Translating Meteorological Observations into Air Traffic Impacts in Singapore Flight Information Region (FIR)

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Outline

- Singapore FIR operations and congestion management needs
- Convective weather challenges
- ATM – Weather Integration Framework – initial applications in Singapore airspace
- AWI Opportunities and Needs for Asia-Pacific Region
Air Traffic Management (ATM) Objective: Congestion Management

- ATM system balances demand for air traffic services with available system capacity in an equitable and efficient manner.
- ATM keeps air traffic flows within levels that can be safely managed by air traffic controllers.
- Demand and capacity predictions are essential to ATM planning and efficient air traffic operation.
Growing Need for Advanced Congestion Management in Singapore FIR

Commercial Aircraft Movements
Changi Airport

Passenger Movements
Changi Airport

Singapore Flight Information Region (FIR) Operations

- Traffic dominated by flights to/from Changi airport
- ATC and ATM ops distributed among 8 en route sectors
- Congestion arises due to:
  - Weather
  - Volume surges
  - Military flight activity
- Traffic regulated via strategic slot allocation
- Tactical flow management via arrival management (AMAN) controller tools / procedures & airborne holding
Significant Weather Challenges in Singapore FIR

- Significant and varied convective weather conditions all year long
  - A forecast challenge

- Changi airport affected by:
  - Lightning
  - Gusty winds, wind shifts
  - Transboundary haze


Radar Images courtesy of Meteorological Services of Singapore (MSS)
Weather and Traffic in Singapore FIR

22 July 2016
0100 – 0600 UTC
ATM – Weather Integration (AWI) Framework

- Most effective ATM of weather-induced capacity degradation requires AWI
- Proactive management of impact of weather is what matters – not weather itself
- Weather impact translation & integration:
  - Simplifies and focuses disparate weather information
  - Fundamentally informs how weather affects operation and decisions needed for impact mitigation
Adopting AWI Framework for Singapore

Initial Focus: Convection in FIR

Initial Efforts:

- Identify / collect pertinent weather & traffic data
- Quantitatively assess weather impact events
  - Conditions
  - Responses
  - ATM Decision Options
  - Outcomes
- Develop models for translating weather data into operational impacts
- Assess available weather forecast usable for AWI
- Create new products tailored to predicting weather impacts on air traffic

MSS Doppler Weather Radar Data

1.0° Radar PPI  5 km Radar CAPPI  7 km Radar CAPPI

Satellite-derived Convection Diagnosis Oceanic (CDO) and Cloud Top Height (CTH) Data – NCAR, BCI, Inc.
Varied Pilot Responses given Convective Weather along its Route

- Objective identification of weather encounters and deviation / penetration response
- Statistical analysis examining encounter characteristics relative to operation characteristics informs weather avoidance likelihoods
Weather Translation leading to Weather Impact Guidance

- With impact translation, can replace weather radar, satellite, CDO, convection observations and forecasts....

- Resource-specific air traffic impact decision support
AWI Opportunities: Asia-Pacific Region

- Weather impact challenges country-specific, but framework and models applicable to broader A-P region
  - Adopting models standing up in Singapore ensure regional synergy
  - Important for Singapore too: many long-haul flights and cross-FIR-boundary weather constraint and ATM decision-making implications

- AWI is new endeavor – would better overcome initial challenges with dedicated program focused on:
  - Defining key air traffic decision needs and explicit weather challenges
  - Establishing strong AWI partnerships between Civil Aviation Authorities (e.g., CAAS) and National Meteorological and Hydrological Services (NMHS; e.g., MSS)
    - Jointly identify gaps and AWI requirements / services
  - Define and develop “two way” training program (air traffic & met ops)
  - Develop regional, multi-country FIR-NMHS partnerships for AWI in support of ATM
Thank you