201507 - Heatwave - Western Europe

Status: Finalized Material from: Linus, Ivan

Discussed in the following Daily reports:

1. Impact

During the week 29 June to 5 July a heatwave affected western Europe, and several July temperature records were beaten, among them the UK July record when Heathrow measured 36.7°C on 1 July. The heat wave spread across many parts of West and central Europe. A ridge from the South built up over western Europe, bringing hot tropical air from Africa. Several significant all-time records have been reported. This heat wave has affected Spain for the most of the week. On Monday, 29 July Madrid broke the record for June temperature measuring 39.7°C. Few days later all-time July record also was broken with a temperature above 40°C. On Tuesday, 30 June temperatures on southern Spain reached nearly 44°C. Heat wave affected France as well. Several locations across France established all-time temperature records. On Wednesday, 1 July the temperature in Paris reached 39.7°C, the second highest temperature in the city ever. On the previous day, 30 June SW France recorded temperatures of 42°C.

At the end of the week Germany set a new national temperature record of 40.3°C in Kitzingen. The hot weather reached Sweden as well where temperatures exceeded 30°C.

Our forecasting system was able to give the onset of this heat wave about 2 weeks in advance. The plots below also show the EFI for 2-metre maximum temperature for day 7, the longest lead time available. The EFI signal is exceptionally strong for this lead time picking up well the most affected areas. HRES also performed very well managing to provide the right magnitude of the highest temperatures pretty well in the medium range (on the plots below 4-day HRES is displayed).

The case is discussed in a Newsletter article: http://www.ecmwf.int/sites/default/files/elibrary/2015/14589-newsletter-no145-autumn-2015.pdf

http://www.bbc.co.uk/news/world-europe-33341325

http://www.bbc.co.uk/news/uk-england-33324881

2. Description of the event

The plot below shows the evolution of EFI for 2-metre temperature for three cities (Madrid - blue, Vienna - black and Stockholm - light blue) from the last week of June up to mid August. The solid lines are based on 1-day forecasts and dashed on 6-day forecasts. For Madrid more or less the whole July was extremely warm, while Vienna had 3 separate periods of heat and Stockholm was only affected by the first. In this page we will mainly focus on the first period.

The plots below shows the evolution of z500 and t850 and analyses spanning from 26 June to 5 July. The plots show the ridge building up from the south-west bringing warm air from north-west Africa to Europe.

Analysis of z500 and t850
The plots below show a summary day-by-day of the heat wave and forecasts. The plots include the observed maximum temperature, HRES forecasts for maximum temperature 4 days before and EFI from 7 days before the verification day.

**Summary of the heat-wave**

- **1. 26 June 00UTC**
- **2. 27 June 00UTC**
- **5. 30 June 00UTC**
- **6. 1 June 00UTC**
- **9. 4 June 00UTC**
- **a. 5 June 00UTC**

Maximum temperatures on Wednesday, reaching 32°C in some parts.
The next plot shows a Hovmuller diagram of v200 (the time-axis increases upwards). The a Rossby wave train is evident that might influenced the meridional flow over Europe around 1st July. On 26 July a cyclone developed east of U.S what also could have played a role of the development of the ridge over Europe.

The plots below shows day 1 EFI values for 2-metre temperature. This shows the evolution of the heat-wave. The heatwave first affected western Europe and later in the week central Europe.
3. Predictability

3.1 Data assimilation

The plot below shows the data assimilation increments from 26 June 12UTC. Over U.S we find significant increments that could have influenced the predictability of the ridge over Europe.
3.2 HRES

3.3 ENS

The plot below shows the EFI for the 10-day period starting on Monday 29 June. A large part of Western Europe was covered by very high EFI values.

The plot below shows the Ensgram for Paris, also initialised 29 June 00UTC. The first part of the high-wave showed a peak on 1 June. The next plot shows the EFI for 1 June.
To see the evolution of the 2-metre temperature forecasts for 12UTC on the 1 June in Paris, the plot below shows all ensemble forecasts issued for this day (including monthly forecasts) and HRES forecasts (red dots). The percentiles for the ERA-Interim climatology is included as the grey bar on the 1 June.
3.4 Monthly forecasts

Forecasts valid Week 27

2-metre temperature

1. 29 June
2. 25 June
5. 15 June
6. 11 June
The plot below shows ensemble forecasts for week 27 averaged in the box 40-50N, 0-10E. From 25 June and onwards the forecast has been very consistent, and the strong signal for the heatwave was predicted already on 22 June. The monthly forecast from 18 June was also for warmer than normal but not the one from 15 June. The z500 anomaly in the ensemble mean pattern over the Euro-Atlantic in the forecast from 18 June has the same structure as the current structure (Atlantic trough and European ridge). This was not the case for the forecast from 11 June that anyway had a warm anomaly for Western Europe.
3.5 Comparison with other centres

4. Experience from general performance/other cases

5. Good and bad aspects of the forecasts for the event

6. Additional material
   - Report from Christian Grams, ETH (ask Linus for access)