INTERNATIONAL CLIMATE ASSESSMENT & DATASET: CLIMATE SERVICES ACROSS BORDERS

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MOTIVATION. The demand for information services on weather and climate is growing rapidly worldwide. In recognition of this, the World Climate Conference-3 in 2009 endorsed the Global Framework for Climate Services (GFCS),[1] a global partnership of governments and organizations that produces and uses climate information and services. GFCS seeks to enable researchers, producers, and users of information to join forces to improve the quality and quantity of climate services worldwide, particularly in developing countries. For example, researchers and policymakers need information about rare weather events, climatic trends, and changing probabilities of high-impact extremes (droughts, heat waves, floods, etc.) at local and regional scales. In particular, food security, weather-related health risks, and the infrastructures we depend upon for water, energy, shelter, and transportation are sensitive to such weather extremes. The availability of long-term data series of meteorological variables, as well as regular updates of these series, are important requirements for assessing the vulnerability of societies to weather extremes and, from a practical viewpoint, designing criteria for new infrastructures.

Archives of in situ observations are typically a national responsibility, but extreme events like wind storms or droughts do not stop at national boundaries, which underlines the importance of regional datasets. Despite the fundamental importance of observations, significant gaps in many records exist, especially in developing countries. Moreover, long-term observations have been made at specific locations only, and only a subset of these are contained in digital archives. Although information, continuous in time and with high spatial detail, can be provided by the current generation of satellites, multidecadal time series are often needed to account for the natural cycles of climate variability. The sole use of satellite data is often insufficient, as these data are usually only available since the late 1970s or later. In situ observations using ground-based instruments are therefore indispensable. Greater regional efforts to rescue, digitize, and manage historical data contribute to archives with data of adequate quality and quantity.

ICA&D CLIMATE SERVICES CONCEPT. The European Climate Assessment & Dataset (ECA&D)[2] is a web-based climate information system coupled to a meteorological database. Established in 1998, it resulted from the collaboration of national meteorological services and universities throughout Europe, the Middle East, and Mediterranean countries. It aims to realize a sustainable operational system for gathering, archiving, and disseminating climate data,

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[1] www.wmo.int/pages/gfcs/index_en.php

[2] www.ecad.eu

Table 1. Variables considered in ICA&D. Most are Essential Climate Variables as defined by GCOS (2010).

Minimum temperature	Sea level pressure	Cloud cover
Mean temperature	Snow depth	Wind speed
Maximum temperature	Relative humidity	Wind gust
Precipitation amount	Sunshine duration	Wind direction

with the added benefits of quality control and data analysis. Contributing institutions provide validated daily series for up to 12 meteorological variables (Table 1). ECA&D uses these data to generate a suite of derived information products—which are updated monthly—for use in climate monitoring and services.

Once the ECA&D concept had been refined by years of development and had demonstrated its utility, it could also be applied to other regions of the world. The International Climate Assessment & Dataset (ICA&D)[3] is the umbrella under which regional implementations, similar to the European ECA&D system, are developed. Currently, ICA&D systems exist in Europe, Southeast Asia,[4] Latin America,[5] and West Africa[6] (Fig. 1).

Two important user groups of the ICA&D services are researchers from a broad range of disciplines and climate service providers who incorporate basic regional climate data and information into their products. For example, scientists use this information in global climate assessments, comparing it against regional climate models or to analyze species migration, and national meteorological services use the regional information provided by ICA&D to support their national monitoring and climate service activities. Although these meteorological services have always been responsible for providing national weather and climate data and information, the regional perspective of ICA&D supports local decisions by taking into account the fact that many challenges are transboundary—for example, when delta areas are dependent on decisions made upstream.

Apart from the basic daily time series that can be downloaded from the regional ICA&D websites (if the data provider has given permission for this), information is also available in the form of maps and graphs of climate indices. Indices are derived from the basic daily time series and provide practical information that supports decision making. The set of indices calculated and disseminated is largely focused on identifying climatic extremes and the ways in which these extremes change over time. A core set of these indices follows the definitions recommended by the Expert Team on Climate Change Detection and Indices (ETCCDI).[7] New indices, targeted at specific user groups, have been added upon request. For example, indices have been developed as a measure for the climatic well-being of tourists in Europe, the length of the growing season, human heat stress, and the onset of the rainy season in tropical areas. An example of

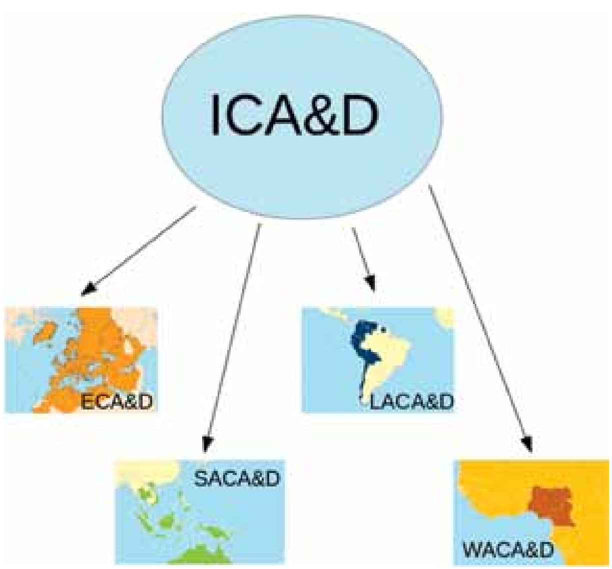

Fig. 1. Schematic representation of ICA&D and its regional implementations (status June 2014). ECA&D: Europe & Middle East; SACA&D: Southeast Asia; LACA&D: Latin America; WACA&D: West Africa.

[3] www.ecad.eu/icad.php

[4] Southeast Asian Climate Assessment & Dataset (SACA&D; http://sacad.database.bmkg.go.id)

[5] Latin American Climate Assessment & Dataset (LACA&D; http://lacad.ciifen.org)

[6] West African Climate Assessment & Dataset (WACA&D; system being set up)

[7] www.clivar.org/panels-and-working-groups/etccdi/etccdi.php

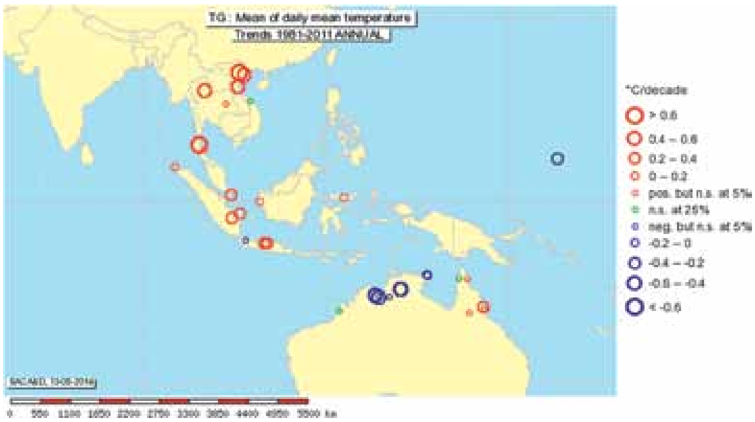

Fig. 2. Trend for 1981–2011 in the annual mean of daily mean temperature. Red circles indicate increasing temperatures and blue circles decreasing temperatures. The size of the circle is a measure for the size of the trend.

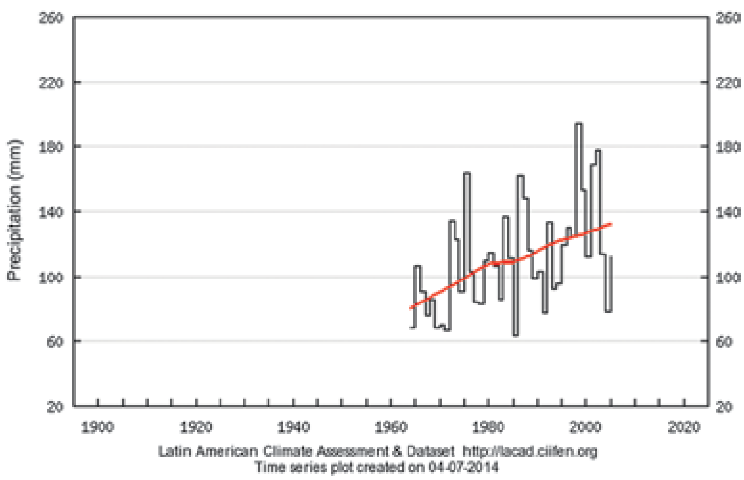

Fig. 3. Time series of the highest one-day precipitation amount at a station in Ecuador.

a climate service product is the trend in the annual mean of daily mean temperature for Southeast Asia over 1981–2011 (Fig. 2), which quantifies the warming rate in that area. The homogeneity of all series is assessed prior to the trend calculation to avoid showing nonclimatic trends in these maps, and the homogeneity information is also available separately. Another example is a time series plot—as shown in Fig. 3—of the annual maximum 1-day precipitation amount at a station in Ecuador. Other maps include deviations from the normal value to assess year-to-year variability.

The ICA&D concept has important capacity development aspects. Knowledge and experience gained in Europe in operating ECA&D over the past decade is shared with other regions of the world, and a collaboration has been set up between appropriate organizations within these regions. In particular, developing countries will be given the highest priority for setting up international cooperation. Another part of the capacity development is the training of these key partners on how to use their regional ICA&D system for their own climate monitoring and services activities. In some countries, parts of the daily climate data have to be digitized prior to inclusion in the system. Experience on how to digitize historical time series as part of data-rescue activities is exchanged, as well. The results of these activities are immediately visible in the data products of ICA&D, something that is often lacking from data-rescue initiatives.

Recently, ICA&D has been accepted by the World Meteorological Organization (WMO) as an element of one of the eight GFCS pilot implementation projects. The work of recovering and organizing existing data, and subsequently making these data available to users, is only just beginning in many regions of the world. Sharing the data in the region contributes to data preservation. A WMO Regional Climate Center can greatly facilitate an ICA&D system by providing an institutional home for its implementation and operation at regional scales, and serves as a backup facility in case of calamities.

STRENGTHS AND WEAKNESSES. The climate services offered by the regional ICA&D systems demonstrate that the daily climate data and derived products give valuable regional climate information to a wide user group when brought together by regional cooperation in a dedicated database and associated web portal. Such cooperation should involve all countries in the region to promote data sharing within the regional ICA&D system and to increase the usefulness of the products. These services serve as excellent showcases within the concept of the GFCS.

ICA&D systems do not pretend to be complete for specific regions. They rely on the data providers in the regions as they decide which of their

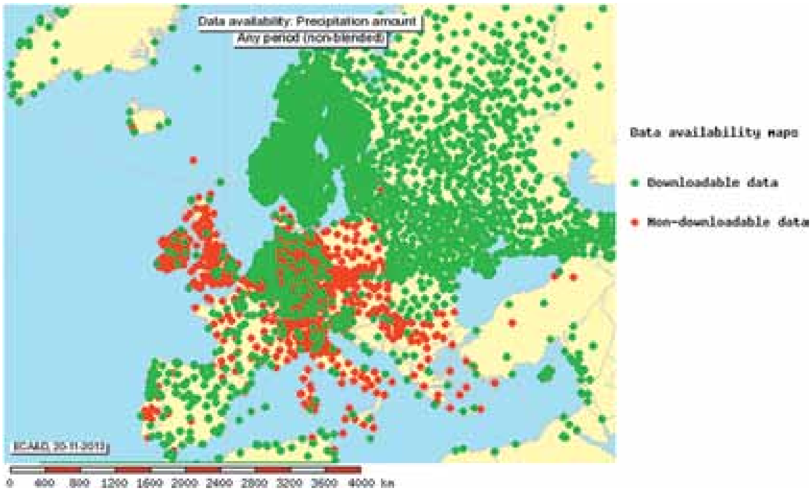

Fig. 4. Precipitation stations in ECA&D with downloadable data (green) and nondownloadable data (red). The color is determined by the data provider's own data policy.

stations will be available in ICA&D and which will not. For country-specific information, the national meteorological service of that country usually has more detailed information available than ICA&D (although sometimes that information is expensive and needs to be compiled upon request). The strength of ICA&D is therefore the availability of up-to-date climate information over a large region without having to contact each of the individual meteorological services, which is an unworkable situation for users of climate data. The similarity in set-up and procedures has the advantage that data are processed following internationally agreed standards and have the same format in the different ICA&D systems. Making data available to the regional and global research communities fuels research on climate (change) in the region. The peer-reviewed research papers originating from this work are an ICA&D spin-off that can be used by the Intergovernmental Panel on Climate Change.[8]

Ideally, a user-driven approach should be followed regarding what information is available through ICA&D. For example, sector-specific and region-specific indices are suggested by or codeveloped with relevant users. The inclusion of specific grape growth indices in ECA&D is an example of this. Of course, it is important to recognize that optimal use of data for decision support at local scales requires tailor-made indices making use of local knowledge.

One of the main difficulties in setting up an ICA&D system in a new region is finding an institute that can commit the necessary resources and is willing to take the responsibility to host, maintain, and invest in the system. The Dutch national meteorological service can assist with these activities when required. Such a hosting institute should have a long-term commitment to the system—for instance, an institute running or nominated to run a WMO Regional Climate Center.

Capacity development of staff members of the hosting institute is essential, and these staff members should be committed to continue to work on the new ICA&D system by inserting new series, contacting potential data providers, and, if necessary, giving in-house training to additional staff members.

[8] www.ipcc.ch

THE GLOBAL FRAMEWORK FOR CLIMATE SERVICES

The 2009 World Climate Conference decided to establish a Global Framework for Climate Services (GFCS) to guide the development and application of science-based climate information and services in support of decision-making.

The vision of the GFCS is to enable society to better manage the risks and opportunities arising from climate variability and change. The focus of GFCS is aimed especially at those societies that are most vulnerable to such risks. This will be done through development and incorporation of science-based climate information and prediction into planning, policy, and practice on the global, regional, and national scales.

The priority sectors of GFCS are agriculture and food security, water, health, and disaster risk reduction. Each of these sectors are vulnerable to climate variability, climate change, and natural hazards. The aim of GFCS is to improve climate services so societies can respond more adequately and build greater resilience to these hazards.

Data policy and restrictions of use of data are prime concerns of many national meteorological services, both in the developed and the developing world. All data in the system (basic time series as well as derived products) are restricted to noncommercial research and education. Daily data are only available for download when the provider has given permission for this. Other daily data cannot be downloaded or otherwise accessed, but they are incorporated (together with the downloadable data) into publicly downloadable derived products. The data provider decides which stations in their network they want to include in the ICA&D system. The data provider remains the owner of data they provided and can replace the daily time series, metadata, and status (e.g., downloadable or not) at any time by informing the corresponding ICA&D team. To illustrate this, Fig. 4 shows the available precipitation stations in ECA&D, which are color-coded to indicate the stations that have downloadable daily precipitation series (green) and those that do not (red).

The success of an ICA&D system relies on the willingness of data providers to share their time series, and on the acceptance of the system in the region. Without the support of data providers, an ICA&D system cannot exist, since its website and climate service monitoring tools need the underlying station time series to be able to display information. Outreach and transparency (i.e., understanding the ownership of the data, what processing is done to the series) are therefore essential parts in this concept, as well as the importance of the return of investment in the form of products useful for the individual data providers.

PERSPECTIVE. The ICA&D systems target a large user group ranging from scientific researchers to policymakers by making available not only the basic time series, but also science-based derived products such as climatology and trend maps. More complex products, such as descriptions of extreme events, are currently available for the European region only, but in the future they can be generated for other regions, as well. Recently, an exploratory study was performed with the Southeast Asian system on the climate-related risks of waterborne diseases such as dengue. This type of research might lead to the inclusion of new health-specific indices in that system.

Another possible extension to all ICA&D systems is a presentation of country-specific information within a regional context. Although national meteorological services often have the best information for any specific country, it is difficult to place exceptional events or years in a regional context without access to information across their national borders. ICA&D can provide this regional perspective, as it includes information for several countries within that region.

High on the user's wish list is a daily regional high-resolution gridded dataset. This is available for Europe and currently being developed for Southeast Asia. In the future, other ICA&D systems might develop a gridded dataset, as well. These gridded datasets can, for instance, be used to validate regional climate models, contributing to the improvement of climate (change) scenario simulations.

Depending on user requirements, the ICA&D systems can be extended with new functionalities and products. The ICA&D teams are open for suggestions from and collaborations with the user community, and anyone with daily station data is welcome to contribute to any of the systems.

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