# UERRA Newsletter No 1

## May 2015

UERRA (www.uerra.eu) has been running for a bit over one year now. The collaborative EU FP7 Project has 12 partners and after holding the first General Assembly/Kick-off meeting in Exeter last year in March, the 2nd General Assembly was held in Tortosa, Spain at the end of January this year.

The first year of the project saw the setting up of the ensemble reanalysis systems to be used in the Project. Some of these systems were developed in the pre-cursor FP7 EURO4M project although in UERRA, there are also new systems or significant developments of the previous systems.

The Met Office is developing the most expansive computationally demanding ensemble assimilation system which will be described below.

SMHI and Météo-France are running atmospheric 3-dimensional data assimilation and 2 dimensional near-surface assimilation respectively and in a one-way coupling mode. There are two atmospheric physics options and different downscaling and surface model options which are used to create ensembles. These systems have been run in reanalysis mode for quite some time already and some results are shown.

The availability of homogeneous observations is essential for climate reanalyses and the Data resque and development efforts from EURO4M have continues in UERRA. The emphasis is now on sub-daily time scales and post 1961 data, as far as possible. There have been quite

# UERRA General Assembly and Consortium meeting 2016

The 2nd General Assembly (GA) of UERRA was kindly hosted by URV in Catalonia, Spain, 27-28 January 2015. It was held at their premises in Tortosa which is inland from Tarragona. URV (Universitat Rovira i Virgili) has 3 premises and the large one in Tortosa has climate research and extensive facilities for meetings. More details on the GA 2 Meeting page.

The **presentations** can be found on the meeting page, and in particular through the links in the Agenda.

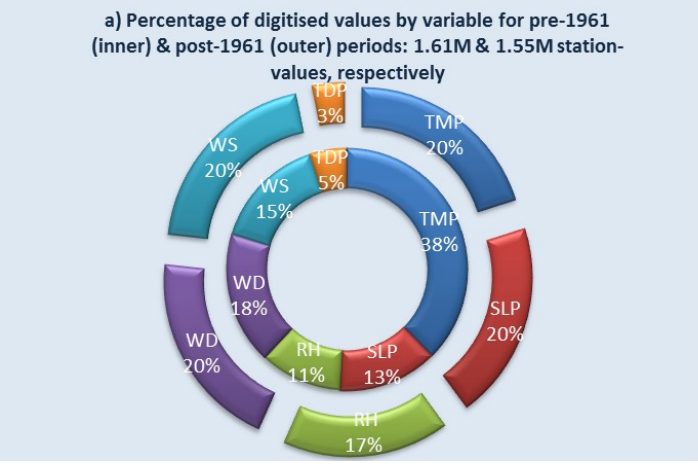
## Over 5 million historical observations have been rescued and are processed

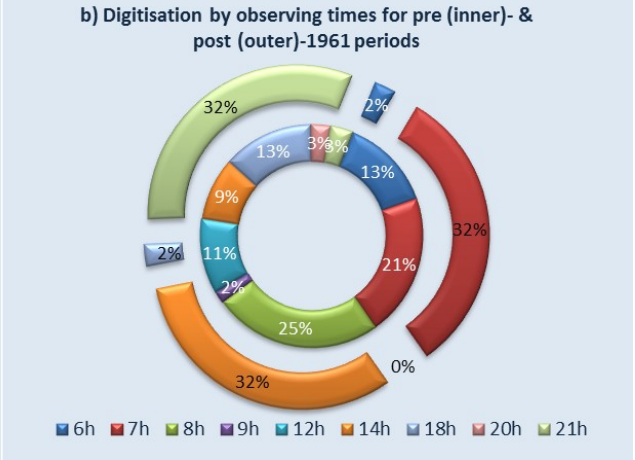
In WP1 over 5.3 million data have now been digitized. This is way above the target promised for UERRA (3.5 million) so the digitizing has gone better than expected. They are from a small number of countries due to the availability of original data or scanned images. They are from Slovenia, Germany, .... and more from Germany, France and Spain will be forthcoming.

In UERRA the emphasis is on sub-daily data (as opposed to daily or monthly means. This is so that the Numerical Weather Prediction (NWP) model based reanalyses can use hourly or six-hourly data in their assimilation time windows.

Moreover, the period after 1960 is the priority for UERRA since the Regional reanalyses start from 1961 (SMHI and Météo-France) or 1978 in case of the Met Office.

The figure shows the distribution of the rescues and processed (quality controlled and corrected) data.




It is important to check for gross errors and supervise the digitization.

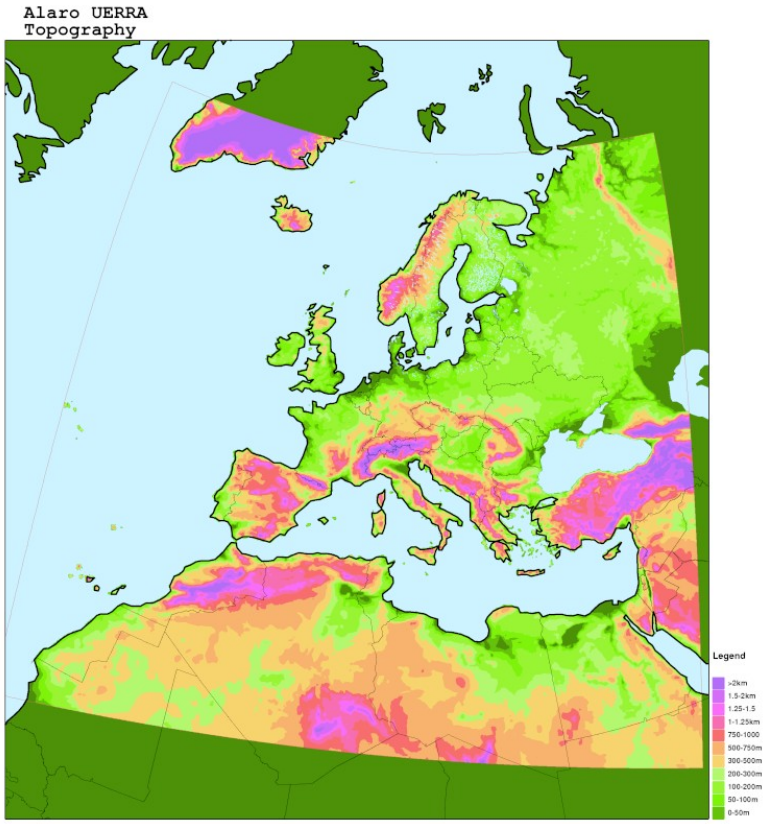
The coverage over time in European regions is shown below. While there are already quite a lot of observations available in southern Europe, there is quite a lot of data missing in northern Europe (e.g. Sweden and Norway) see below. Data is being or has been digitized nationally and the original data (on paper Journals) are not readily passed aroung from the national Meteorological Services (NMSs). It remains for those services to submit their data to the international data bases (like ISPD and ISD within NOAA)

The Climatic Research Unit of University of East Anglia has gone through an exercise to identify which data already exist in the ECMWF Mars archives and compared with the rescued data. There are e.g. difficulties identifying stations at the same (almost) location when AWS replaced manual ones. A data set from EURO4M has been encoded to ODB format but there are still some issues before it can go into ECMWF archives (sse later discussions).

## HARMONIE Upper air 3-dimensional reanalyses two physics ensemble

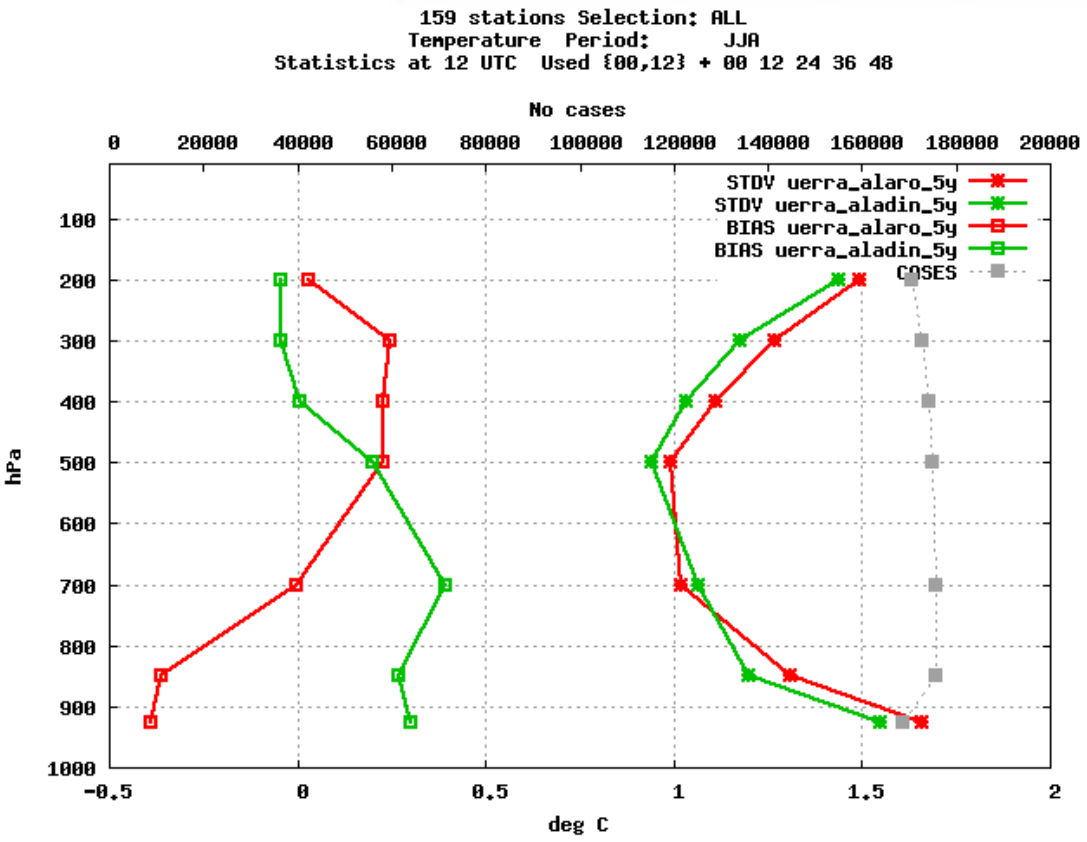
The 3-dimensional reanalysis system at SMHI was set up and tried last year using 3-dimensional variational analysis in the HARMONIE NWP modelling system. It has two different formulations and software packages for the parameterisation  of physical processes that are not resolved at the 11 km model grid resolution (e.g. clouds particles, condensation, radiation, turbulence, soil and surface

processes). Two parallel reanalyses using the two physics packages have been running since the beginning of the year. The period covered is 2006-2010 and most of the period has been processed. The European-Atlantic region is covered and the grid resolution is 11 km, The computing facilities at ECMWF are used.

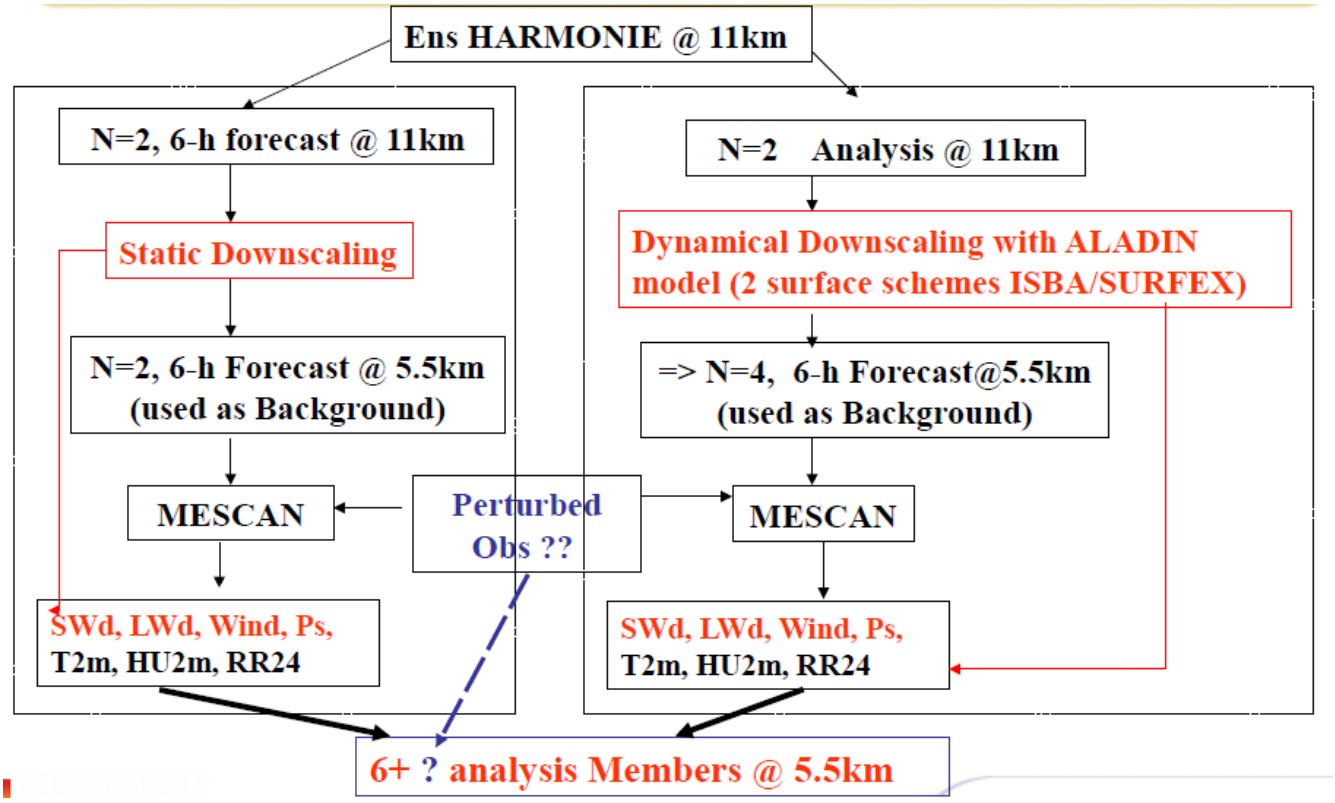



The purpose of these runs is threefold: 1) to evaluate the spread in the reanalyses (using the same observations) due to model physics differences; 2) to decide on the best physics for the full 50+ years reanalysis at this resolution (11 km) and 3) to provide background or input to the 2-dimensional ensemble 5 km reanalysis at Météo-France (see below).

From the first three years the verifications of the of the forecast parts of the reanalyses shows similar results but where there are differences, the ALADIN physics package scores a bit better.

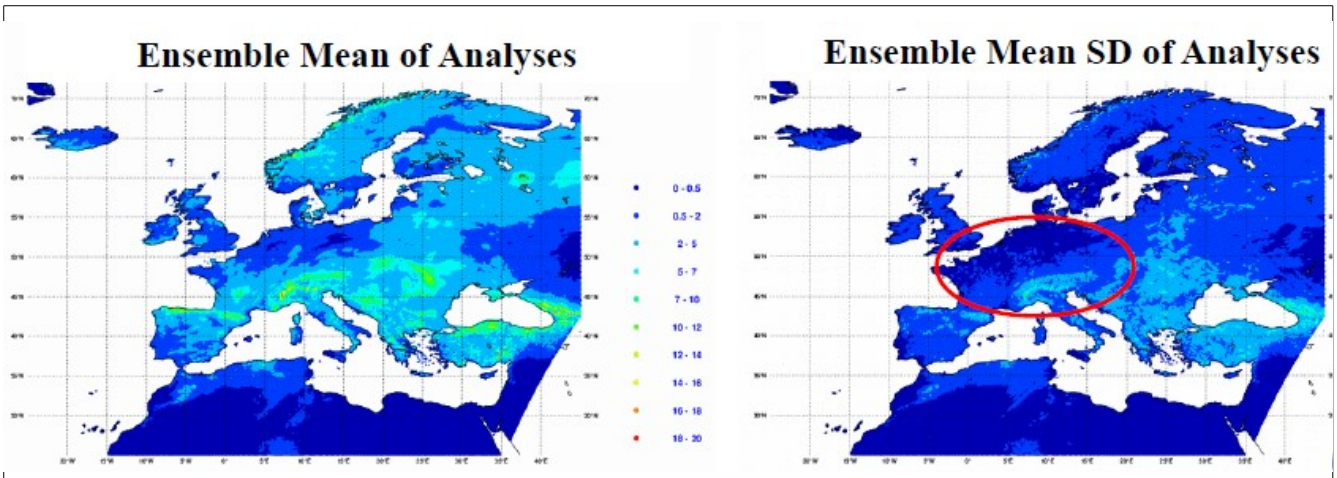


# Near surface ensemble reanalysis




A 2-dimensional reanalysis system of near-surface variables such as precipitation, temperature and humidity was developed in EURO4M. This MESCAN system is downscaling the background or analyses from the 3-dimensional HARMONIE reanalysis system to a 5 km resolution. This is in order to resolve orography and land features better than the 11 km or coarser reanalyses. Moreover and in particular, it uses direct observations that were not used in the 3-dimensional system.For the same 5-year period run by SMHI, Météo-France has established a small ensemble reanalysis system from the two physics runs by SMHI. 6 members are created by also doing a dynamical downscaling (running a high 5 km resolution NWP forecast) and also by using one or the other of the surface parameterisation schemes. The figure above shows the setup of the system.

It is possible to get some information about uncertainty by examining the variations and spread in the 6 different reanalyses (see the Figure below). The areas of high precipitation over the Alps and ohter mountainous regions also have large ensemble spread.

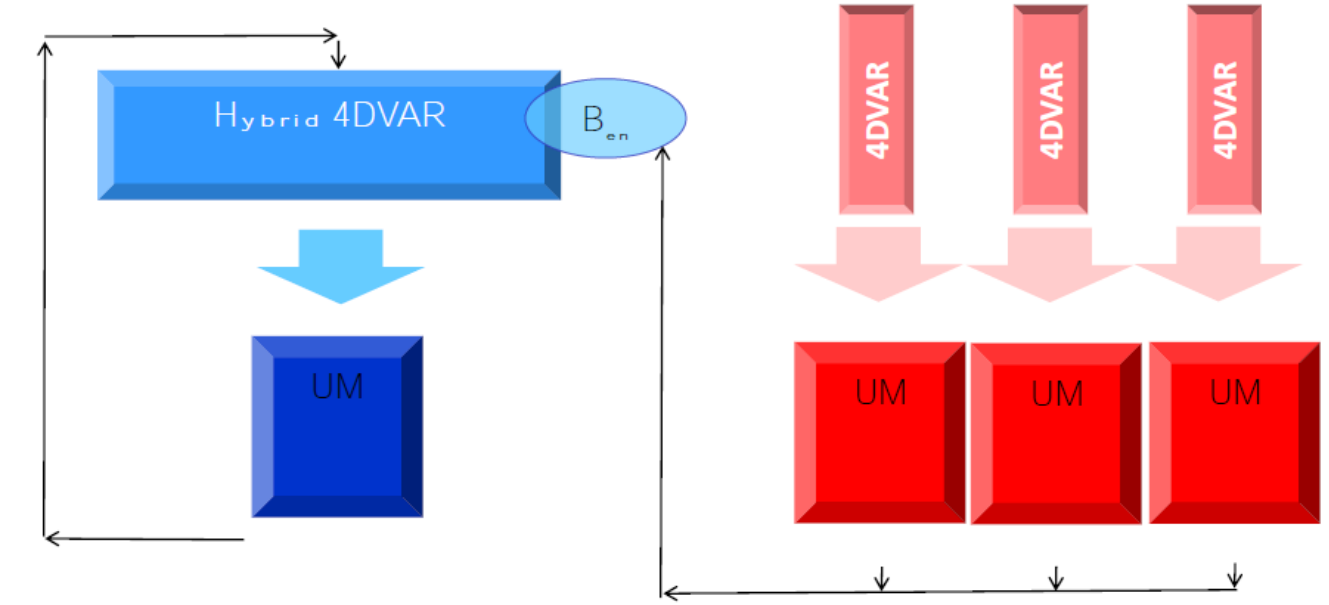



*Precipitation mean and ensemble spread for*

## Large ensemble reanalysis systems being developed at the Met Office

Large ensemble data assimilation systems with about 20 members are being developed at the Met Office and University of Bonn. The assimilation systems are otherwise quite different. The Met Office reanalysis system will be used for production early 2016 and cover the period from 1978. The University of Bonn will still be developed and the aim is to run a 5 year period for demonstration.

The Met Office has tested different combinations of ensemble and 4-dimensional variational assimilation and there is a report documenting many of the considerations and choices. An Ensemble of hybird 4D-VARs turned out to be the best available option for this regional applications. Observations, model and lateral boundaries have perturbations to create the ensemble spread.



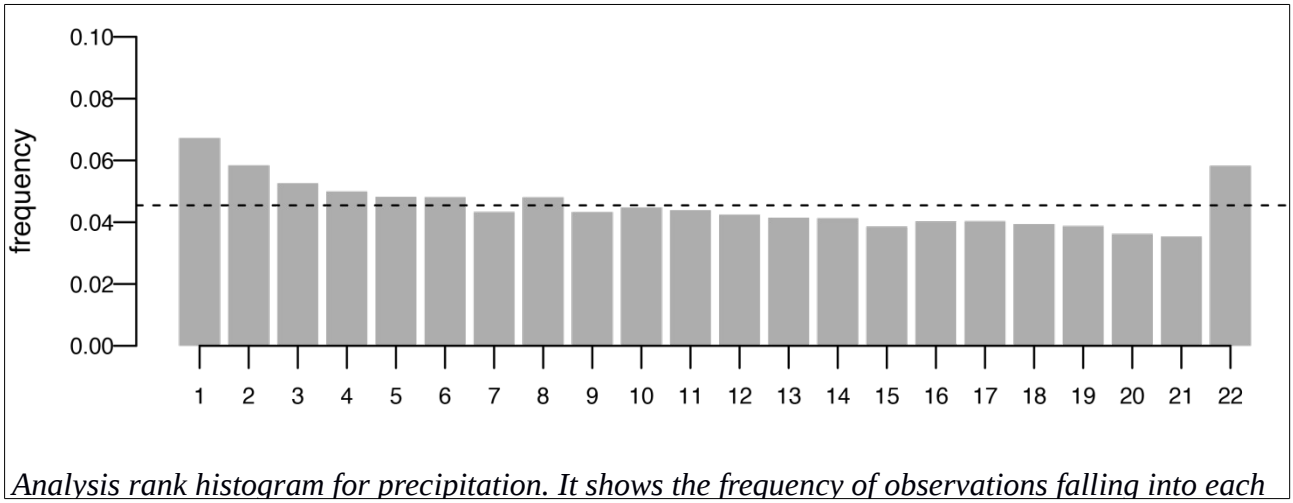

*Design of the Met Office Ensemble 4DVAR reanalysis system*

## The COSMO Ensemble reanalysis developing at University of Bonn

The University of Bonn has developed an Ensemble nudging scheme within the COSMO modelling system from DWD. It is a first step to combine a hybrid LETKF (Localised Ensemble Transform Filter) with  the nudging scheme.

The ensemble capabilities have been implemented inot the COSMO nudging scheme so that each member is nudged towards perturbed observations. The perturbations have been designed to be random within the assumed range of observation errors. Physical checks have been implemented to ensure that the observations are reasonable and are physically consistent, e.g. with respect to vertical temperature lapse rate.

A summer and a winter period have been tested with the ensemble nudging of perturbed observations and the ensemble spread looks good (so that most events are captured by the ensemble and all members are equally probable). The example below shows that observations are quite uniformly distributed over the bins and not too many are outside of the ensemble spread (bin 1 and 22).




*Analysis rank histogram for precipitation. It shows the frequency of observations falling into each*

## Data services and evaluation procedures being developed

Last year the main procedures for evalutation and uncertainty estimations were defined in UERRA including user requirements. It was done both through developing of common on-line documents and a Workshop at DWD last June.

The table below summarizes the basic methods and data sources that will be used. A common software package is being developed but using some main components that already exist at the partner's institutes and that can be freely available.

## Task 3.1 Coordinated uncertainty evaluation

- D 3.2 Common evaluation procedures (-> data source):
  - **A: feedback statistics**
    - Data source: radiosonde soundings
    - Parameters: T,Ws, RH
  - **B: point measurements**
    - Data source: station data
    - Parametes: Ws, Tmin, Tmax, number of days of threshold exceedance of T and RR
  - **C: gridded measurements**
    - Data source: gridded data
    - Parameters: RR, Tmin, Tmax
  - **D: satellite data products**
    - Data source: CM-SAF and CCI
    - Parameters: global radiation, total cloud cover, swe
  - **E: ensemble based comparison**
    - Data source: WP1 ensemble of gridded data
    - Parameters: RR, Tmin, Tmax
  - **F: user related models**

An important and necessary condition for the evaluation work and software development is the access to the different reanalysis data in a consistent and as unified way. A lot of work has gone into defining the common (as far as possible) set of archive types and parameters to be stored in MARS at ECMWF. The archives are designed with a user perspective in mind, both the scientific community but also the general user community in society. The inventory from CORE-CLIMAX is cross-checked in order to make sure all the relevant Essential Climate Variables (ECVs) defined by ESA are covered.

To start with, a test data set with EURO4M renalysis data set is stored or being stored in MARS (Met Office, SMHI, DWD and MF. An example from the archive explorer is shown below.

**Per Unden** | Sign out

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- Contact

- About
- Forecasts
- Computing
- Research
- Learning

## Navigation

- Job list

## See also...

- FAQ
- Accessing forecasts
- GRIB decoder

# Surface

| Date (30 values) | Time (4 values) | Step (1 values) | Parameter (5 values) |
|---|---|---|---|
| 2009-04-01 | 00:00:00 | 0 | Relative humidity |
| 2009-04-02 | 06:00:00 | | Temperature |
| 2009-04-03 | 12:00:00 | | Total cloud cover |
| 2009-04-04 | 18:00:00 | | U component of wind |
| 2009-04-05 | | | V component of wind |
| 2009-04-06 | | | |
| 2009-04-07 | | | |
| 2009-04-08 | | | |
| 2009-04-09 | | | |
| 2009-04-10 | | | |

View node in the old webmars.

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- Check for availability
- View the MARS request
- Estimate download size
- Retrieve the selection in GRIB or NetCDF (experimental)

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### Note about availability

Some of the fields may not be archived at all levels or all forecast time steps. Before retrieving data you may want to check the availability of the requested fields. For that, follow the *Check for availability* link.

### Retrieving

In order to retrieve data, you must select at least one item in the lists above. You can select more than one item in each list.

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**Current selection:**

levtype **sfc**
month jan , **apr**
year 2008 , **2009**
type an , **fc**
expver 1 , **2** , 3 , 4
stream **oper**
class be , co , cs , de , dm , e2 , ea , ei , em , en , er , gr , la , mc , ms , nr , od , rd , **rm** , s2 , se , sr , ti , tr , uk

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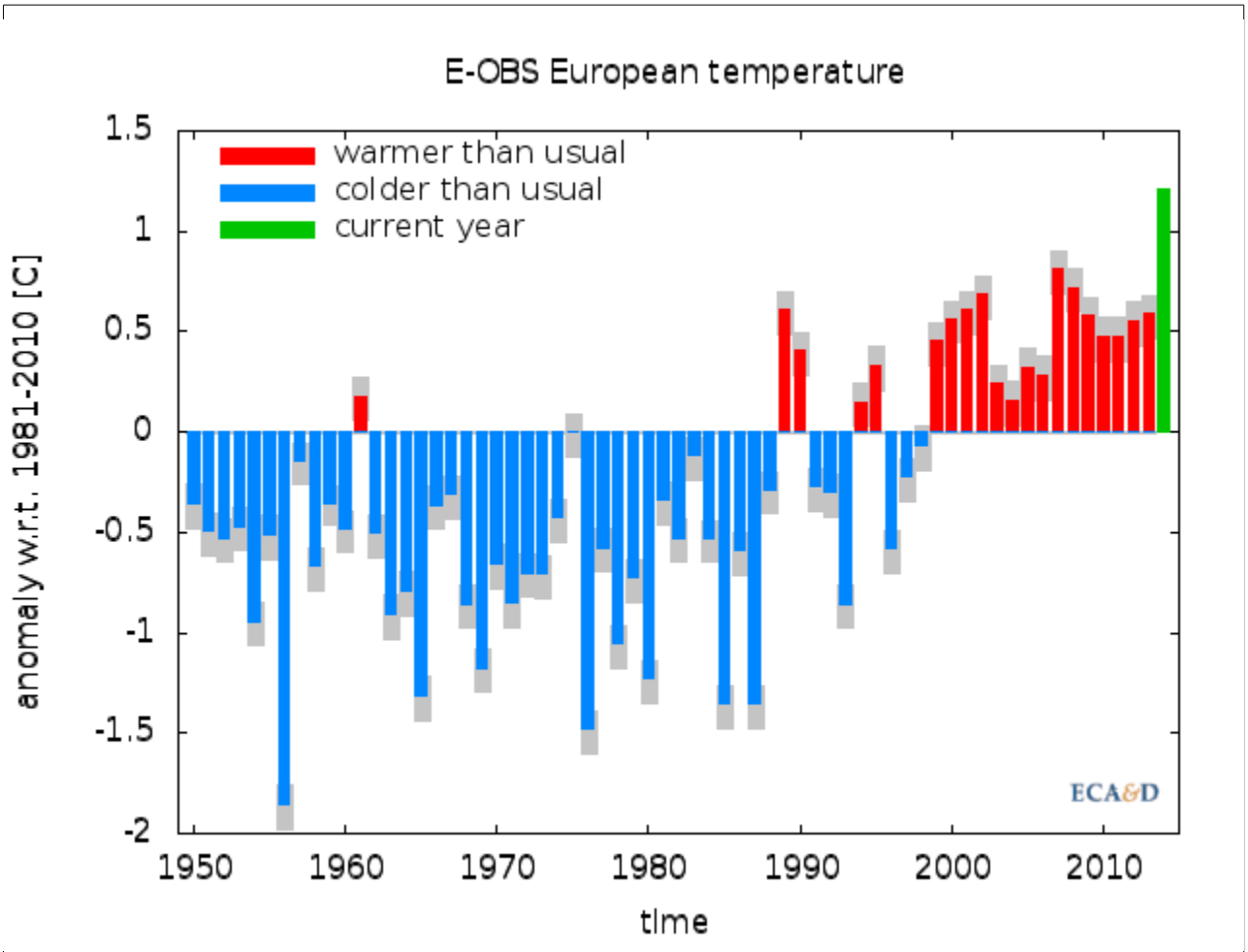
## Use oriented products and climate information for the public and stake holders

Climate indicator bulletins (CIBs) are regularly produced by KNMI. The activity carries over from the previous FP7 EURO4M project into UERRA. One example is showing the records for 2014 based on the E-OBS gridded observation data set. It is show that the year was the warmest on record over Europe (and this agrees with other climate analyses even though there some may be one or a few tenths of a degree less than the record warmest).

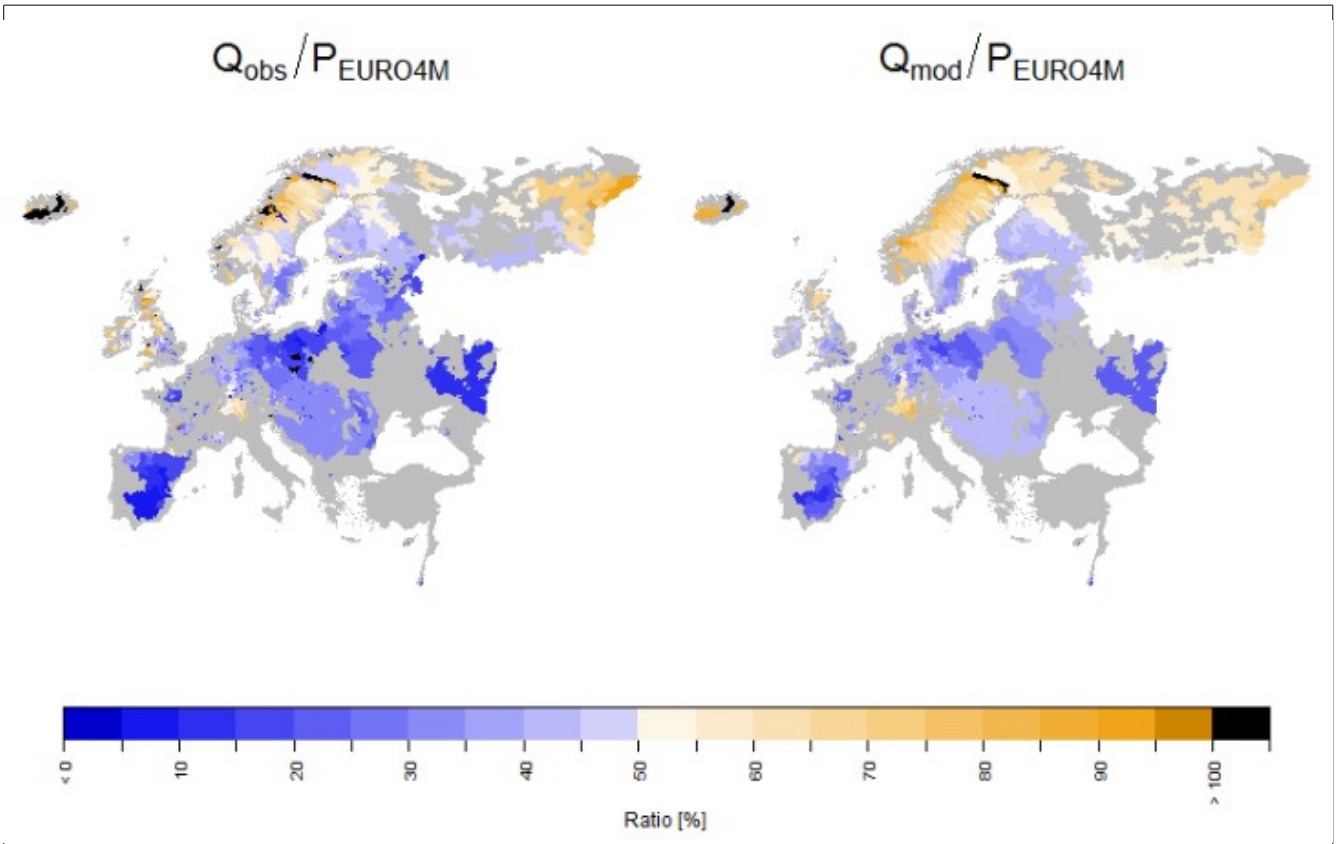
KNMI, with input from DWD, has created a Climate Indicator Bulletin (CIB) issued 16 December 2014, that 2014 was to become he warmest (or almost) the issued warmest year on record in Europe (see: http://cib.knmi.nl/mediawiki/index.php/2014_warmest_year_on_record_in_Europe). These bulletins are generic in the sense that they serve the full range of climate users and applications sectors in Europe within the wider global community. The analyses made use of the E-OBS gridded data set which was updated as part of the UERRA project. The activity to calculate derived climate change indices which are relevant for applications using the E-OBS gridded data set has started.




*E-OBS annual mean temperatures 1950-2014 compared to the normal.*

A User-oriented approach to validation of long term means of mainly precipitation (but also temperature to a smaller extent) is to use river basing discharge data to evaluate the model reanalysed values over long term, for example from the EURO4M-HIRLAM reanalysis simulation. The main idea is to make use of observed records of discharge from river catchments across Europe, which in a long term mean can be expected to be balanced by the precipitation falling within the upstream area and the loss through evapotranspiration. The precipitation is given by EURO4M, whereas evapotranspiration can only be estimated. In a first part of the evaluation, the catchment delineation and routing routines of a large-scale hydrological model for Europe, E-HYPE, are used to accumulate the precipitation spatially over a catchment. Then the temporally and spatially aggregated precipitation is compared with observed discharge from the corresponding catchment. An accumulated precipitation less than the discharge (even without considering evapotranspiration) indicates inadequate precipitation. For the second part of the evaluation, simulations with E-HYPE are carried out, and similar analyses are performed as in part one, but using the simulated values of discharge, now including an estimated evapotranspiration.

The hydrological modelling at SMHI had not used the model evapotranspiration and instead used only the temperature input so that is a source of added error.




*Discharge over precipitation Q/P-ratio for observed discharge, and Q/P-ratio for modeled discharge. All panels show annual means for the period 1991-2010. Values of discharge and precipitation are projected upon the upstream area of each Q-station.*

In this study we explored a novel method of employing a multi-basin hydrological model together with discharge observations to evaluate precipitation data sets. The E-HYPE model framework was applied to distribute precipitation from the WFDEI and EURO4M data sets over the catchments of E-HYPE in order to evaluate the accumulated values in two separate steps. In a first step (i), the accumulated precipitation was compared to observed discharge at the river mouths, and in a second step (ii) E-HYPE simulations were carried out to estimate losses due to evapotranspiration or longer term storage. This was performed for average values for the period 1991-2010.

Both of the analysis steps have distinct uncertainties. The main uncertainty is the amount of loss of water between the precipitation event and the water leaving the catchment as discharge. E-HYPE can estimate evapotranspiration, but little observations are available for evaluation, and the more advanced parameterizations require more uncertain input data, e.g. near surface winds. A simple parameterization purely based on daily average temperature was therefore used in this study; although more advanced schemes can be explored in subsequent studies in UERRA.

Comparing the Q/P-ratios for both observed and modelled discharge revealed some interesting features for different regions. The east-west gradient of differences was highlighted for Scandinavia and the British Isles, where a likely explanation for the gradient is a too deep inland penetration of precipitating systems in the dominant westerly flow. Furthermore, a seasonality issue was observed for the Scandic and Alps mountain ranges. The value of the explored method is in indicating where such issues with the precipitation data are, but subsequent meteorological analyses are necessary to find the exact circumstances of the biases of the atmospheric model.

## User Workshop and General Assembly early 2016

There will be two user workshops in UERRA; the first one will establish early contacts with users or potential users of reanalysis products. The idea products and their likely properties and how they might fit different applications.

One new and important issue is what sort of uncertainty information is needed and how to use it for their applications.

The users learn and assess the products for their applications and give feedback on how they fit for specific purposes.

In connection with the UERRA General Assembly (1-3 February 2016) the User Workshop will continue the 3-4 February. A number of users will be approached from contacts established in earlier project and that the UERRA institutes have had, especially with users of EURO4M data.

Another possibility is to use the EUMETNET network and invite users withing the NMSs. Other networks like JPI-Climate, ECRA and organisations like EEA will also be approached.

One can lend on EURO4M lists and experiences or at least use it as a starting point.

# Getting prepared for Copernicus Climate Change Services

UERRA is developing a pre-operational regional C3S (Copernicus Climate Change Service) in several areas. The different Work packages in UERRA naturally aim for these areas and UERRA partners are expected to be active in the tendering process.

Observation collection and processing: Call and start now in 2015.

Regional Climate Reanalyses: Call in late 2016 and start in 2017.

Evaluation and quality control: Proof-of-concept call and start now in 2015.