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Historical reconstruction climate variability and change in Mediterranean regions(*)

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Summary. — In the frame of "US-Italy cooperation on Science and Technology of climatic change", sponsored by INGV, we organized a meeting focusing on decadal climate variability in the Mediterranean regions in the context of long-term climate change. Our aim is to assess past climate variability using historical climate reconstructions and sources in the Mediterranean region both of western US and southern Europe. This report summarizes some key aspects of climate variability in the Mediterranean region in the past 200 years and identifies uncertainties and unresolved scientific questions still open for further research.

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1. – Historical reconstruction climate variability and change in Mediterranean regions

Mediterranean climates in the western US and in southern Europe are located in the semiarid reaches of the subtropics and comprise regions of marginal water supply. The bulk of annual precipitation is delivered in winter, and its failure, particularly in consecutive years leads to severe economic and social hardships. Preliminary studies using a suite of global climate models and historical analysis of instrumental records for the past century, suggest that European Mediterranean climate may be at enhanced risk from global climate change. Recent severe drought episodes have affected both regions in southern Europe and the US West, and recent extreme heat waves, particularly in summer of 2003, which resulted in excess deaths in Western Europe of around 20000 people have caught the public's attention and have displayed the vulnerability of this area in relation to climate change.

Within this context a research program for the reconstruction of past climate was set up within the US-Italy Bilateral Agreement on Cooperation in Climate Change Research and Technology with the aim of better understanding climate variability and change in Mediterranean regions, and to use this knowledge to advance climate modeling, climate projections, and decision support.

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Among the goals of the scientific cooperation between the United States and Italy should be the mutual improvement of scientific capabilities in climate science, including the production and distribution of reliable climate data sets relevant for the study of climatic variability in Mediterranean regions, with particular attention to precipitation, temperature, atmospheric pressure, and other parameters, such as contained in the global reanalysis products. We envision also the need for climate model data, based on existing and potentially new suites of experiments, that permit both an interpretation of the known observed climatic variations, but also provide guidance for future climatic conditions in Mediterranean regions.

With respect to observational data, it would be desirable to set up methodologies to compare instrumental and proxy series on a regional and global scale. It would also be fruitful to stress the importance of analyzing climatic extremes, such as flooding, drought events, heat and cold waves by both statistical and modeling approaches. It is thought that particular attention may be directed towards looking for external fingerprints, such as those related to solar irradiance variability and major explosive volcanic eruptions. Detected changes in the frequency of the extreme events can be important indicators of climate change with potentially significant societal impacts.

With respect to climate model data, it would be desirable to establish archives of variables that permit direct comparison with observations. Included in this are daily rainfall and temperature, in addition to the more common monthly archives of surface and free atmospheric variables. Coordinated experiments that test specific theories of the climatic sensitivity of Mediterranean climates are encouraged. An important question to be addressed in these experiments is the role of ocean forcing, both remote and within the confines of the Mediterranean region, in addition to experiments dealing with external forcings, such as greenhouse gases, solar, and volcanic aerosols.

Since global climate patterns are relevant for determining important effects at regional scales, such in the Mediterranean and the western United States through so-called teleconnections, collaboration should be encouraged also on the analysis of larger scale data sets, and on analysis of global climate model outputs as mentioned above. The availability in the Mediterranean Sea region of most of the long-record quantitative or semi-quantitative historical climatological data sets makes this area especially promising in the context of reconstructing centennial and multi-centennial aspects of climatic variability at continental scales.

The development of long-term, high-quality climate data sets for parts of the Mediterranean region would in itself be a very relevant scientific benchmark. The Mediterranean regions are generally characterized by high population density, high agricultural productivity of economically relevant products, and a relative scarcity of water resources. Hence, a detailed description of major historical aspects of the climate of the Mediterranean for the past 100–200 years would serve the socioeconomic interests of the region.

A first important step of the cooperation between the United States and Italy took place in Bologna, Italy, with a workshop held on October 5-6, 2004. The goal of the meeting was to assess the nature of changes in the Mediterranean area for the past few centuries. Comparative analysis of the different patterns of change within the Mediterranean climate region of the western United States was also a workshop topic. The meeting, organized by Dr. Teresa Nanni of the Italian ISAC-CNR, and Dr. Henry Diaz of NOAA/OAR/CDC, was an important starting point for the establishment of cooperation between United States of America and Italy in the area of cooperation in climate change research.