Aviation Weather Testbed

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Chief, Aviation Support Branch
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National Centers for Environmental Prediction
“From Sun to Sea”
Mission

- The AWC delivers consistent, timely and accurate weather information for the world airspace system. We are a team of highly skilled people dedicated to working with customers and partners to enhance safe and efficient flight.
AWC’s Partners/
Stakeholders

✈️ FAA
  ✈️ Command Center
  ✈️ Flight Service Stations
  ✈️ Research and Development (AWRP)
  ✈️ Policy and Requirements

✈️ NWS
  ✈️ CWSUs
  ✈️ AAWU
  ✈️ WFOs
  ✈️ NCEP Centers
    ✈️ SPC, SWPC, TPC, HPC, NCO

✈️ USAF
  ✈️ Weather Agency (AFWA)
    ✈️ 15 OWS, Scott AFB
  ✈️ Airline Met Services
  ✈️ United Kingdom’s Meteorological Office
  ✈️ Meteorological Service of Canada (MSC)
# AWC Products & Services

## U.S. Products (except Alaska and Hawaii)
- Flight Hazard Forecasts and Warnings
  - SIGMET
  - Convective SIGMET
  - AIRMET
  - G-AIRMET
  - Area Forecasts (FA)
  - Low Level Significant Wx
  - Collaborative Convective Forecast Product (CCFP)

## Global and Oceanic Products
- Flight Weather Forecasts Maps for the entire World (Airlines)
  - Mid-Level Significant Wx
  - High Level Significant Wx
- Flight Hazard Warnings for Atlantic, Pacific, Gulf of Mex. and Caribbean
  - International SIGMET
  - Tropical Aviation Wx

## Automated Aviation Products
- Graphical Turbulence Guidance (GTG)
- Current Icing Product (CIP)
- Forecast Icing Potential (FIP)
- National Conv. Weather Diagnostic/Forecast (NCWF)

## Aviation Services
- ADDS: Aviation Digital Data Service
- AviationWeather.gov
- International Flight Folder Documentation Program (IFFDP)
Domestic Operations Branch

Five Operational Desks
- FA East, Central, West
- CCFP (Collaborative Convective Forecast Product)
- Convective SIGMET

Domestic Products
- SIGMETs – Aviation Warnings
- AIRMETs – Aviation Advisories
- FA – Aviation Area Forecast
- CCFP – NAS Convective Planning Forecast
- SIGWX Low – Significant Low-Level Aviation Graphic
International Operations Branch

Three Operational Desks
- SGWX Northern Hemisphere
- SGWX Southern Hemisphere
- Tropical Desk

Domestic Products
- Significant Weather High
  - Global 24-hour High-Level Forecasts
- Oceanic SIGMETs
  - Aviation Warnings for Atlantic and Pacific
- FACA and FAGX
  - Area forecasts for the Caribbean and Gulf of Mexico
## AWC Product Issuances

<table>
<thead>
<tr>
<th>Product</th>
<th>#/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convective SIGMET</td>
<td>30,000</td>
</tr>
<tr>
<td>Non-Convective SIGMET</td>
<td>500</td>
</tr>
<tr>
<td>Collaborative Convective Forecast Product (CCFP)</td>
<td>25,000</td>
</tr>
<tr>
<td>AIRMETs</td>
<td>26,280</td>
</tr>
<tr>
<td>Area Forecasts (FA)</td>
<td>6,570</td>
</tr>
<tr>
<td>Significant Weather Low</td>
<td>1,460</td>
</tr>
<tr>
<td>Significant Weather High</td>
<td>18,890</td>
</tr>
</tbody>
</table>
AWC’s Area of Responsibility for Aviation Warnings (SIGMETs)
Area Forecasts, AIRMET & SIGMET

- 15 forecasters 24/7
- CONUS & Coastal Wtrs
- Text & Graphic Weather Forecasts.
  - AIRMETs
    - 26280 routine issues
  - FA
    - 6570 routine issues
  - SIGMET
    - ~ 500 avg annual
  - Low-Level Graphic
    - 1456 routine issues
Convective SIGMET

- 5 GS-12 Forecasters
- SIGMET for thunderstorms
  - “Warning” Product
  - Associated Hazards: Turbulence, Icing, & Wind Shear
- CONUS and coastal waters
- Issued Hourly / Valid for 2 hrs
- ~ 30,000 issued annually
Collaborative Convective Forecast Product (CCFP)

- 5 Forecasters
- Strategic traffic flow management
- Collaborators:
  - FAA
  - Meteorologists at CWSUs, Airlines, and AWC
  - MSC
- ~ 25,000 Forecast Polygons annually
- New Operational DS Desk (ATCSCC)
- Added new ECFP (Exended Convective Forecast Product – now operational)
  - http://www.aviationweather.gov/products/ecfp

Developed in AWT; Operational 15 April 2012
Significant Weather Forecasts

- 8 Forecasters
- Covers FL250 - FL630
- Worldwide forecast
  - 24 hour forecasts
    - Jet Streams
    - Thunderstorms
    - Turbulence
    - Tropopause Heights
    - Active Volcanoes
    - Tropical Cyclones
- 18,980 routine issuances/yr *
Oceanic SIGMETs

- 5 GS-13 Forecasters
- Thunderstorms
- Tropical Cyclones (Hurricanes)
- Severe Icing & Turbulence
- Dust Storms & Sandstorms
- Volcanic Ash
Gulf of Mexico & Caribbean Area Forecasts

- Same five forecasters as Oceanic SIGMETs
- Weather Forecasts primarily for Helicopter Operations
  - Clouds
  - Visibility
  - Thunderstorms
  - Rain/Fog
  - Wind
- 4,000 Operating Oil Platforms
- 30,000 personnel living on oil platforms
- 600 Helicopters
- 1.3 Million flights annually

4,000 Operating Oil Platforms

30,000 personnel living on oil platforms

600 Helicopters

1.3 Million flights annually
World Area Forecast System (WAFS)
- Formulated by ICAO and the WMO
- Improve the quality and consistency of enroute guidance provided for international aircraft operations

World Area Forecast Centers (WAFC)
- WAFC – Washington
  - AWC provides Significant Weather Forecasts
  - NCEP Central Operations Provides Wind and Temperature Grids Charts
  - NWS Telecommunications Gateway supports satellite data broadcasts
- WAFC – London
  - Met Office – Exeter
Aviation Digital Data Service

- ADDS makes available to the aviation community text, digital and graphical forecasts, analyses, and observations of aviation-related weather variables.

- ADDS joint developed
  - NCAR, GSD, and AWC

- Operational 2003

- Now averaging
  - 10 million hits per day
  - 100 GB per day

- Not just a display capability

- Already has many NEXTGEN data service capabilities

- Data service easily capable of supporting JMBL
  - Has existing capability to support 4D data cube
  - slices, dices, and returns a subset of data (flight paths or subset cubes)
Extremely Popular

[Graph showing the increase in hits and gigabytes over time, with a significant rise after July 04, indicating AADS OPERATIONAL AT AWC]
Aviation Weather Testbed

The Aviation Weather Testbed (AWT) accelerates science & technology innovations into operations for safe and efficient flight, and is a key player in Developing aviation weather services for NextGen.
New AWT Facility (Completed 2010)

1100 sq ft
Aviation Weather Testbed Facility

2011 Summer Experiment
Testbed History

The Aviation Weather Testbed (AWT) primary focus for the past decade has been Research-to-Operations (R→O) for the FAA Aviation Weather Research Program (AWRP)

- Transitioned AWRP Research to AWC operations
- Previously known as the FAA Testbed

Beginning in 2010 (following the 2009 UCAR Review), the Testbed has been evolving to engage directly in the science-infusion process for aviation operations

- Aviation desk at the 2010 HWT Spring Experiment
- Hosted the 2011 Traffic Impact Summer Experiment
- SREF-based dashboard high-impact winter weather support for CDM-WET
- Hosting the 2012 Summer Experiment
Four Algorithms developed by NCAR/RAL and fully transitioned to the AWC queued in the approval process

1. **Graphical Turbulence Guidance - 2**
   - Significant upgrade to existing algorithm
   - More accurate and extends down to 10,000 ft

2. **Forecast Icing Severity**
   - Significant upgrade to existing algorithm
   - Change from Potential to Severity

3. **National Ceiling & Visibility Analysis**
   - New diagnostic algorithm
   - Concerns over performance

4. **National Convective Weather Forecast - 2**
   - Significant upgrade to existing algorithm
   - Introduces convective probabilities
R→O Success Criteria

Research must meet all these criteria to be transitioned into NWS Operations

**Demonstrated Benefits**
Improvement in operational forecast and/or analysis quality or decision support

**Efficiency**
Adherence to time constraints and ease of use needs

**Sustainability**
Availability of resources to operate, upgrade, and/or provide support

**Compatibility**
IT compatibility with operational hardware, software, data, communications, etc.
Strategies for Energizing the AWT

1. Expand R2O successes: deliver to operations!
2. Strengthen relationships with FAA Aviation Weather Group (Engage in NextGen)
3. Establish new partnerships to ensure broad aviation weather community involvement (e.g., CIRA)
4. Involve NWS operational meteorologists during evaluations of emerging science and technology
5. Involve industry and TFM experts for impact DSS development and testing
6. Expand R20 experimental activities in the AWT (e.g., turbulence, icing, etc.)
7. Complete the AWT Charter!!!
2011 Aviation Weather Testbed Summer Experiment

- ~40 Participants from 15 organizations
- Three seminars

- Eight data sets evaluated

- Daily forecasts produced by each team

- 18Z-00Z Aviation Weather Impact Graphic
  Day 2-7 Impact Forecast using NAEFS

- Five evaluation forms completed by each team, addressed scientific and operational questions

- June 27 – July 22, 2011
- Visitors: July 11 – July 22
2011 AWT Summer Experiment: Participants
# 2011 Aviation Weather Testbed Summer Experiment

<table>
<thead>
<tr>
<th>Data Set</th>
<th>Source</th>
<th>Status</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-member 4km WRF-ARW Ensemble</td>
<td>DoD/AFWA</td>
<td>Active</td>
<td>18Z start, 36-hour forecast, data starts at 00Z</td>
</tr>
<tr>
<td>Derived Traffic Impact Potential</td>
<td>NCAR</td>
<td>Active</td>
<td>Derived from AFWA Ensemble</td>
</tr>
<tr>
<td>3km HRRR</td>
<td>GSD</td>
<td>Active</td>
<td>Hourly</td>
</tr>
<tr>
<td>Short-Range Ensemble</td>
<td>EMC</td>
<td>Active</td>
<td>Every six hours</td>
</tr>
<tr>
<td>Convective NearCast - Satellite</td>
<td>GOES-R/CIMSS</td>
<td>Active</td>
<td>Fifteen minute updates</td>
</tr>
<tr>
<td>Convective Initiation - Satellite</td>
<td>GOES-R/CIMMS</td>
<td>Active</td>
<td>Fifteen minute updates</td>
</tr>
<tr>
<td>Convective Probability</td>
<td>MDL</td>
<td>Active</td>
<td>NextGen Capability Evaluation</td>
</tr>
<tr>
<td>CoSPA</td>
<td>MIT/LL</td>
<td>Active</td>
<td>CCFP first-guess polygons</td>
</tr>
<tr>
<td>NAEFS</td>
<td>EMC</td>
<td>Active - AFWA</td>
<td>Every six hours</td>
</tr>
</tbody>
</table>
Example Forecasts: July 22\textsuperscript{nd}, 2011
Estimated Weather Delays: \(~1500\)

Aviation Weather Impact Graphic (18-00Z)

Format of graphic not required – teams free to create what is needed

Exceedance Probability Graphic

Contours at 30\% and 60\%
Can high resolution models provide insight into forecasts for aviation weather traffic flow impact?

Yes! However...

Amount of data is overwhelming

Day-to-day performance not clear

Each model offered predictive skill, but not consistently in any one area
How effective are the forecast graphics for communicating weather risk to a national air traffic manager?

- Less “meteorology” and more “impact” needed
- Keep the graphics very simple
- Difficult to translate weather information (boundaries, etc.) into expected impact
Experiment Results: Conclusions

perimental Forecasts:

- “Traffic light” green/yellow/red threat assessment was major theme
- Small time windows (~2 hours) per forecast better than six hour block
- Graphical outlook favored over graphics and text together

Experimental Data:

- Data mining tools for specific features a necessity, especially from ensemble models
- All data sets showed some forecast value
- Traffic impact information added value to forecast
- GOES-R Nearcast valuable for convective initiation, needs a enhanced display
Ongoing AWT Projects

- SE2012
  - TFM Decision Support
  - Convective Initiation
  - NWP/Ensembles Verification

- ATCSCC
  - Operational Bridging
  - Meteorologist-in-the-Loop (MITL)

- GOES-R
  - Evaluation of Demo Projects

- AWIPS-2
  - Operation Test & Evaluation

- OTE
  - Operation Test & Evaluation

- ECFP
  - SREF-Based Dashboard DSS

- NextGen
  - IC4D
    - Probabilistic Forecast
    - Ensemble Calibration
    - EDR/ASDI

- NWP Ensemble Guidance
  - Cig/Vsby
  - Traffic Impacts

- AWT Projects
  - AWTW-2
  - OTE
  - NWP Ensemble Guidance
  - Cig/Vsby
  - Traffic Impacts
ECFP
Extended Convective Forecast Product
Operational: 15 April 2012
AWT Summer Experiment
2012 Planning

• Dates: June 4th – June 15th 2012

• Focus: Evaluate new and emerging data sets and issue an experimental “Aviation Weather Statement”

• Purpose: Industry reps and FAA operators interact directly with AWC forecasters and external researchers to create new forecast product

• Key questions: How to handle uncertainty in models? Is the proposed AWS format adequate for NAS planning?
2012 AWT Summer Experiment

June 4th – June 15th, 2012

Four desks: Two focused on traffic flow management DSS; one on GOES-R proxy products; one on high-res models and ensemble evaluation

Links to NextGEN Capability Evaluation
2012 AWT Summer Experiment and the Remainder of the Year

- **Storm Scale Ensemble of Opportunity (SSEO)**
  - Ceiling and visibility guidance at high-resolution; Turbulence

- **AFWA Ensemble (now operational)**

- **Data:**
  - Eddy Dissipation Rate (EDR)
  - Aircraft Situation Display to Industry (ASDI)

- **Impact-based verification (real-time)**
  - Partnering with NOAA/GSD & DTC

- **Global data sets**
  - NAEFS & GEFS; Global Graphic Turbulence Guidance (GTG, NCAR)

- **Training**
  - Bring the operational forecaster along

http://testbed.aviationweather.gov
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