NowCastSAT-Aviation: Thunderstorm nowcasting for the en-route flight phase

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NowCastSAT-Aviation (NCS-A) is a novel product presently in pre-operational mode 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 global detection of convective cells, rendering both detailed contours as well as simplified polygons marking large regions of dense thunderstorm activity.

The detection algorithm combines near real-time geostationary satellite data with numerical weather predictions calculated with the ICON model. The brightness temperature difference of the water vapor channels measured with satellites is used to identify thunderstorms. A stability parameter from the NWP model is subsequently applied to filter the satellite-based detection, as thunderstorms are not present in stable atmospheres.

Optical flow is applied to a series of satellite images in order to perform the short-term forecast in NCS-A. Optical flow returns a motion vector field for each pixel, which is applied to the latest image. The use of optical flow constitutes a novel approach within the scope of satellite meteorology.

Lightning data of the LINET network is used as reference for the validation. Scores are calculated using an object-based methodology. A probability of detection (POD) of 75% is obtained, with a false alarm rate (FAR) of 35%. Forecasts are useful up to 2 hours with a POD around 50%, and a FAR around 50%.

NCS-A covers the globe with geostationary satellites: Meteosat-10 (Europe Middle East and Africa), Meteosat-8 (Indian Ocean Data Coverage), Himawari-8 (Asia-Pacific), GOES-16 (America). Furthermore, increased time resolution over Europe is available with Meteosat-9 Rapid Scan Service (RSS). End user visualization is implemented with Web Map Service (WMS) solutions (OpenLayers, Cesium virtual globe, and NinJo workstation). Alternatively, direct data dissemination of polygons is available with geoserver, or per ftp in xml format.

We first present the methods applied to detect and forecast thunderstorms. The validation results regarding both detection and short-term forecast over central Europe are discussed afterwards. Finally, we outline the technical infrastructure of NCS-A, from data collection to end-user delivery, together with a brief outlook of future developments.