ENSEMBLES Newsletter

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Welcome to the second issue of the ENSEMBLES stakeholder newsletter. In this newsletter, we make an announcement for the final ENSEMBLES symposium, to which you are invited. We also draw your attention to three ENSEMBLES focal themes, the ENSEMBLES contribution to seasonal-to-decadal predictions and climate change impacts on malaria incidence and energy demands in the Mediterranean region.

Happy reading!

ENSEMBLES Final Symposium

The five-year EU funded FP6 research project ENSEMBLES is now coming to an end and a final symposium under the theme: 'A changing Climate for Europe' is organised 17-19 November 2009 at the Headquarters of the Met Office in Exeter, UK.

The purpose of the final symposium is to present the results of the ENSEMBLES project. In the symposium both the policy-relevant results and the research work will be presented and discussed.

The symposium is aimed at expert users of climate change research, decision-makers and climate scientists.

Presentations will cover the ensemble modelling methods developed in the project over a range of time/spatial scales.

Approaches which were used to improve models will be discussed (e.g. by better representation of atmospheric processes and feedbacks).

In addition, the evaluation of models against a dataset of European climate observations will be presented.

There will also be talks on the ways in which model output is downscaled and transformed for climate change impact modellers. Results from the climate change impact models will also be shown.

Throughout the symposium panel discussions will take place where scientists who are presenting the results can be engaged in open debate with the audience.

Who is the symposium for?

The ENSEMBLES final symposium is for:

- climate scientists
- expert users of climate change research
- decision-makers (at national and European levels)
- climate experts on international and coordination projects
- researchers in EC FP7 projects in climate and the environment.

Met Office, Exeter, UK

Seasonal-to-decadal prediction systems

Seasonal time-scale climate predictions are now made routinely based on comprehensive coupled dynamical models of the atmosphere, oceans and land surface. However, the non-linear nature of the climate system makes dynamical climate forecasts sensitive to uncertainty in both the initial state and the model used for their formulation.
Uncertainty in model formulation arises due to the inability of dynamical models of climate to simulate every single aspect of the climate system. In ENSEMBLES, three approaches to address model uncertainty in seasonal-to-decadal predictions have been explored: (1) the multi-model method, (2) the perturbed-parameter approach and (3) the stochastic physics approximation (information included in the ENSEMBLES final report).
Two streams of coordinated seasonal-to-decadal experiments were carried out during the project: *Stream 1* covered the 1991-2001 hindcast period for seasonal to annual range. *Stream 2* hindcasts (1960-2005) consisted of a comprehensive set of seasonal, annual and decadal integrations. The seasonal/annual hindcasts consisted of nine ensemble members per model, whereas the decadal runs were done with 3 members per model.
Regarding initialisation strategies, a substantial effort on the ocean initialisation for seasonal-to-decadal climate prediction was carried out. A project report (Weisheimer et al, 2007) summarised the choices made. All developments fed directly into the production of seasonal-to-decadal *Stream 2* hindcasts by providing ocean initial conditions. The effects of initialisation on skill vary with region and start date, dependent, for example, on where persistent anomalies in upper ocean heat content are located at any given time.

Results

An intercomparison to highlight the relative merits of the three systems in the *Stream 1* seasonal and annual hindcasts was performed (Doblas-Reyes et al., 2009). It was found that the three methods to account for model error performed with comparable levels of skill overall. Figure 1 shows results for a probabilistic measure of skill. The multi-model ensemble gives better results than the perturbed parameter ensemble for hindcasts out to 7 months ahead, whereas the stochastic physics and perturbed parameter results show similar levels of skill. The improved scores for the multi-model ensemble arise from a wider spread of outcomes, reducing the frequency of overconfident projections which fail to encompass the observations.
The perturbed parameter hindcasts also show improved skill when results from the individual model variants are averaged to form an ensemble mean (in this case there is a single hindcast from each variant, so the ensemble mean is made from nine members). Figure 2 shows an example, plotting a time series of global pattern correlations for nine year average hindcasts of surface temperature throughout the *Stream 2* period. While individual ensemble members sometimes give better results than the ensemble-mean, the average skill of individual members is consistently smaller. The results also show that the skill increases for more recent hindcasts.

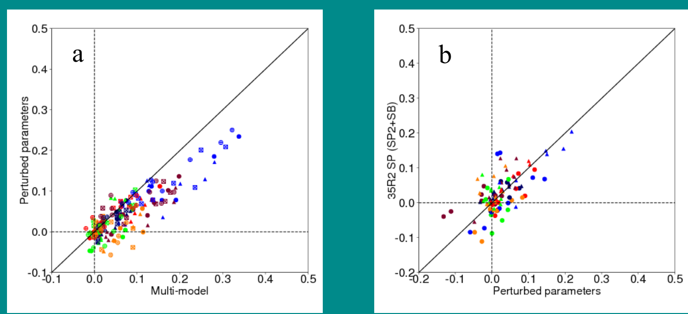


Figure 1: Time-Scatter plot of Brier Skill scores for different forecasting systems . Panel (a) shows results from Stream 2 hindcasts for the multi-model and the perturbed parameter approaches. Panel (b) compares the perturbed parameter results against recent simulations with the latest version of the stochastic physics approach.

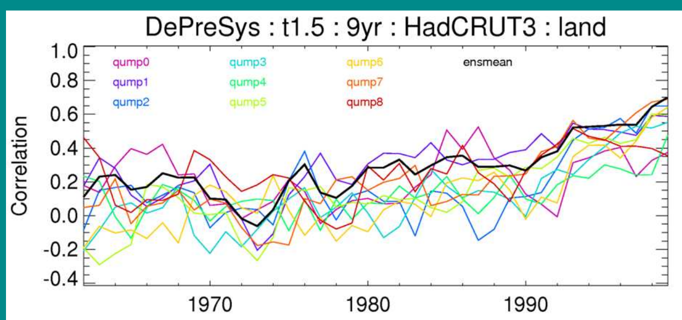


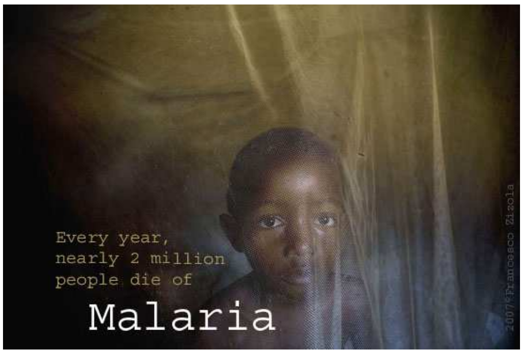
Figure 2: Time series of correlation between hindcast and observed global patterns of near-surface temperature anomalies, for hindcasts of nine-year means during the Stream 2 period, for individual variants (coloured lines), and for the ensemble mean over the nine constituent variants.

References

Doblas-Reyes, F.J., A. Weisheimer, M. Déqué, N. Keenlyside, M. McVean, J.M. Murphy, P. Rogel, D. Smith and T.N. Palmer (2009): Addressing model uncertainty in seasonal and annual dynamical seasonal forecasts. *Quart. J. R. Meteorol. Soc., 135, 1538-1559, doi:10.1002/qj.464.*

Weisheimer, A., F. Doblas-Reyes, P. Rogel, E. Da Costa, N. Keenlyside, M. Balmaseda, J. Murphy, D. Smith, M. Collins, B. Bhaskaran, *and T. Palmer (2007): Initialisation strategies for decadal hindcasts for the 1960-2005 period within the ENSEMBLES project. ECMWF Technical Memorandum,* ***521***.

Health



The 2007 IPCC report of Working Group II states that emerging evidence of climate change effects on human health shows that climate change has:

- increased heatwave-related deaths
- increased malnutrition and consequent disorders
- altered the distribution of some infectious disease vectors
- increased cardio-respiratory morbidity and mortality associated with ground-level ozone
- increased the burden of diarrhoeal diseases
- mixed effects on malaria; in some places the geographical range will contract, elsewhere the geographical range will expand and the transmission season may be changed

Tier-2 validation of ENSEMBLES for West Africa

The Liverpool Malaria Model (LMM) is a dynamic process based malaria model that drives the life cycle of the mosquito and malaria parasite using daily rainfall and temperature data. The climate data are taken from each of the ensemble members (not just the model means or ensemble mean) from the ENSEMBLES seasonal ensemble prediction system (EPS). Here we show new model runs undertaken for West Africa in conjunction with the EU FP6 AMMA project. Previous work in DEMETER found the ERA-40 reanalysis-driven LMM simulations for West Africa were inadequate; the epidemic fringe of the highest variability grid points was located too far south compared to that observed and to DEMETER, with the result that the DEMETER-driven models could not be satisfactorily evaluated in West Africa. In this study, NCEP reanalysis has been used to drive the reference model runs and provide an alternative baseline to ERA-40 in order to carry out tier-2 validation of ENSEMBLES. Here we show the malaria incidence climates (long term averages) for the forecasts months August, September and October (Months 2 to 4) from the May start dates averaged for the years 1971 to 2005. We show the reference runs using the NCEP reanalysis and output from three of the models that are part of the ENSEMBLES seasonal EPS. Although not shown, we have found that the model runs also have a constant band of high interannual variability in malaria incidence along the desert fringe and that the prediction for this zone of interannual variability is skilful.

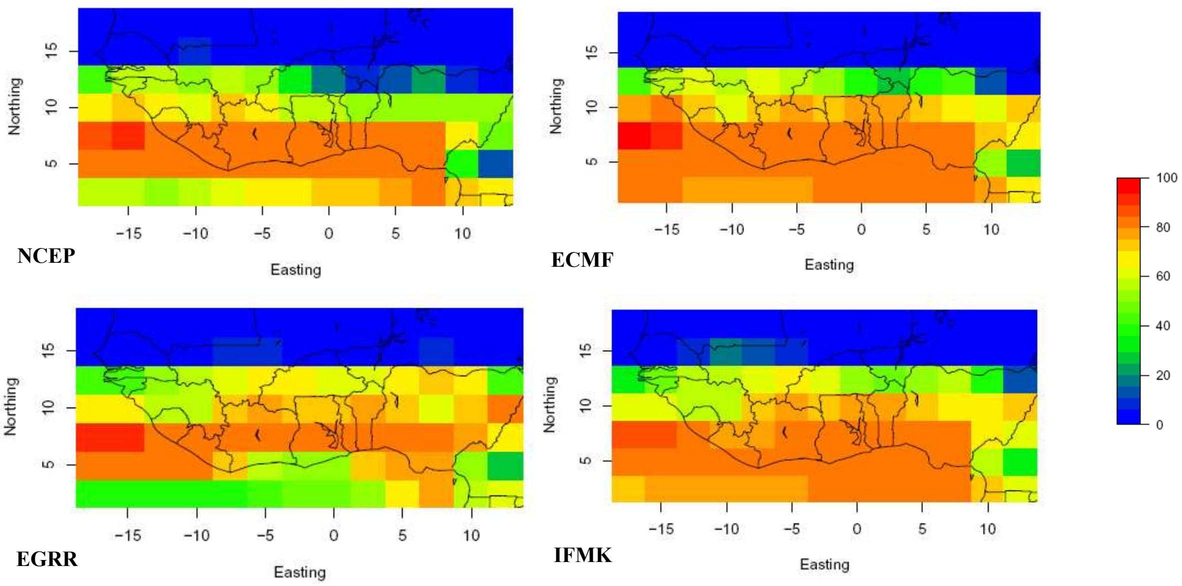


Figure 3: Time-averaged LMM incidence for West African grid (cases per 100 people per month): May forecast months 4-6 (ASO), 1971 to 2005 for LMM driven by NCEP reanalysis and ensemble mean for each ENSEMBLES model.

Potential energy demand for space heating and cooling in the Mediterranean

In the Mediterranean region under present-day conditions the maximum values of energy consumption are related to cold weather in winter (for heating) and hot weather in summer (for cooling). With higher temperatures under a changing climate it would therefore be logical to expect decreased heating demand during the colder part of the year and increased cooling demand in the warmer part.

This hypothesis has been examined using daily temperature outputs from simulations conducted in ENSEMBLES with six regional climate models (RCMs) assuming the A1B emissions scenario. Simulated temperatures representing the present (for 1960-1989) and the future (2021-2050) were extracted for the Mediterranean region at a horizontal resolution of 25 x 25 km. A measure that is commonly used as a proxy for energy demand is accumulated temperature. This can be defined here as the difference of mean daily temperature from a threshold or base temperature at which energy consumption is at a minimum. During the warmer part of the year, temperatures commonly exceed a base temperature above which cooling is activated. By accumulating the daily exceedances during a given period, an indication of total energy demand can be estimated for that period (Cooling Degree Days or CDD).

Similarly, the sum of daily temperature departures below a temperature threshold is a useful proxy for heating demand in the colder part of the year (Heating Degree Days or HDD). In this study, based on earlier work in southern Europe, 15°C is used as the base temperature for estimating HDD, and 25°C as the corresponding threshold for CDD.

Figure 4 presents changes in annual CDD and HDD up to 2021-2050. An increase in cooling requirement is indicated in all regions, with large increases over southern Spain, eastern Greece and western Turkey, and the largest increases over Cyprus and North Africa. Smaller changes are estimated for Sardinia, Corsica and the Aegean islands (Figure 4a). In contrast, heating demand, declines over much of the region (Figure 4b), less so in the coastal regions that do not currently experience cold winters.

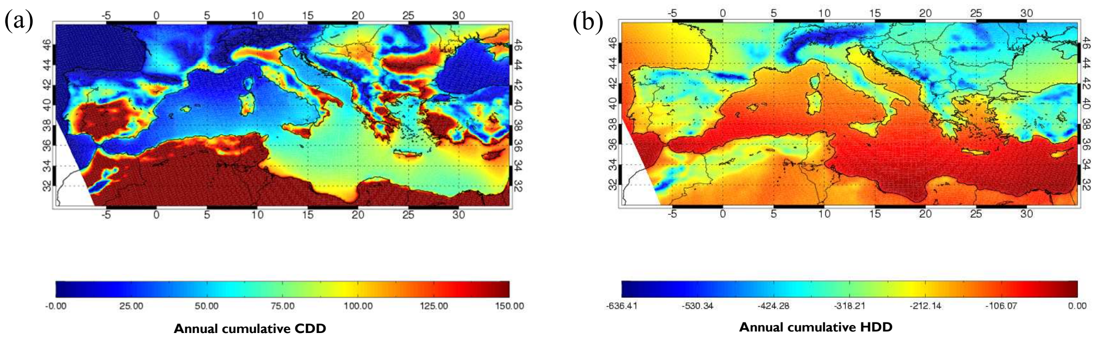


Figure 4: Projected change in potential annual energy demand between 1960-1989 and 2021-2050 for (a) cooling and (b) heating, based on accumulated temperature (°Cd).

Another dimension of cooling demand is illustrated in Figure 5, which shows the number of days requiring cooling of more than 5°C at present (Figure 5a) and the change by 2021-2050 (Figure 5b). Over north Africa more than one additional month of heavy cooling would be required, while over parts of southern Spain and Italy, eastern Greece, western Turkey and Cyprus, 20 more days would be needed. In both cases this represents more than a doubling compared to today, suggesting a need to plan for additional generating capacity to meet the extra demand.

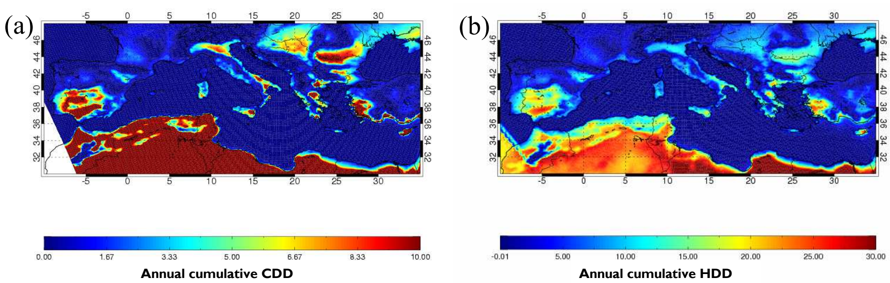


Figure 5: Number of days with a large cooling demand (> 5°Cd) in the baseline period (left) and change between future and baseline period (right).

PROGRAMME FOR THE ENSEMBLES FINAL SYMPOSIUM

Met Office, Exeter, 17-19 November 2009

Reducing uncertainty in model projections through the use of ensemble modelling.
Tim Palmer, ECMWF

Results from projections in climate and extreme weather events.
Martin Beniston, University of Geneva

Results from the project on climate change impacts on human health.
Sari Kovats, London School of Hygiene and Tropical Medicine

Case study result from work on climate change impacts in agriculture.
Marco Bindi, DISAT

Projections and analysis from E1 scenario, stabilising atmospheric concentration of equivalent carbon dioxide at 450ppm.
Jason Lowe, Met Office

Setting the scene for the first project aim: The Ensemble Prediction System (EPS).
Francisco Doblas-Reyes, ECMWF

The Ensemble Prediction System in Global Climate Models.
James Murphy, Met Office

The Ensemble Prediction System in Regional Climate Models.
Jens Christensen, Danish Meteorological Institute

Temperature and precipitation probability density functions in ENSEMBLES projections.
Michel Déqué, CNRM

Using probabilistic information in climate impact application models.
Tim Carter, SYKE

Setting the scene for the second project aim: Quantifying and reducing uncertainty in climate models.
Jean-Louis Dufresne, CNRS

Project results on climate feedback processes and climate surprises.
David Salas, CNRM

Representing the Carbon cycle in ENSEMBLES climate models, including results from the Stream 2 modelling.
Richard Betts, Met Office

Results from the project on climate change and variability.
Buwen Dong, University of Reading

Results from and overview of the research work done in the project on extreme weather and climate events.
Noel Keenlyside, Leibniz Institute of Marine Sciences, University of Kiel

The climate observation dataset – how it was configured and used to validate climate models to help reduce uncertainty in projections.
Albert Klein Tank, KNMI

Socio-economic feedbacks to the climate system and the uncertainties found in them. Construction of the E1 scenario using reverse engineering to reduce uncertainty.
Francesco Bosello, FEEM

Setting the scene for the third project aim: Maximising the results by linking the ensemble prediction system to a range of applications.
Clare Goodess, University of East Anglia

Storm and wind – what can ENSEMBLES tell the insurance sector?
Gregor Leckebusch, Free University of Berlin

Forest fires and heat stress – projections of future impacts.
Christos Giannakopoulos, National Observatory of Athens

Projections of future climate change and their use in the energy sector.
Marta Nogaj, EDF

Using RCM Simulations from ENSEMBLES to assess Climate Change Impacts to Hydrology & Water Resources.
Phil Graham, Swedish Meteorological Hydrological Institute

Using ENSEMBLES predictions and projections for disease risk mapping – in Europe and Africa.
Andy Morse, University of Liverpool

If you have any questions about the Ensembles project or any of the material presented in this newsletter please contact the project office at: ensemblesfp6@metoffice.gov.uk.