Improving Weather Information
Storm Prediction for Aviation

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NBAA Friends and Partners in Aviation Weather
21 October 2010 in Atlanta, GA
# Types of Convective Weather Forecasts

<table>
<thead>
<tr>
<th>Forecast</th>
<th>Type</th>
<th>Coverage</th>
<th>Generated</th>
<th>Outlook / Updates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal Aerodrome Forecast (TAF)</td>
<td>Text</td>
<td>Terminal</td>
<td>Human</td>
<td>0 – 24 h updated every 6 h</td>
</tr>
<tr>
<td>Convective Outlooks</td>
<td>Graphic &amp; text</td>
<td>CONUS</td>
<td>Human</td>
<td>1, 2, 3, &amp; 4 - 8 days updated as needed</td>
</tr>
<tr>
<td>Mesoscale Discussion</td>
<td>Graphic &amp; text</td>
<td>Regional</td>
<td>Human</td>
<td>few hours issued as needed</td>
</tr>
<tr>
<td>CCFP</td>
<td>Graphic</td>
<td>CONUS</td>
<td>Human</td>
<td>2, 4 &amp; 6 h updated every 2 h</td>
</tr>
<tr>
<td>CIWS</td>
<td>Graphic</td>
<td>CONUS 1 km</td>
<td>Automatic</td>
<td>0 – 2 h 5 min updates</td>
</tr>
<tr>
<td>CoSPA</td>
<td>Graphic</td>
<td>CONUS 3 km</td>
<td>Automatic</td>
<td>2 – 8 h 15 min updates</td>
</tr>
<tr>
<td>LAMP</td>
<td>Graphic</td>
<td>CONUS 20 km</td>
<td>Automatic</td>
<td>0 – 24 h hourly updates</td>
</tr>
</tbody>
</table>

2009 & 2010 Additions
16 September 2010

- CCFP & LAMP show highest confidence on 2nd wave of storms, & confidence is increasing with decreasing lead time
- CoSPA indicating two significant waves, but intensity of 1st wave weakens for short-term forecast (related to blending transition)
- Intensity of storms that affected NY area airports was not really grasped by any forecast until they impacted!
1 day convective outlook updated at 1952Z & valid 9/16 20Z until 9/17 12Z . . . suggest a risk of storm intensification . . . includes a 2% chance for tornado & 5% risk of damaging winds in NY area
Grappling with Uncertainties & Risks

• Forecast Uncertainties
  - observations (limited coverage & measurement errors)
  - numerical weather prediction (non-linear dynamic system, initialization)
  - incomplete process understanding
  - calibration

• Quantification of Uncertainty
  - human subjectivity (local weather expertise, experience with models)
  - statistical procedures (MOS processing, trends, similar past situations)
  - ensemble techniques (multi-model, time-lagging, spatial or diagnostic)
  - combination thereof

• Uncertainty Communication
  - no forecast is complete without description of uncertainty
  - what do we communicate: confidence, uncertainty, or probability?
  - ambiguity in definition of event, timing & location
  - choice of words & graphics
  - do forecast providers understand what aviation users need (impact & risk)?
  - how do aviation users interpret a weather forecast & its limitations?

... true for both weather & ATM prediction
Some Food for Thought . . .

• **Action in Response to Probabilistic Forecast**
  - “5% chance of damaging winds”: maybe 95 times out of 100 similar situations a “wait & see” strategy may be best approach . . .
  - where is that “human threshold” that triggers proactive steps? (may depend on context or yesterday’s experience)
  - how would fully-automated system deal with low probabilities?

• **How Good is Good Enough?**
  - how accurate can forecasts become (predictability limit)?
  - how accurate do forecasts need to be in order to be useful & valuable?
  - finding answer to last question requires weather integration into decision making process

• **What Information are Aviation Users Looking for?**
  - presence or absence of weather hazards in space & time (key locations)
  - weather hazards exceeding critical thresholds (intensity or organization)
  - high impacts for safety & efficiency of air traffic
  - last point requires translation of weather to impact & capacity estimation