

Understanding Terrestrial Ecosystem Response to Antarctic Climate Change

The McMurdo Dry Valleys Terrestrial Observation Network: An NSF Workshop; Portland, Oregon, 14–15 July, 2012

International observing platforms, such as the Arctic Observing Network (AON) and the Southern Ocean Observing System (SOOS), have become a primary method for detecting the long-term effects of climate change on complex ecosystems. Based on the success of this model for research coordination, a workshop was held in Portland, Oregon, in July 2012, with support from the U.S. National Science Foundation (NSF) Office of Polar Programs Antarctic Integrated Systems Science program, to develop criteria for the implementation of a McMurdo Dry Valleys Terrestrial Observation Network (TON).

The McMurdo Dry Valleys of Antarctica (78°S, 162°E) are a natural laboratory for studying climate change impacts on terrestrial ecosystems because they experience extreme seasonality (illuminating phenological impacts) in a location near the physical limits of life (where ecological responses to change are large). The Dry Valleys are one of the last locations on Earth where “pre-Anthropocene” ecosystem processes can be documented to provide a baseline against which the impacts of climate change can be measured.

To design requirements for the Dry Valleys TON, a group of about 40 investigators convened from the United States, Canada, New Zealand, Korea, and Australia, representing the biological and Earth sciences, data management, environmental managers, and program officers from Antarctic national programs. The workshop received input on the design and implementation of Arctic monitoring networks, including key insights into methods for harmonizing historical measurements between national programs. Then the workshop divided into specialist groups (physical processes, biogeochemistry, community structure, and environmental management) to address topics related to development of the TON.

Throughout the workshop, there was a strong consensus that the Dry Valleys are on a threshold for change, and that the coordination of long-term terrestrial observations in an urgent international priority. Although some TON-like measurements are ongoing, participants identified a need for new sensor networks, remote-sensing data acquisition, and field sampling programs. Additionally, observational records and methods need to be made compatible and shared between national programs.

Therefore, workshop participants developed four key components for moving forward. First, a list of the key physical and biological processes that must be measured in order to detect ecosystem-level responses to environmental change was established (e.g., spatially resolved monitoring of the control of ground temperature on primary productivity and rates of biogeochemical cycling). Second, participants drafted a consensus list of standards and protocols for measuring these processes. Third, an information management system was outlined that can account for the different types of data housed in the TON and the required infrastructure for making them accessible. Finally, a list of short- and long-term assessment activities (e.g., integrated trampling metrics) was developed to inform questions about the efficacy of current environmental management policies in the McMurdo Dry Valleys Antarctic Specially Protected Area. The workshop concluded with the participants committed to working toward a McMurdo Dry Valleys TON by establishing short-term benchmarks and soliciting the support of all Dry Valleys investigators and national programs to help coordinate new and existing science events, logistics, and data streams.

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