

Final report of the PREVIEW
observation Data Targeting
System (DTS)

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July 2009

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Summary

ECMWF has participated in an eleven-month trial to assess the feasibility of operational adaptive control of the observing system. For this project, ECMWF developed an interactive web-based Data Targeting System (DTS) to efficiently manage the data targeting process. This covers the process from the weather event selection to the request of additional observations based on model guidance on where such observations will be most beneficial. The DTS development was carried out by ECMWF in partnership with the UK Met Office. The work was jointly funded by EUCOS and the European Commission as part of the PREvention, Information and Early Warning (PREVIEW) Integrated Project of the EU 6th Framework Programme.

The real-time trial of the DTS ran from 4 February until 19 December 2008. The trial was focused on improving short range (1–3 day) forecasts of potentially high-impact or high-uncertainty weather events in Europe. The DTS was used on a daily basis by forecasters across Europe to request Sensitive Area Predictions (SAPs), which predict locations where additional observations may reduce the uncertainty of potential severe weather events in subsequent forecasts. The DTS displayed SAP results from ECMWF, the Met Office and Météo-France. Based on these results and on the available observational resources, the lead user of the DTS (an experienced forecaster located at the Met Office in Exeter) could then use the system to issue requests for additional, unscheduled observations.

This trial has proved that the concept of data targeting can work in an operational environment. Observations have been successfully targeted from 20 different countries, plus ships and aircraft observations. The DTS was also used to support three other research field campaigns in 2008:

- Norwegian THORPEX-IPY experiment in the Arctic (25 February to 16 March 2008);
- THORPEX Pacific Asian Regional Campaign (T-PARC), summer campaign focusing on tropical cyclones and their transition into mid-latitudes (1 August to 5 October 2008);
- Mediterranean Experiment (MEDEX) focused on cyclogenesis and high impact weather in and around Mediterranean area (11 September to 19 December 2009).

Both the THORPEX-IPY and MEDEX experiments were embedded in the PREVIEW DTS daily routines. For T-PARC, a second DTS was run in parallel, covering the Pacific region.

This report presents the main features of DTS and provides an overview of the use of the system and the additional observations made during the 11-month real-time trial. The impact of the additional observations on forecast performance will be evaluated in future work carried out under the EUCOS studies programme. An archive of the DTS, including all necessary metadata, is being maintained to facilitate this work.

1. Introduction

Over the past decade several field programmes have been carried out to investigate the feasibility and potential benefits of observation targeting (see Langland, 2005, for a review). The PREVIEW DTS was planned to build on the lessons learnt from Atlantic-THORPEX Regional Campaign (A-TReC) which took place between October and December 2003, and attempted for the first time to control a complex set of observing platforms in a real-time (Leutbecher et al., 2004; Petersen and Thorpe, 2007; Fourrié et al., 2006). Despite the success of this programme, a significant manual effort was necessary to make it work. The DTS project had the ambition of making data targeting a practical and viable concept in the operational environment.

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 or area of interest. The process of observation targeting involves three main steps:

1. Case identification: where and when is a potential high-impact event forecast?
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?

For the PREVIEW project, the focus was on improving 1-3 day forecasts of events with large societal and economic impact over Europe. The aim was to deploy additional observations only in those regions where they are likely to be most important for a specific forecast.

A number of techniques can be used to predict locations where additional observations may reduce the uncertainty of potential severe weather events in subsequent forecasts. These locations are referred to as sensitive areas. For PREVIEW, two different methods were used to predict these sensitive areas. ECMWF provided sensitive area predictions (SAPs) based on a singular vector (SV) method, while the UK Met Office and Météo-France provided SAPs generated using the Ensemble Transform Kalman Filter; ETKF. For a review of these and other SAP methods see Langland, 2005. The SAPs are described in more detail in Section 4.

To demonstrate the feasibility of running an operational system to adaptively control the observing system, the PREVIEW DTS was run in real time for an 11-month trial during 2008. The DTS was used on a daily basis by forecasters across Europe to request SAPs. Throughout the trial the following observing systems were available for targeting:

- Additional radiosonde ascents at 06 or 18 UTC from 62 stations managed by 18 European Met Services, Canada and Bermuda.
- Aircraft Meteorological Data Reporting (AMDAR) measurements from commercial aircraft participating in the EUMETNET observing programme.
- Radiosondes from 10 Automatic Shipboard Aerological Program (ASAP) ships operating in the Atlantic and participating in the EUMETNET observing programme.

2. The Data Targeting System (DTS)

The DTS was designed as an interactive web-based system to allow users in different centres to participate in real-time adaptive control of the observing system with a minimum of manual effort. The DTS included the following facilities:

- **Forecast Display:** web page with forecasts charts to help the forecaster with the identification/selection of meteorological events;
- **Case Proposal:** web form to enable user to select a weather event and ask for sensitive area calculation for that particular event;
- **Sensitive Area Prediction Calculations:** the DTS submitted SAP requests to three different centres (ECMWF, UKMO and Meteo-France) and displayed the results of these calculations;

- **Observation proposal:** web form to enable user to select areas where additional observations should be made based on the sensitivity guidance (SAPs) and available extra observational resources;
- **Observation requests:** the DTS automatically issued the observation requests by e-mail directly to the observation provider;
- **Observation monitoring:** web page with updated display of the list of observations requested and subsequently deployed;
- **Archive:** details of all case proposals, SAP requests and observation requests were archived for future reference. SAP results from all participating centres were archived in the ECMWF MARS data archive.

Access to the DTS was limited to registered users who were issued with user accounts and passwords to access the web site. The system allowed three types of access: general (view only); restricted (edit on-line forms to make suggestions and comments); and privileged (make decisions). The participating users (restricted access) and the privileged user are hereafter referred to as users and lead user, respectively. A user was able to interact with the system at two stages (Figure 1):

- to suggest a case or comment on a proposed case (Case Proposal);
- to comment on a proposed observation request (Extra Observation Proposal).

The lead user was responsible for analysing all the proposed cases and deciding whether to accept them or not for SAPs (Case Evaluation). It was the lead user who, based on SAP results and observation availability, proposed the additional observations to be requested. The lead user then evaluated all users' comments on the suggested extra observations and made the final decision that triggered the notification to the observation providers (Observation Evaluation).

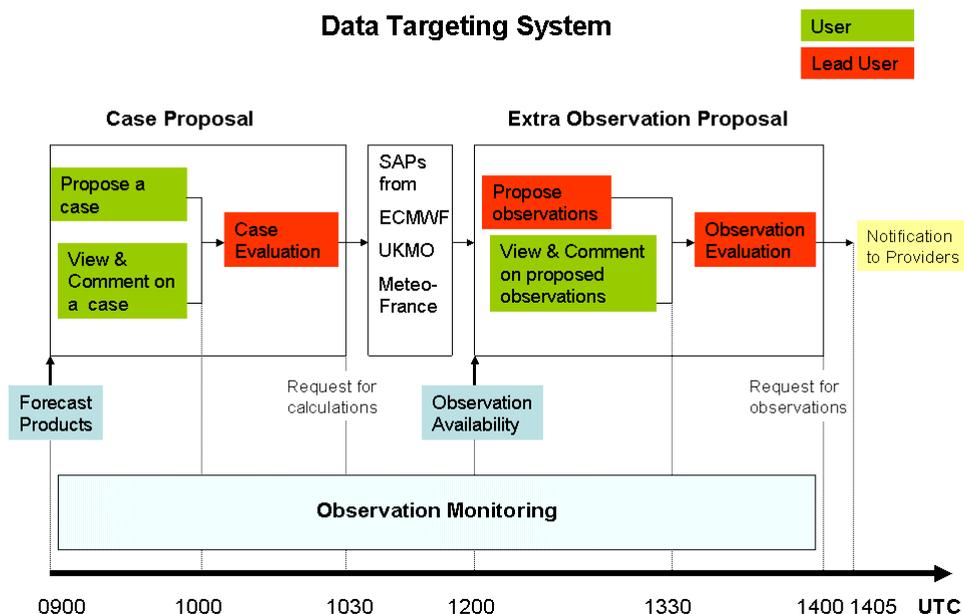


Figure 1. The main components of the DTS. See text for details.

The daily system time table is shown in Table 1. The DTS automatically restricted access to the different components to the times shown in the table. Forecast products used for the case selection were available by 09:00 UTC. One hour was then allowed for all users to submit proposals for cases. At 10:00 the DTS prevented users from submitting additional cases. The lead user then had 30 minutes to review all the suggested cases and select which ones to request SAPs for. At 10:40 all SAP requests were automatically submitted by the DTS; results were displayed on the DTS web pages by 12:00. The lead user then assessed the SAP results and made proposals for additional observations; other users were able to view and comment on these proposals before the lead user finalised the selection. At 14:05 the DTS automatically issued notifications to the observation providers for all observation requests made by the lead user.

Table 1. Preview DTS daily system timetable

Time (UTC)	Activity
9:00	Deterministic and ensemble products displayed for case assessment
9:00-10:00	Users' case suggestions
10:00-10:30	Lead user finalise case decision and submit request for SAP
10:40-12:00	SAP run
12:00	SAP results and observations availability displayed
12:00-13:30	Lead user suggestions for observation areas
12:05-14:00	Comments from users on proposed observations
14:00	Lead user finalise the request of targeted data
14:05	E-mails are sent with observation requests

3. Meteorological Event Selection

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. Selection of appropriate weather events for targeting was one of the main decisions in the project. Forecast of events with potentially large societal impact were prime candidates to be selected especially if there was substantial uncertainty in these forecasts. However, cases of large uncertainty even if not associated with severe weather conditions were considered to be important because wrong forecasts of less extreme conditions may still have a considerable economic impact. So, the lead-user prioritised the selection of events by following the criteria:

1. Severe life threatening weather with large degree of associated uncertainty;
2. High uncertainty in the forecast but less severe weather conditions;
3. Severe weather conditions with low uncertainty in the forecast.

The DTS contained a range of forecast products to help the forecaster with the case selection. The forecast display webpage included products from the ECMWF deterministic forecast and the ensemble prediction system (EPS) and also products from the Met Office Global and Regional Ensemble Prediction System (MOGREPS). The DTS provided a link for Preview users to view a selection of charts from the Arpège deterministic forecast on the Météo-France web site. Details of the forecast products are given in Annex I.

3.1 Case proposal

Users across Europe were able to use the DTS to propose cases to be considered for targeting. The DTS webpage provided an online form designed to enable users to provide information about their proposal, including the geographical area over which the forecast event would occur, and to propose a potential sensitive area prediction or SAP (Figure 2).

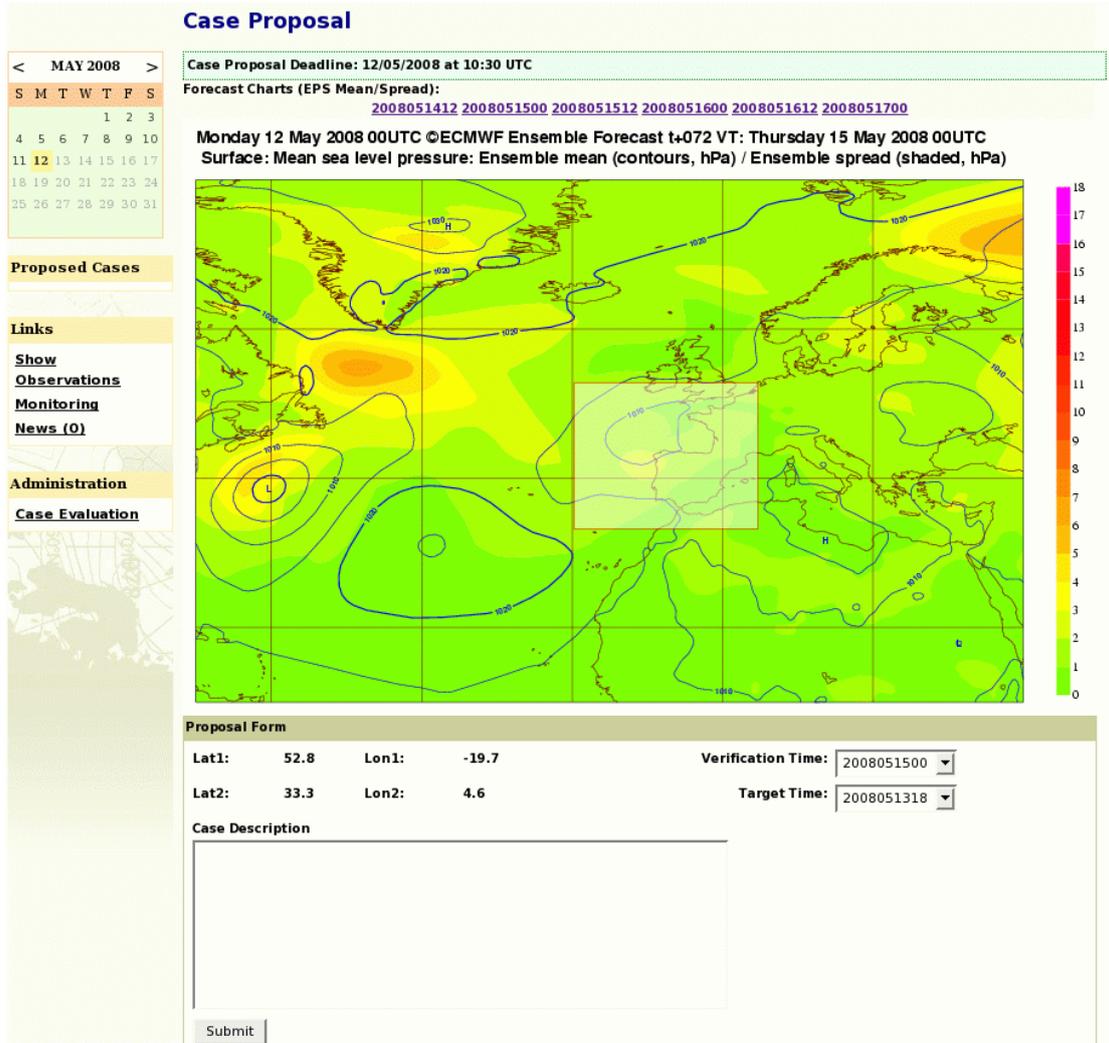


Figure 2. The DTS main page contains an online form that enables the user to select a particular area where a potential significant weather event is forecast to occur in the range $t+60$ to 120 hours and propose a potential SAP request. The user clicks on the chart to select a region (highlighted) and can adjust the size and position of the region. The user types a description of the event in the box below the chart.

An event was identified by its time (verification time, VT), location (verification area, VA) and the relevant weather parameter (i.e. heavy precipitation, high low level winds). The forecast range covered by the system was 60 to 120 hours (with 12-hour steps). In addition to identifying the verification region and time, users needed also to decide on the targeting time (i.e. the time at which the observations needed to be deployed, TT). The minimum TT allowed was $T+42$ (necessary because observations requests needed to be issued with a minimum of 28 hours notice); maximum TT was $T+102$.

After being submitted, each case proposal was recorded and displayed on the web. Submitted proposals were accessible to all users, who were able to add comments on the form below each case on the web page. The lead user was required to review all proposed cases and decide which ones should result in an SAP request. All cases were initially assigned a status of “unknown” by the DTS. Only the lead user had the web access credentials to change this status. The lead user edited each proposed case and changed the status from “unknown” to either “accepted” or “discarded”, providing appropriate justification in the comment box.

Sensitive area prediction requests were automatically submitted for all accepted cases.

4. Sensitive Area Predictions

Three centres provided sensitive area predictions for the DTS trial: ECMWF, the Met Office and Météo-France. Details of the SAP requests were provided by the DTS via the ECMWF ftp site. This information was picked up automatically each day by the Met Office and Météo-France. Once their calculations were completed the results were returned, also by ftp, to ECMWF. The DTS retrieved all SAPs, including those from ECMWF, and plotted the results for the DTS users to view and compare.

Methods to determine the sensitive areas are either adjoint-based (singular vectors (SVs) and adjoint sensitivities) or are based on linear diagnosis of ensemble forecasts (e.g. Ensemble Transform Kalman Filter; ETKF). In the DTS, ECMWF provided SAPs based on the SV method, while the Met Office and Météo-France SAPs used the ETKF method.

4.1 ECMWF guidance maps

The ECMWF sensitive area predictions use singular vectors (Buizza and Montani, 1999, Leutbecher et al., 2004) to predict the sensitivity of the forecast to the initial conditions at a future time. The singular vector method identifies those perturbations which grow fastest between the target time and verification time and show greatest amplitude in the verification region at the target time. The amplitude of the perturbations is measured using the vertically integrated total energy at both targeting and verification time. A general discussion of SV sensitivity to the choice of metric is given by Palmer et al. (1998). Leutbecher et al. (2004) compare the effect of different initial metrics on the sensitive areas from the Atlantic-THORPEX Regional Campaign (A-TReC). Buizza et al. (2007) demonstrate the impact on forecasts of using total energy SVs to predict sensitive areas. In the DTS, the ECMWF SV calculations were performed using the tangent-linear and adjoint versions of the operational ECMWF global forecast model, run with horizontal resolution T95 (~200km) and 62 hybrid levels.

The target area is defined as the region where the weighted average of the vertically integrated total energy of the first 10 singular vectors (SVs) exceeds a certain threshold value. Different sizes are obtained by choosing an appropriate threshold. In the DTS, sensitive areas of sizes 8, 4, 2 and 1×10^6 km² were computed (those regions are centred on locations of maximum SV amplitude). An example is shown in Figure 3, where increased sensitivity (from larger to small areas) is indicated by darker shading. Since TESVs are based on a dynamical approximation, the maxima are generally associated with mid-latitude baroclinic zones. The ECMWF SAPs were plotted in DTS overlaid with three different ECMWF forecast fields, mean sea level pressure (msl), temperature at 850hPa (t850) and geopotential at 500hPa.

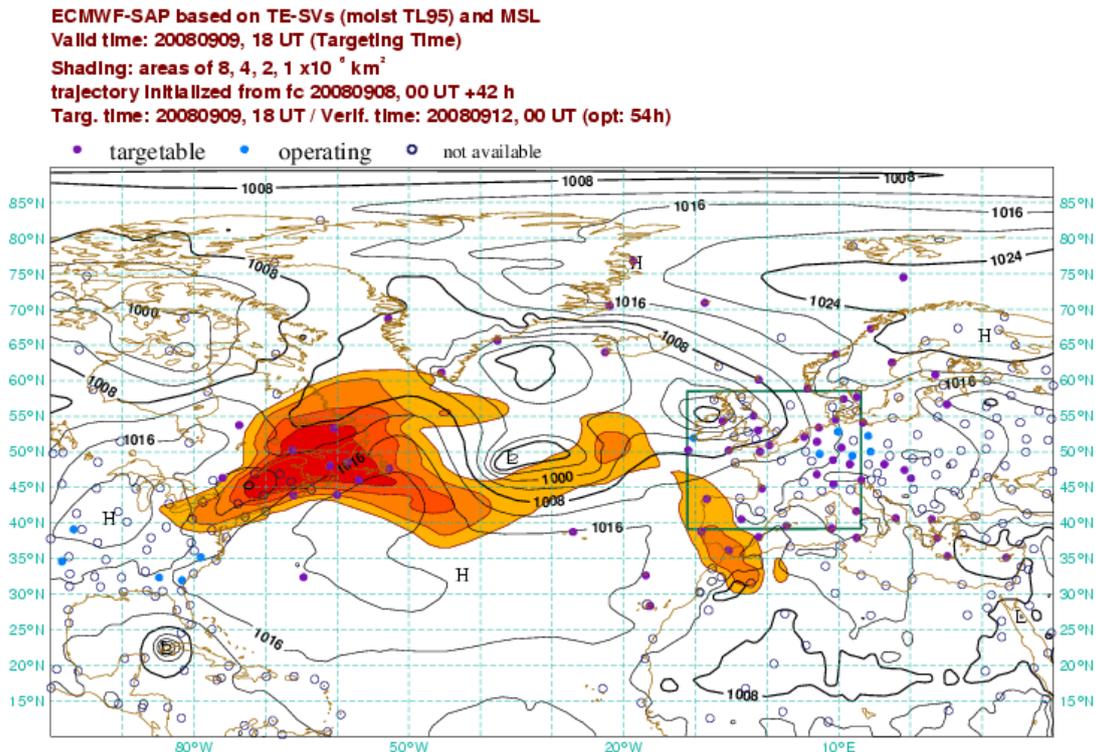


Figure 3. Example of ECMWF sensitive area prediction. On 8 September 2008, the lead user has identified a case of potential severe weather over France and the UK on 12 September: the verification region is marked by green rectangle. The lead user then requested sensitive area predictions to show where additional observations on 9 September (at 18 UTC) could reduce the uncertainty in later forecasts of the event. The figure shows the results from the ECMWF SAP (shaded contours), suggesting that extra observations in eastern Canada would be most beneficial in this case. Sensitive areas of sizes 8, 4, 2 and 1×10^6 km² are shaded; The ECMWF forecast of mean sea-level pressure for the targeting time, 18 UTC 9 September, is also shown. The circles identify radiosonde stations that are either available for targeting (purple), operating routinely at the target time (blue) or not available at that time.

4.2 Met Office guidance maps

The ensemble transform Kalman Filter or ETKF (Bishop et al., 2001) method combines error covariance estimation from ensemble forecasts with error statistics associated with the routine and targeted observation networks to predict the reduction in forecast error variance within a predefined forecast verification region.

The Met Office ETKF calculations use the MOGREPS ensemble forecast outputs (horizontal resolution 90km, Bowler et al., 2008) and a total energy norm. The summary map is the vertical average of the total energy signal variance at 850, 500 and 200 hPa within the verification region produced assuming hypothetical targeted observations at the same three levels vertically aligned. As for the ECMWF maps, sensitive areas of sizes 8, 4, 2 and 1×10^6 km² were plotted for ETKF results overlaid with three different MOGREPS forecast fields from control forecast run, mean sea level pressure (mslp), temperature at 850hPa (t850) and geopotential at 500hPa (see example in Figure 4).

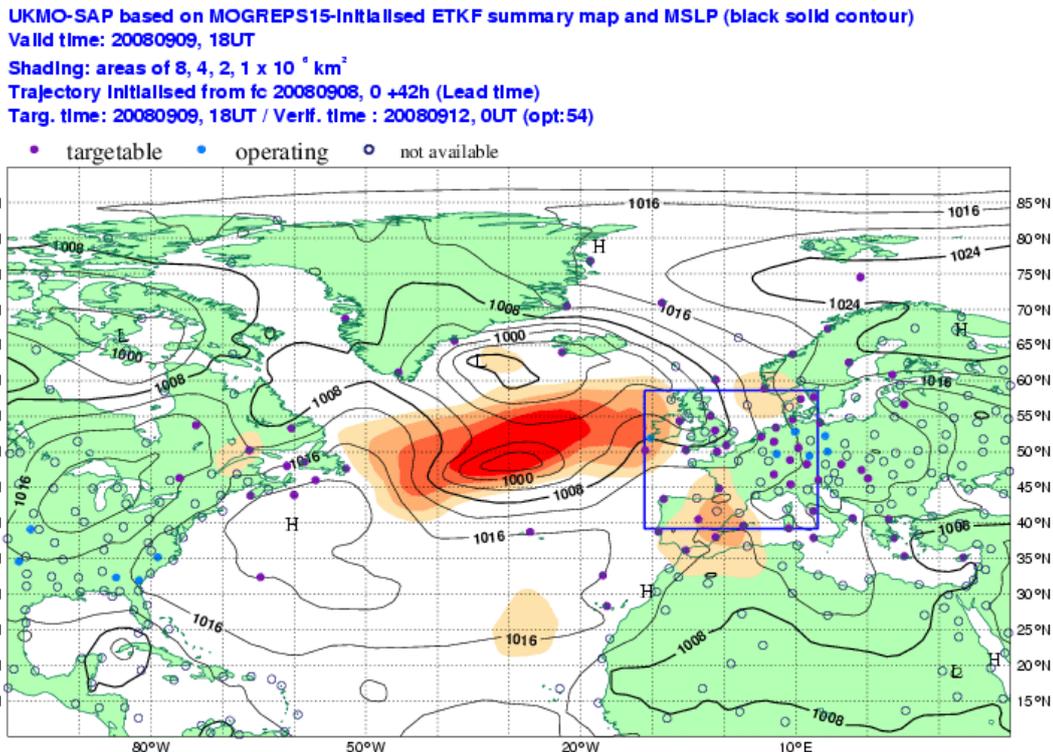


Figure 4. Example of Met Office sensitive area prediction, for case described in Figure 3. Sensitive areas of sizes 8, 4, 2 and 1×10⁶ km² are shaded; contours of MSLP are plotted every 4 hPa. Met Office predicted sensitive areas of sizes 8, 4, 2 and 1×10⁶ km² are shaded; the Met Office forecast of mean sea-level pressure for the targeting time, 18 UTC 9 September, is also shown.

ETKF sensitive areas are often found to be in regions in which strong zonal winds are expected, particularly at mid-tropospheric levels in areas near the jet stream. Sensitive regions are also associated with areas of large mid-tropospheric baroclinic instability, through the Eady index, and low to mid-level baroclinic regions due to the frequent spatial correlation with the horizontal temperature gradient (Peterson et al, 2007). The ETKF sensitive regions also tend to be associated with relatively low ensemble spread which amplifies into the verification region.

4.3 Météo -France guidance maps

The ETKF calculations produced by Météo-France were based on the 11 members of the PEARP ensemble (56 vertical levels, horizontal resolution between 23 km over Western Europe and about 150 km over Pacific; Nicolau, 2002) and a total energy norm. The summary map is the vertical average of the total energy signal variance at 850, 500 and 200 hPa within the verification region produced assuming hypothetical targeted observations at the same three levels vertically aligned. As for ECMWF maps, sensitive areas of sizes 8, 4, 2 and 1×10⁶ km² were plotted for ETKF results overlaid with three different PEARP forecast fields from control forecast run, mean sea level pressure (mslp), temperature at 850hPa (t850) and geopotential at 500hPa (see example in Figure 5) .

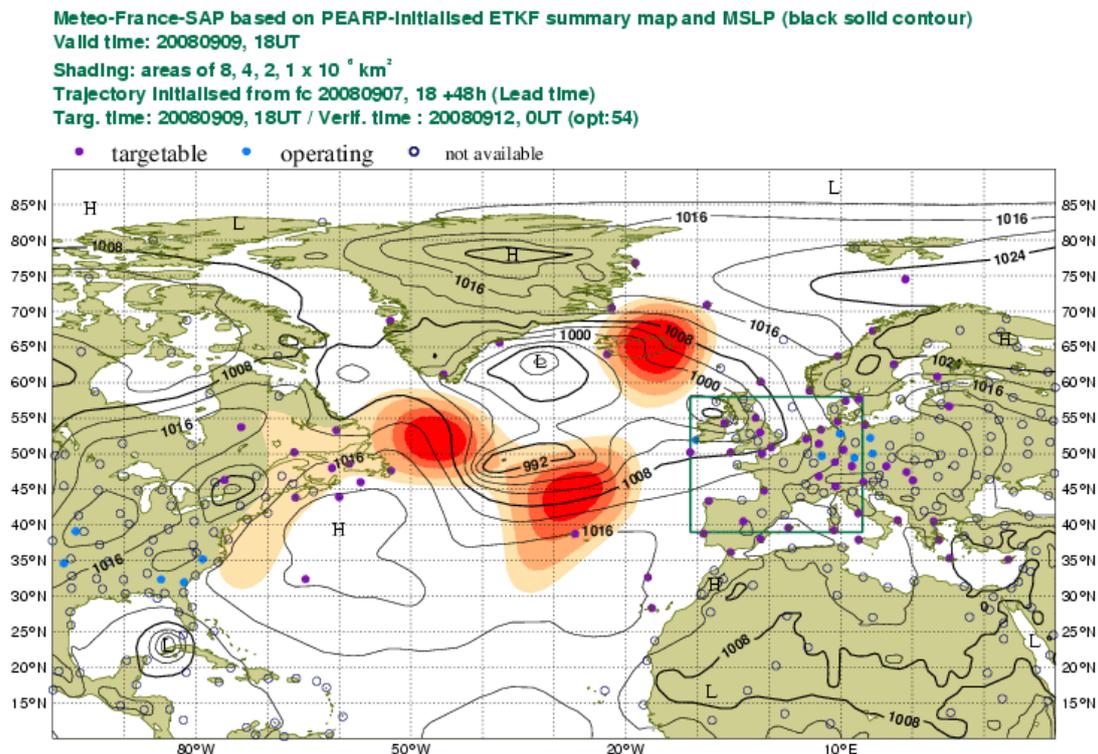


Figure 5. Example of Météo-France sensitive area prediction, for case described in Figure 3. Sensitive areas of sizes 8, 4, 2 and 1x10⁶ km² are shaded; contours of MSLP are plotted every 4 hPa. Météo-France predicted sensitive areas of sizes 8, 4, 2 and 1x10⁶ km² are shaded; the Météo-France forecast of mean sea-level pressure for the targeting time, 18 UTC 9 September, is also shown.

5. Data Targeting Observations

Throughout the trial the following observing systems were available for targeting:

- Additional radiosonde ascents at 06 or 18 UTC from 62 stations managed by 18 European Met Services, Canada and Bermuda.
- Aircraft Meteorological Data Reporting (AMDAR) measurements from commercial aircraft participating in the EUMETNET observing programme.
- Radiosondes from 10 Automatic Shipboard Aerological Program (ASAP) ships operating in the Atlantic and participating in the EUMETNET observing programme.

Additional radiosonde ascents were mainly considered at 06 or 18 UTC (most stations made routine ascents at 00 and 12 UTC) from 62 stations managed by 18 European Met Services, Canada and Bermuda (see Table A.II- 1 in Annex II).

For each of the 10 ASAP ships, the DTS received a position report once a day by email. Therefore the positions of ships displayed on the DTS observation proposal charts were the current positions of the ships (close to model initial time) and not the projected positions at the targeting time (TT). Later in the trial, a Danish ASAP became available; a new process was used to obtain the ASAP positions from the report sent to GTS by the automatic weather stations (BATOS) on board of some vessels. The ASAPs are listed in table Table A.II- 2 in Annex II).

Requests for additional E-AMDAR aircraft observations were sent by the DTS via e-mail to the E-AMDAR Technical Co-ordinator located at the Met Office. Based on the e-mail information (target time and region) the Technical Co-ordinator was responsible for implementing the additional observations where possible.

Part of the success of a project such as PREVIEW DTS relies on the observational resources, which need to include a spatial and temporal coverage that complement the routinely observation network, and on a quick and efficient communication with the observation providers. In the DTS the prompt reaction of the most European Met Services to take part in the trial was essential. The participation of Canadian Met Service by providing additional radiosonde ascents from some Canadian stations was a valuable resource. Without the

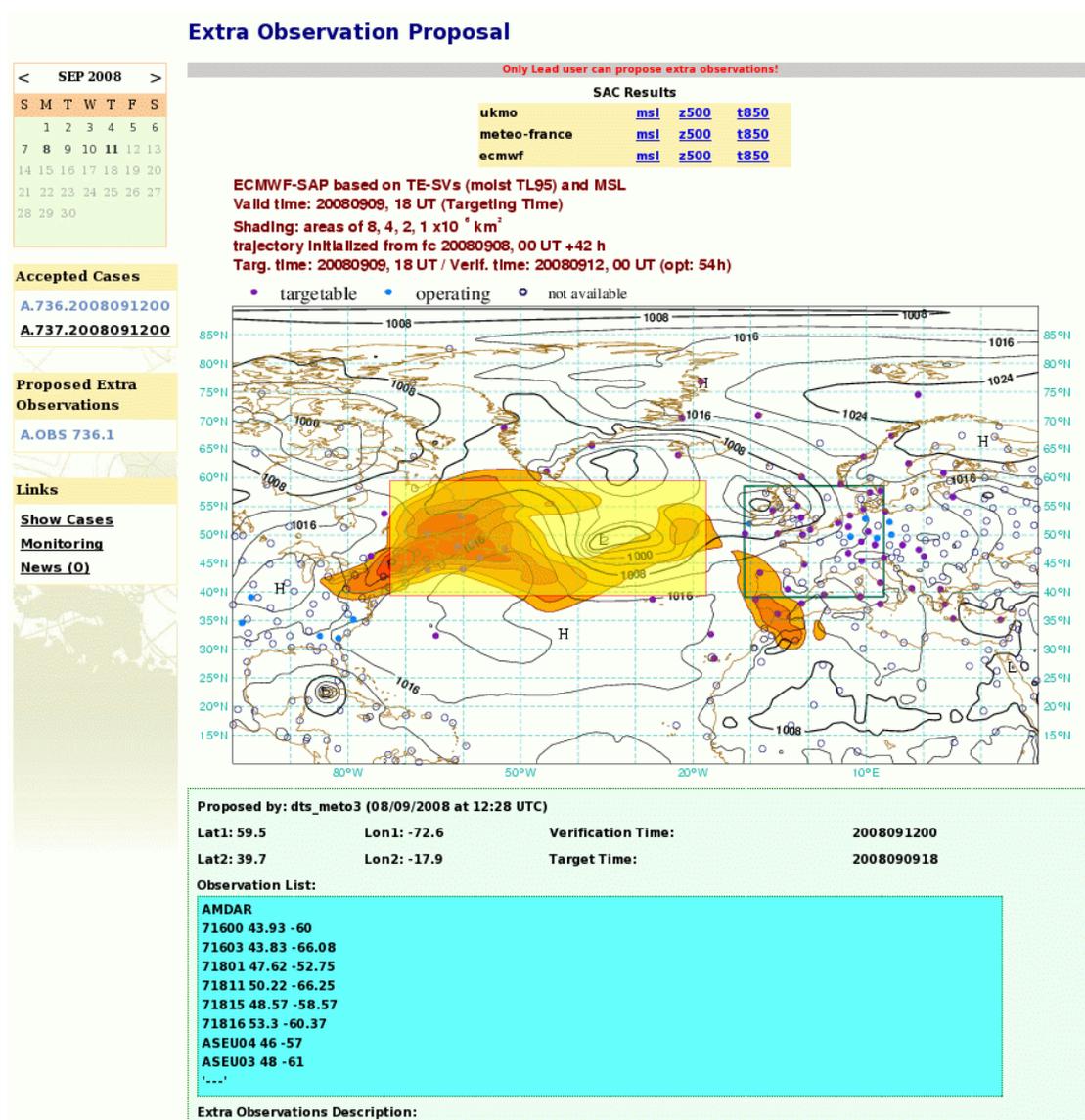


Figure 6. The DTS Observation proposal page. This example is for the same case as shown in Figure 3-5. Having examined the SAP results from the three centres, the lead user has selected the area where additional observations will be requested (area highlighted in yellow). The DTS has automatically listed the observations that are available for targeting within the selected region (in this case 6 Canadian radiosondes, 2 ASAP ships and AMDAR data). The lead user can edit this list if required, after which the DTS automatically issues the observation requests by email to the observation providers.

ability to request extra radiosondes from the Newfoundland and Nova Scotia region, the targeting opportunities would have been much reduced, especially for cyclogenesis events affecting northwest Europe. The possibility of targeting ASAPs was particularly important since in many cases the SAP areas were over the Atlantic.

For each accepted case, sensitive area prediction results were plotted overlaid with the available observations. Based on these results, the lead user selected one or more regions to target. The DTS automatically identified all available observations in the selected area (yellow box in Figure 6) and listed these in the table below the chart, labelled 'Observation list'. The lead user could modify the observation list interactively. Once this list was finalised by the lead user, the DTS automatically generated and sent emails to the relevant observation providers.

5.1 Observation request

The DTS automatically generates and sends emails to the relevant observation providers (from dts@ecmwf.int) according to the observation requests accepted by the lead user. A minimum of 24h notice was required for deployment of additional observations by most of the providers participating in DTS. The system issues the e-mails at 14:05UTC and the closest target time is 18UTC next day (so, roughly 28h minimum). The e-mails are requesting observations from three different systems participating in the PREVIEW data targeting activity: radiosonde operated by the National Meteorological Services, ASAP Ships operated by EUMETNET-ASAP Programme (each e-mail is sent to DWD and routing to ASAP unit) and AMDAR aircraft operated by EUMETNET-AMDAR Programme. One example for each type of provider is displayed in Figure 7 and Figure 8.

<p>Station</p> <p>Subject: DTS Observation request - station ID – Obs. Date/Time Subject: DTS Observation request - 26435 - 23/01/2008, 18 UTC</p> <p>Dear Sir/Madam,</p> <p>Please find attached the extra observation request as part of the Data Targeting Project.</p> <p>Extra Observation Request based on 22/01/2008, 00 UTC run</p> <p>E-mailed to = provider_email_contact CC-ed to = moh@ecmwf.int, Station ID = 26435 Requested Date and Time = 23/01/2008, 18 UTC</p> <p>Data Targeting Project is a research project to improve NWP models by introducing extra observations on sensitive areas. It is jointly funded by EUCOS and the EU and is being developed and managed by ECMWF and the Met Office.</p> <p>Project Website: www.ecmwf.int</p> <p>For project related queries and questions, please contact: Stewart Turner, UKMO, stewart.turner@metoffice.gov.uk, David Richardson, ECMWF, david.richardson@ecmwf.int</p> <p>For technical queries and questions, please contact: ECMWF DTS Team, ECMWF, dts@ecmwf.int Doug Mansfield, UKMO, doug.mansfield@metoffice.gov.uk,</p> <p>Best Regards, DTS Team</p>	<p>ASAP-ship</p> <p>Subject: DTS-Sounding Request-ship_id Subject: DTS-Sounding Request-ASEU02</p> <p>Dear Sir/Madam,</p> <p>This is an automatic generated message. According to the numerical weather prediction models you are sailing in an area which some extra observations might be more important. Therefore we would appreciate it very much if you could perform the following additional launches (starting time 85-60 min earlier as usual):</p> <p>Requested Date and Time = 23/01/2008, 18 UTC</p> <p>Data Targeting Project is a research project to improve NWP models by introducing extra observations on sensitive areas. It is jointly funded by EUCOS and the EU and is being developed and managed by ECMWF and the Met Office.</p> <p>Project Website: www.ecmwf.int</p> <p>For project related queries and questions, please contact: Stewart Turner, UKMO, stewart.turner@metoffice.gov.uk, David Richardson, ECMWF, david.richardson@ecmwf.int</p> <p>For technical queries and questions, please contact: ECMWF DTS Team, ECMWF, dts@ecmwf.int Doug Mansfield, UKMO, doug.mansfield@metoffice.gov.uk,</p> <p>Best Regards, DTS Team</p>
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Figure 7 E-mail examples to request a particular observation to a radiosonde station (left) and to an ASAP-ship (right).

AMDAR

Subject: DTS Observation request - AMDAR - Date and Time
 Subject: DTS Observation request - AMDAR - 23/01/2008, 18 UTC

Dear Sir/Madam,

Please find attached the extra observation request as part of the Data Targeting Project.

Extra Observation Request based on 22/01/2008, 00 UTC run

E-mailed to = provider_email_contact
 CC-ed to = moh@ecmwf.int,
 Station ID = AMDAR
Requested Date and Time = 23/01/2008, 18 UTC
Requested Area (AMDAR) = Top Left (Lat/Lon) : 72.9/-49
 Bottom Right (Lat/Lon) : 52/-34.4

Data Targeting Project is a research project to improve NWP models by introducing extra observations on sensitive areas. It is jointly funded by EUCOS and the EU and is being developed and managed by ECMWF and the Met Office.

Project Website: www.ecmwf.int

For project related queries and questions, please contact:
 Stewart Turner, UKMO, stewart.turner@metoffice.gov.uk,
 David Richardson, ECMWF, david.richardson@ecmwf.int

For technical queries and questions, please contact:
 ECMWF DTS Team, ECMWF, dts@ecmwf.int
 Doug Mansfield, UKMO, doug.mansfield@metoffice.gov.uk,

 Best Regards,
 DTS Team

Figure 8 E-mail example of an AMDAR observation request.

5.2 Observation Data Monitoring

The DTS provided information on a daily basis about the additional observations requested by the system (Figure 9). The requested observations were listed and information about station id, case number (case from where the request was originally triggered), station's latitude and longitude, target time (i.e. time when the observations are to be deployed) and observation status (e.g. requested) was provided. Users could check the status of observations requested by the system on a particular day (click on **Requested** on LHS of page) or observations to be deployed on a given day (click on **Targeted** on LHS of page).

The monitoring information was updated every morning to show if requested observations had been made. The status of each observation that was requested for the previous day would change from "requested" to "deployed" or "not deployed".

This component of the system turned out to be very important because a record of the data that was generated in response to targeting requests was available in real time. It was useful not only for the lead-user to know in real time the result of his actions but also for the observation providers that could easily track their own deployments. This information will also be a very useful reference in future, when an assessment of the trial will take place, for a quick check on the result of a particular request.

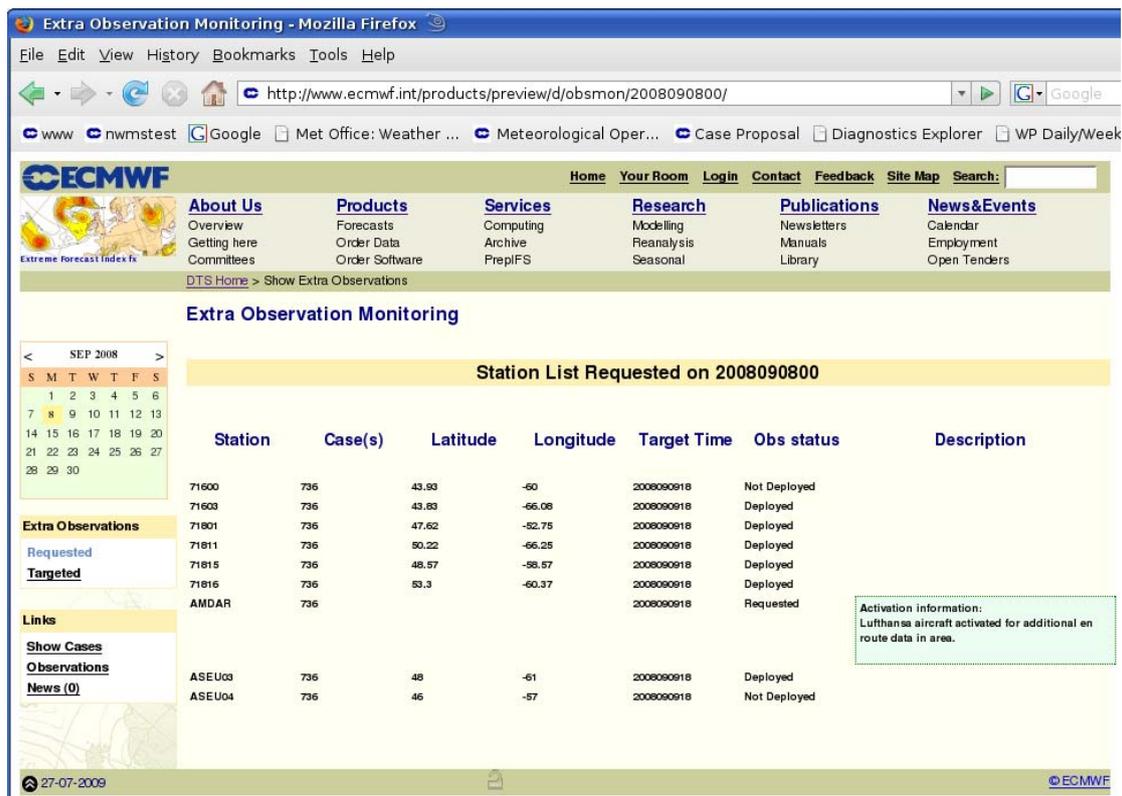


Figure 9. The DTS observation monitoring web page. This example is for the same case as shown in Figure 3-Figure 6. After the targeting time has passed, the DT checks which requested observations were actually made. In this case the monitoring shows that most requested observations were made, including AMDAR data from aircraft crossing the target area. However, one ASAP and one radiosonde request could not be met.

6. Archive

The DTS archived all the data to provide a complete trace of each event in which target observations were considered, including cases where no observations were requested. The information archived on a daily basis includes: case suggestions, comments on cases, case evaluation, SAP requests, observation availability, lead-user extra observation suggestions, user’s comments, and extra observation requests. All this information is archived in the DTS database (DTS DB) and available on the web. The only information that was kept just for 5 days were the forecast charts. The SAP summary maps for each case were also archived in DTS DB and available on the web; the corresponding numerical fields were archived as GRIB files in the ECMWF operational archive MARS

(<http://www.ecmwf.int/services/archive/d/catalog/class=dt/stream=seap/expver=14/>).

See Annex III for an example of a MARS retrieval.

7. Statistics of the real-time trial

During the 11-month trial (4th February until 19 December 2008), there were a total of 628 cases proposed by the following DTS users: dts_mfr2a (Meteo-France); dts_meto3 (UKMO, Lead user); dts_ipyn2a (IPY-THORPEX experiment user); dts_dwd2a (DWD); moh (ECMWF, Cristina Prates); dts_medex2a (MEDEX experiment user - active since 11th of September 2008). SAPs were computed for 548 of these cases (the

accepted ones) and from these, 184 sets of observations were requested. From these set of observations resulted: 1402 radiosonde observation requests, 87% of which were deployed; 226 request for E-ASAP (ship), 54% of which were deployed; 224 E-AMDAR (aircraft) observation requests. A full analysis of this is included as Annex IV.

8. Conclusions

One of the main goals of the project was to make data targeting practical and viable in an operational environment. This goal was achieved with the DTS: the system operated successfully in a real-time pre-operational environment and is a very straightforward and user-friendly tool.

The deployment rate for requested observations was very high, particularly for land station, confirming that the automatic ‘requests by e-mail’ is sufficiently reliable. The deployment rate of E-ASAP ships, although smaller than land station, can be considered quite successful considering the constraints involved, particularly the approximate estimate of the ships’ locations at TT. AMDAR requests have a high deployment rate although we do not have the final figures yet. Sending automatic e-mails to request observations to the observation providers has proven to be very efficient. The overall response to the observation requests has shown that observations providers are ready to take part in this type of project.

The DTS was designed to be portable, in that control of the targeting process could be easily transferred to a new lead user in a different location. This was demonstrated during the trial, when the lead user role was transferred to Météo-France on two occasions just by giving the right permissions to the user.

Finally, the acknowledgment from other campaigns, mainly TPARC, that the system was a valuable resource for their campaigns, is an encouragement to keep the design adopted for the system and try to improve it.

Glossary of Terms

AMDAR	Aircraft Meteorological Data Relay (wind speed and air temperature data from commercial aircraft)
ARPEGE	Action de Recherche Petite Echelle Grande Echelle - Meteo-France Numerical Weather Prediction Global Model
ASAP	Automatic Shipboard Aerological Programme (a EUMETNET programme established to provide radiosonde ascents from commercial ships)
A-TReC	Atlantic-THORPEX Regional Campaign
ETKF	Ensemble Transform Kalman Filter
DB	Data Base
DTS	Data Targeting System
LHS	Left Hand Side
MARS	Meteorological Archive Retrieval System
MOGREPS	Met Office Global and Regional Ensemble Prediction System
MSLP	Mean Sea Level Pressure
ODB	Operational Data Base
PEARP	Prevision d'Ensemble ARPege (ensemble model based on ARPEGE)
PREVIEW	PREvention, Information and Early Warning
RH	Relative Humidity
SAP	Sensitive Area Prediction (a calculation of the location of the region where a more accurate understanding of the initial state of the atmosphere will benefit the quality of the target forecast over the validation region)
SV	Singular Vectors
T2m	Air Temperature at 2m
TESV	Total Energy Singular Vectors
TT	Targeting Time (the time when additional observations are to be deployed)
VA	Verification Area (the geographic region over which the forecast event will occur)
VT	Verification Time (the time at which the forecast event will occur)
Z500	Geopotential at 500hPa

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Annex I: Charts available on the Forecast Display webpage

Figure A.1- 1. The forecast display main webpage of EURORISK PREVIEW Data Targeting System

Display of ECMWF and MOGREPS15 forecast products:
Deterministic Products : T850 and Z500 T2m&30m wind MSLP& 200hPa wind speed 700hPa RH & Horizontal Wind 850hPa RH & Horizontal Wind MSLP and 850hPa wet-bulb potential temperature 850hPa RH and vertical velocity 700hPa RH and vertical velocity
Ensemble Prediction System: Probability charts 10m wind gust probability above 15m/s 10m wind gust probability above 25m/s 2m temperature probability below 273.15K 10m wind speed probability above 10 m/s 10m wind speed probability above 15 m/s Precipitation probability of at least 1, 5, 10 or 20 mm
Extreme Index Forecast Charts
T2m 10m wind speed 10m wind gust Precipitation
Ensemble Mean and Spread Charts (ECMWF and MOGREPS15)
MSLP 500 hPa Geopotential 200 hPa Geopotential 850 hPa Temperature
Ensemble Quartiles (ECMWF and MOGREPS15)
Total precipitation 10-m wind 10-m wind gust (ECMWF only) 925-hPa wind CAPE (only ECMWF)

Table A.I- 1: List of ECMWF and MOGREPS15 forecast products available via the DTS webpage.

There is also a collection of charts from Meteo-France deterministic forecast model Arpege available; the link is provided from DTS web page. The forecast products displayed included the following charts: Temperature and Geopotential at 500hPa; MSLP and Total Precipitation; MSLP and 1.5 PVU isotachs; MSLP and 850hPa wet-bulb potential temperature. They were generated from the most recent analysis (00UTC run) and cover the range 60 to 96 hours with a 12-hour time interval.

Annex II: Conventional radiosonde stations and ASAP ships available on DTS

Country	N. of stations for targeting	Station ID
Austria	1	11035
Cyprus	1	17607
Finland	1	02963
France	1	07510
Germany	7	10035
		10184
		10200
		10410
		10548
		10739
		10868
Greece	3	16622
		16716
		16754
Greenland	5	04220
		04270
		04320
		04339
		04360
Iceland	1	04018
Hungary	2	12843
		12982
Italy	6	16044
		16080
		16245
		16320
		16429
		16560
Latvia	1	26435
Netherlands	1	06260
Norway	5	01001
		01028
		01152
		01241
		01415
Portugal	3	08508
		08522
		08579

Country	N. of stations for targeting	Station ID
Spain	5 (incl. Canary Island)	08001
		08221
		08302
		08430
		60018
Switzerland	1	06610
Sweden	2	02365
		02527
U.K.	7 (incl. Gibraltar)	03005
		03238
		03354
		03808
		03882
		03918
		08495
Bermuda	1	78016
Canada	8	71600
		71603
		71722
		71801
		71811
		71815
		71816
		71823

Table A.II- 1: List of conventional radiosonde stations available via DTS for extra observation request.

Ship ID	Managed by
ASGB01	E-ASAP Ship
ASDE04	E-ASAP Ship
ASEU04	E-ASAP Ship
ASDE02	E-ASAP Ship
ASEU01	E-ASAP Ship
ASDK02	Danish ASAP ship
ASEU03	E-ASAP Ship
ASDE01	E-ASAP Ship
ASDE03	E-ASAP Ship
ASEU05	E-ASAP Ship
ASEU02	E-ASAP Ship

Table A.II- 2: Automatic Shipboard Aerological Program (ASAP) ships operating in Atlantic and available via DTS for additional observation requests.

Annex III: Access to Sensitive Area Calculation archived on MARS via webpage

The SAPs fields on MARS webpage are displayed based on Target Time (Observation Time). However the SAPs were being produced on a daily basis (model initialisation time is the reference) and a maximum of 10 cases per day (without any pre-define domain) were foreseen and differentiated by assigning different values to the variable "domain". The cases are assigned by the following way: h (case 1); i (case2); j (case 3); k (case 4); l (case 5); p (case6); p (case 7); q (case 8); r (case 9); y (case 10).

An example for 09/11/2008 case 1 for instance:

<http://www.ecmwf.int/services/archive/d/catalog/class=dt/stream=seap/expver=15/origin=ecmf/type=sv/year=2008/month=sep/levtype=ml/date=2008-09-11/>

and the retrieve for the summary map is:

```
# Call mars
mars <<EOF
retrieve,
number=0,
time=00:00:00,
date=2008-09-11,
step=0,
domain=h,
levtype=ml,
param=126.128,
levelist=1,
stream=seap,
origin=ecmf,
opttime=48,
leadtime=48,
expver=15,
class=dt,
type=sv,
target = "sac_ecmwf.grib"
EOF
```


Annex IV: Statistics of PREVIEW’s 11-month trial

	dts_met03	dts_ipyn2a	dts_mfr2a	dts_dwd2a	dts_medex2a	moh	Total
Proposed	353	74	79	8	100	14	628
Accepted	327	73	49	7	79	13	548
Rejected	26	1	30	1	21	1	80

Table A-IV. 1: Meteorological Cases submitted to the system by the different DTS users. The lead user reviewed each proposed case and decided either to accept or reject. Sensitive Area Prediction requests were only submitted for accepted cases. The users taking part were the following: dts_mfr2a (Météo-France); dts_meto3 (Met Office, Lead user); dts_ipyn2a (IPY-THORPEX experiment user); dts_dwd2a (DWD); moh (ECMWF, Cristina Prates); dts_medex2a (MEDEX experiment user - active since 11 September 2008).

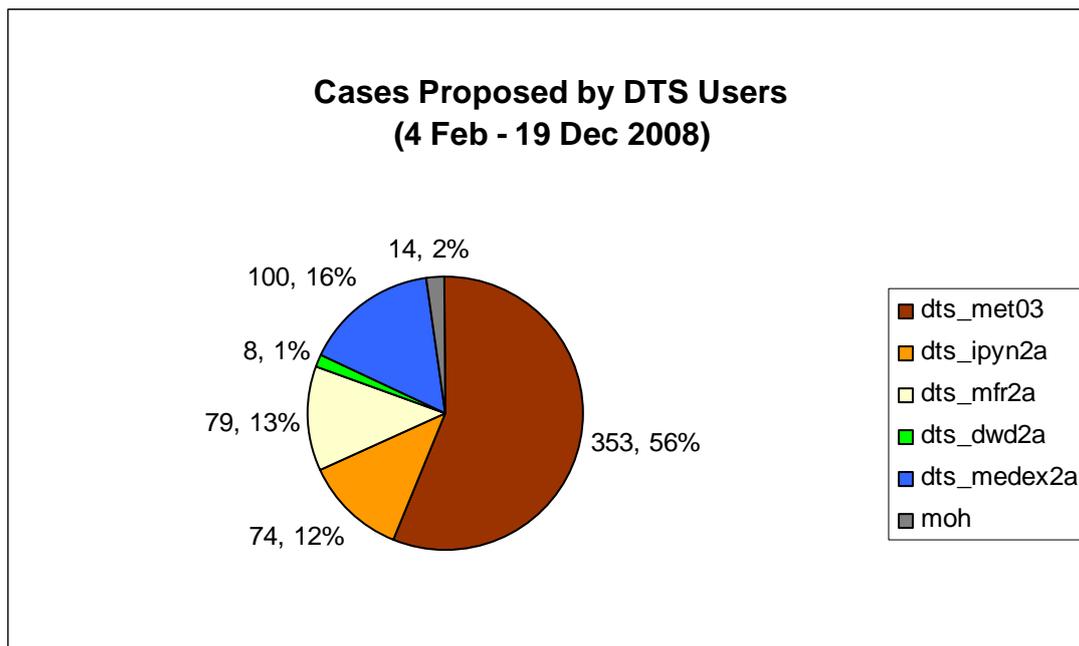


Figure A.IV- 1: Number of cases proposed by each of the DTS users.

Obs. Type	Requested	Deployed	Not Deployed
Land Stations	1402	1228 (87.6%)	174
E-ASAP	226	123 (54.4%)	103
E-AMDAR	224	Not Available	Not Available
Total (exc. AMDAR)	1628	1351 (83.0%)	277

Table A-IV. 2: Observation Cases submitted to the system requesting additional deployments. A total of 184 observation cases were requested out of 548 accepted SAP proposed cases. It can happen that for the same observation case E-AMDAR is requested for more than one area.

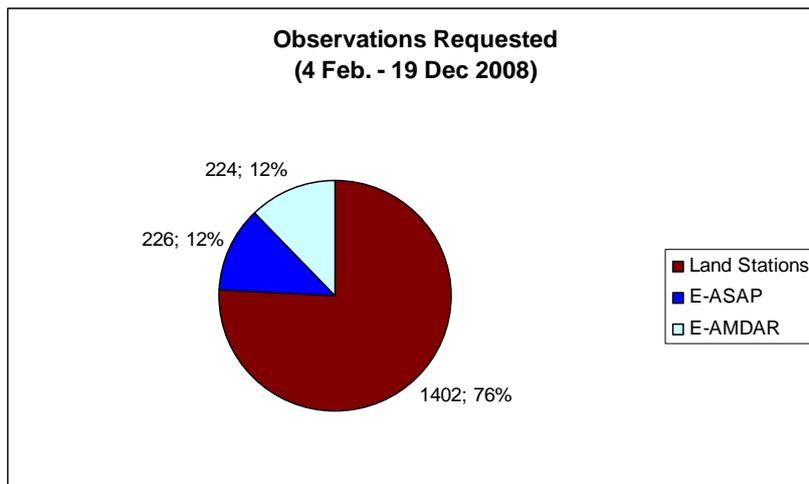


Figure A.IV- 2: Number of observations requested.

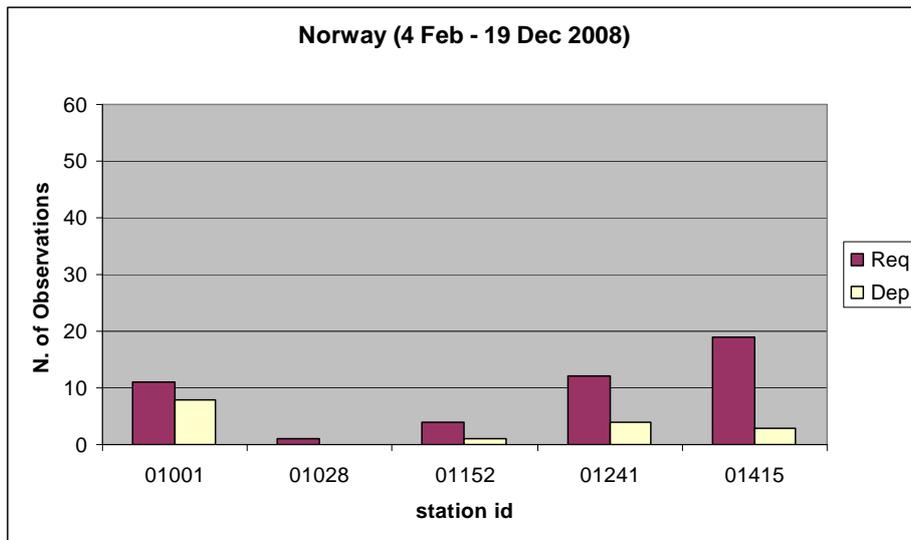


Figure A.IV- 3: Number of observations requested and deployed per station managed by the National Met Services of Norway: 01001, 01028, 01152, 01241 and 01415.

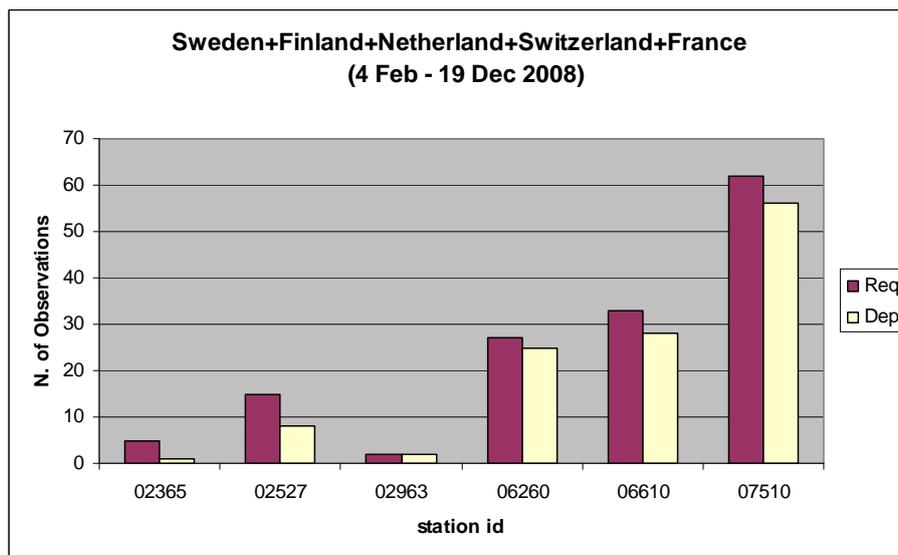


Figure A.IV- 4: Number of observations requested and deployed per station managed by the National Met Services of Sweden (02365 and 02527), Finland (02963), Netherland (06260), Switzerland (06610) and France (07510).

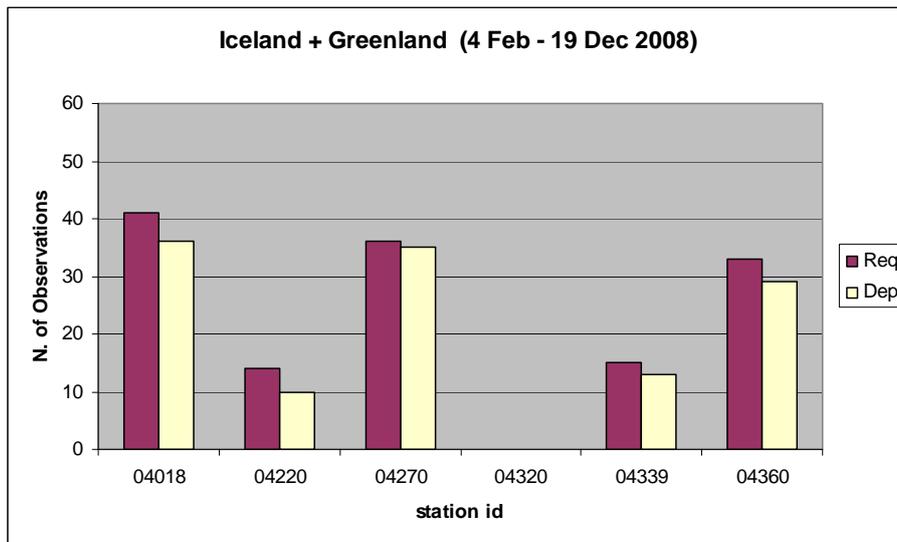


Figure A.IV- 5: Number of observations requested and deployed per station managed by the National Met Services of Iceland (04018) and Denmark (Greenland: 04220, 04270, 04320, 04339 and 04360).

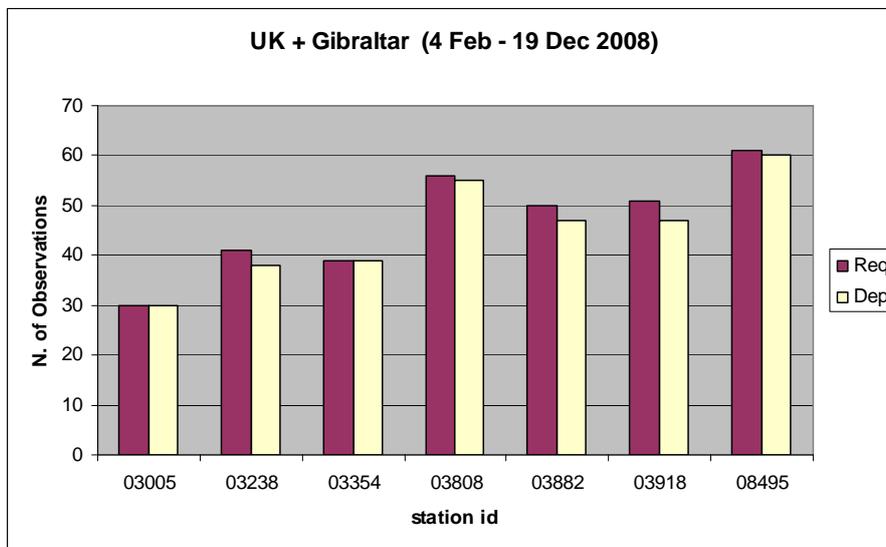


Figure A.IV- 6: Number of observations requested and deployed per station managed by the UK Met Office: 03005, 03238, 03354, 03808, 03882, 03918 and 08495 (Gibraltar).

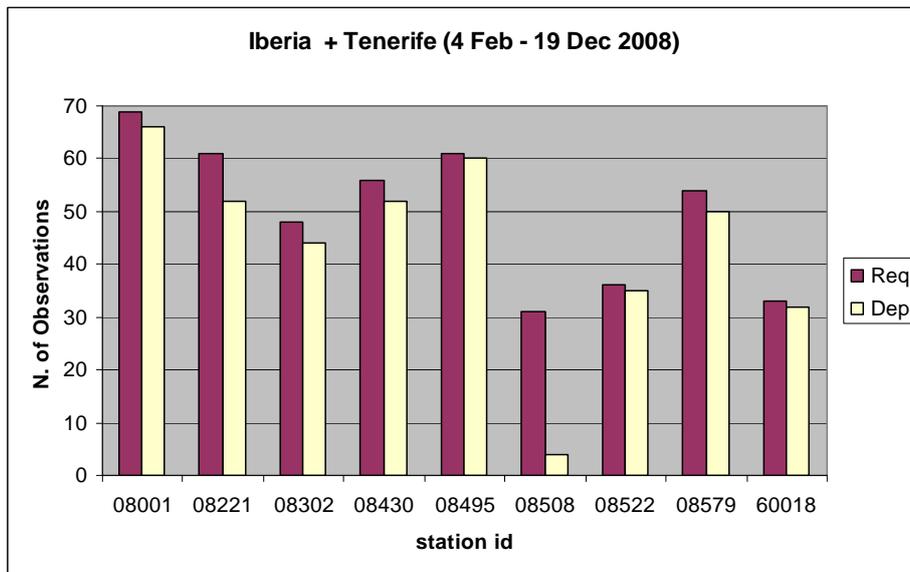


Figure A.IV- 7: Number of observations requested and deployed per station managed by the National Met Services of Spain (08001, 08221, 08302, 08430 and 60018 - Canaries) and Portugal (08508, 08522 and 08579).

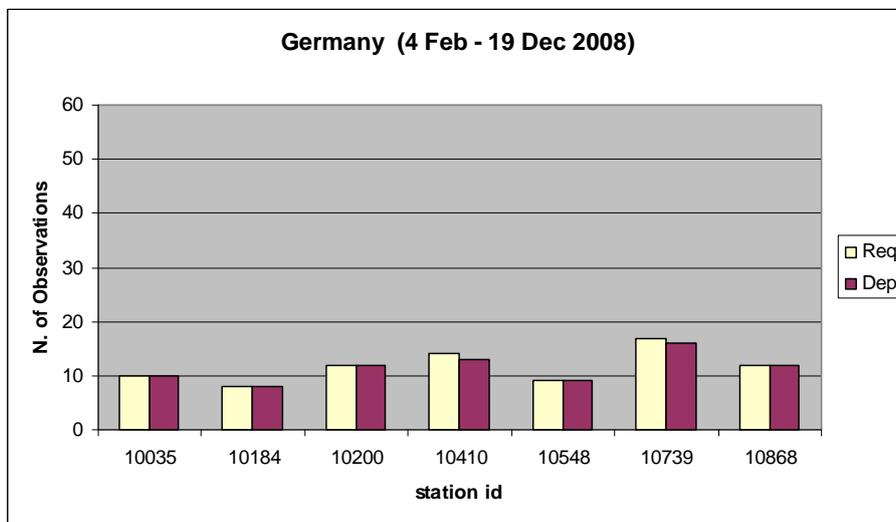


Figure A.IV- 8: Number of observations requested and deployed per station managed by the Germany Met Service (DWD): 10035, 10184, 10200, 10410, 10548, 10739 and 10868.

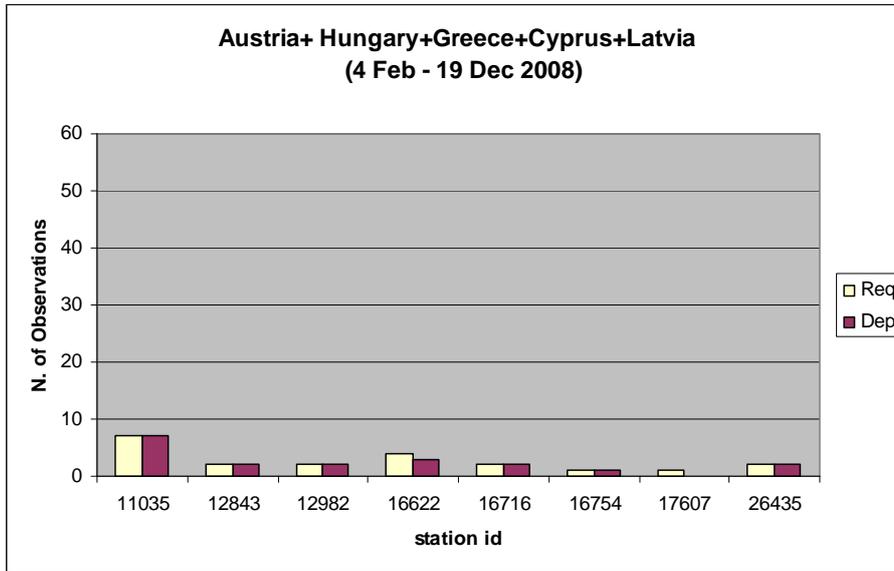


Figure A.IV- 9: Number of observations requested and deployed per station managed by the National Met Services of Austria (11035), Hungary (12843 and 12982), Greece (16622, 16716 and 16754), Cyprus (17607) and Latvia (26435).

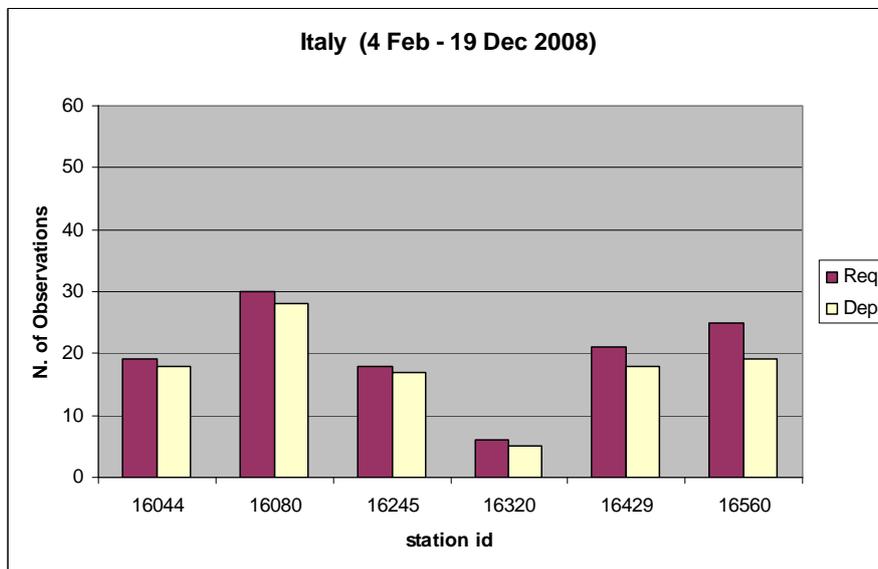


Figure A.IV- 10: Number of observations requested and deployed per station managed by the Italian Met Service: 16044, 16080, 16245, 16320, 16429 and 16560.

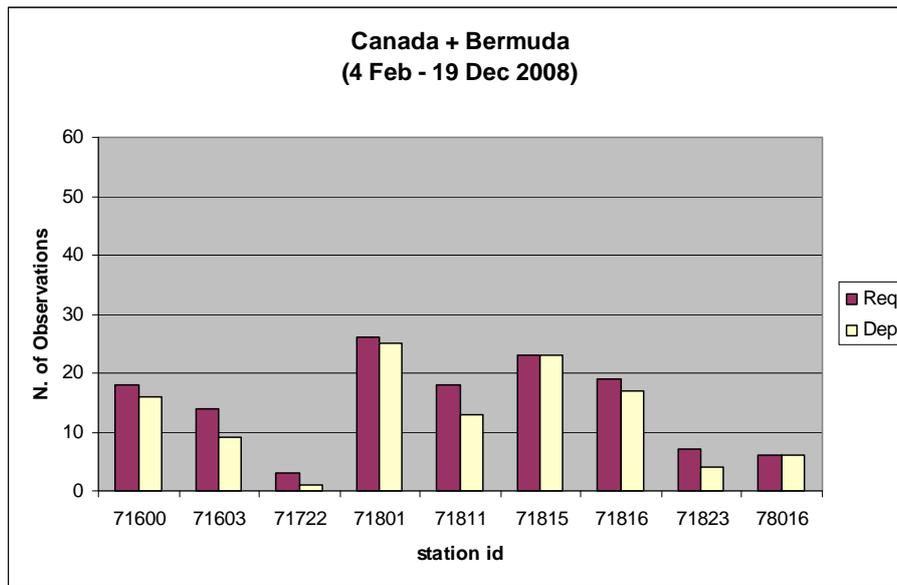


Figure A.IV- 11: Number of observations requested and deployed per station managed by National Met Services of Canada (71600, 71603, 71722, 71801, 71811, 71815, 71816 and 71823) and Bermuda (78016).

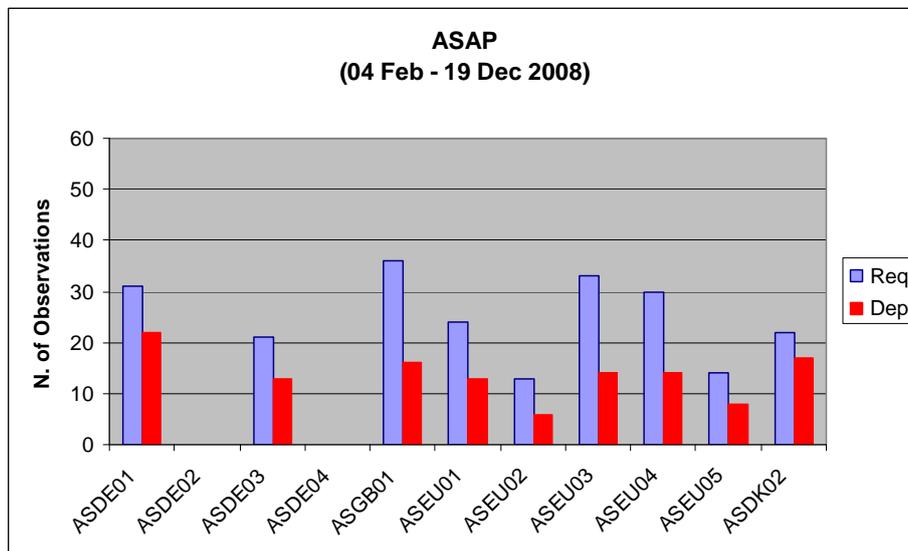


Figure A.IV- 12: Number of observations requested and deployed per ASAP ship.