Forecasters' tasks and upcoming plans at the Royal Meteorological Institute of Belgium (RMIB)

Introduction

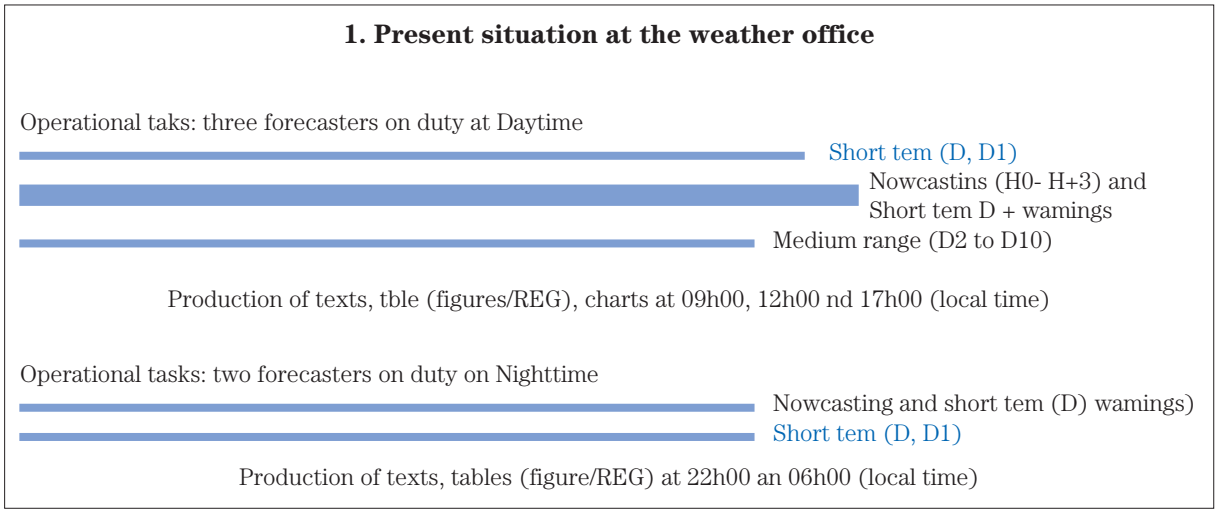
The present status of the main operational tasks of the forecasters at the RMIB (Belgium) will be presented first. There is no doubt that in the last ten to fifteen years forecasters have to rapidly consider more and more raw data issued from systems of observations and meteorological models to make more realistic forecasts (at global and regional scales, from deterministic model and ensemble Prediction System (EPS)). So the problem of how best to reorganize forecasters' tasks is raised. A few methods to approach this problem are developed hereafter for different forecast ranges including the weather warnings.

Main forecasters' tasks

A short survey of the operational tasks and their organization at Day- and Night-times at the Royal Meteorological Institute of Belgium (RMIB) is presented in Figure 1. Two forecasters collaborate to make the (very) short-term forecast products. The first one is responsible for nowcasting over our regions; this nowcasting includes a mesoscale analysis and a forecast of the "sensible" weather expected for the next three hours. The other one elaborates a short-term forecast for today (D) and tomorrow (D1) up to the following night making use of the synoptic and mesoscale analysis and model outputs. This forecaster is also responsible for the issue and the update of short term weather warnings (D, D1) which are elaborated for ten Belgian sub-regions (called "provinces").

A third forecaster exploits the global model data to produce medium range forecasts from D2 to D10. To achieve it, deterministic and probabilistic forecasts (EPS) issued from global models (mainly ECMWF) are compared to least the last three runs and interpreted by the forecaster to produce consistent medium range products targeted over our regions.

Figure 1: operational tasks presently achieved by forecasters during Day- and Night-times



Nowcasting

Surface and upper-air observations including teledetection (satellite, radar, lightning) are regularly processed to be visualized on the forecasters' workstations over pre-defined domains centred over Belgium (illustrated in Figure 2). Direct and derived products from the teledetection covering our areas are produced, such as a few combined RGB satellite pictures for MSG (mainly severe convection and microphysics), a set of twelve SAF Nowcasting products (mainly cloud and precipitation products), a radar network composite image (mainly PPI (to estimate precipitation intensities) and Doppler products) and a lightning image based on our detection system (SAFIR). All these teledetection products available every five or fifteen minutes are interpreted by forecasters in connection with the surface and upper-air data to make a mesoscale analysis over our areas and its close surroundings. The forecaster puts the emphasis on the main elements of his analysis to describe every three hours in a short text description of weather situation over our areas. An additional text is also created by the forecaster to present the next three hours of the forecast for the same regions. To achieve it the forecaster takes advantage of his analysis, the SAF Nowcasting products and of the first steps of the Limited Area Models outputs (mostly ALARO and UKmeso). A real time verification of raw model forecast compared to observations and to the forecaster' analysis, and a deep knowledge of the main conceptual models are essential to produce a better nowcast (Figure 2 : illustration of a rapid upper-air wind at 500 hPa observed on the western part of our areas, and verification of the raw ECMWF forecast at the same date).

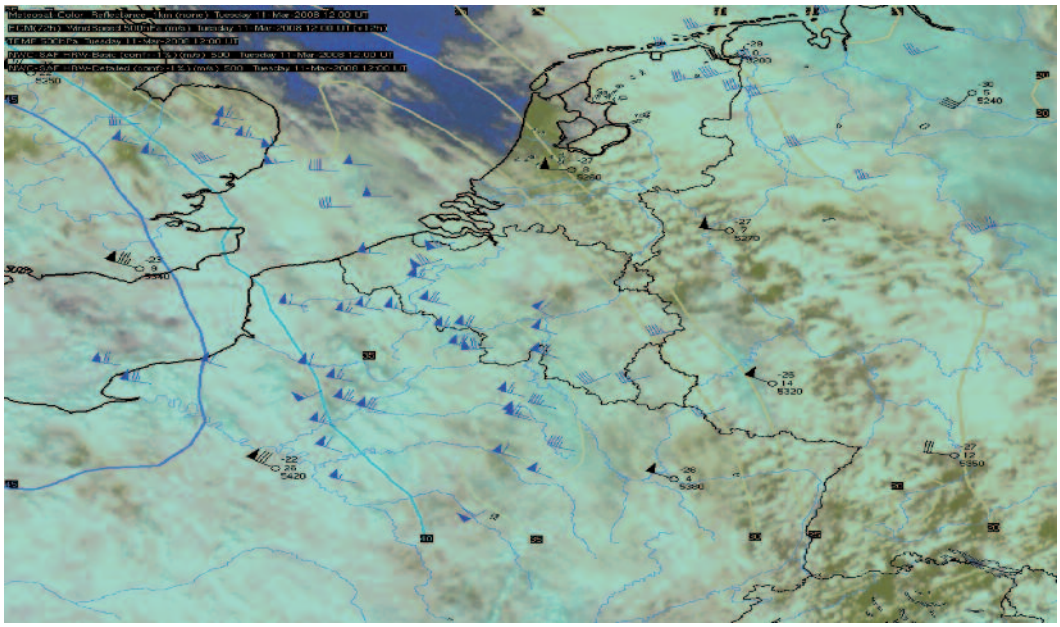


Figure 2: superposition of different observations into a mesoscale domain centred over Belgium, including satellite imagery (visible channels: composition RGB) – upper-air wind flags at 500 hPa (from TEMPS, in black) – High Resolution Wind flags at 500 hPa (from SAF Nowcasting, in blue) and coloured lines which indicate the 12 hour ECMWF forecast for the 500 hPa wind speed verifying at the same date.

The future objective is to improve the quality of nowcasting. To achieve it the INCA system (Integrated Nowcasting through Comprehensive Analysis) has recently been chosen and will be installed and configured at the RMIB in 2010. Several meteorological fields like temperature, humidity, wind, cloudiness, precipitation and precipitation type, and some derived fields like icing potential, wind chill, gusts and visibility will be processed in a mesoscale domain centred over Belgium, every hour at a resolution of one kilometre. Training will be required to test and use the INCA system operationally. We expect that this more objective tool will be a benchmark to help forecasters in their nowcasting tasks.

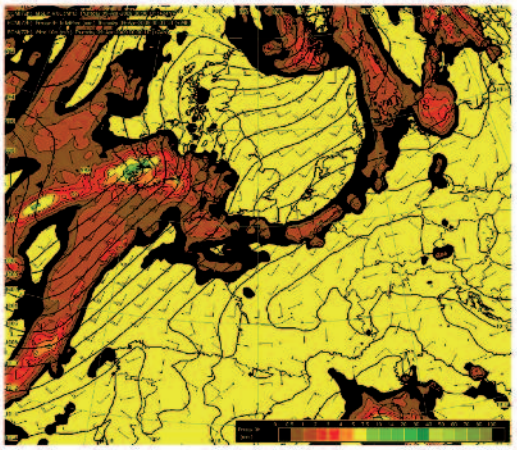
Short Range forecasts

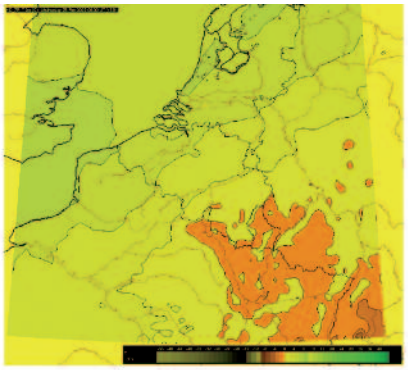
For short range forecasts (D, D1) forecasters mostly make use of raw data issued from the ECMWF model at a grid resolution of 25 km and from Alaro. This latter is a Limited Area Model (LAM) presently coupled to Aladin France which is run at the RMIB four times a day (at 00, 06,12 and 18h00 u.t.c.) in a mesoscale domain centred over Belgium, respectively at grid resolutions of 4 and 7 kilometres. The

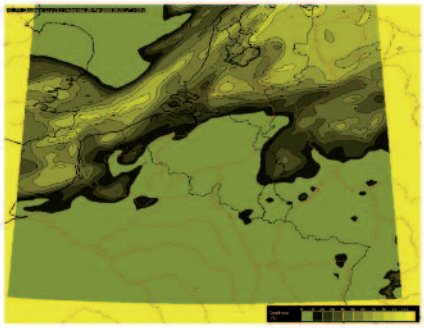
model data are regularly treated, updated and visualized on the forecasters' workstations; in Figure 3 two surface forecasts charts are illustrated for the ECMWF and Alaro models, respectively. Radiosonde forecasts and meteograms at different stations are also available for these models. Furthermore forecasters can compare these models with a selection of raw data issued from the DWD and the UKmeso models.

Figure 3: Example of raw model data visualized on synoptic and mesoscale charts.

– ECMWF: MSLP, Wind 10m, 3h amount of precipitation + legend (see below)
– ALAORO 7km:T2m (upper right), Low Cloudinesse (bottom right) + legends







In 2010, a new flow of raw data issued from the 15 kilometre grid resolution ECMWF model will be implemented and disseminated over a large part of Western Europe and the near ocean. The first version of our Alaro model will also be implemented. Alaro will be soon coupled to Arpege and new derived parameters requested by forecasters will be tested like temperature and vorticity advection, instability indices and wind shear. Furthermore we plan to use a diagnostic scheme called SURFEX to improve the "local" forecasts; to do it an adaptation to the real orography and the physiographic characteristics will be performed with an Alaro model forcing at a grid resolution of four kilometres.

The introduction of probabilistic forecasts at short range (up to D2) has also been planned (GLAMEPS project). A few tens of LAM forecasts (issued from Aladin and Hirlam runs) will be computed at high resolution into a large domain defined over North Atlantic and Europe. Perturbed analysis will be built taking into account a downscaling or an assimilation of data and the singular vectors computed with the ECMWF model targeted for this domain.

Medium Range forecasts

Medium range forecasts rely basically on deterministic and probabilistic (EPS) data issued from the ECMWF model between D2 and D10 (a few raw products from the GFS model are also provided). These raw model data are processed daily by forecasters to produce weather forecasts which focus over our areas in the range D2 to D10.

A methodology has recently been introduced to forecasters, giving guidelines for exploitation of deterministic and particularly EPS data at the RMIB.

That methodology presently leads to the issue of a few products for our areas :
– text describing the most probable weather scenario for the next week, between D2 and D7, including an estimation of its uncertainties and a confidence index
– text in which an estimation of the evolution for the next days is reported, between D7 and D10
– an internal report (to the attention of successive forecasting teams) which aims at pinpointing the main sources of uncertainty in surface parameters forecasts, appropriate to the weather situation
– a table giving a day by day (from D2 to D10) set of values (the most probable value and the most probable interval of values) for a few surface parameters (minimum and maximum temperatures, wind speed and probability of precipitation) at three Belgian stations

To improve medium range forecasts the higher resolution deterministic (15 km grid) and EPS (30 kilometre grid) model from ECMWF will be tested as a matter of priority. As far as EPS is concerned our main objective is to process more raw data for our regions to upgrade the "local" spread of the forecasts for different weather situations or "regimes". We plan to produce probabilistic forecasts for a larger number of surface parameters in order to produce more realistic and consistent medium range forecasts, pre-warnings and a better estimation of the forecast departure from climatology and/or persistence. Our products (texts, tables, charts and graphs) will certainly be updated to use these probabilistic forecasts. To achieve that purpose a reorganization of the role of the forecaster is needed to treat the medium range raw model forecasts in a more relevant way. We are also aware of the necessity to train forecasters to better interpret, illustrate and comment on probabilistic forecasts available for the general public (web site), media and specific users.

Warnings

Warnings are currently made for ten sub-regions ("provinces") in Belgium and a short-range period (D, D1). They are classified in close relation to the impact of a set of weather parameters on life; conditions like wind (heavy gusts), precipitation (high amounts), snow (depth, freezing rain and ice), thunderstorms (severe convection), cold spells and heat waves. These warnings are regularly exchanged with our European colleagues via Meteoalarm. Furthermore more privileged discussions on the alarm level choice (orange and red levels) have been established with Météo-France (Lille) and the KNMI (De Bilt), and soon with the DWD (Essen and perhaps Offenbach). A dispersion model developed at the RMIB is also used (Figure 4); this model is forced by ECMWF and/or LAM (Aladin and ETA) model data to produce for a given source a predicted plume which tends to reflect the total distribution of pollutants at successive time steps over European areas.

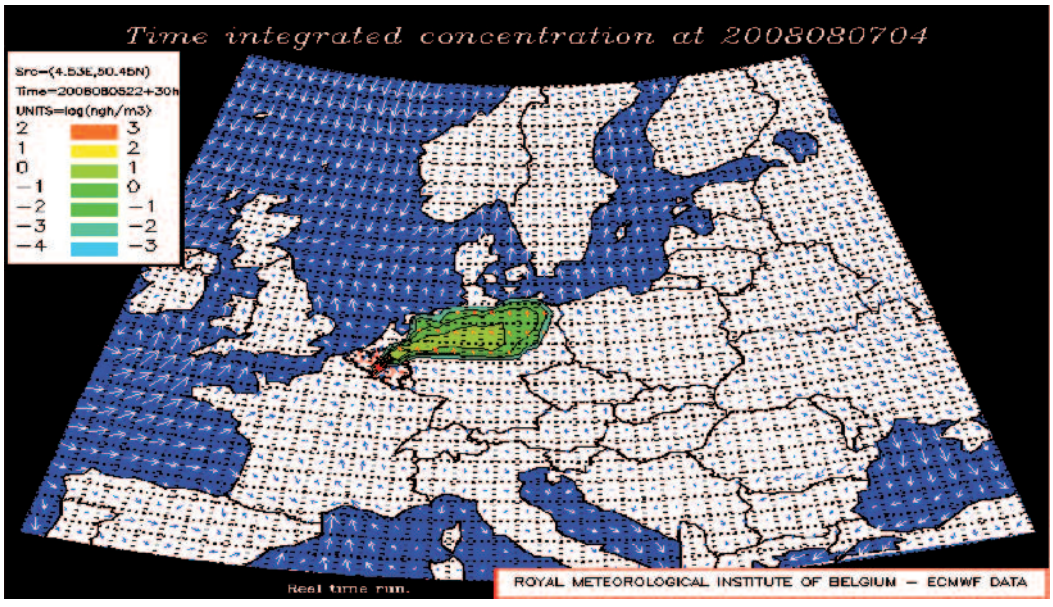


Figure 4: output from the dispersion model at the RMIB - the colored areas of the plume indicate the time integrated concentration at a given forecast range.

A future target is to introduce new tools like INCA and new model data to help forecasters to issue warnings as soon as possible for regions where the impact would be the highest. For example to estimate the risk of severe thunderstorms at short term (D, D1) an interactive "meteorological checklist" will be used by forecasters for "winter" and "summer" periods. The production of flash warnings (valid for the next 3 to 6 hours) and pre-warnings (valid for the next 2 to 5 days) will be encouraged as soon as the newly appropriated nowcasting and EPS tools are be tested for our areas.

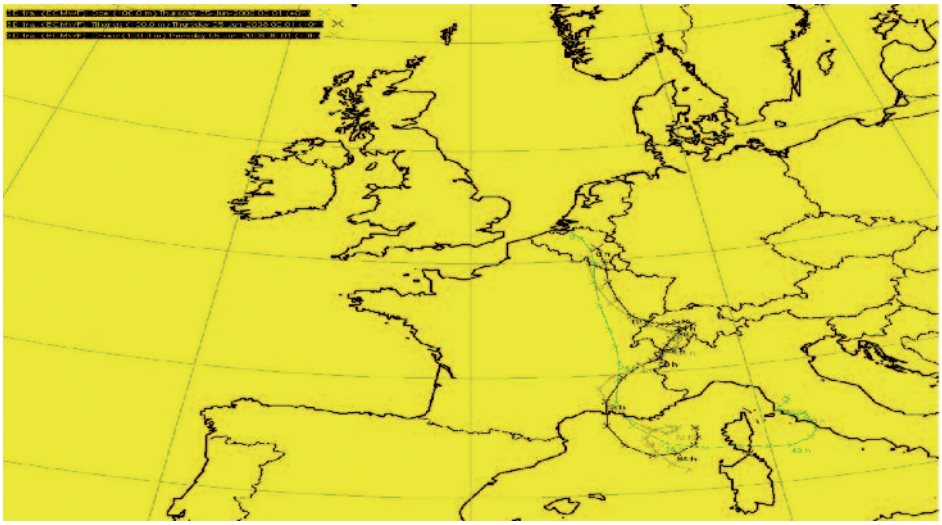


Figure 5: output of the Flextra model (3D trajectoires) for predifined localisations)

Illustration of forward trajectoires computed with the Ecmwf model and displayed every 3 hours up to days from three predifined belgian stations(gray, blue and red curves).

A FLEXTRA model is currently used to compute trajectories for pre-defined localizations taking the ECMWF model forecasts (Figure 5: illustration of forward trajectories). Further implementations with a forcing of ECMWF and Alaro models are under development to interactively compute backward and forward trajectories from any location in Europe, mostly for short-term forecasts.

Conclusions

Many experiments and case studies have shown that the "human side" is a very important component to produce more realistic weather forecasts. To enhance the quality of their products forecasters have to treat raw data with a critical eye. A few tools and methods have been proposed at the RMIB to help forecasters to make better use of these data while keeping a major role to in the analysis and forecasting process.

Jean **Neméghaire**
RMIB, Belgium