NowCastSAT-Aviation – Satellite-based detection and nowcasting of convective cells

Stéphane Haussler, Richard Müller, Manuel Werner and Matthias Jerg

NowCastSAT-Aviation (NCS-A) is a novel product presently under development at Deutscher Wetterdienst (DWD). The intended scope of use is aeronautical meteorology for the en-route phase of intercontinental flights. During this segment of long-distance flights, only a limited amount of ground-based meteorological data is available to pilots, due to remote areas with scarce or nonexistent radar coverage. NCS-A provides near global detection of convective cells, rendering both detailed contours as well as simplified polygons marking large regions of dense thunderstorm activity.

Coverage
- Meteosat-10: Europe Middle East and Africa,
- Meteosat-8: Indian Ocean Data Coverage (IODC)
- Himawari-8: Asia-Pacific
- Meteosat-9 Rapid Scan Service (RSS): Increased time resolution over Europe

End user visualization and data delivery
- Web Map Service (WMS) solutions with OpenLayers and Cesium virtual globe
- NinJo workstation
- Direct data dissemination of polygons in xml format or geoserver

Nowcasting with optical flow
Forecasts of NCS-A are based on the nowcasting of satellite imagery with optical flow. Optical flow returns a motion vector field for each pixel, which is applied to the latest satellite measurements. The OpenCV implementation of [1] is used.


Detection of convective cells
The detection algorithm combines near real-time geostationary satellite data with numerical weather predictions calculated with the ICON model.
- Determine large regions with potential for thunderstorms (ICON KO ncev KC < 2)
- Identify cold/hot clouds in this region with satellite imagery (WV062 – WV073 > −1)

Verification
The lightning data of the LINET network which covers large parts of Europe are used as reference for testing. Scores are calculated using an object-based methodology.

<table>
<thead>
<tr>
<th>Contingency table</th>
<th>LINET yes</th>
<th>LINET no</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCS-A yes</td>
<td>Hit</td>
<td>False alarm</td>
</tr>
<tr>
<td>NCS-A no</td>
<td>Miss</td>
<td>Correct negative</td>
</tr>
</tbody>
</table>

**Scores**
- **Probability of detection:** POD = (Hits / (Hits + Misses))
- **False alarm rate:** FAR = False alarms / (Hits + False alarms)

Outlook for 2018
- Extend coverage over the American continent with GOES-16
- Define and include severity levels (Moderate, Strong, Severe)
- Determine the Cloud Top Height (CTH) of convective cells
- Operationalization

Department of Aeronautical Meteorology
stephane.haussler@dwd.de