Optimization model for large-scale air traffic flow management
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Motivation
Large scale air traffic flow management model needed for:
- Strategic planning
- Congestion prediction
- Traffic management coordination
- Dynamic airspace configuration

Reducing complexity
- Model does not rely on the current center & sector paradigm
- Considers a simplified network of routes and specific capacitated elements, including:
  - Weather systems
  - Busy airports or multiple airport systems

Hierarchy of airspace modeling
This model provides highest level in effort:

Strategic plans & aggregate flows
- Tier 1: Strategic
  - Wide area weather forecast

Regional weather forecast
- Tier 2: Tactical
  - Regional TFM initiatives

Real-time weather & flight data
- Tier 3: Opportunistic
  - Immediate actions

Case study
- Scenario constructed with real weather systems and schedule
- Airport capacities reflect nominal values
- Weather system duration drawn from forecast data, capacity estimated empirically

Structure
Large scale integer program minimizes a weighted sum of ground and airborne delays, considering:
- Airport and airspace capacity constraints
- Network forcing constraints
- Aircraft connectivity constraints
Based on earlier work by Bertsimas, Lulli, and Odoni

Delay propagation
- Captured by applying a flow model of individual aircraft into and out of large airports

Flights from previous time periods
- Arrivals: $a_{t+2}$, $a_{t+1}$, $a_t$
- Departures: $d_t$
- $B_{t+1}$, $B_t$, $B_{t+1}$

Continuing work
- Develop automated system for identifying disruptions and network structure surrounding them
- Create more sophisticated case study
- Reduce model complexity