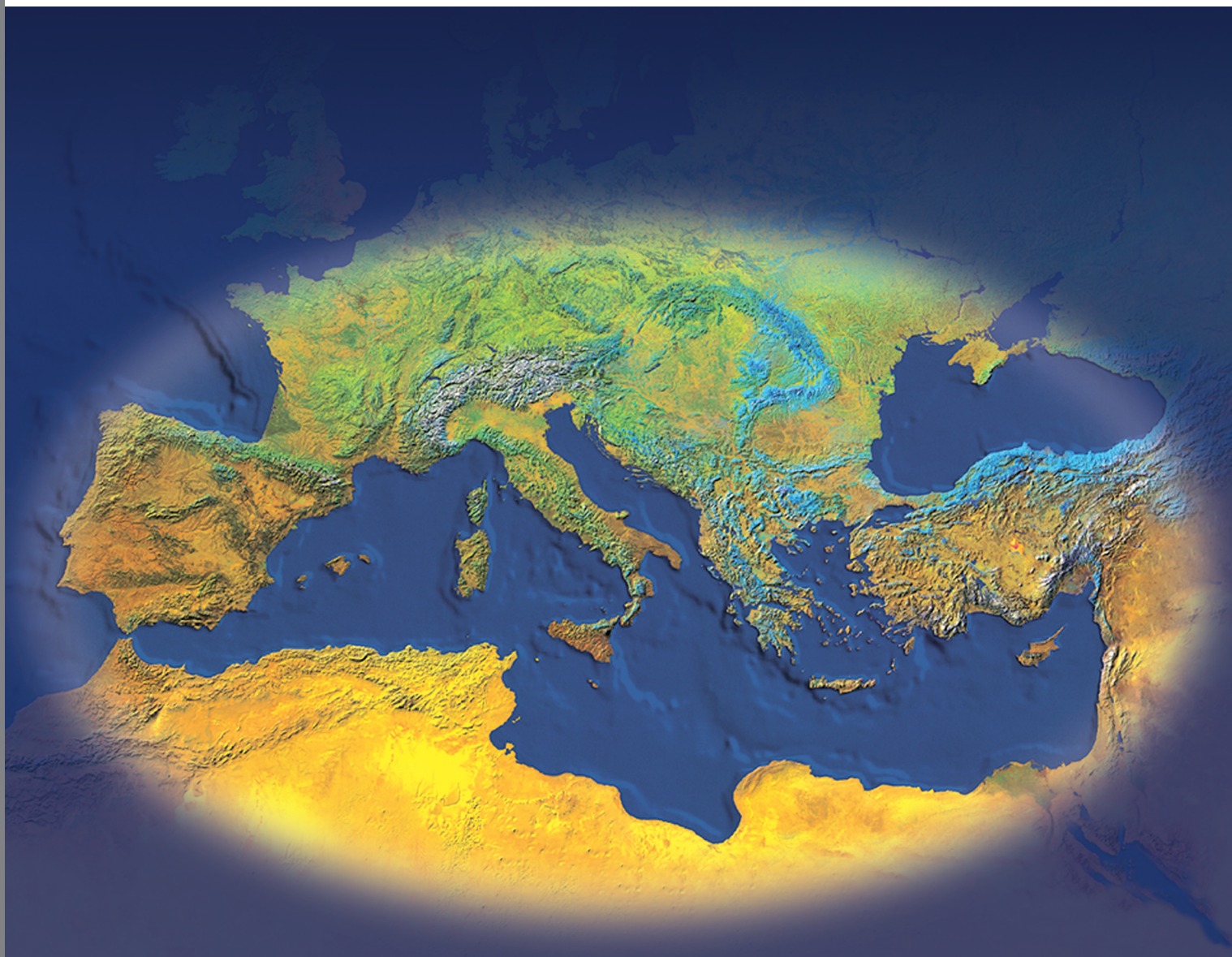
EUROPEAN SCIENCE FOUNDATION

SETTING SCIENCE AGENDAS FOR EUROPE

RESEARCH NETWORKING PROGRAMME

MEDITERRANEAN CLIMATE VARIABILITY AND PREDICTABILITY (MedCLIVAR)

Standing Committee for Life,
Earth and Environmental Sciences (LESC)



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The European Science Foundation (ESF) was established in 1974 to create a common European platform for cross-border cooperation in all aspects of scientific research.

With its emphasis on a multidisciplinary and pan-European approach, the Foundation provides the leadership necessary to open new frontiers in European science.

Its activities include providing science policy advice (Science Strategy); stimulating co-operation between researchers and organisations to explore new directions (Science Synergy); and the administration of externally funded programmes (Science Management). These take place in the following areas: Physical and engineering sciences; Medical sciences; Life, earth and environmental sciences; Humanities; Social sciences; Polar; Marine; Space; Radio astronomy frequencies; Nuclear physics.

Headquartered in Strasbourg with offices in Brussels, the ESF's membership comprises 75 national funding agencies, research performing agencies and academies from 30 European nations.

The Foundation's independence allows the ESF to objectively represent the priorities of all these members.

Cover picture: Orography and Sea-depth of the Mediterranean region
(courtesy of Deutsches Zentrum für Luft- und Raumfahrt, DLR)

Introduction

MedCLIVAR is an international programme which aims to coordinate and promote the study of the Mediterranean climate. MedCLIVAR's scientific priorities are: description of climate past evolution, assessment of climate variability at different space and time scales, understanding the mechanisms responsible for it, identifying trends and providing climate prediction in relation to future emission scenarios.

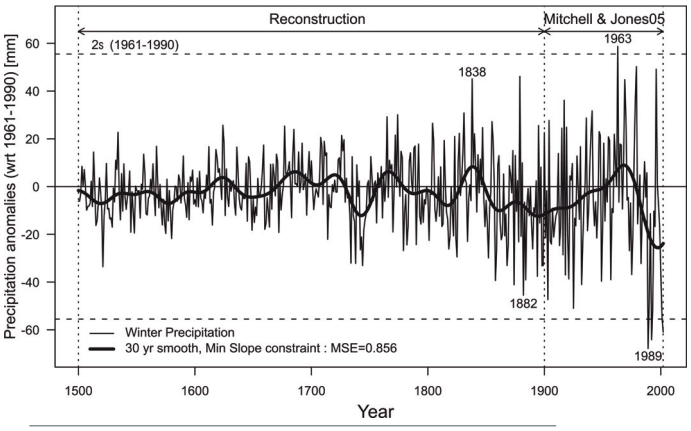
The Mediterranean climate is characterised by the Mediterranean Sea, which represents a relatively large mass of water, and its peculiar geographical location: at mid-latitude, on the west side of a large continental area, surrounded by three continents with high mountain ridges, and with a restricted exchange with the Atlantic Ocean.

In general the Mediterranean climate exhibits hot and dry summers, and mild and rainy winter seasons. However, within such a small spatial scale there are large climate contrasts as the area includes Alpine regions in the north, with permanent glaciers and relatively high precipitation rates, and subtropical semiarid regions in the south where the extended Atlas mountain ridge also plays a major role. Moreover the Mediterranean is a transition zone between mid-latitude climate regimes, located at the border of the mid-latitude storm track, and the tropical climate, located under the descending branch of the Hadley cell.

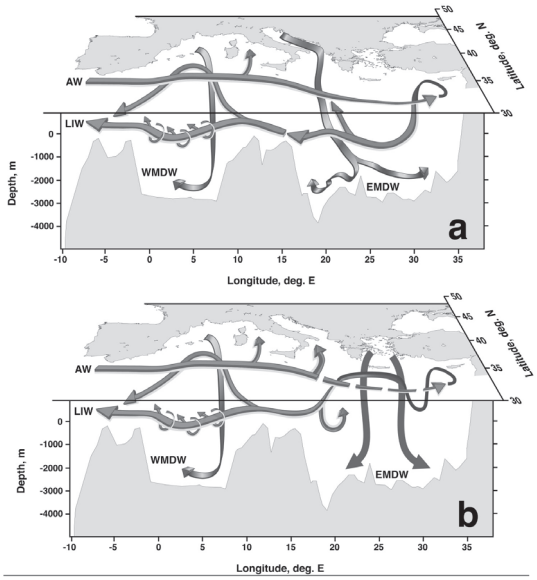
These characteristics make the Mediterranean region potentially very sensitive to climate change. Indeed, simulations of future climate scenarios tend to agree that higher emission levels could produce a temperature increase larger than the global average value, further reduce precipitation and increase the interannual variability of both temperature and precipitation (floods, droughts and heat waves).

Progress in the understanding of the Mediterranean climate has important environmental, societal and economical implications. The Mediterranean region is characterised by large cultural, economical, political, demographic gradients in a situation already under environmental stress (heat waves, highly variable precipitation, limited water resources, drought, floods), where lack of readiness and adequate adaptation strategies could result in critical situations, in particular in connection with the occurrence of extremes and inadequate evaluation of climate change impacts.

The running period of the ESF MedCLIVAR Research Networking Programme is for five years from May 2006 to May 2011.



Winter (DJF) averaged-mean Mediterranean precipitation anomalies (with respect to 1961-1990) from 1500 to 2002, defined as the average over the land area 10°W to 40°E and 35°N to 47°N (thin black line). The values for the period 1500 to 1900 are reconstructions; data from 1901 to 2002 are from the Climatic Research Unit Norwich, UK. The thick black line is a 30-year smooth 'minimum slope' constraint (mean squared error, MSE=0.856) calculated according to Mann (2004). The dashed horizontal lines are the 2 standard deviations of the period 1961-1990. The driest and the wettest Mediterranean winters for the reconstruction and the full period are denoted. (from Luterbacher et al., 2006)



Sketches of the Mediterranean overturning circulation before the Eastern Mediterranean Transient (EMT) (top) and during the EMT (bottom). Before the EMT the Modified Atlantic Water (MAW) moved eastwards to form about 1/3 of the Levantine Intermediate Water (LIW). LIW is then transported westwards branching to the Adriatic and crossing back to the western basin. After crossing the Strait of Sicily it follows the coasts of the western Mediterranean anticlockwise. Deep-water formation of about 0.3 Sv took place in the Adriatic Sea and the Gulf of Lions. During the EMT the MAW is deflected northwards into the north of the Ionian basin and its eastward transport diminishes. The intermediate water formation is then deflected northwards into the Cretan Basin where about 1 Sv of deep water is formed. (from Tsimplis et al., 2006)

MedCLIVAR Objectives

- To reconstruct the past climate variability by using a multiproxy approach of available instrumental observations (whose dense network includes some of the longest existing time series worldwide), documentary evidence and natural archives; to explore the physical mechanisms and address the importance of different forcing factors of past variability at different time and space scales using coupled-paleoclimate model runs.

- To investigate the connections between Mediterranean and global climate variability, considering the influence of both the mid-latitude climate patterns (e.g. the North Atlantic Oscillation, the Eastern Atlantic pattern and other teleconnection patterns) and the tropical climate patterns (e.g. El Niño Southern Oscillation, the Asian and African Monsoons). This includes also the study of the role of these patterns on the occurrence of extreme events in the Mediterranean area.

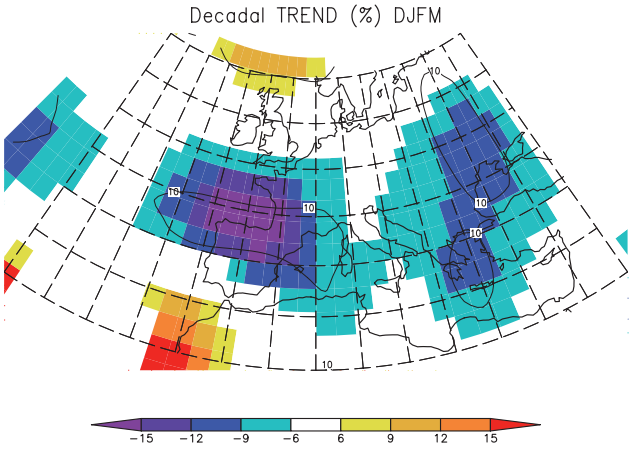
- To understand the mechanisms responsible for the Mediterranean Sea circulation, for sea level trends and variability, for long-term as well as abrupt changes of water mass characteristics, for variability of dense water formation processes and of vertical stratification.

- To assess the possible feedbacks of the Mediterranean dynamics on the global climate system. These include the effect of Mediterranean sea surface temperature (SST) on the export of moisture to regions around it, on Sahel precipitation, on large-scale atmospheric circulation, as well as that of the salty Mediterranean outflow across the Gibraltar Strait on the Atlantic Meridional Overturning Circulation.

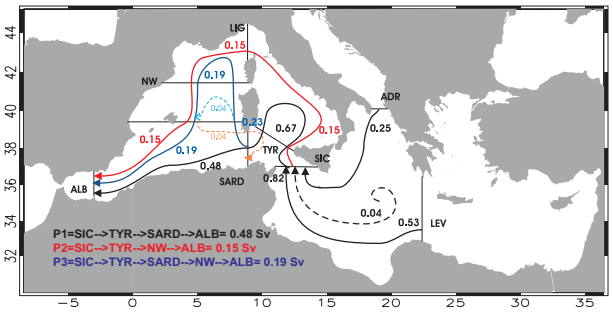
- To identify the environmental and climatic effects caused by the strong anthropogenic influence at regional scale to which the Mediterranean region has been exposed since ancient time due to heavy demographic pressure. This topic includes the compilation of a list of critical parameters for monitoring the evolution of the present climate; identification of possible gaps of currently deployed monitoring networks and suggestions for their improvement and extension.

- To understand and predict the response of the Mediterranean climate to the increase of radiatively active gases and aerosols. This includes the analysis of the effects on the intensity of extreme and hazardous events (e.g. heat waves, cold spells, extreme weather, dry periods, floodings), of consequences on regional resources (e.g. water, agriculture, energy requirement, etc) and of impacts of climate change in general.

- To make available scientific information and data on regional climate variability, trends and changes to public opinion, authorities and stakeholders in the Mediterranean countries.



Decadal trends (% relative to the mean over the study period) of the average number of cyclones detected in winter (DJFM) based on NCEP/NCAR reanalyses. The solid line indicates the grid cells with significant trends at least at the 10% level relative to the period 1960-2000. (figure adapted from Trigo, 2006).



Lower branch of the Mediterranean thermohaline circulation in a model experiment. The numbers indicate mass transport expressed in Sv. Particles are released in the Alboran Sea and integrated forward and backward in time in two Lagrangian experiments. In a first experiment particles are integrated forward in time till they reach again the starting section in the Alboran Sea (ALB). Contrastingly, in the experiment in which particles are integrated backward in time, particles are stopped when they reach the 'ADR' and 'LEV' section in the Eastern basin. (from Artale et al., 2006)

MedCLIVAR Implementation

MedCLIVAR promotes several tasks that will facilitate its implementation. This includes the collection, quality control and analysis of observations plus proxy data (documentary and natural), the development and application of coupled models for describing and understanding the physical processes responsible for Mediterranean climate variability and predictability at seasonal, inter-annual, decadal, centennial and millennial time-scales, the occurrence of extremes embedded in these variations, and the socio-economic impacts of climate change. The tasks of MedCLIVAR are organised in five groups:

1. *Analysis of past climate*: construction of quality-controlled paleo-climatic and instrumental data sets in order to extend the record of past Mediterranean climate variability over the time-scales of interest and their comparison with coupled paleo simulations including natural and anthropogenic forcing

2. *Systematic observations of the present climate*: construction of homogeneous sets of data for regional climate analysis and comparison with model simulations; analysis of the observed climate record, detection and attribution of the anthropogenic climate signals at regional climate scale. Within this task, MedCLIVAR is particularly interested in promoting and validating regional reanalysis datasets (e.g. those carried out by ECMWF and NCEP/NCAR).

3. *Understanding climate processes at regional scale*: diagnostic use of oceanic and atmospheric models for the purpose of understanding the processes responsible for the past and present Mediterranean climate variability.

4. *Simulations of future climate scenarios*: production and analysis of model simulations aiming at identifying the climate response of the Mediterranean regions to future emission scenarios, providing sets of data that could be used for performing regional simulations, creation of an archive of model simulations relevant to the Mediterranean region, and assessing the impact of the projected climate changes

5. *Dissemination of results*: make available scientific information on regional climate variability, trends and changes to public opinion, authorities and stakeholders in the Mediterranean countries.

ESF MedCLIVAR Initiatives

MedCLIVAR within ESF proposes to:

- assist scientists in developing coordinated research projects;
- favour the exchange of information, data and expertise;
- establish a network of European, Middle-East and North African institutes and scientists actively involved in regional climate studies;
- provide a source of information to assist governments and local authorities in decision making;
- provide material and documentation to the public and science policy decision-makers to inform them on climate issues.

In order to pursue these goals the following initiatives will be undertaken:

Workshops scheduled one per year for five years on the following themes:
- Evaluation of new proxy data to reconstruct Mediterranean Past Climate
- Connections between Mediterranean and global climate variability
- Understanding the mechanisms responsible for the Mediterranean Sea circulation and sea level trends
- Feedbacks of the Mediterranean dynamics in the global climate system and its influence on other regions. Identification of the environmental and climatic effects caused by the strong anthropogenic influence at the regional scale
- Scenarios of future Mediterranean climate under the increase of radiatively active gases and aerosols

A Conference scheduled towards the end of the Programme in order to review progress made and set new challenges

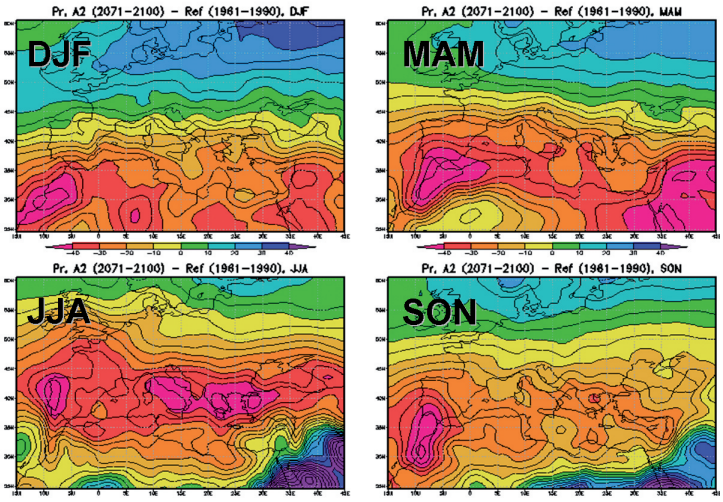
Summer Schools which target PhD students and post-doc researchers. Two schools are planned during the third and fifth year of the project on the following subjects:
- Climatic variability, trends and the occurrence of extreme events
- Teleconnections and climate change at regional scale

Scientists' exchange grant programme, to offer to scientists the opportunity for exchanging information, sharing data and developing common work on the Mediterranean climate. Grants will allow researchers to spend a period (up to five months) in a host institution. Every year about eight proposals will be selected for funding. The subject

ESF MedCLIVAR Initiatives

of the proposed research should be relevant to the MedCLIVAR objectives and tasks. Proposals devoted to climate dynamics on ecosystems, agriculture, water resources, economic activities, health and social aspects will be given high priority. Moreover, preference will be given to grants contributing to the development of the MedCLIVAR data archive.

MedCLIVAR Web Pages (*http://www.medclivar.eu/* and *http://www.esf.org/medclivar*), the main tool for distribution of information on the programme, its advancement, and main results. The web page will contain a Mediterranean data archive and links to existing sets of data with information relevant for the MedCLIVAR programme. Periodic reports will also be published on this page, as well as links to published papers and reports on MedCLIVAR related research. Dissemination of information is aimed not only at scientists but also at public opinion, authorities and stakeholders.



Multi Global Model Ensemble average change in precipitation for the four seasons, 2071-2100 minus 1961-1990, A2 scenario. Units are % of 1961-1990 value. DJF is December-January-February, MAM is March-April-May, JJA is June-July-August, SON is September-October-November (Courtesy of F. Giorgi).

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For the latest information on this Research Networking Programme consult the MedCLIVAR websites: **www.esf.org/medclivar** and **www.medclivar.eu**

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