WEATHER TRACKING

EURO4M project co-ordinator Albert Klein Tank of KNMI discusses why both satellite and ground-based observation products are required to monitor and respond to climate change in Europe

Society's ability to manage the risks associated with weather and climate is critical for the sustainability of economic development. There is evidence that temperature and some other characteristics of weather and climate have changed as a result of anthropogenic influences, including increases in atmospheric concentrations of greenhouse gases (IPCC, 2012). Science-based adaptation in response to a changing climate requires successful monitoring and assessment. Most users need information products about climate trends and changing probabilities of high impact extremes (heat waves, floods, etc). In particular, the infrastructures we depend upon for food, water, energy, shelter and transportation are sensitive to high or low values of meteorological variables. New infrastructure is typically designed on the basis of historical information on weather and climate extremes. This includes design criteria, such as precipitation extremes that occur once in 50 to 100 years for the design of roads, bridges, dams, reservoirs and sewerage systems. Besides data with high spatial detail provided by satellites, multi-decadal series are needed to account for the natural cycles of climate variability. The sole use of data for the satellite era (since the late 1970s) is insufficient. An integrated long-term observational basis also supports development of computer models used to more accurately predict the future climate.

EURO4M project

One particular project gathering data and building knowledge about changes in weather and climate in Europe is the "European Reanalysis and Observations for Monitoring" project (www.euro4m.eu). This project, funded under theme nine, 'Space' of the European Commission's Seventh Framework Programme (FP7), develops the capacity required for state-of-the-art and user-orientated products for the monitoring of climate change at the European scale. It does so by optimising the use of space-based and ground-based sources through seamless integration of the Essential Climate Variable data sets from satellites (which are spatially extensive but go back to the 1970s only), ground-based stations (which go back to the mid-19th Century but are spatially sparse and maintained by individual nations), and model-based regional reanalyses (which are comprehensive but computationally expensive). The ambitious goal is to deliver the best possible and most complete gridded climate change time series and monitoring services covering all of Europe and to improve understanding of climate change and variability. The EURO4M project brings together the experience and knowledge of a team of scientists throughout Europe with partners based in the UK, Netherlands, Spain, Romania, Switzerland, Germany, Sweden and France. Special arrangements have been established with key international organisations, including the European Environment Agency, the European Centre for Medium-Range Weather Forecasts, the network of European meteorological services and the Global Climate Observing System.

> 'Despite the fundamental importance of observations for the delivery of climate services, significant gaps in observations exist, especially in developing countries.'

Reanalyses of past weather and climate

The EURO4M project team is keenly aware of the need to make sure that the information is as accurate, complete and reliable as possible. People have high expectations about how easily accessible 'climate quality' data sets of Essential Climate Variables (such as temperature and precipitation) are. Approaches to achieve quality assurance within the EURO4M project include comparing and evaluating the data from different sources as well as assimilating climate observations into very detailed and state-of-the-art weather forecasting models for the European domain. The great benefit of these model-based reanalyses is that they provide a complete and consistent picture of the atmosphere, covering the whole of the three-dimensional domain, not only of the observed variables, but also of those that are not directly measured.

Climate indicator bulletins

Most users have neither the resources nor the intention to handle the terabytes of basic observation data from the different sources (satellites, ground-based stations and reanalyses). They need integrated climate products with added value serving stakeholders such as the European Commission for their climate actions and the European Environment Agency for their environmental assessment reports. An example of an integrated product developed as part of EURO4M are the so called climate indicator bulletins. These bulletins are user-driven information products which provide simple, effective and timely knowledge abstractions from the large amount of raw observation and reanalyses data available in EURO4M. The bulletins focus on user groups in sectors such as disaster prevention, health, energy,

water resources, ecosystems, forestry, agriculture, transport, tourism and biodiversity at European, national and local levels. The first bulletin, issued in February 2013, is on European temperature. It describes the trend patterns for a core set of impact relevant temperature indicators and includes uncertainty information. The observations are presented in their historical context with special attention to trends and recent temperature anomalies (see Fig. 1). EURO4M bulletins play a key role in gathering information to contribute to GMES (Global Monitoring for Environment and Security), the European initiative for the establishment of a European capacity for Earth Observation. At the national (and local) level, a wide range of users also benefit from the Europe-wide efforts as these provide a reference for co-ordination across country borders and across different sectors.

'A more integrated approach towards observations combining satellite and ground-based data is crucial for successful monitoring of weather and climate extremes across Europe.'

Rapid response

Also, there is a need for actual information to place observed high-impact weather events in a long-term historical context as and when they occur. At the time of the 2003 summer heat wave in Europe, it took several months before factual information about the spatial extent and rareness of this event became available. Through the high resolution datasets that are being produced by EURO4M, such observed high impact events can be placed in a long-term historical context in near real-time. This is being achieved through producing different versions of the information products for the user community, stakeholders and policy makers – quick versions of online reports during emerging extreme events as well as high quality summary statements which optimally integrate all available observational information with some delay.

Global Framework for Climate Services (GFCS)

The demand for information services on weather and climate is growing rapidly in Europe and abroad. The World Climate Conference-3, in 2009, endorsed the Global Framework for Climate Services, recognising that for effective services to be delivered, observations of appropriate types and of adequate quality and quantity must be made, and these observations must be available at the right place and at the right time. Despite the fundamental importance of observations for the delivery of climate services, significant gaps in observations exist, especially in developing countries. Greater efforts to rescue, digitise and manage historical data are proposed in order to make use of all the observational data that already exists. EURO4M contributes to capacity development working closely with EU candidate countries and developing countries, which will be among the largest potential beneficiaries of international co-operation in climate services.

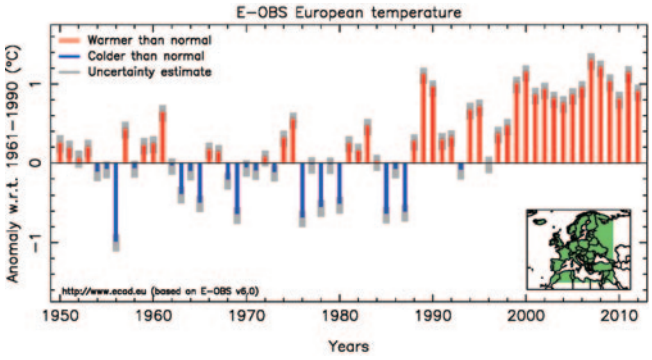

Fig. 1 Temperature evolution as observed in Europe since 1950. Land surface air temperatures are measured at an extensive network of stations in Europe. These data have been collected and aggregated into European temperatures as described in Van der Schrier et al., 2013. The annual mean values in this dataset are presented for the land area between 35°-75°N and 25°W-45°E (see inset). As in the global temperature record, the warmest years in Europe cluster at the end of the series. Between 1950 and 2012 the Europe-average warming trend in the observations is 0.18°C/decade. For comparison, the global (land-only) trend over the same period is 0.12°C/decade. The upward trend in Europe is most prominent since the mid-1980s. The grey bars indicate the estimated uncertainties which take into account the errors introduced by spatial interpolation over areas without observation stations, inhomogeneities that result from station relocations or changes in measurement instruments etc., and biases due to urbanisation. The uncertainties tell us that although we are not 100% certain about the ranking of individual years, the overall warming trend is clear

Outlook

The EURO4M project has been underway since April 2010, and has achieved some successes. Existing station-based gridded datasets for Europe have been further developed, updated and published. EURO4M partners have worked with existing data recovery and digitisation activities to improve the climate databases for the European region and extend the ground-based time series in the Mediterranean backwards into the 19th Century. Satellite climate data records have been further developed and evaluated for climate quality. In addition, new model-based European regional reanalysis capabilities have been developed as well as downscaled high resolution reanalyses. In a year from now these pioneering activities will lead to publication of the first available multi-year comprehensive regional reanalysis datasets. This will demonstrate the potential for much longer regional reanalyses as part of follow-on future GMES activities.

Dr Albert Klein Tank
Project Co-ordinator
Royal Netherlands Meteorological Institute KNMI

tel: +31 302206872

albert.klein.tank@knmi.nl
www.euro4m.eu