PREVIEW observation targeting experiment

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Abstract

ECMWF is developing an interactive web-based Data Targeting System (DTS) as part of the EURORISK PREVIEW programme funded by EUCOS and the EC (under the 6th Framework Programme). The aim of this project is to develop a pre-operational system to provide data targeting information and request additional observations to improve short range (1-3 days) forecasts of potentially high-impact or high uncertainty weather events in Europe. An 11-month trial will take place from February to December 2008. Users from participating centres will be able to use the DTS to propose suitable cases; decisions will be taken by the lead user at the UK Met Office.

The DTS will contain the following functionalities: i) display of forecast products to help the user identify potential significant weather events over the next t+60 to 120 hours; ii) interactive facility to enable users to select a targeting case and submit a request for Sensitive Area Predictions (SAP); iii) display of SAP results provided by at least two centres based on different prediction techniques (Singular Vectors from ECMWF and Ensemble Transform Kalman Filter from UKMO) to assist the lead user to identify appropriate regions for additional observations; iv) interactive facility for lead user to request extra observations.

The presentation will demonstrate the prototype DTS that is being tested by the Met Office lead user during autumn 2007.

1   Introduction

The PREVIEW Data Targeting System (DTS) will be an interactive web-base system to provide data targeting information and request additional observations to improve short-range (1-3 days) forecasts of potentially high-impact or high uncertainty weather events in Europe. The development of the DTS prototype has been performed by ECMWF and managed by UK Met Office. The DTS has been developed under the EURORISK PREVIEW programme funded by EUCOS and EC (under 6th Framework Programme).

The DTS was planned to build on the lessons learnt from Atlantic-THORPEX Regional Campaign (A-TReC) (October and December 2003), which attempted for the first time to control a complex set of observing platforms in a real-time (Leutbecher, 2004). Despite of the success of this programme a significant manual effort was necessary to make it work. DTS has the ambition of making data targeting a practical and viable concept in the operational environment.

Users from participating centres will be able to use the DTS to propose cases; decisions will be taken by the lead user at the UK Met Office. Thirteen EUCOS members have already confirmed their participation in the 11-month trial that will take place from February to December 2008.

2   Process of Targeting: main steps

The idea of observation targeting is to add observational data into specific regions of the atmosphere in order to improve a forecast for a particular weather event of area of interest. Those regions are called sensitive areas and try to predict where the forecast is sensitive to rapidly-growing errors in the initial conditions (using singular vectors) or where the analysis error is large (using ensemble methods). The DTS uses these two different methods to provide targeting guidance in the form of sensitive area predictions or SAPs.

The process of targeting observation involves the following main steps:

(1) Case identification: which forecast/region has potential high impact or large uncertainty associated?

(2) Sensitive area prediction: where might a more accurate definition of the initial state of the atmosphere benefit the quality of the forecast over the region in question?

(3) Observation selection: which additional observations should be deployed?

2.1   Case identification

The first step in the process of targeting observations is the event selection i.e. the identification of a potential significant weather event for which it might be important to improve the forecast. The data targeting activity in DTS is focus on forecasts in the range T+60 to T+120 hours and high priority is given to situations where available ensemble predictions indicate a potential high-impact weather event, but with a large degree of associated uncertainty. The weather event should be identified by its time (verification time, VT), location (verification area, VA) and the quantity that is under scrutiny (i.e. heavy precipitation, high low level winds). In addition to identifying the verification region and time, users must also decide on the targeting time (i.e. the time at which the observations need to be deployed, TT). See the example displayed in Figure 1.

2.2 Sensitive Area Prediction (SAP)

Sensitive areas are the regions where extra observations are expected to have the largest impact on the forecasts for the verification area. The several available mathematical methods to determine the sensitive areas are either adjoint based (singular vectors and adjoint sensitivies) or are based on linear diagnosis of ensemble forecasts (e.g. Ensemble Transform Kalman Filter; ETKF). In DTS prototype, results obtained from both types are available; ECMWF and UKMO provide SAPs based on Total Energy Singular Vectors (TESV) (Buizza and Montani, 1999) and ETKF methods (Bishop et al., 2001), respectively. During the trial it is expected that Meteo-France will also join and provide some SAP products.

2.3 Observation Selection

The selection of observation target area(s) is defined based on SAP results and available observational resources. Targeted observations in DTS will comprise additional radiosonde ascents, routed Aircraft Meteorological Data Reporting (AMDAR) aircraft and Automatic Shipboard Aerological Program (ASAP) ships.
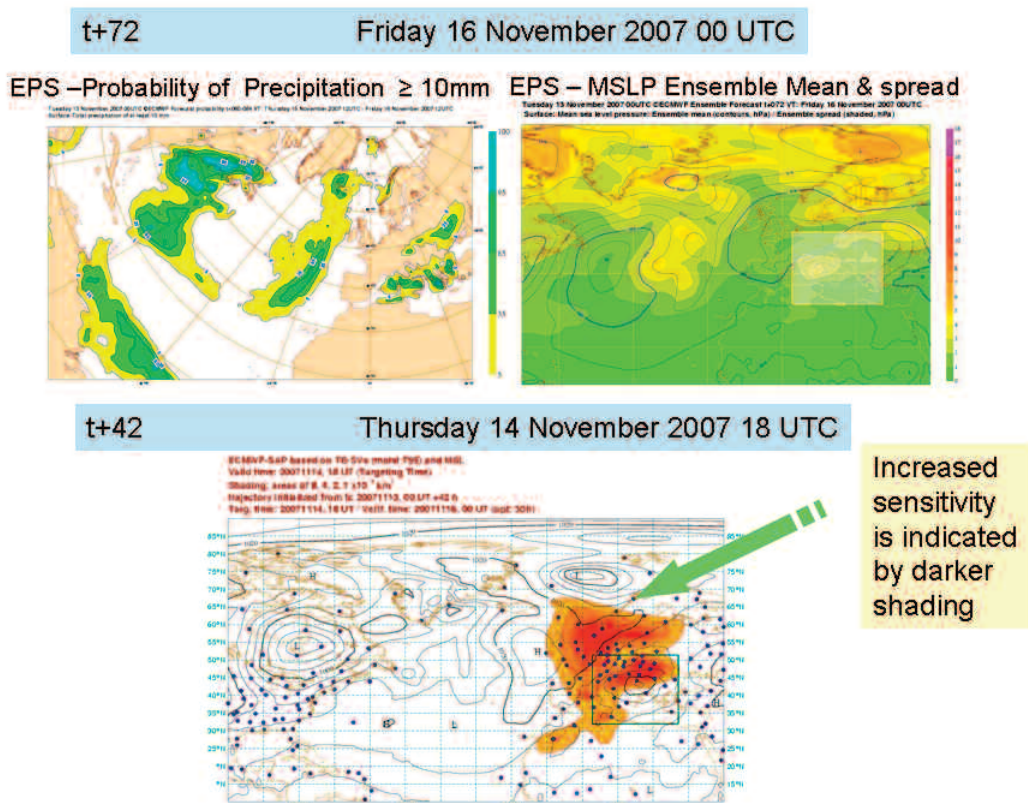

Fig. 1   The top left chart shows a moderate precipitation event forecasted by ECMWF EPS for 00UTC on 16 November 2007 over Mediterranean region. On the top right it is displayed the ECMWF MSLP ensemble mean and spread chart with the selected VA (yellow box enclosing the low system associated with the precipitation event). The bottom chart shows the sensitive area predicted by ECMWF TESV for extra observations at 18UTC on 14 November 2007 to improve the forecast in the region enclosed by the green box (VA) and verifying at 00UTC on 16 November 2007.

3   DTS prototype system

The prototype system consists of four main components which cover the targeting process: Forecast displays, Case proposal, Sensitive Area Prediction Calculations and Extra Observation Proposal. The participating users (restricted access) can interact with the system at two levels: suggesting a case or adding comments on a proposed case (Case Proposal) and on commenting on a proposed observation request (Extra Observation Proposal). The lead user (privileged user) is responsible for analysing all the proposed cases and deciding whether to accept it or not for SAPs. It is the lead user who based on SAP results and observation availability proposes the additional observations to be requested and evaluates all the comments on the suggested extra observations and makes the final decision that will notify the observation providers.

3.1. Forecast Displays

The DTS contains a selection of forecast products to help the forecaster with the weather event identification. The forecast display webpage (Figure 2) includes products from both the deterministic and ensemble ECMWF forecast models. These products are generated from the most recent analysis (00UTC run) and cover the range 60 to 120 hours with a 12-hour time interval.

Fig. 2   The forecast display main webpage Eurorisk Preview Data Targeting System

3.2   Case proposal

An online form is available to the user to propose a potential SAP request (Figure 3). For that the user has to follow the steps: select VT; select VA; choose TT and add a justification before submit the proposal SAP request. There is the possibility of other users to view and add comments to each proposal. It is the lead user that accepts or rejects proposed cases.

3.3. Sensitive Area Prediction Calculations

Sensitive area prediction requests are automatically submitted for all accepted cases. Once generated the sensitive area results are plotted overlaid with available observations for both techniques, TESV (ECMWF) and ETKF (UKMO).

3.4   Extra Observation Proposal

A webpage is available for lead-user to suggest areas where extra observations should be requested accordingly to the availability of observations (Figure 4). The user can comment on the lead user suggestions. The lead user has to review the comment suggestions and finalise the observation selection. DTS generates an e-mail sending a consolidate list of observation requests.

4 Summary and Future Developments

One of the main goals of the project was to build in a system that should not rely significantly on manual effort. This goal was successfully achieved with the DTS prototype. The system is easy to use, and has been tested by the UKMO (lead user) during the last two months (started on 17th September 2007) with just a few breakdowns.

The observation monitoring component is being developed and should be integrated into the system on begin of January 2008. Effectively request of observations needs to be implemented. The Forecast display will be extended to include UKMO forecast products.

It is worth mentioning that some projects have already informally requested to use the system on their experiments namely TPARC (THORPEX Pacific Asian Regional Campaign) which will take place during Summer 2008 and MEDEX (Mediterranean Experiment) that is planned to occur between September 2008 and January 2009.
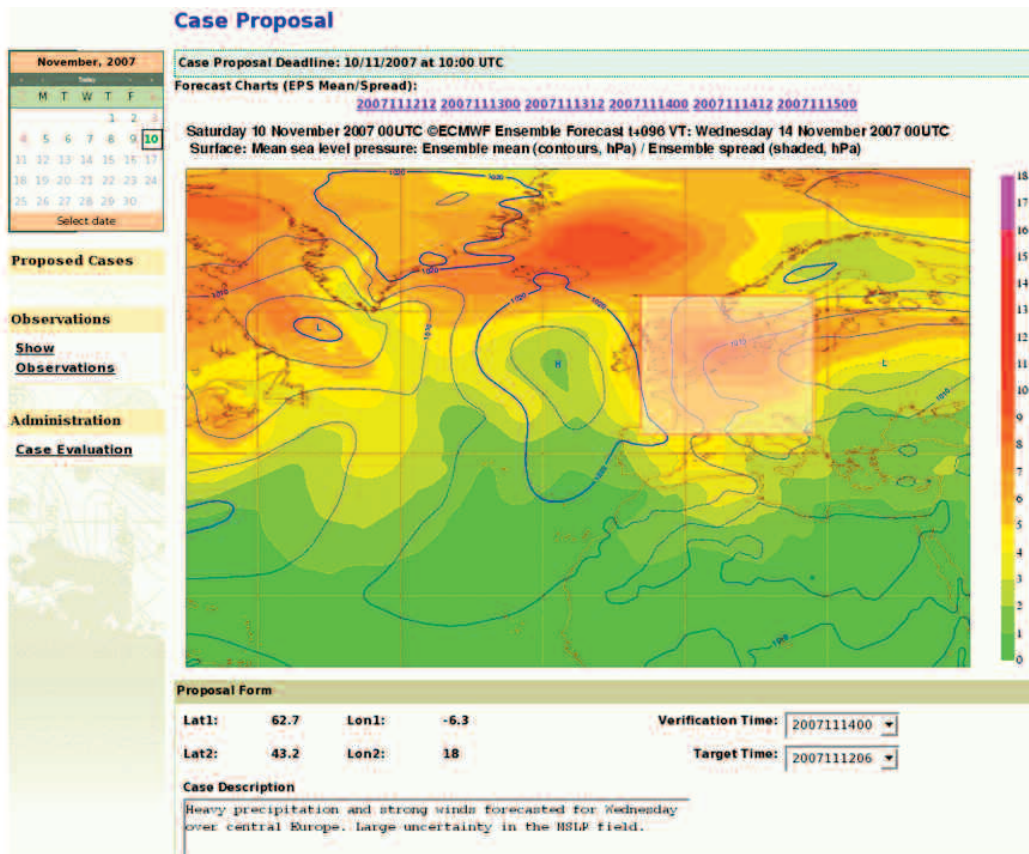

Fig. 3 DTS main page contains an online form that enables the user to select a particular area where potential significant weather events are forecasted to occur in the range t+60 to 120 hours and propose a potential SAP request.

References

Bishop CH, Etherton BJ, Majumdar SJ, 2001, Adaptive sampling with the ensemble transform Kalman filter. Part I: Theoretical aspects *Mon. Weather Rev.* **129**, 420-436.

Buizza R, Montani A,1999, Targeting observations using singular vectors, *J. Atmos. Sci.* **56** 2965-2985.

Leutbecher M., Doerenbecher A., Grazzini F., Cardinali C., 2004, Planning of adaptive observations during the Atlantic THORPEX Regional Campaign 2003, *ECMWF Newsletter* **No. 102**, winter 2004/05.

Extra Observation Proposal

SAC Results :

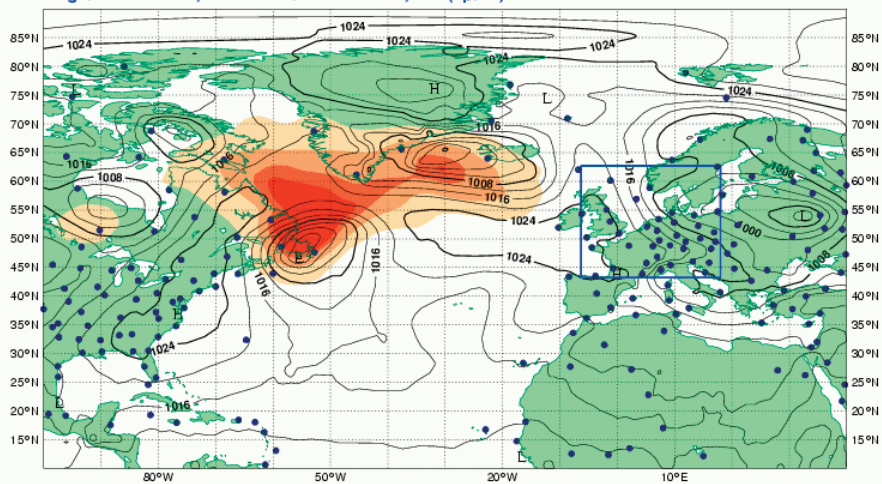ecmwf msl z500 t850
ukmo msl z500 t850

UKMO-SAP based on ECMWF-initialised ETKF summary map and MSLP (black solid contour)
Valid time: 20071112, 6UT
Shading: areas of 8, 4, 2, 1 x 10 ˙ km²
Trajectory initialised from fc 20071110, 0 +54h (Lead time)
Targ. time: 20071112, 6UT / Verif. time : 20071114, 0UT (opt: 42)

Proposal Form

Lat1:	-	Lon1:	-		Verification Time: 2007111400
Lat2:	-	Lon2:	-		Target Time: 2007111206

Observation List:

Fig. 4   Extra observation proposal main page.