Aviation Weather Research Program – Requirements and Priorities

Bruce Carmichael

Juneau, AK
Aviation Weather Research Program Goals

• **Address Air Transportation System Needs**
  – Reduce Weather-Related Accidents & Incidents
  – Relieve Weather Impact on System Capacity & Efficiency

• **Provide Solutions**
  – Provide Capability via Applied Research to Generate Weather Observations, Warnings, and Forecasts with Higher Resolution & Accuracy
  – Improve Accessibility & Delivery of Weather Information
Focused Research Teams

Meteorological Teams
- In-Flight Icing
- Convective Weather
- Turbulence
- National Ceiling and Visibility
- Terminal Ceiling and Visibility
- Oceanic Weather
- Winter Weather
- Model Development & Enhancement
- Advanced Wx Radar Techniques
- Quality Assessment
- Aviation Forecasts

Core Members
- NCAR
- NWS (NCEP: AWC, EMC)
- NOAA (FSL, ETL, and NSSL)
- MIT/LL
- NRL
- FAA WJ Hughes Tech Center
- Universities

Extended Members
- NASA Glenn/Langley/Ames; DoD; Airlines; Port Authorities; Cities
- Weather Service Industry (CRDAs)
- Aviation Trade Associations
In-Flight Icing R&D: Synergy with NASA Glenn

Motivation
- >25 accidents/year; 50% fatalities & destroyed aircraft
- >$100M/year in injuries, fatalities, and aircraft damage

Challenge
- Accurate & timely nowcasts/forecasts of conditions conducive to aircraft icing
- Reduced fatal GA accidents especially in Alaska

Recent Success
- Current Icing Potential (CIP) product with flight path tool implemented operationally ($20M and 20% reduction/year)
- Forecast Icing Potential (FIP) product implemented for operational use ($2.4M/year for commuter airlines)

Future Plans
- FIP SLD Operational – FY05
- Icing Severity Operational – FY06
- CIP – AK Operational – FY07
- FIP – AK Operational – FY08

Wing icing in-flight is very hazardous

Flight path tool highlights terrain and icing potential
Convective Weather R&D: Synergy with NASA Ames

Motivation
- As traffic rebounds, convective weather accounts for 75% of the summer delays
- $22M in injuries, fatalities, and aircraft damage/year due to convectively-induced turbulence

Challenge
- 1-6 hour forecasts of initiation, growth and decay of thunderstorms, both terminal & en-route
- Avoidance of hazardous storms and route optimization

Recent Success
- National Convective Weather 1-hour Forecast (NCWF) operational
- Terminal Convective Weather Forecast (TCWF) implemented on ITWS prototypes

Future Plans
- 2-hour NCWF with growth & decay Operational – FY06
- Terminal Convective Weather Forecast (TCWF) implemented into ITWS – FY06 (nationalized benefit: $524M/year)
- 3-6 hour product Operational – FY09
Turbulence R&D

Motivation
- 65% of weather related injuries; >4000 severe encounters in 2002
- $100M/year in injuries, fatalities, and aircraft damage
- Major airspace capacity and workload issue

Challenge
- Accurate & timely nowcasts/forecasts of en-route turbulence
- Reduction in turbulence injuries/fatalities (25%)

Recent Success
- Clear-Air Turbulence (CAT) product FL200+ operational

Future Plans
- CAT product FL100+ Experimental – FY05
- CAT product FL100+ Operational – FY06 ($100M/year)
- Convectively-Induced Turbulence product Operational – FY09

It's not only ride quality, Turbulence can be deadly!

Accurate forecasts at any altitude.
National Ceiling & Visibility R&D

Motivation
- 72% of GA-CONUS & 55% of GA-Alaska aviation weather fatalities
- $100M/year in injuries, fatalities, and aircraft damage
- Accurate & timely nowcasts/forecasts of low ceiling and visibility conditions to reduce accidents especially for GA aircraft
- Reduction in fatalities, aircraft damage by 50%

Recent Success
- Ceiling & Visibility product approved for test use

Future Plans
- C & V product experimental – FY05
- C & V product AK experimental – FY06
- C & V product operational – FY07
- C & V product AK operational – FY08
Terminal Ceiling & Visibility R&D

Motivation
- Terminal capacity becomes unpredictable resulting in wasted opportunities
- > 8 fatal accidents/year due to NE winter weather C&V
- $28M/year in injuries, fatalities, and aircraft damage due to NE winter weather C&V

Challenge
- Accurate and timely forecasts of low ceilings and visibility in the terminal area during Northeast winter weather conditions

Recent Success
- Marine Stratus Forecast System transfer to NWS - FY04 (>5M delay benefit)

Future Plans
- Integrate component C&V products for Northeast airports – FY05
- Demonstrate prototype integrated Northeast C&V display – FY06
- Integrated C&V product experimental – FY07
Oceanic Weather R&D: Initial Funding from NASA Langley

**Motivation**
- $22M in injuries, fatalities, and aircraft damage/year

**Challenge**
- Accurate & timely nowcasts/forecasts of convection, icing, turbulence, winds, and volcanic ash along oceanic routes
- Reduction in current $9.4M/year injuries, fatalities, aircraft damage by 50%

**Recent Success**
- Cloud Top Height product approved for test use

**Future Plans**
- Flight Level Winds Product Operational – FY05
- Convective Diagnosis Product Experimental – FY06
- Cloud Top Height Product Operational – FY07
- Turbulence (CAT) Product Operational – FY08
- Convective Diagnosis Product Operational – FY09
- Volcanic Ash Product Operational – FY10

Volcanic ash is not just a maintenance issue.

Accurate forecasts of oceanic weather hazards are critical to flight safety.
Winter Weather R&D

Motivation
- 10/31/02 – ice ingested into engines of 12 aircraft on takeoff – 10 engines needed repair & 2 engines replaced @ $2M; additional $ due to out of service impacts; 7 more on 10/31/03
- 10/10/01 – Dillingham, AK; ice on wings of air carrier: 10 fatalities/destroyed aircraft on departure

Challenge
- Accurate and timely 2-6 hr forecast of winter precipitation
- Reduction in ground delays and enhanced safety

Recent Success
- Weather Support to Deicing Decision Making (WSDDM) at LGA, JFK, EWR ($16.7M/year benefits)
- WSDDM at DIA ($1.36M/year benefits)
- 4-hr forecast

Future Plans
- 6-hr forecast – FY06
- 12-hr forecast – FY09

Determining the holdover times are critical to safe operations

Accurate nowcasts/forecasts of winter precipitation and liquid water content are critical to flight safety and efficient runways plowing