

NowCastSAT Aviation (NCSA) Convective cell detection and nowcasting

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NowCastSAT Aviation (NCSA) provides near real-time, near global detection and nowcasting of convective cells.

- The intended scope of use is the **en-route phase of intercontinental flights**.
- In the context of aviation meteorology, **cumulonimbus clouds** shall be understood to include all associated weather phenomena: thunderstorm, moderate or severe icing, moderate or severe turbulence and hail [1].
- To allow for leeway regarding the (arguably loose) definition of cumulonimbus [2], we use the wording **convective cell**.
- Practically, we test our results against the LINET measurements [3] of the electrical discharges associated with lightning
- **Nowcasting** consists of forecasting on a time scale of a few hours.

 International Civil Aviation Organization (ICAO), Annex 3 to the Convention on International Civil Aviation, Nineteenth Edition, July 2016
World Meteorological Organization (WMO), International Cloud Atlas Volume 1, 1975
https://www.nowcast.de/en/lightning-detection-products/real-time-lightning-data.html



NowCastSAT-Aviation (NCSA)







Global coverage

- Satellites MSG4, MSG1, Himawari-8, GOES-16
- Frequency every 15 minutes
- **Projection** regular lat/lon 3600x1800 pixels
- Resolution approximately 13 kilometers

Rapid Scan European Coverage

- Satellites MSG3
- Frequency every 5 minutes
- **Projection** regular lat/lon 2736x1670 pixels
- Resolution approximately 3 kilometers







(left) Brightness temperature difference of the 6.2 μm and 7.3 μm channels, with values above -1 in color. (right) Optical flow in HSV representation. Colors represent the direction, and values the intensity of the flow.







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Brightness temperature difference of the 6.2 μm and 7.3 μm channels, with values above -1 in color. (left) Meteosat-10 measurement (right) Forecast







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Deutscher Wetterdienst Wetter und Klima aus einer Hand

Algorithm

- Determine large regions with potential for thunderstorms (ICON KO index KO < 2)
- Identify optically dense clouds in this region with satellite imagery (WV062 WV073 > -1)



(left) Brightness temperature difference in the water vapor channels (WV062 - WV073), with values above -1 in color (middle) ICON KO index, with values below 2 in color (right) Detected (resp. forecasted) convective cells Richard Müller, Stéphane Haussler, Matthias Jerg, The Role of NWP Filter for the Satellite Based Detection of Cumulonimbus Clouds, Remote Sensing, 2018





Contiguous detected pixels define a detected object, and contiguous measured pixels define a measured object.

	LINET yes	LINET no
NCS-A yes	Hit	False alarm
NCS-A no	Miss	Correct negative

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





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Modes

- Global service with an update frequency of 15 minutes and a resolution of 13 kilometers
- Rapid scan service over the European region with an update frequency of 5 minutes and a resolution of 3 kilometers

Performance

- Probability of detection above 75%
- Forecasts for up to 2 hours

Outlooks

- We are pushing NCSA to our live systems
- We are working towards including cloud top height information





Thank you for your attention

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