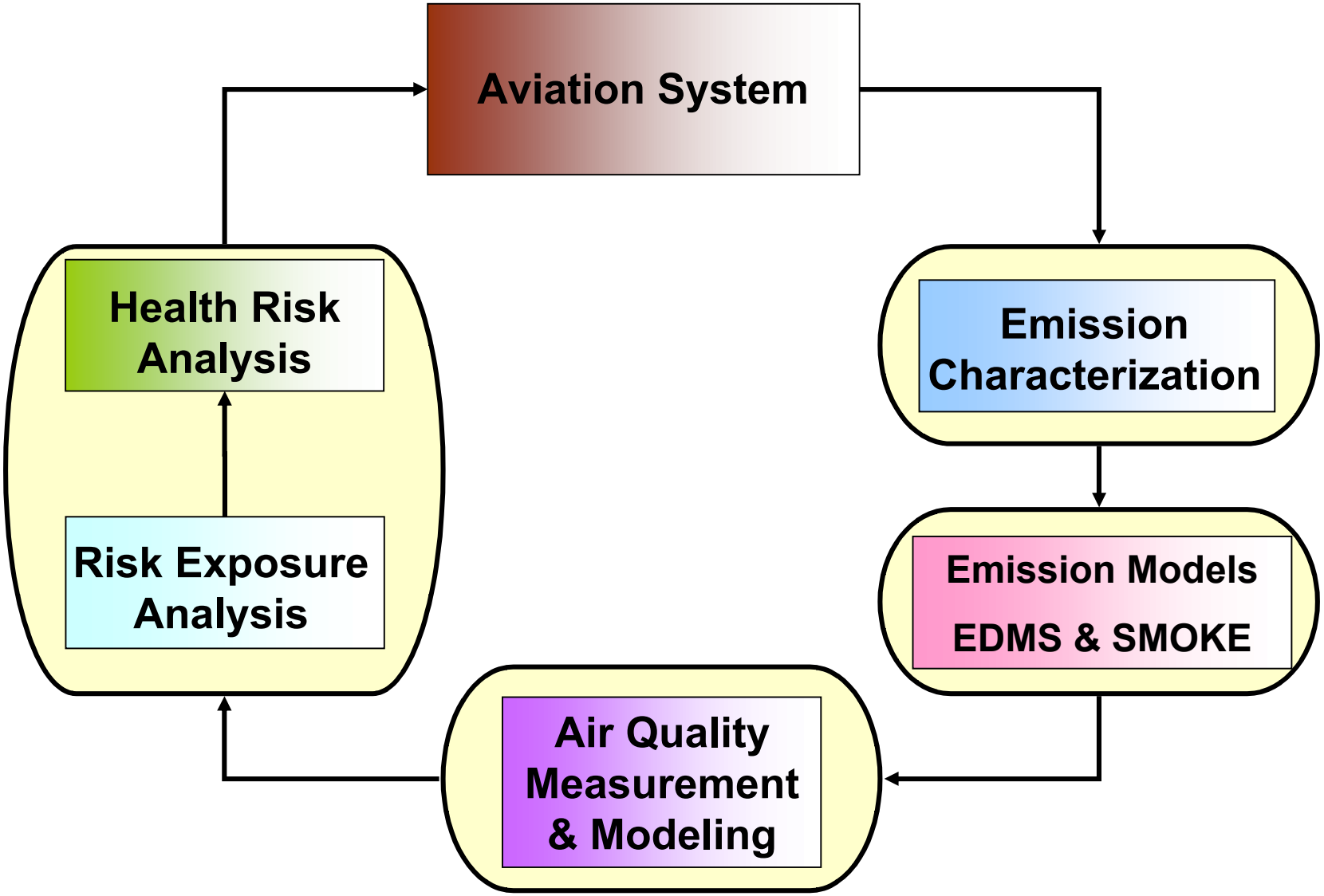
- Incremental air quality and health impacts
- Spatial extent and persistence
- Relative contributions from primary and secondary emissions
- Major uncertainties & unknowns in impact analyses
- Useful metrics to measure impacts
- Capability to predict impacts for future aviation scenario
- Incremental environmental impacts and world-wide varying air quality standards
- Health impacts specific to aviation emissions

Present gaps and limitations in quantifying impacts

- **Lack of emission characterization**
- **Inadequacy of air quality models**
  - **treat all air pollutant emissions as inert**
  - **have limitations on spatial extent**
  - **do not treat interaction of emissions with background air**
  - **do not account for chemical and physical transformations**
- **Lack of coordinated modeling and measurement approach**

These gaps need to be addressed for comprehensive and consistent air quality, risk exposure and health impact analyses.

Unified Research Approach for Impact Analyses



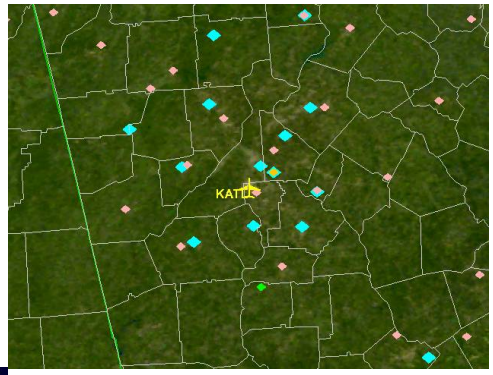
Current Focus – Air quality and health impact analyses

- Impact study for 3 selected airports (ATL, ORD and PVD)
  - multi-scale annual air quality analysis
- Model-data air quality analysis for TF Green (PVD) airport
  - high resolution air quality monitoring and modeling
- Nation-wide study – 325 airports
  - development of PM Response Surface Model
- HAPs emissions and their health impacts
  - prioritization and emission characterization

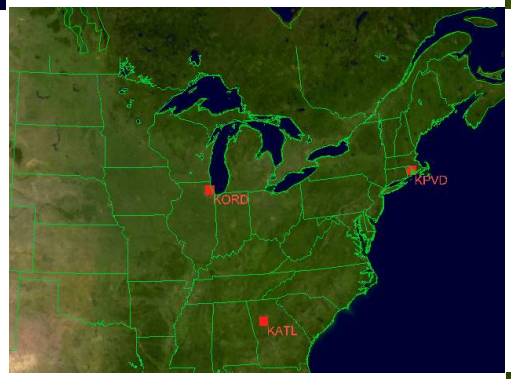
Use of incremental change in air pollutant (ozone, PM, HAPs etc.) concentrations for health risk assessment.

Current focus – Variable scale impact modeling and analysis

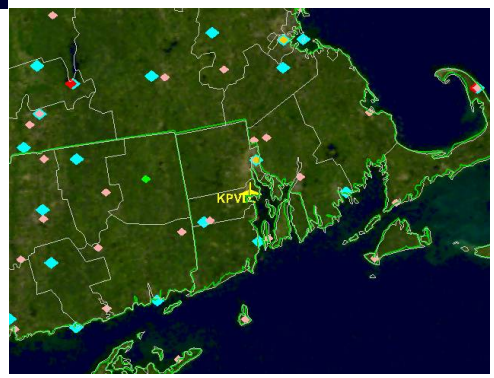
- Continental U.S.
- 36×36 km



- ATL Region
- 4×4 km



- Eastern U.S.
- 12×12 km



- PVD Region
- 4×4 km

■ Location of 3 selected airports

Ambient monitoring network

AQS IMPROVE CASTNET STN FRM

Summary

PARTNER is pursuing comprehensive and consistent research approach to examine air quality and health impacts of aviation emissions.

Environmental impact analyses of aviation emissions is critical component of analysis to inform policy decisions.