Overview: Hypotheses of hydrologic and aeolian drivers of ecological connectivity

The McMurdo Dry Valleys (MDV) is a polar desert on the coast of East Antarctica, a region that has not yet experienced the climate warming that is now occurring elsewhere. The MCMLTER project has documented the ecological responses of the glacier, soil, stream and lake ecosystems in the MDV to a cooling trend that occurred from 1986 to 2000, which was associated with the depletion of atmospheric ozone. In anticipation of the eventual amelioration of the ozone hole in the next 50 years, our overarching hypothesis is:

Climate warming in the McMurdo Dry Valley ecosystem will amplify connectivity among landscape units leading to enhanced coupling of nutrient cycles across landscapes, and increased biodiversity and productivity within the ecosystem.

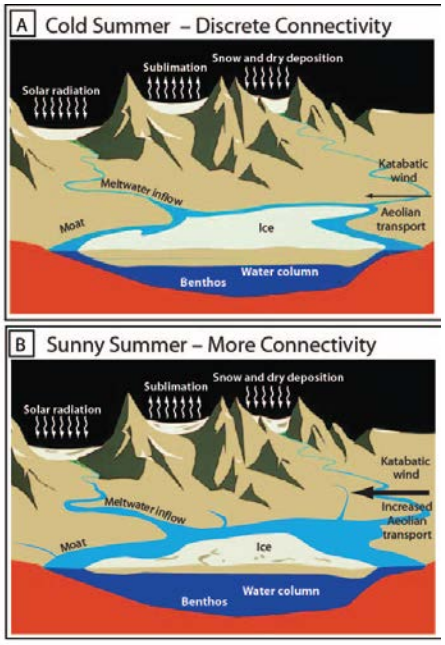

Fig. 1. Schematic diagram of Dry Valleys contrasting cold to sunny summers.

Our specific hypotheses (see inside cover) address the ways in which pulses of water and wind will influence contemporary and future ecosystem structure and function.

In MCM 4, we are examining contemporary patterns in ecological connectivity in the MDV as a basis for predicting future changes and hypothesize that warming will act as a slowly developing, long-term press of warmer summers, upon which transient pulse events of high summer flows and strong katabatic winds will be overprinted (Fig. 1).

In the past decade, we have observed the end of the cooling trend and three summer climate events which have caused high streamflows and strong winds (Fig. 2). These events are not correlated with increased summer temperatures, but rather are associated with the persistence of the ozone hole over the MDV into mid-summer, when the sun is directly overhead (Jaros et. al., submitted). These high streamflows and sediment deposition have dramatically changed many aspects of the Dry Valley landscape.

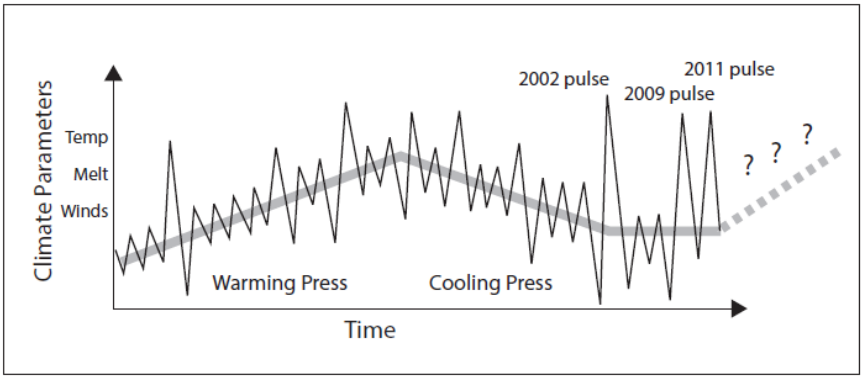

Fig. 2. Revised conceptual diagram of presses and pulses.

If increased ultraviolet radiation in mid-summer is indeed the primary driver, then these events may represent millennial extremes, exceeding in magnitude conditions that may occur with the sealing of the ozone hole (Fig. 3).

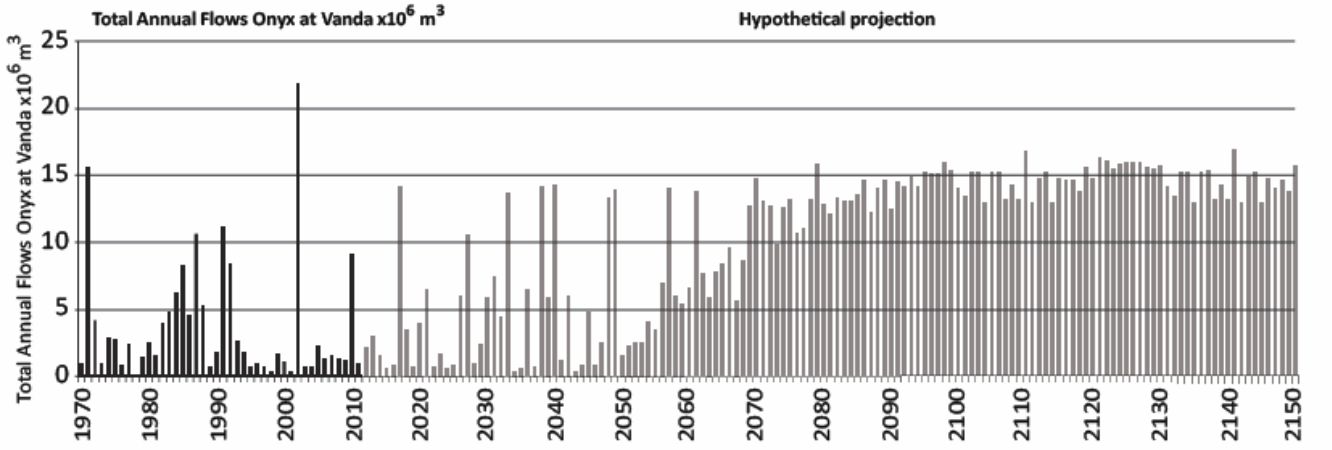

Fig. 3. Revised hypothetical projection based on positive influence of ozone hole persistence on glacial meltwater generation.