1. Lightning Safety at Airports

Problem in a Nutshell
- Lightning is a safety concern
- Safety procedures that trigger ramp closures in place to mitigate risk
- Traffic impact on gate, ramp & airport operations

Objectives
- Document operational procedures & decision support information
- Assess uncertainties
- Identify inefficiencies & safety risks
- Assess traffic impacts
- Examine tradeoffs between safety & efficiency cost to identify most effective ramp management

Today’s Approach
- Reactive based on lightning within critical distance
- Reset waiting period with each lightning stroke
- Variety of lightning information and safety rules used

Ramp Closure Case

2. Annual Impact Statistics from Lightning & Traffic Data

Weather Impacts
- Maximum lightning impacts (i.e., number of ramp closures & duration) for Florida
- Minimum lightning for west: coast & Hawaii

Traffic Impacts
- Maximum number of flights affected by ramp closures for high lightning & high traffic demand airports (e.g., ATL, MCO, MIA, TP, FLL, DEN, IAH, DFW, ORD)
- Maximum gate pushback delays (over normal) for metropoles (e.g., JFK, LGA, EWR, ORD, MDW, IAD, BWI)

3. Traffic Delay & Safety Risk Assessment

- Isolating contribution of lightning-induced ramp closures to other traffic delays by performing NAS simulations utilizing AvMet’s Dynamic ATM Research Tool (DART)
- Weather-aware, superfast-time NAS simulator
- Modeling discrete air traffic operations for individual & aggregate flights in terminal & en-route airspace given aviation weather constraints
- Simulation of ground delays and incorporation of ramp closures

- Targeting various impact scenarios
- Varied traffic demand, number & duration of ramp closures, delayed opening and closing of ramps, ramp closure timing relative to traffic demand, different airport complexities etc.

- Focusing on immediate impacts on arrival & departure operations

Risk Computation
- Multiplication of:
  - Number of lightning strokes
  - Number of people servicing aircraft
  - Chance of getting injured (various levels)
  - Monetary value of injury

Economic Assessment
- Minimum for cost of both hazards risk & demand delays
- Safety procedure
- Total lightning safety

Delay Computation
- Compute arrival and departure delay of flights due to ramp closures
- Multiply delays with factors considering direct operating costs and passenger value time based on FAA standards

Case Study Example: ATL – 8 August 2014
- Busy airport & long ramp closure duration
- Weather impacts during high-demand period
- 80 simulations using combinations of traffic demand, lightning sources & safety procedures

4. Summary & Ongoing Work
- Substantial cost of ground delays from lightning related ramp closures
- Substantial costs can be associated with lightning risk if not mitigated
- Different lightning information and safety rules affect delay & risk cost
- Lighting impacts depend on traffic profile & time of impact
- Ongoing: analysis of 3 summer months for different airports to build statistics in order to quantify how uncertainties in lightning data, procedures, & simulation results affect determination of economic balance

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