AUTOTREND – Automated guidance for short-term aviation forecasts

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Introduction
Although recent advances in Numerical Weather Prediction (NWP) modelling at KNMI have been substantial, these models still have not reached a state where they can resolve clouds and precipitation at the resolution and accuracy required for aviation meteorological forecasting. Aviation forecasters compensate for these deficiencies by combining model data with detailed recent observations and topographical information on the vicinity of the airport. In particular the quality of short-term forecasts (up to two hours ahead and provided in the form of TREND bulletins) is highly dependent on the availability of local observations and observations from upstream areas.

Objectives
The aim of AUTOTREND was to develop tools, which objectively integrate available observations and topographical information with existing model data. The main purpose has been to develop and implement these tools in an operational environment, and use them to provide detailed guidance on weather conditions such as winds, visibility, clouds and precipitation, that affect air traffic at civil airports in the Netherlands.

Results
In cooperation with the German company Meteo Service Weather Research¹, KNMI has developed a TREND-guidance, consisting of a short-term (0-2h) weather forecast. This weather forecast is provided for support of all air traffic during landing and take-off.

The TREND-guidance has been integrated into the operational environment at KNMI to support the aviation weather forecaster. The guidance is based on statistical and physical post-processing of NWP model data and observations. The technique used for the statistical post-processing is Model Output Statistics (MOS). The guidance contains site-specific information on the development of clouds, visibility, significant weather, and wind within the next 6 hours. Figure 1 shows an example of forecasted cloud amounts in the TREND-guidance.

The guidance is updated every 30 minutes with model data from KNMI’s NWP model HIRLAM², and recent local and upstream observations. Encoding software has been provided that translates the guidance into the required aeronautical TREND-code³. A graphical user-interface with an integrated code editor enables the forecaster to modify the suggested ‘first guess’ code. Figure 2 shows how the TREND-guidance and TREND-code have been integrated into the userinterface.

TREND forecasts depend on actual observations and are required to be added to those observations, quasi-instantaneously. Actual observations are provided as half hourly Meteorological Aviation Routine Weather Reports (METARs) or Special Aerodrome Weather Reports (SPECI’s). The TREND-guidance based on those observations is not yet available at that time, which forces us to add the guidance of 30 minutes previously to the METAR instead. This 30-minute delay has a large impact on the quality of the guidance, which can be demonstrated by objective verification.

Figure 1. TREND-guidance total cloud cover (N, upper panel) and cloud cover per layer (lower panels, abscissa indicate layer levels in ft). The breadth of the bands indicates the number of okta’s. This example shows an increase in cloud amount, due to advection of low stratus clouds from upstream locations.
Verification results are presented in Figure 3 in terms of Ranked Probability (skill) Scores (RPS); the TREND guidance is compared to the forecasters’ TREND-code and to persistence of the observation at issue time and 30 minutes before that. Lower RPS values represent a better forecast skill.

**Outlook**

A guidance system consisting of post-processing of NWP model data in combination with local and upstream observations is able to provide more detailed and accurate meteorological information on changing weather conditions at airports. By presenting this guidance information to the forecaster, aviation weather forecasts can be produced more efficiently. For short-term, TREND forecasts, the forecast skill, however, is reduced significantly when the guidance depends on observations which are too old. In order to benefit optimally from the detailed information available in the guidance, the update frequency of the guidance needs to be increased and the delay times minimised.

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