Summer campaigns at MUC

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Summer campaigns 2010 und 2011 at MUC Airport

Cb-Nowcasting
POLDIRAD
Model Forecasts 2010
Cb Warnings
Flight Tracks 2010
Wake Vortex Separation 2010

Nowcasting-Site (DFS, DWD, DLR, weitere)
WIIS 2010 (DFS, LH HCC, FMG)
MetFROG 2011 (DFS)
Ninjo (DLR, DWD)
WxFUSION (DLR)
Campaign-Site (public)
Quantitative Evaluation

Pixel-based (perfect match)

Object-based (overlap only)

POD = \frac{\text{hits}}{\text{hits} + \text{misses}}

FAR = \frac{\text{false alarms}}{\text{hits} + \text{false alarms}}

POD: probability of detection, FAR: false alarm ratio
## Quantitative Evaluation for Rad-TRAM over 39 thunderstorm days in 2011

<table>
<thead>
<tr>
<th>Method</th>
<th>15 min.</th>
<th>30 min.</th>
<th>45 min.</th>
<th>60 min.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pixel-based</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>POD / FAR</td>
<td>0.65 / 0.36</td>
<td>0.47 / 0.53</td>
<td>0.34 / 0.65</td>
<td><strong>0.27 / 0.73</strong></td>
</tr>
<tr>
<td>POD STD / FAR STD</td>
<td>0.06 / 0.03</td>
<td>0.04 / 0.05</td>
<td>0.03 / 0.05</td>
<td>0.03 / 0.06</td>
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<tr>
<td><strong>object-based</strong></td>
<td></td>
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</tr>
<tr>
<td>POD / FAR</td>
<td>0.74 / 0.25</td>
<td>0.65 / 0.35</td>
<td>0.56 / 0.43</td>
<td>0.48 / 0.52</td>
</tr>
<tr>
<td>POD STD / FAR STD</td>
<td>0.06 / 0.02</td>
<td>0.05 / 0.03</td>
<td>0.05 / 0.04</td>
<td>0.04 / 0.04</td>
</tr>
<tr>
<td><strong>object-based for nowcast objects only</strong></td>
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<td></td>
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</tr>
<tr>
<td>POD / FAR</td>
<td><strong>0.98 / 0.01</strong></td>
<td><strong>0.95 / 0.03</strong></td>
<td><strong>0.89 / 0.09</strong></td>
<td><strong>0.75 / 0.23</strong></td>
</tr>
<tr>
<td>POD STD / FAR STD</td>
<td>0.06 / 0.004</td>
<td>0.06 / 0.007</td>
<td>0.06 / 0.01</td>
<td>0.05 / 0.03</td>
</tr>
</tbody>
</table>

POD: probability of detection, FAR: false alarm ratio, STD: standard deviation
Evaluation of the User-Feedback

• The display is clear and intuitive
• The display of the future development is very useful
• 5 minutes updates have the advantage that rapidly developing situations can easier and earlier be assessed than with 15 minutes updates
• The nowcasting up to one hour is accurate enough to enable reasonable planning (e.g. the ordering of overtime, or the estimation of how long the airport will be affected by a thunderstorm)
• The early and precise display of the products had a positive effect on the planning (Feedback Peter Roth, DFS)

Suggestions:

• Output of cloud top height
• Forecasts up to 2 hours desired
• Display of the products in the cockpit
Outlook summer campaign 2012
an initiative supported by DLR, DWD, ProMUC, ATMOSPHERE and TriaGnoSys

Summer 2012: *first, simultaneous demonstration* of the DLR thunderstorm products for all stakeholders in the aircraft and at MUC airport (collaborative decision making, CDM in MUC)

**Activities for the users at DFS, FMG and DLH:**
- Thunderstorm warnings via Email
- Cb-TRAM and Rad-TRAM in DFS MetFROG
- Cb-TRAM and Rad-TRAM on the DLR Nowcasting-Seite
- Datalink into the cockpit

**New in 2012:**
- Automation of the thunderstorm products
- Cb-TRAM in MetFROG
- Output of thunderstorm tops
- Datalink into the cockpit (DLR HALO will participate and DLH expressed strong interest)
On-board equipment

- Iridium receiver/sender
- ATMOSPHERE box
- Display (EFB)

Communicates via LAN or wireless on-board

Driven by battery

ATMOSPHERE box can be connected to the avionics (read-only) to retrieve data from on-board sensors

ATMOSPHERE box can receive data from the ground (e.g. weather data, NOTAMS)

http://www.youtube.com/watch?v=AyqyWzOnHY&lr=1
Cb-TRAM in the ATMOSPHERE Display
Outlook summer campaign 2012

EMI-test successfully performed on 7 March 2012

Photo: Christian Mallaun, DLR-FX

Photo: Katrin Witte, DLR-FX
Outlook summer campaign 2012
an initiative supported by DLR, DWD, ProMUC, ATMOSPHERE and TriaGnoSys

Nowcasting Products

Iridium

Cb-/Rad-TRAM

Server

ATMOSPHERE

DFS MetFROG

on-board part

ground part

Cb-/Rad-TRAM

Cb-/Rad-TRAM
Conclusions

The **DLR products** Cb-TRAM and Rad-TRAM were presented in real time to the users at MUC (DFS Center and Tower MUC, FMG, LH HCC) in displays they are familiar with.

The user feedback on the DLR products was very positive.

The DLR thunderstorm warnings were very helpful for the optimisation of the operations.

The DLR products are appropriate to provide all users the same picture of the weather situation.

They **help to improve the safety and efficiency** of air traffic.

The DFS asked for a further summer campaign 2012 where the DLR products shall be provided to users both at the ground and in the air.