

Met Office 4D-VAR Reanalysis

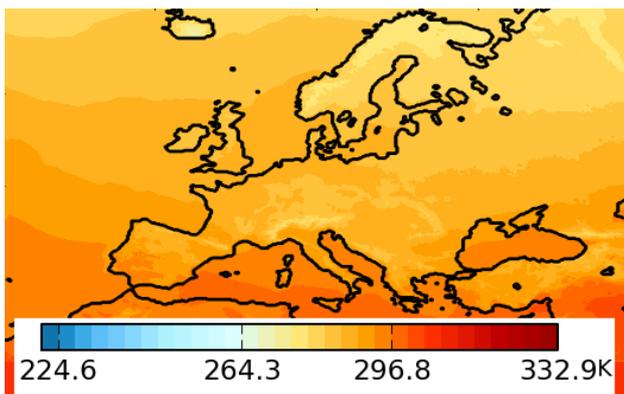
The Met Office atmospheric reanalysis was for a 2-year period, 2008 and 2009. It was produced at 12km resolution over the European domain. The data assimilation was 4D-VAR at 24km resolution run every 6 hours (00,06,12,18 UTC). From each analysis a 24-hour forecast was run.

Reanalysis fields

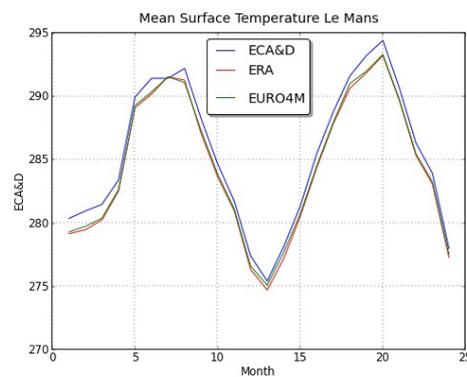
Full fields are available from each 6-hourly analysis at a range of times from the start of the 6-hour analysis period (21,03,09,15 UTC) through to forecast fields 27 hours later (nominally 24 hours after the central analysis time). A wide variety of surface fields together with fields on model and pressure levels has been archived in the ECMWF MARS system. These can be retrieved from the ECMWF MARS website <http://old.ecmwf.int/services/archive/d/catalog/class=rm/stream=oper/expver=1/type=fc/>

Monthly Means

Monthly statistics including screen level means and climate indices were produced. Many of these are available from the KNMI ADAGUC website <http://euro4mvis.knmi.nl/> under "Demo", "4D-VAR-UKMO". Others are available from the Met Office on request.



Picture 1: Mean surface temperature in September 2008



Picture 2: Monthly mean surface temperature at Le Mans

Infobox

<p>SPECIFICATIONS</p> <p>Output data sets Monthly means of meteorological variables and climate indices as listed.</p> <p>Data Spatial resolution: 0.11° (12km) Temporal resolution: monthly means Rotated lon -lat grid (pole lat=40°N, lon=200°S) Format: netcdf</p> <p>Availability Area: Europe Jan 2008 - Dec 2009</p>	<p>Validation Monthly means were validated against ECA&D observation datasets.</p> <p>Outlook This reanalysis is a pilot project and is not intended to be updated into the future.</p>	<p>Description and Validation Met Office United Kingdom</p> <p>Contact Richard Renshaw Met Office FitzRoy Road Exeter EX1 3PB United Kingdom Tel.: +44 1392 886409 email: richard.renshaw@metoffice.gov.uk web: www.metoffice.gov.uk</p>
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Meteorological Variables

Monthly means of the following:

- mean daily cloud cover
- mean daily screen level relative humidity
- mean daily mean sea level pressure
- mean daily precipitation
- mean daily screen level temperature
- mean daily 10m wind speed
- mean daily screen level temperature range
- mean precipitation on wet days
- mean of daily minimum screen level temperature
- mean of daily maximum screen level temperature

Climate indices

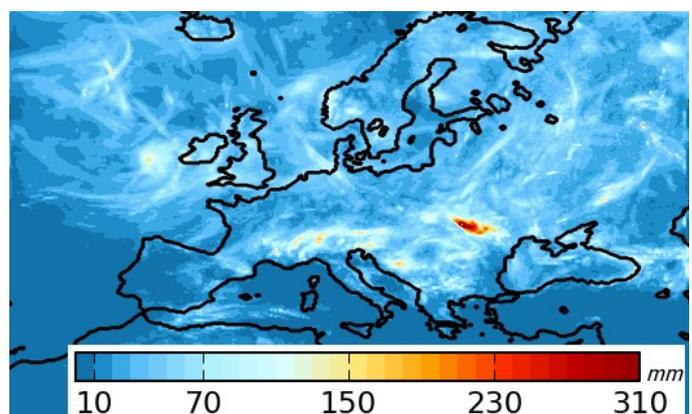
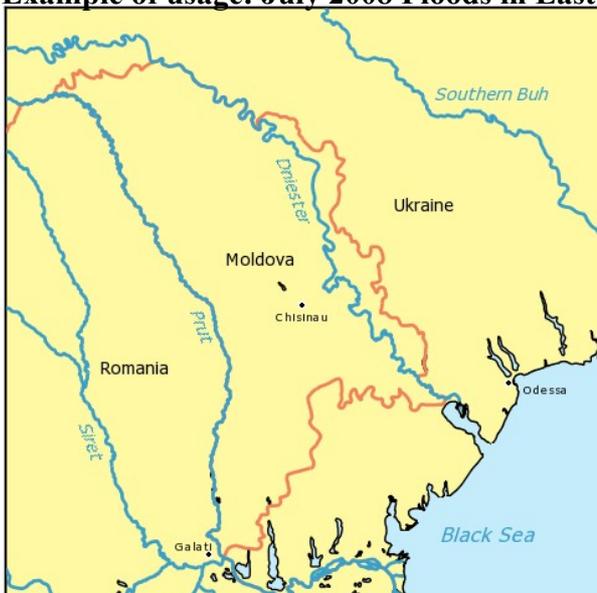
Monthly Core Climate indices:

- number of frost days
- number of summer days
- number of icing days
- number of tropical nights
- maximum of maximum screen level temperature
- maximum of minimum screen level temperature
- minimum of maximum screen level temperature
- minimum of minimum screen level temperature
- maximum 1-day precipitation
- maximum 5-day precipitation
- number of days with precipitation greater than 10mm
- number of days with precipitation greater than 20mm
- maximum length of dry spell
- maximum length of wet spell

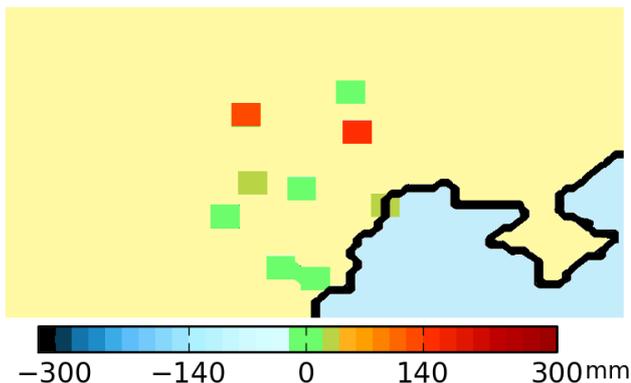
Other Climate Indices:

- number of wet days
- number of mostly sunny days
- number of mostly cloudy days
- number of windy days
- number of calm days
- maximum of daily maximum wind gust

Example of usage: July 2008 Floods in Eastern Europe

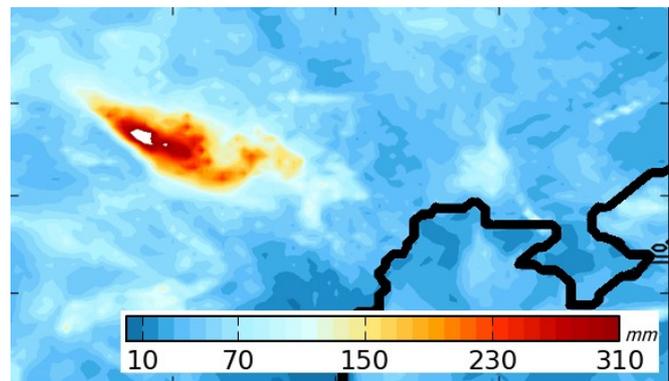


Picture 3: Region of flooding



Picture 5: Reanalysis minus ECA&D

Picture 4: Maximum of 5-day precipitation July 2008



Picture 6: Regional maximum of 5-day precipitation

Validation methods, consistency and uncertainty:

The reanalysis produces analysis fields of variables four times a day. The quality of these fields was verified by applying the Met Office verification software (VER) to short forecasts from these analyses. Since accurate short forecasts require accurate analyses, this process will verify the quality of the raw reanalysis data. The verification will take the form of a weighted sum of skill scores and equitable threat scores (ETS) for variables of interest, taking forecast error to be the difference between the forecast and all suitable observations in the ECMWF operational archive.

Monthly means and climate indices produced from the raw reanalysis data will be validated by comparison with the ECA&D dataset which includes the same measures calculated for observation stations.

Verification and validation scores will be compared against those of the ERA-Interim global reanalysis to demonstrate the benefit of the increased resolution of the EURO4M reanalysis.

Statistical measures:

The monthly means and climate indices are obtained by calculating means, maxima, minima etc. of variable from reanalysis data providing fields of means and climate indices. These can also be interpolated to produce location-specific time-series etc.

The indices make use of the following definitions:

Frost day daily minimum temperature is less than 0°C

Summer day daily maximum temperature is greater than 25°C

Icing day daily maximum temperature is less than 0°C

Tropical night daily minimum temperature is greater than 20°C

Wet day daily precipitation is greater than or equal to 1mm

Dry day daily precipitation is less than 1mm

Wet spell period of consecutive wet days

Dry spell period of consecutive dry days

Mostly sunny days daily mean cloud is less than or equal to 2 oktas

Mostly cloudy days daily mean cloud is greater than or equal to 6 oktas

Windy days daily mean wind speed is greater than or equal to 6Bft or 10.8ms⁻¹

Calm days daily mean wind speed is less than or equal to 2ms^{-1}

Skill Score This is a measure of the improvement of a forecast compared to persistence.

$$skill = \frac{P^2 - F^2}{P^2}$$

where P and F are the RMS errors of persistence and forecast, respectively.

ETS This is a measure of the ability of a forecast to capture an event (e.g. $>1\text{mm}$ precipitation).

$$ETS = \frac{AD - BC}{(B + C)T + AD - BC}$$

where A are the number of events forecast and registered in observations, B are the number of events forecast, but not registered in observations, C are the number of events registered in the observations, but not forecast, D are the number of events not registered in the observations and not forecast and T are the total number of events ($T = A+B+C+D$)