Editorial

doi: 10.22498/pages.25.1.1

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The study of Decadal Climate Variability and Predictability (DCVP) is the interdisciplinary scientific enterprise to characterize, understand, attribute, simulate, and predict the slow, multi-year variations of climate on global and regional scales. Particular interest in decadal climate variations and their role in the global surface climate change stems from the need to detect and attribute the uneven rise in global mean surface temperatures (GMST) since the beginning of the industrial period. The most recent expression of decadal variability in GMST has been the slowdown in warming between roughly 1998 and 2012. This period, often termed as the "hiatus", triggered intensive debate in the public domain, even if global temperatures had exhibited long undulations before, including two cooling events in the late 19th to early 20th century and in the mid 20th century and two intervals of rapid warming, one from about 1910 to 1940 and the other between the early 1970s and 1998. While these departures from the expected warming due to the steady increase in greenhouse gas forcing have been attributed in part to natural (volcanic) and anthropogenic (industrial) aerosols, there is ample evidence that long-term internal interactions between climate system components – the ocean and the atmosphere, in particular – have also been involved.

Decadal and longer variations in sea surface temperatures (SSTs) have a rich and non-uniform spatial pattern related to variations in the distribution of precipitation and associated atmospheric convection in the tropics, to alterations in position and strength of the storm tracks at midlatitudes, to changes in sea-ice extent at polar latitudes in both hemispheres, etc. Changes in atmospheric circulation thus contributes to changes in regional climates worldwide and importantly over the continents, directly affecting humans and their environment. The most prominent example of the terrestrial response to decadal climate variability is the long-lasting decline of rainfall in the North African Sahel in the second half of the 20th century, which included the devastating famines of the 1970s & 1980s. These decadal-scale shifts have been attributed to slow variations in North Atlantic SSTs, which have also affected Atlantic tropical cyclone activity over the same time frames. Similarly, the multi-year pulses of North American droughts (e.g., the Great Plains "dust bowl" in the 1930s and the recent protracted dry period in the Southwest US), which impacted lives and livelihoods in the US and northern Mexico, have been attributed to the state of the tropical Pacific and tropical Atlantic Oceans. For the Mediterranean region, in South European countries along the northern rim and in the Maghreb and the Middle East, recurrent heat waves and prolonged dry spells since the mid 1960s, attributed to a combination of internal decadal variability and greenhouse gas forcing, have devastated regional agriculture productivity, lead to loss of life and, perhaps arguably, to widespread societal instability and in Syria to violent conflict and war.

In order to anticipate the impacts of climate change, it is important for society to know how the climate response to anthropogenic forcing and the climate impact of natural variability will mix together to affect the near-term future. The study of DCVP aims to provide science-based information to decision makers through research, observations, and decadal predictions. This goal remains challenging despite decades of research and of extensive progress in observing and modeling the climate system. Predicting the impact of internal decadal climate variability is complicated by our incomplete understanding of the nature of the underlying phenomena, in particular their physical origins and their interaction with external forcing. Existing obstacles in DCVP research thus test our ability to attribute past variations to the combined role of internal variability and external forcing, as well as to reliably predict the near-term climate on global and regional scales.

Progress in DCVP research can only be made through international, cross disciplinary collaborations between scientists. Because of the difficulties to observe and model the Earth's climate at timescales of a decade or longer, this area of research is wholly dependent on emerging connections between those who perform, collect and analyze instrumental observations of the present, those who develop and analyze proxies of past climate, and with scientists who develop models and perform dedicated modeling experiments. To review ongoing research on DCVP and propose the road to future progress on the subject, the International WCRP CLIVAR Project and PAGES held an international workshop with representatives of these various disciplines in November of 2015, under the patronage of the International Centre for Theoretical Physics in Trieste Italy. This issue of Exchanges grew out from the presentations and discussions features in this workshop.

The articles in this issue of Exchanges were selected and reviewed by the members of the CLIVAR Working Group on DCVP and the PAGES 2k Network. These contributions are meant to provide brief reviews that address the progress made in understanding and resolving different key issues in DCVP. We greatly appreciate the voluntary efforts made by these authors to capture the exciting and rapidly growing literature on the subject in these brief summaries and hope that they will stimulate further research collaboration on the subject.