

# Simulation and Analysis of Technology and Operational Procedures to Reduce the Combined Effects of Emissions and Contrails

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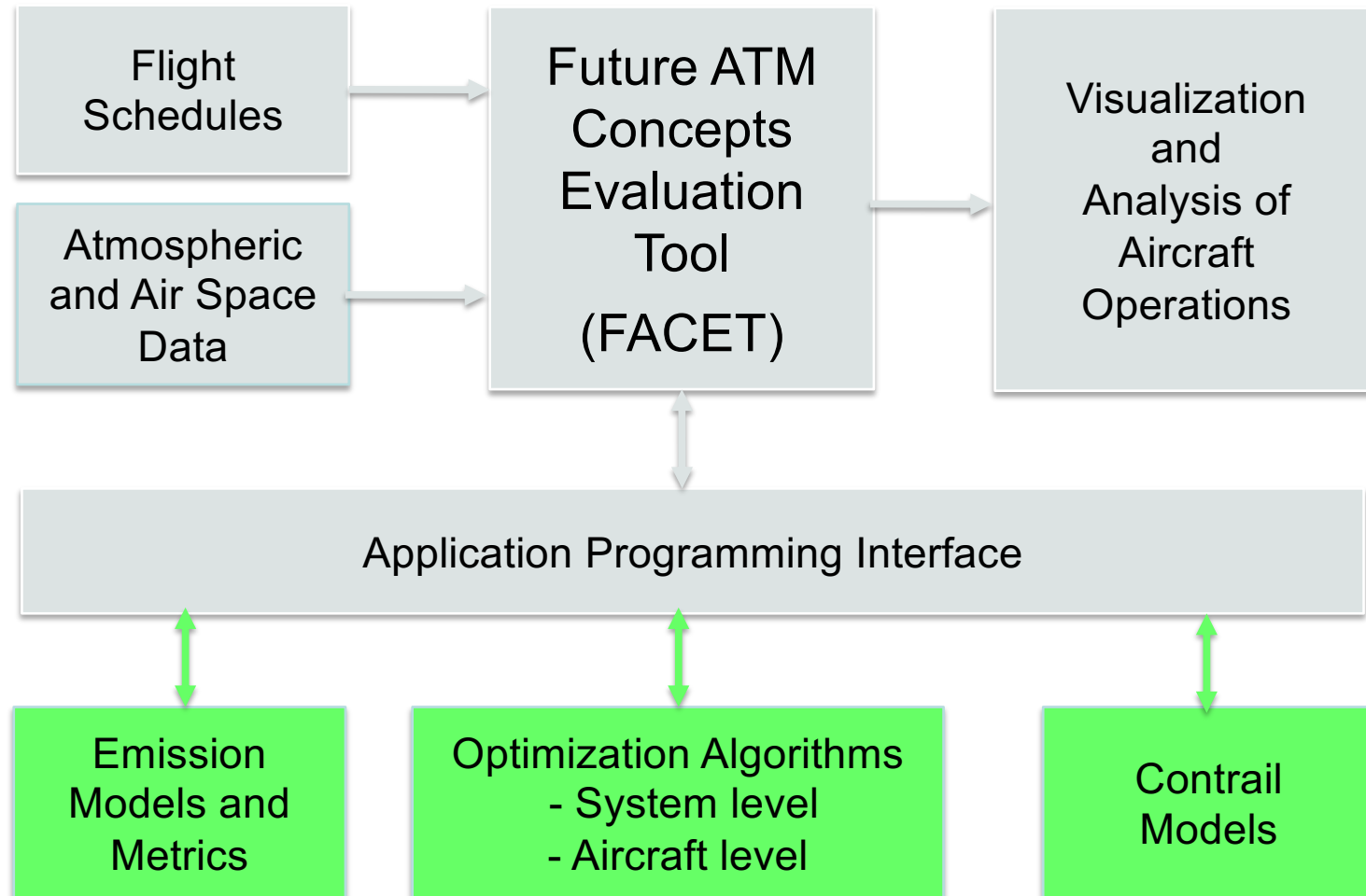
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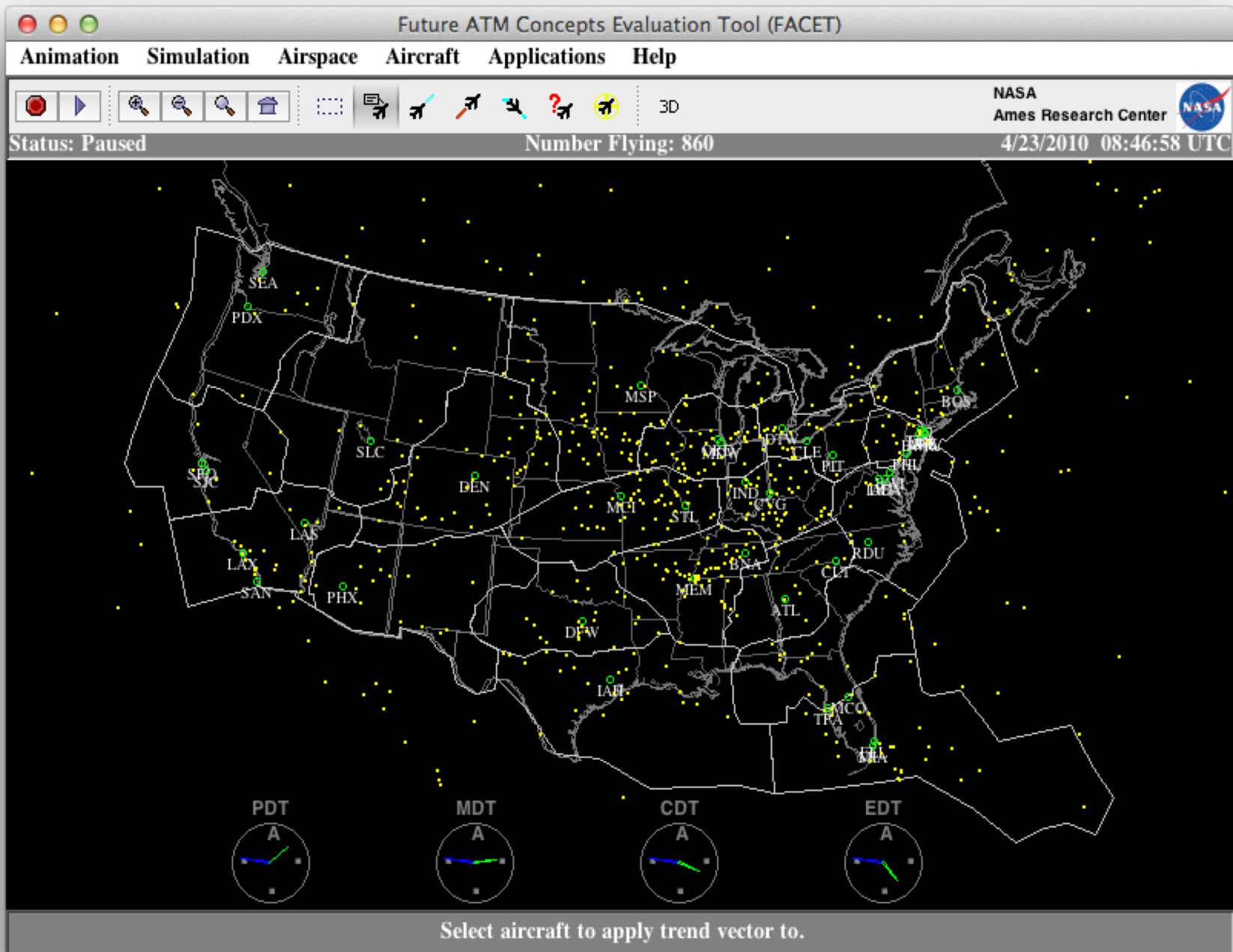
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# Emission Impact Assessment

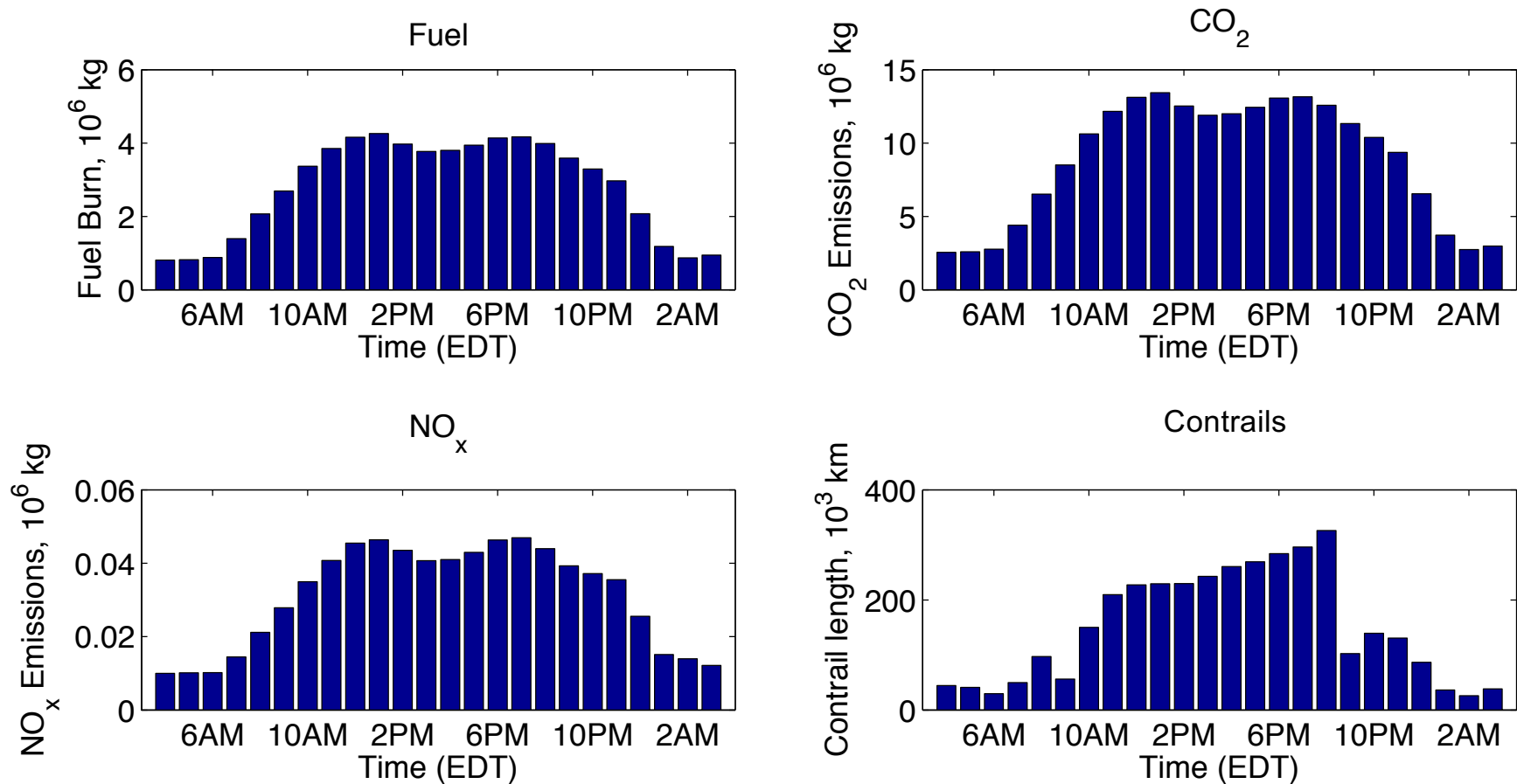
- Airspace operations is a trade-off balancing safety, capacity, efficiency and environmental considerations
- Need integrated analysis tools to evaluate different policy and technology options for sustainable aviation



# Air Traffic Simulation

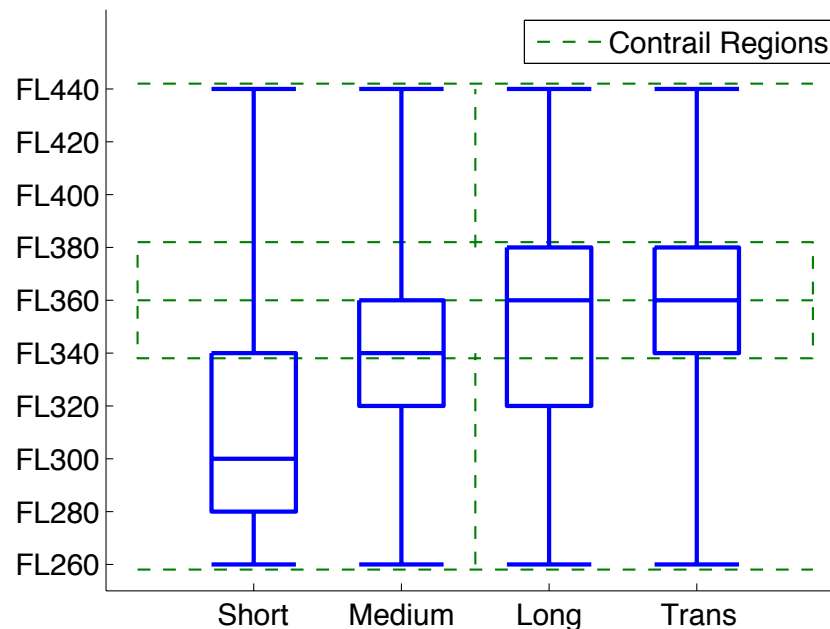


# Typical Daily Aircraft Fuel Consumption and CO<sub>2</sub>, NO<sub>x</sub> and Contrails Production in US

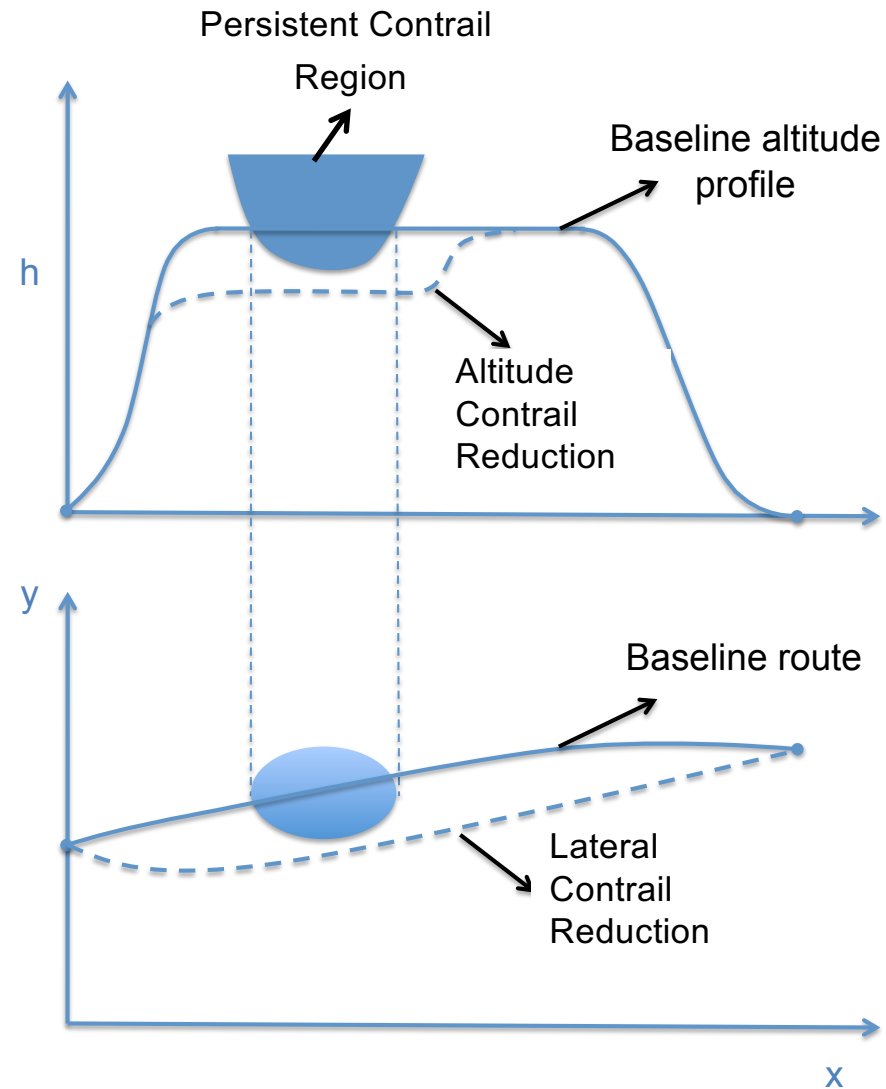


# U.S. Airspace Analysis

Class	Number of Flights	Contrail Minutes	Total Distance (1000 miles)
Short	13,212	12,796	3,672
Medium	8,096	52,504	5,814
Long	2,864	36,021	3,378
Transcontinental	1,953	67,420	3,378
Total	26,125	168,741	16,242



# Contrail Reduction Concepts



## Key Findings from the Analysis

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- Contrail reduction beyond a certain amount may not be environmentally friendly due to the use of extra fuel and the emission of additional amount of CO<sub>2</sub>
- Trade off between reduction in absolute global temperature change and fuel consumption.
- Effect of NO<sub>x</sub> negligible except for a small impact around 25 years
- Short flights (less than 500 miles), although half the number of flights in the National Air Space, contribute a small number of contrails (about 7%) due to their altitude profile.
- Changing altitude is an efficient way of achieving contrail reduction.
- Contrail reduction more efficient on high-contrail days
- Effect of contrails becomes less important as the decision-making horizon is increased
- Findings true even in the presence of uncertainty in contrails

## Workshop Questions

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- What is “global ATM research” and how does it differ from ATM research in general?
- What are the grand challenges in global ATM research?
- What ATM research areas are the most understudied? Overstudied?
- Think of the value chain linking ATM research to development to deployment and use. What are the weakest links in this chain and how can we strengthen them.
- What advice would you give to a young researcher thinking of going into Air Traffic Management? Would you recommend it? What problems should they work on?