On the usage of satellite derived products in ADWICE for diagnosing in-flight aircraft icing over Europe

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Why do we need a Post-processing like ADWICE?

- Risk/Intensity of icing is proportional to
  - Amount & size of supercooled large droplets (SLD)

- But no direct (or insufficient) information of SLD from NWP (here: COSMO-EU)!

- Therefore, other techniques must be used:
  - e.g. ADWICE
Diagnostic Icing Algorithm (ADWICE DIA)

PIP (3D) as „first guess“

Observational data (2D)
SYNOP/METAR & RADAR + SATELLITE (www.nwcsaf.org)

Catalog for icing scenarios
(Confirm/reject PIP and identify possible icing risk)

Freezing  Stratiform  Severe  Moderate
Convective  General  Light

Icing scenario

Icing intensity
(fuzzy logic)

Diagnostic Icing Product (DIP)

Roloff et. al., in preparation: The German In-flight Icing Warning System ADWICE for European Airspace – Current Structure, Recent Improvements and Verification Results
Cloud-Mask:

Satellite Products (www.nwcsaf.org):

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Reduction of Icing
Cloud-Top-Height:

Reduction/Height correction of Icing
Combination of Cloud-Top-Temperature, Cloud Phase & Cloud Mask:

- CTT = -20°C < T < 0°C
- Cloud Phase = Liquid
- Cloud Mask = True

General icing risk from cloud top to -1000m

Addition of icing / agreement of icing

Satellite Products (www.nwcsaf.org):

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Example: cross-section
Example: Icing Intensity (Prognosis)
Example: Icing Intensity (Diagnosis with Sat-Data)
Verification: Model vs. PIREPs

- 472 PIREPs from Oct–Dez 2013

- Hereby:
  - 458 Icing
  - 14 „no icing“

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Verification with PIREPS

- PIREPS are inaccurate in time and location (horizontal and vertical)
- Icing degree (LGT, MOD, SEV) is subjective and depends on type of aircraft
- Therefore: Maximum of forecasted / diagnosed icing intensity in a model-cube was compared to the related PIREP/AIREP:
“A320 REP MOD ICE BTN FL100 AND FL190 BTN VENEZIA AND VIC REP AT 11.00“

„HIT“

„MISS“
Verification Results for Europe

<table>
<thead>
<tr>
<th></th>
<th>Hit-Rate</th>
<th>1-False-Alarm-Rate</th>
<th>Vol%</th>
<th>Area under curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIP</td>
<td>86.65</td>
<td>66.67</td>
<td>11.15</td>
<td>0.7666</td>
</tr>
<tr>
<td>DIP (without Sat-data)</td>
<td>83.43</td>
<td>71.43</td>
<td>10.18</td>
<td>0.7743</td>
</tr>
<tr>
<td>DIP (with Sat-data)</td>
<td>83.23</td>
<td>71.43</td>
<td>8.77</td>
<td>0.7733</td>
</tr>
</tbody>
</table>

- Vol % = number of GP with diagnosed icing / number of all model GP
- Verification study over USA shows similar results (Tendel, 2013)
The implementation of satellite derived products into the ADWICE-Diagnosis leads to a reduction of grid-points diagnosed with icing by >16%, while Hit-Rate do not degrade!
Global setup of ADWICE-Prognosis ICON-Model:

ADWICE Icing Intensity (max in column) – Forecast
[ ICON 2014-10-16 00 UTC + 11h ]