EGU22-2823, updated on 19 Aug 2022
https://doi.org/10.5194/egusphere-egu22-2823
EGU General Assembly 2022

Data assimilation and nowcasting of severe weather for air traffic management purposes

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One of the main challenges for meteorologists is to improve the prediction of events that develop on small spatial and temporal scales, having important repercussions in air traffic activities. In this regard, the H2020 SESAR Satellite-borne and IN-situ Observations to Predict The Initiation of Convection for ATM (SINOPTICA) project, aims to demonstrate that the prediction of severe weather events with high spatial and temporal resolution, can benefit the ATM and aviation safety. SINOPTICA assimilates non-conventional observations such as Global Navigation Satellite System (GNSS), weather radar, and lightning data into numerical weather prediction model with a nowcasting technique called PHAse-diffusion model for STochastic nowcasting (PHAST) allowing to predict the highly localized convective events triggering in the vicinity of airports.

As part of the project, three severe weather events were identified on the Italian territory which caused the closure of the airports, delays on arrivals and departures, and numerous diversions. The results of the numerical simulations, carried out with the Weather Research and Forecasting (WRF) and nowcasting technique PHAST, were integrated into the Arrival Manager 4D-CARMA (4-Dimensional Cooperative Arrival Manager), an adaptive air traffic sequencing and management system for controllers, which generates and optimizes 4D trajectories to avoid areas affected by adverse phenomena and, under certain circumstances, reducing controllers' and pilots' workload. The results show that the nowcasting technique is able to predict the convective cells in shape, intensity and time. In addition, the assimilation of lightning and GNSS data improves the forecast accuracy of the above-mentioned events in line with expectations and ATM needs.