



Probabilistic forecasts of precipitation type for European airports based on multi-model ensemble

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The Single European Skies (SES) legislative framework of the European Union has the primary aim of meeting future capacity and safety needs of the European airspace. The SES ATM Research (SESAR) programme is the technological pillar of the SES legislation and as such develops and deploys modern and harmonised solutions to fulfil SES objectives. Weather plays an enabling role in aviation and as such modernisation needs extend to new and improved meteorological services and operational models. As the first phase of SESAR draws to a close, a Large Scale Demonstration project titled TOPLINK is carrying out an operational trial phase from April to July 2016 to validate new and improved meteorological services at the airports and in the cockpit via a real-time data feed.

The contribution to TOPLINK from the Finnish Meteorological Institute (FMI) draws from our Arctic location and expertise. FMI provided a probabilistic forecast of the likelihood of rain, drizzle, snow, sleet, freezing rain or freezing drizzle based on an algorithm developed by operational aviation weather forecasters at FMI operational forecast centres in close cooperation with the meteorological research group. The precipitation type algorithm assigns the following precipitation types: freezing drizzle if the surface temperature is between -10°C and 0°C , rain is not convective, stratus present with a base below 300m and content at least 5/8, weak ascent inside the stratus, stratus layer thick enough, stratus top and average temperature cold enough and a dry layer above the stratus. Freezing rain is forecasted if the following conditions are met: surface temperature below freezing, adequately thick melting layer above the surface, adequately cold freezing layer at the surface beneath the melting layer and if stratus is present, the melting layer above it cannot be dry. Drizzle or rain if an adequately warm layer above the surface. Sleet if the layer above the surface is not too warm/thick and if the warm layer above the surface is dry.

The probabilities are obtained by carrying out the precipitation type calculation using the ECMWF, GFS and HIRLAM NWP models using two previous model runs in addition to the most recent run to generate nine ensemble members. Probability is calculated from proportion of members reporting the phenomena. The probabilities are calculated for 45 major European airports up to 120h ahead in 3h time intervals. The forecast is then formatted into GML for application in any end user system and disseminated using FMI's Open Data interface. TOPLINK partners will then continue to disseminate the information onward via proprietary software and tools for ATM and pilots.

The verification results from the winter season 2015-2016 (November 2015 –March 2016) are encouraging for rain, drizzle, snow and sleet but fail to show skill for freezing rain and freezing drizzle. This is partly explained by the fact that these phenomena are very rare and to for the other part due to the fact that especially automatic observations are not reliable for freezing phenomena and thus we have to rely on manual SYNOP and METAR observations which are unfortunately also very rare. We expect that the indication of freezing phenomena in the product does correctly represent the increased likelihood to observe freezing phenomena but cannot be used without the consideration of all weather parameters by the forecaster. As such, more research would have to be done to ascertain the skill of the method using a longer analysis period. It is also highly likely that the thresholds to trigger the different phenomena are very dependent on the local circumstances and would thus benefit from at least a statistical calibration to each location.

Aviation weather services are moving ever more to a data-driven environment where users will be using data only instead of products they currently use. This creates pressure on the MET service providers to transfer the meteorological knowledge of the forecasters into impact-focused products automatically generated and disseminated to the end users.

