

## I.4. The need of a historical climate data and metadata rescue project for the Mediterranean: the GCOS MedMEDARE project

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### ABSTRACT:

This contribution is focused on describing the context, objectives, status and expected outcomes of the Global Climate Observing System (GCOS) Data Rescue project titled "The Development of Mediterranean Historical Climate Data and Metadata Bases" (MedMEDARE), which is one of the sixteen projects being prioritised in the GCOS Regional Action Plan for the Mediterranean Basin. The MedMEDARE project is aimed at developing quality controlled and homogeneous instrumental climate data and metadata bases for the Mediterranean Basin that can be confidently used for enhancing the detection and prediction of regional climate variability and change, and its impacts over the Mediterranean socio-ecosystems, in order to better define national strategies for the adaptation.

### INTRODUCTION:

Under the GCOS Regional Workshop Programme, aimed at the development of Regional Action Plans (RAPs), took place in Marrakech (Morocco, 22-24 November 2005) the start of the process for the definition of a RAP for the Mediterranean Basin. The GCOS RAPs are intended to identify regional and national needs and deficiencies for climate information, in order to improve systematic observations and data for climate, as they relate to climate policies, national activities and sustainable development. At the same time, RAPs are devoted to agree on a number of key regional priorities and articulate these needs and priorities for bringing them to the attention of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and donor agencies.

The "Marrakech" Regional GCOS Workshop had as aims to identify gaps and deficiencies in climate observing networks and systems in the

Mediterranean Basin and to initiate discussions on the development of the Mediterranean Regional Action Plan, which was aimed at improving regional capabilities in atmospheric, oceanic, and terrestrial data collection and the production and delivery of climate products and services (GCOS, 2006a). GCOS organized this workshop in cooperation with the National Meteorological Service of Morocco, and the Global Environment Facility/UN Development Programme provided funding for the workshop, with additional contributions from the United States and Spain. Figure 1 shows the front-page of the Report of the GCOS Regional Workshop for the Mediterranean Basin, where deficiencies, gaps and needs for enhancing the Mediterranean observing systems for climate are assessed. Workshop participants agreed on the process for the selection of 10 to 15 high priority projects, drawn from a lengthier list of potential topics. These projects should reflect broad regional concerns and add value for people and countries across the Mediterranean region. A follow up meeting to develop the Mediterranean RAP was also agreed.



Figure 1: Front-page of the Report of the GCOS Regional Workshop for the Mediterranean Basin

The Follow-up to GCOS Regional Workshop for the Mediterranean Basin to prepare a draft of the RAP for the Mediterranean Basin was subsequently held in Tunis (Tunisia, 16-18 May 2006) and organized by the GCOS Secretariat and Sahara and Sahel Observatory, as local organiser. About 25 attendees (see Figure 2) discussed the RAP priorities and presented their projects' proposals to fill in current gaps and deficiencies of the Mediterranean atmospheric, oceanic and terrestrial observing systems previously identified, as well as building capacity for data management, analysis, applications, and improve the recovery of historical data across the region. The Mediterranean RAP aims to enhance both regional and national efforts to monitor and detect climate variability and change and their related impacts over the regional and national socio-ecosystems in support of the identification of the best policies aimed at mitigating and adapting the countries to the expectable impacts of current and future climate change. The agreed draft Action Plan, which included 16 project proposals, was then circulated widely across the region for review, being approved and published by GCOS Secretariat in September 2006 (GCOS, 2006b).



**Figure 2:** Attendees to the Follow-up to GCOS Regional Workshop for the Mediterranean Basin, Tunis, Tunisia, 16-18 May 2006

Among the 16 approved projects, the Project No 12, titled *The Development of Mediterranean Historical Climate Data and Metadata Bases - a GCOS DARE Project (MedMEDARE)*, was devoted to develop quality controlled and homogeneous Historical Climate Data and Metadata Bases for the Mediterranean Basin, which can be more confidently used in climate change detection/attribution studies as well as in the definition of the best strategies to adopt in order to minimize the anticipated environmental and socio-economic impacts associated with a warmer climate.

Here, then, is exposed and discussed the need of such a project, which will enhance the understanding and detection of the Mediterranean climate variability and change, their impacts over the Mediterranean socio-ecosystems and better define policies in order to mitigate climate change and adapt the countries to the expected climate change impacts. Consequently, the needs for developing high-quality historical climate records for the region are stressed in the second section. The third section is focused on describing current status and availability of long-term climate records and the potential for data rescue activities across the region. Aims, status and expected outcomes of the GCOS MedMEDARE project are addressed on section 4; and, finally, in the conclusions section is summarised main issues raised in this report.

#### **THE NEEDS FOR THE DEVELOPMENT OF A HIGH-QUALITY DATASET FOR THE MEDITERRANEAN BASIN:**

The Mediterranean basin and its margins are very sensitive to a diversity of physical, chemical and biological degradation processes, being specially vulnerable to interannual (and longer timescale) climate variability. Climate change may add to existing problems of soil erosion and salinity, land degradation, loss of biodiversity, water scarcity and desertification. There are also concerns that an increase in the frequency and severity of hotter and

drier conditions may be accompanied by a northward expansion of the area prone to desertification and would lead to a longer fire season, increased fire risk (both in frequency and severity), prolonged drought duration, runoff decrease or decline of hydropower potential, among other negative effects (Alcamo et al., 2007). Such changes pose major threats to water supplies, human health and food production, and have the potential to disrupt the national economies of the countries across the region. These impacts reinforce the need to enhance our knowledge of spatial and temporal patterns of climate variability, and their related causal mechanisms, across the Mediterranean region, in order to better understand, detect, predict and respond to global climate variability and change.

To better analyse and interpret changes in climate variability, climatic extremes and their related impacts over the Mediterranean Basin, long-term, high-quality and reliable climate instrumental records are essential pieces of information required before undertaking any robust and consistent climatic studies. Moreover, the development of the most appropriate environmental and societal climate change adaptation and mitigation strategies also requires high quality climate data. In this latter context, scientists, decision makers and application communities require the best data for their particular needs. High quality and high-resolution climate data is also need for regional detection/attribution studies of climate change (integrating observational and modelling activities), the calibration of satellite data or the generation of climate quality reanalyses.

In addition, there is the pressing social, economical and political need of undertaking robust climate change scenarios generation and their associated future impacts scenarios at the national levels, in order to adapt their socio-ecosystems to the expected impacts of climate change. This requires the best, high-resolutions and reliable instrumental climate records in order to train/verify regional models and validate their outputs. Many countries

across the region have initiated their National Action Plans through developing and defining their best adaptation strategies, and for doing so, they need use not only the best available methods and tools but also the best climate data and observations they can get from their meteorological network. In this regard, the United Nation Framework Convention on Climate Change Nairobi Work Programme on impacts, vulnerability and adaptation to climate change projection (UNFCCC/NWP) is also urging to assist to the countries (specially to the developing countries, including the least developed countries) "to improve their understanding and assessment of impacts, vulnerability and adaptation;... and make informed decisions on practical adaptation actions to respond to climate change on a sound scientific, technical and socio-economic basis, taking into account current and future climate change and variability of national climate change scenarios" (UNFCCC, 2007). One of the most useful and essential way to reach these targets is addressing their needs and deficiencies on climate data and observations, for filling in the identified gaps in support of adaptation.

Summarising up: high-quality/high-resolution climate data are required by scientists, practitioners/sectoral technicians, stakeholders, policy-makers and others end-users in order to improve:

- ∞ the understanding of climate variability and change, their forcing factors and their associated socio-ecosystem impacts across the region,
- ∞ studies on climate change detection and attribution and, therefore, the inputs for defining/adopting the best national strategies aimed at mitigating present and future climate change impacts over the region,
- ∞ current knowledge on climate extremes occurrence, persistence, intensity and severity (including to place them in the long context), as they are causing and will cause high socio-economical impacts,

- ∞ the development of climate change scenarios by combining instrumental climate data with projections from Regional Climate Model (RCM) simulations, as well as for the validation of Global Climate Model (GCM) outputs

#### STATUS AND POTENTIAL FOR DATA RESCUE ACTIVITIES OVER THE MEDITERRANEAN:

Unfortunately, and even the wealthy heritage of climate observations in the Mediterranean basin, the availability of climate records is currently very limited both from a spatial and temporal view.

Long and reliable climate records are particularly missed over Southern and Middle East Mediterranean countries. Over south Mediterranean countries climate data availability is remarkably limited to the last 30 years in few countries, with some exception (Tunisia), and non-available at all for other few.

found over the Middle East countries, but including long missing periods in time series due to the disruption of meteorological operational activities related to political conflicts in the sub-region. Over the Balkan region the situation is a bit better, as some countries (i.e. Romania, Croatia) have developed long records for a few key ECVs, although lack of human and financial resources are argued to be among main causes of low data availability over this area (see the corresponding national reports at this issue). Better panoramas is observed over the northern and western Mediterranean countries, as most of them have developed or are developing long and high quality climate records, although they are mostly restricted to some of the main ECVs (temperature, precipitation and pressure) and their spatial coverage is sparse.

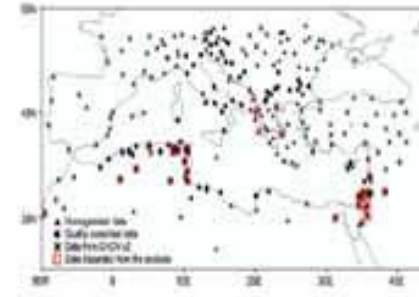
Domain	Essential Climate Variables (ECVs)	
<b>Atmospheric (over land, sea an ice)</b>	Surface:	Air temperature, Precipitation, Air pressure, Surface radiation budget, Wind speed and direction, Water vapour
	Upper-air:	Earth radiation budget, Upper-air temperature, Wind speed and direction, Water vapour, Cloud properties
	Composition :	Carbon dioxide, Methane, Ozone, Other long-lived greenhouse gases, Aerosol properties
<b>Oceanic</b>	Surface:	Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Currents, Ocean colour, CO2 partial pressure
	Sub-surface:	Temperature, Salinity, Currents, Nutrients, Carbon, Ocean tracers, Phytoplankton
<b>Terrestrial</b>	River discharge, Water use, Ground water, Lake levels, Snow cover, Glaciers and ice caps, Permafrost and seasonally-frozen ground, Albedo, Land cover, Fraction of absorbed photosynthetically active radiation, Leaf area index, Biomass, Fire disturbance.	

**Table 1:** The GCOS Essential Climate Variables for the atmospheric, oceanic and terrestrial domains, <http://www.wmo.ch/pages/prog/gcos/index.php?name=essentialvariables>

A bit better long-term data availability for some key Essential Climate Variables (ECVs, see Table 1 for definition), as temperature and/or precipitation, is

This assessment applies to both data on a monthly (with better spatial and temporal coverage) and on daily and hourly scales. The later time resolution, in particular hourly data, shows the worst temporal and

spatial coverage across the region including the countries with a bit better data availability. Even more, data is mostly restricted to only some of the main ECVs. A similar uneven geographical distribution appears when looking at the higher spatial scales. Dense data networks, covering from the second half of the 20<sup>th</sup> century onwards, are only available in few northern and western Mediterranean countries, being absent for most of the Mediterranean countries. Figure 3 shows the Mediterranean air temperature network used by Xoplaki et al. (2003) in their assessment of summer temperature variability and its connection to large-scale atmospheric circulation and SSTs over the period 1950-1999.



**Figure 3:** Location map of temperature stations with monthly values showing details of their quality as employed by Xoplaki et al. (2003) in their study on Mediterranean summer temperatures and its connection to large-scale atmospheric circulation and SSTs covering the period 1950-1999

Therefore, over the whole Mediterranean Basin and on national basis there is a very limited availability of high-quality/high-resolution climate data, which is impeding to enhance our knowledge on regional climate variability and change, current and future associated impacts and, then, limiting our ability to better adapt to the countries to the most adverse climate change impacts. Moreover, information for the longer time scales and for changes in extremes

is considerably far away of being good and sufficient. The obtrusive lack of data at the highest time scales is constraining our understanding of changes in climate variability and extremes, which are likely causing higher impacts in the Mediterranean socio-ecosystems than changes in the mean climate.

Against the preceding backdrop, the Mediterranean countries have a very long and rich meteorological monitoring history, going back in time several centuries in some countries (i.e. Italy, France, Spain) and at least to the mid-19<sup>th</sup> century across much of the region. The data scrupulously recorded in the past are held in a high variety of data sources and data keepers: at National Meteorological and Hydrological Services (NMHS) historical archives, other national and international archives and libraries, both public and private or in diverse colonial documentary sources. This wealthy heritage of climate data is, however, largely under-exploited, mainly due to the different political, social and economic situations that exist amongst Mediterranean countries. Although some NMHSs, academic and research institutions across the region have undertaken data rescue activities aimed at transferring historical climate records from fragile media (paper forms) to new media (imaging), fewer long-term records than are needed are readily available in digital form. This reality is preventing the region for developing more accurate assessments of regional climate variability and change. Furthermore, the requirement for high-quality integrated climate products is impeding the adoption of optimum strategies to mitigate and/or adapt to the negative impacts of global climate change over the Mediterranean Basin.

#### THE GCOS MEDMEDARE PROJECT - AIMS, STATUS, PROSPECTS AND EXPECTED OUTCOMES:

The recognition of the big Mediterranean potential for climate data rescue activities together with the limited temporal and spatial availability of high-quality climate datasets led to the selection of a

project focused on the recovery and development of the longest Mediterranean adjusted climate records, as one of the key priorities of the region identified in the GCOS RAP for the Mediterranean Basin. Such a project should target the longest and reliable Mediterranean time series on different time scales (from a sub-daily to a monthly basis) for the ECVs. Therefore, the MedMEDARE project was defined.

The main aim of the Project is to develop quality controlled and homogeneous instrumental climate data and metadata bases for the Mediterranean Basin, which can be more confidently used in climate change detection/attribution studies as well as in the definition of the best strategies to adopt in order to minimise the expectable impacts over the Mediterranean socio-ecosystems associated with a warming world. This general aim will be pursued through carrying out a set of activities leading to reach the following objectives:

- ∞ Inventorying, selecting, locating, recovering, digitizing, quality controlling and homogenizing the key and longest Mediterranean records for the atmospheric domain surface ECVs and their corresponding metadata on a national basis
- ∞ Developing an integrated, internet based, system to on-line access to the recovered information
- ∞ Assisting the involved countries in building capacity in data rescue techniques and procedures and in the updating of data records from their own observing network
- ∞ Contributing to sustainable development activities across the region by enhancing and making available the new recovered climate data, in order to make possible better assessments of climate variability and change over the region.

The MedMEDARE project attracted the attention of different Mediterranean NMHSs (Algeria, Cyprus, France, Italy, Morocco, Tunisia, Turkey) and several

research institutes and international organizations. The project is structured in three principal modular and interrelated components:

- ∞ Data and metadata location and recovery
- ∞ Data and metadata digitisation
- ∞ Data quality control and homogenisation

The implementation of these modular components will be carried out both in parallel and in sequential order during a period for 5 years. Currently, the GCOS Secretariat is publicising the Mediterranean RAP among several international forums and bodies, in order to seek for support to the RAP from international donor agencies and to identify a "champion" organization in the region to take the lead in pushing ahead the projects included in the Mediterranean RAP.

The expected outcomes of the MedMEDARE project are among others:

- ∞ the recovery and preservation in digital format of key, not currently available, historical surface climate data and their corresponding metadata,
- ∞ the development of high-quality and homogeneous long-term climate data and metadata bases for atmospheric surface ECVs over the region,
- ∞ the implementation of an on-line, Internet based, accessible system for regularly making available the already validated climate information,
- ∞ ensure capacity building and continuity for the involved countries on data rescue techniques and procedures, quality control, homogenization and development of high-quality/high-resolution climate datasets,
- ∞ allow NMHSs to improve services and products offered to the end-users or
- ∞ increased awareness of the importance of accounting with high-quality climate datasets as an essential and previous step for strengthening

the national development agenda for sustainable development.

## CONCLUSIONS:

The need and the potential for the development of high-quality and long-term climate datasets over the Mediterranean Basin have been discussed and shown. Both for better detecting, predicting and responding to climate variability and change and for the wealthy heritage of Mediterranean climate data, the achievement of the GCOS MedMEDARE project is in a pressing need if the Mediterranean countries want to be ready to face and minimise the costs of the expectable impacts of global climate change on the Mediterranean socio-ecosystems. The decided involvement of the WMO/World Climate Data Monitoring Programme through, first, the organisation of the International Workshop on Rescue and digitisation of climate records in the Mediterranean Basin and, second, the support to the MEDARE Initiative born in that workshop guaranty the achievement in the near future of this enterprise aimed at providing to the region of reliable climate data.