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iPort-VIS: Site Specific Fog Forecasting for Munich Airport

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Abstract

The German Weather Service (DWD) together with University at Bonn attempts to implement a site specific fog forecasting system at Munich International Airport. The presentation provides an overview of the project and links to other presentations during this conference which focus on the instrumental setup at the airport as well as the scientific aspects of the PAFOG model development. The integration of all components within DWD is outlined including technical aspects necessary to ensure a stable prototype for evaluation at the end of the project.

1. Introduction

The German ministry for economy and technology is instigating improved effectiveness and competitiveness of the German aviation industry by funding an aviation research program. This supports among other activities forecasting techniques for various weather related phenomena affecting airport management and traffic including poor visibility. DWD in cooperation with University Bonn and the German Aviation Control (DFS) is implementing a site specific fog forecasting system for Munich International Airport. The planned system aims at coupling the one-dimensional version of the fog forecasting model PAFOG with the high-resolution model COSMO-DE of DWD. Following experiences of other institutes on fog forecasting [1] local observations will be integrated using a nudging approach in order to integrate local observations during the model run. Therefore, additional instruments will be installed close to the runways to provide an observational data base for both model initialization and model diagnostics.

2. The fog forecast model PAFOG

The fog forecast model PAFOG has been developed during recent years. Beside many scientific details, one technical requirement was the implementation of a fast model which, ideally, could be integrated within a meteorological workstation enabling aviation forecasters to perform sensitivity studies as part of the routine forecast work by manually varying the initial conditions. This resulted in a parameterization of the cloud microphysics as described in detail by Bott and Trautman in [2]. As part of the present project, the previously pure scientific model has been migrated to DWD software standards as being used with the COSMO consortium. The radiation module has been substantially upgraded. Since the model has to rely on assumptions of aerosol particle concentrations one modification tries to estimate aerosol concentration using observed visibility. These modifications for initialization with visibility measurements under fog and non-fog conditions are expected to be of particular use on airports where visibility measurements are taken on a regular basis. Finally, the most important extension to the previous PAFOG version is the introduction of nudging terms within the prognostic equations in order to perform a nudging with measured temperature and humidity profiles above the ground and close to the surface.

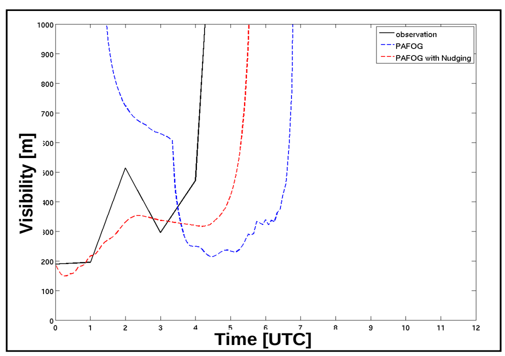


Figure 1: PAFOG case study for September 14, 2005 initialized at 00 UTC.

First trials using both visibility measurements under fog conditions and temperature and humidity measurements from the 98 m tower at the DWD Lindenberg Meteorological Observatory show the systems potential. Figure 1 shows a case study for September 14, 2005 – 00 UTC. The blue curve depicts the surface visibility forecasted by PAFOG without nudging. PAFOG together with nudging of the measured temperature and humidity profile from the 98m tower at the Lindenberg site results in an improved representation of the surface visibility (red line). The observed visibility (automatic measurement) is indicated by the black line. The details of the scientific model development are described in more detail by Thoma during this conference [4].

3. Instrumentation at the airport

A further challenge of this project is to provide the measurements on the airport site. Various discussions with both meteorological and technical experts took already place during the initialization of the project.

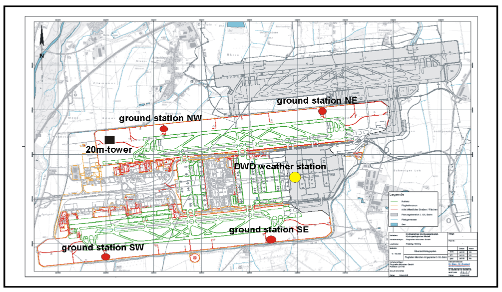


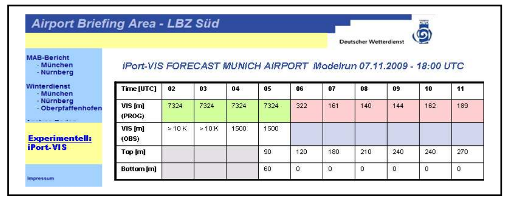
Figure 2: Overview of the instrumentation locations at Munich Airport.

The required instrumentation needed to be specified in great detail prior to the actual procurement of all components of the measuring system. The instruments are currently being installed at their designated locations on the airport. Soil profile measurements are taken at the official wind measurement poles close to the heads of the two runways. Radiation measurements are done on the routine observation field of the DWD observation network. Instruments for temperature, humidity, and wind observations above ground are mounted at an existing 20m tower being installed during the project RegioExakt as part of the "KlimaZwei" initiative of the Federal Ministry of Education and Research [5].

The details on all aspects of the instrumentation are outlined by Röhner during this conference [3].

4. Application aspects

The final goal of the project is to provide a prototype which can be evaluated in respect of its potential benefit within the forecasting routine at the airport. Therefore, the application aspects have to be addressed at an early stage. The planned evaluation strategy is based on a field campaign towards the end of the project in autumn/winter 2011/2012. In order to enable the potential stakeholders to assess the value of the system within a routine environment, regular information exchange with both, aviation forecasters and air traffic controllers, with focus on the visualization of the final forecast product is a key issue.



Airport Briefing Area - LBZ Süd

Deutscher Wetterdienst

MAB-Bericht
- München
- Nürnberg

Winterdienst
- München
- Nürnberg
- Oberpfaffenhofen

Experimentell:
iPort-VIS

Impressum

iPort-VIS FORECAST MUNICH AIRPORT Modelrun 07.11.2009 - 18:00 UTC

Time [UTC]	02	03	04	05	06	07	08	09	10	11
VIS [m] (PROG)	7324	7324	7324	7324	322	161	140	144	162	189
VIS [m] (OBS)	> 10 K	> 10 K	1500	1500						
Top [m]				90	120	180	210	240	240	270
Bottom [m]				60	0	0	0	0	0	0

Figure 3: Presentation of visibility forecast with the meteorology briefing system at DWD.

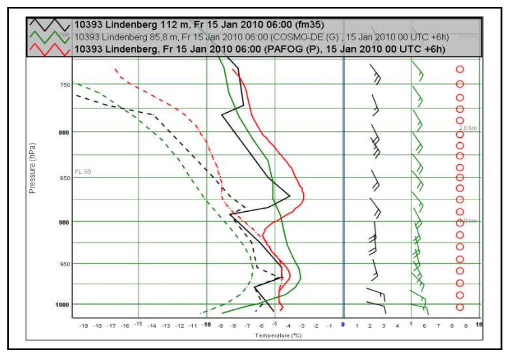


Figure 4: Visualization of prognostic temperature and dew point profile from PAFOG for a t+6h time step together with the observed radiosonde profile. The COSMO-DE profile is marked by Green, PAFOG in Red, and the observed sounding in Black.

One option is to provide very condensed information in a tabular form with a browser based information system of the DWD aviation meteorology office at the airport as shown in Figure 3. In order to provide a more detailed insight, the forecasted vertical profile could, for example, being visualized by the DWD meteorological workstation NinJo (Figure 4).

5. Technical integration at DWD

Finally, all aspects of the development need to be integrated within the DWD infrastructure in order to meet the necessary quality management standards.

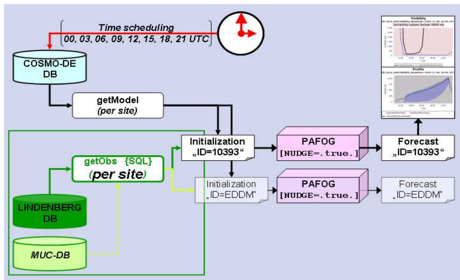


Figure 5: iPort-VIS workbench as framework to integrate all technical aspects of the visibility forecasting system.

This covers aspects such as software configuration management, the operationally used interface to the model data as well as the observational data base. Therefore, it is attempted to provide all measurements from the airport site via a relational data base as it is being used for measurements of the Lindenberg Meteorological Observatory of DWD. Since the system is developed on the base of measurements from the observatory the project follows a similar data flow in order to reduce the technical adaptation necessary to transfer the system from the Lindenberg site to the airport location and its instrumentation. Currently, a stable test system is running based on a regular initialization with each newly available COSMO-DE model run (update every 3h). From Lindenberg observed soil profiles for initialization and atmospheric temperature and humidity profiles from the 98m tower for four consecutive hours of nudging are integrated. An overview of the test system is illustrated in Figure 5.

6. Summary and Conclusions

The project "LuFo iPort-VIS" focuses on the implementation of a site specific visibility forecast module based on the 1D fog forecasting model PAFOG and additional measurements. The 1D fog model PAFOG has been extended in order to integrate temperature and humidity observations by a nudging technique. In parallel to the scientific extension of PAFOG, the required instrumentation is currently being installed on the airport. In order to test the model and perform diagnostics before the installations are completed, the model is currently applied to the location of the Lindenberg Meteorological Observatory of DWD which provides an optimum data base for model initialization and verification. The project will be concluded by a field campaign which aims at deciding on the usefulness of the entire system for operational aviation forecast and air traffic management in the vicinity of the terminal area.

Acknowledgements

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