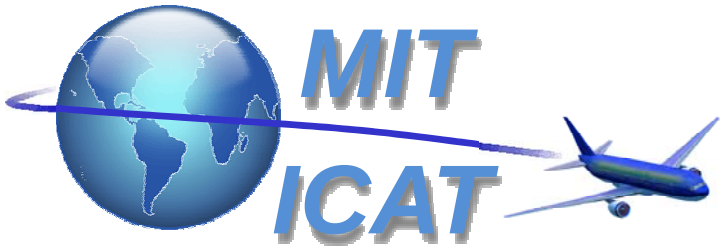

Near-Term Operational Opportunities to Reduce Aviation Environmental Impact

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Motivation

- **Need to identify and evaluate ways to reduce the environmental impacts of aviation in the near-term with minimal implementation barriers**
- **Minor adjustments to operating procedures or limited equipment/infrastructure changes**
  - Some techniques already being implemented, e.g. CDAs
  - Some still in research stage, e.g. surface movement optimization
  - Others yet to be fully defined
- **Require effort to systematically identify, evaluate and prioritize potential near-term operational changes**
- **Joint effort between Purdue and MIT sponsored under the FAA Partnership for Air Transportation Noise and Emissions Reduction (PARTNER) Center of Excellence**

Approach

Stage 1

1. Identification of Benefits Pool via Literature Review & System Analysis
2. Obtain Stakeholder Input
3. Categorize Mitigation Options
4. Evaluate Potential Environmental Impact of Identified Mitigation Options
5. Identify Barriers to Implementation of Identified Mitigation Options
6. Identify Most Promising Mitigation Options for Detailed Investigation in Stage 2

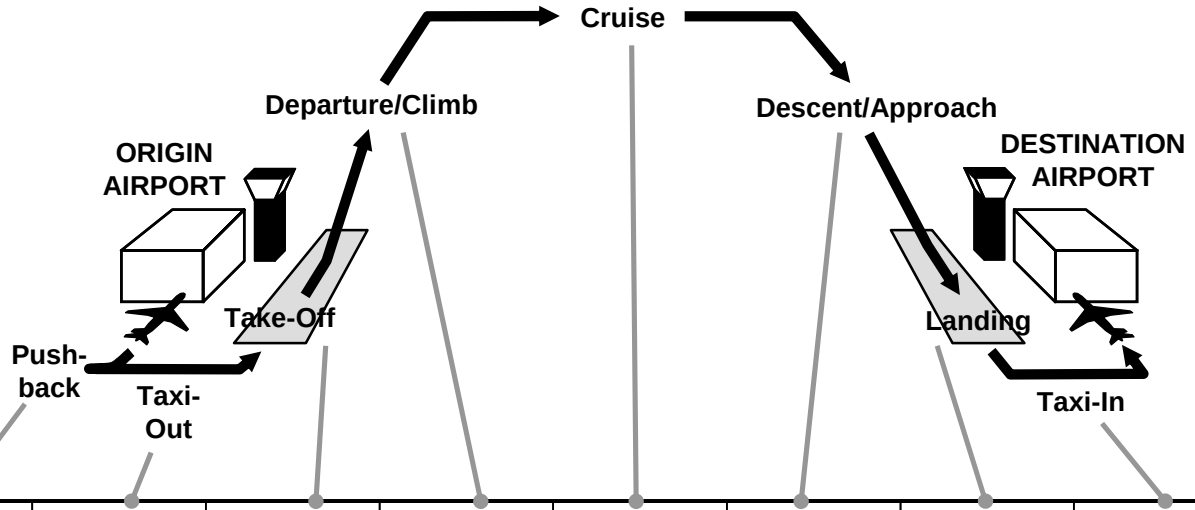
Stage 2

7. Investigate Environmental and Operational Impact of Selected Mitigation Options
8. Stakeholder Interviews on Selected Mitigation Options
9. Document and Disseminate Results

- **Project started recently**
- **Currently obtaining stakeholder input**

Operational Areas Targeted

- **Preliminary list created of potential study areas**



Potentially near-term	• Basic push-back management strategies (e.g. N-control)[1]	• Single engine taxi	• Engine take-off power optimization	• Continuous Climb Departures in terminal area	• Optimal cruise altitude & speed assignment, e.g. cruise climb	• Continuous Descent Approaches in terminal area	• Displaced thresholds	• Single engine taxi
Potentially medium-term	• Advanced push-back management strategies[2]	• Optimal taxi routing with no/minimal holding[2]	• Runway allocation for optimal taxi routing[2]	• Optimal Continuous Climb Departures to cruise[3]	• Wind optimised ground track at optimal cruise altitude & speed[3,4]	• Continuous Descent Approaches from cruise[3]	• Steeper glideslope angles • Runway allocation for optimal taxi routing[2]	• Optimal taxi routing with no/minimal holding[2]

Notes:

[1] Proposed to be tested in PARTNER/Lincoln Lab field trial

[2] Under development in Lincoln Lab Arrival/Departure Management Tool (A/DMT) project

[3] Part of NextGen/SESAR objectives

[4] Part of AIRE & ASPIRE objectives for oceanic operations

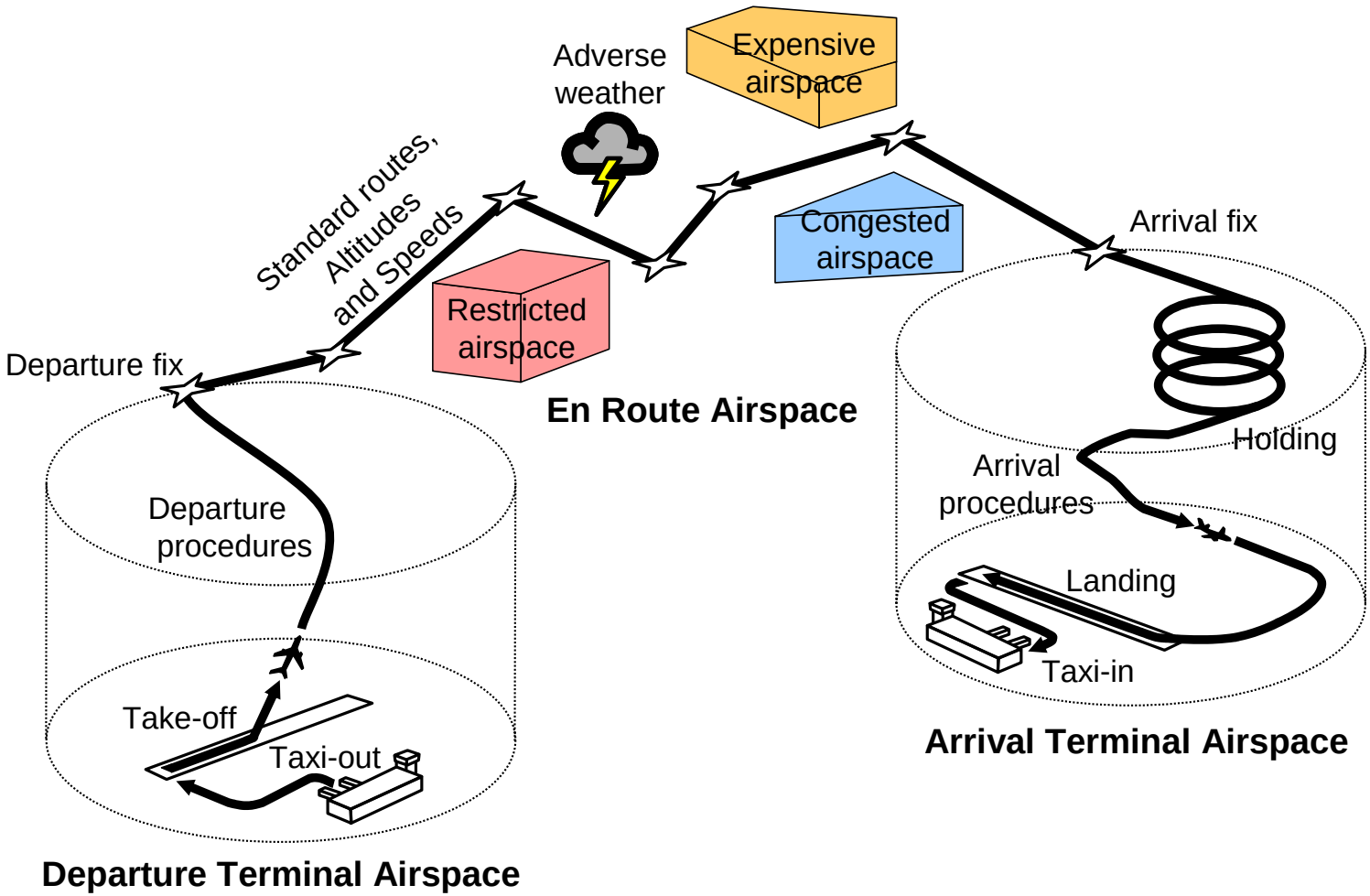
Areas of Aviation Climate Impact

Potential solutions separated into four climate impact categories

- **Fuel Burn / CO_2 Emissions**
- **Climate Change**
- **Surface Emissions**
- **Noise**

Air Traffic Inefficiencies

- **Based on prior ATM studies**
- **Inefficiencies result in higher fuel burn**



Source: Dr. Tom Reynolds

Fuel Burn / CO_2 Emissions

- **Horizontal Routing Efficiency**
  - Wind optimized routing (enabled by National Route System)
  - Closer spacing of routes
- **Vertical Routing Efficiency**
  - Reduced cruise climb step size
    - *RNP/RNAV with multiple lanes*
  - Continuous cruise climbs
  - Optimized Profile Descent (OPD)
- **Cruise Mach reduction**
- **Tightened Arrival and Departure Standard Routings**
  - RNP Enables SIDs and STARS
  - OPDs
- **Improved Airline/ATC Coordination on Efficiency**
  - Tactical CDM
  - Airborne Flow Program (AFP)
- **Policy Measures**
  - Fuel Tax
  - CO_2 Caps
  - Incentivizing Modal Shifts for Short Range
    - *Slot Access, Air Navigation Fees*
  - Incentivizing Larger Guage

Climate Change

- **Contrail Minimization**
  - Restrict/Limit Access to Forecast High Contrail Potential Zones
    - *Similar to CCFP and Convective Weather Procedures*
  - Clearance Procedures, Forecasting, Monitoring
  - Conflicts with most fuel efficient route, hard to qualify tradeoffs
  - Monitoring?
- **Management of Emergent Climate Change Sources**

Surface Emissions

- **Single-engine taxi**
- **Pushback and queue management strategies**
  - Ground power at penalty box locations
- **Surface Taxi Route Optimization**
  - Runway assignments
- **Tow-Outs Using Efficient Tugs**

Noise

- **Advanced Approach Procedures**
  - Low Power/Low Drag
  - Continuous Descent Approach (RNAV/RNP)
  - Optimized Profile Descent (OPD)
  - Decelerating Approach
  - Increased Glide Slope Angle
- **Displaced Thresholds**
- **Optimal thrust cutback on takeoff**
- **Noise Optimized Trajectories**
  - Avoid flights over noise sensitive areas
    - *New trajectories can open door to environmental review*
  - Lateral and vertical trajectory control

- **Other Ideas?**