Based on a contingency table (→ **Table 1**), the skill of the EPS to forecast the exceedance of the heat-threshold with respect to different exceedance probabilites was assessed for June to August 2006 (→ **Figure 4**).

Table 1: contingency table

	Analysis **yes**	Analysis **no**
Forecast **yes**	hits	false alarms
Forecast **no**	misses	correct negatives

The skill scores that accounted for hits, misses and false alarms at the same time showed that exccedance probabilities between 20% and 40% had in general the highest skills. This skill decreases with increasing lead time, but also lead times close to 10 days still show some skill.

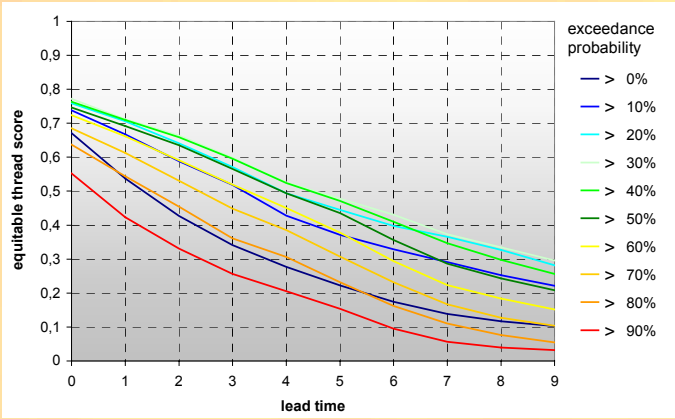

Figure 4: Equitable thread score for forecasting heat waves. 1 = perfect skill; 0 = no skill

For an exceedance probability of 30% hypothetical costs and benefits for summer 2006 (June, July, August) have been estimated. This cost/benefits analysis showed that in 2006 there would have been significant benefits from the medium-range heat information in many European areas if public health interventions would have been triggered based on this information.

Conclusions & Recommendations

We were able to demonstrate that the ensemble prediction system of the European Centre for Medium Range Weather forecast showed some skill in predicting heat events in Europe, even for forecasts with lead-times close to 10 days.

A decision maker should be aware of the uncertainty of medium-range weather forecasts. He must decide which probability is high enough to take action. In summer 2006 exceedance probabilities of 20% - 40% showed the highest skills.

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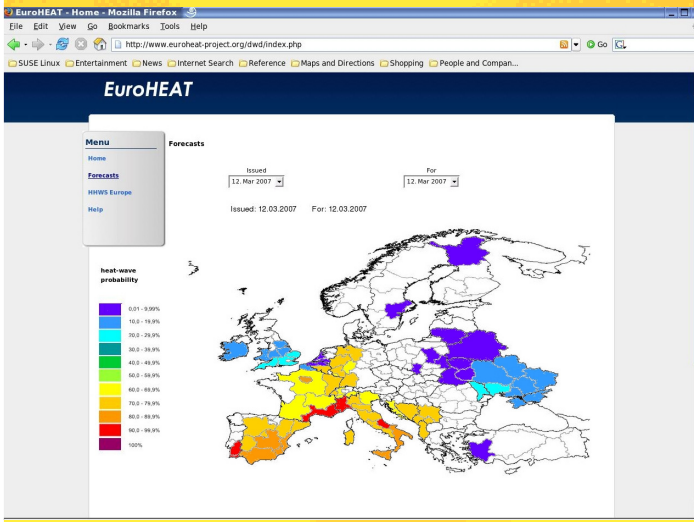
Climate Information Decision Support Tool for Heat in Europe

EuroHEAT



Scientific Background

http://euroheat-project.org/dwd

Weather forecasts short-range vs. medium-range

Weather forecasts are based in general on numerical weather prediction (NWP) models. The basic idea of NWP is to sample the state of the atmosphere at a given time (=initial conditions) and to use mathematical equations for the physics and dynamics of the atmosphere to estimate its state some time in the future. The models are initialised using observed data from different kinds of weather observations (e.g. weather stations, radiosondes, satellites). These data are then used in the model as starting point for a forecast.

There are slight uncertainties in the initial conditions. A reason for these uncertainties is that there are small errors in the observations. They are in general not relevant for short-range (0-3 days) forecasts, but increase the uncertainty of medium-range forecasts (3-15 days). In order to overcome this problem the so-called ensemble technique can be applied for medium-range weather forecasts.

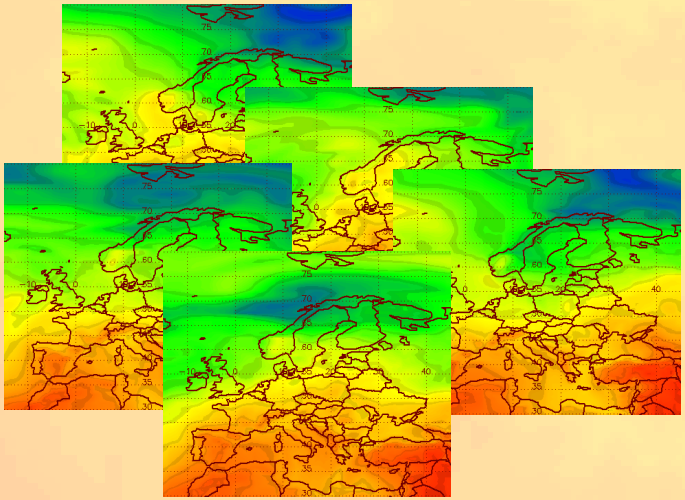


Figure 1: Example of ECMWF ensemble forecasts with the same starting date and the same lead time

Ensemble prediction systems (EPS) stimulate possible initial uncertainties by adding, to the original initial conditions, small perturbations within the limits of uncertainty of the initial data. This creates an ensemble of slightly different initial conditions. Each ensemble member is then used as starting point for a forecast. Instead of one forecast with a specific starting date and lead time an EPS produces an ensemble of forecasts (→ **Figure 1**).

The Web-based decision support tool bases on the EPS of the European Centre for Medium Range Weather Forecasts (ECMWF). This system consists of a 50 member ensemble.

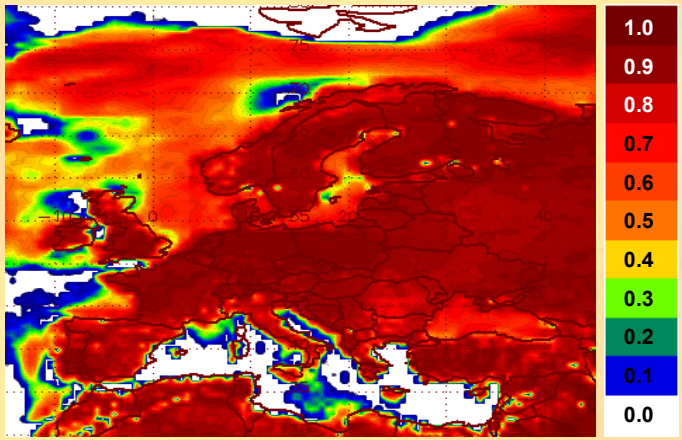


Figure 2: Skill score of EPS forecast with a lead time of 12 hours for 2m temperature (summer 2006)

How good are medium-range weather forecasts?

Due to an increase in the uncertainty of a forecast with increasing lead time, it is necessary to assess how good the forecasts for diverse lead times are. One possibility for such an assessment is to calculate the skill of the forecasting system with respect to a reference forecast.

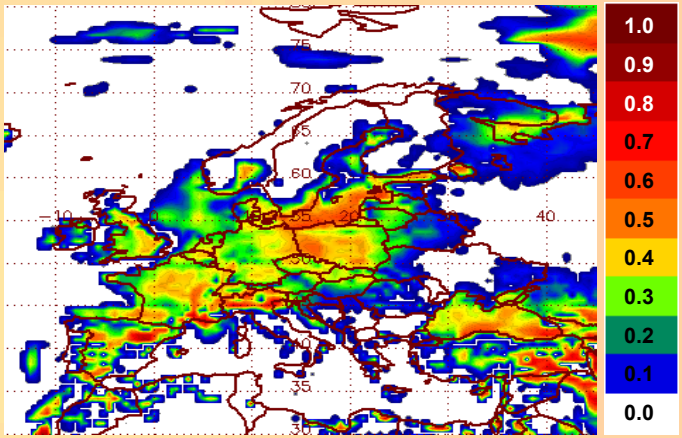


Figure 3: Skill score of EPS forecast with a lead time of 9 days for 2m temperature (summer 2006)

For the skill score displayed in figure 1 and 2, the mean climatic conditions have been used as reference forecast and compared to the ensemble mean. A skill score of 1 indicates a perfect forecast and a skill score of 0 indicates that the forecasting system is not better than climatology.

The skill of the EPS forecast is very good for short lead times (→ **Figure 2**), but decreases significantly with increasing lead time. Nevertheless, even for longer lead times the EPS produces a better forecast than climatology over most of the land areas (→ **Figure 3**).

Probabilities for heat-waves

The probability of a heat event can be calculated based on the number of ensemble members that reach or exceed the threshold for heat. The medium-range decision support tool uses 2m temperature to assess the thermal environment. The threshold for heat that is used is relative to the local 2m temperature of the past 30 days but also has an absolute component. This kind of heat-wave definition can be applied all over Europe and takes the fact into account that people adapt to the local meteorological and climatological conditions.