Modelling, Water Tracks, and Weathering Connectivity – Michael Gooseff and Berry Lyons

Over the past decade, we have developed a conceptual model that documents the connectivity of glaciers (primary source of water) to lakes on the valley floor via stream channels. The stream channels provide two important functions beyond conveyance of water and associated solutes and energy to lakes – (1) they provide habitat for algal mats that include diatom and microbial communities, and (2) they accommodate active exchange of water between the channel and the hyporheic zone underneath and adjacent to the channel. We have demonstrated that MDV streams have the highest silicate weathering rates published. A simple end-member mixing model of dilute glacial meltwater (with an electrical conductivity signature of ~18 uS/cm) and hyporheic waters (~175 uS/cm) is used to quantify the continuous influence of hyporheic zones on flow that reaches the stream gauges (Fig. 1).

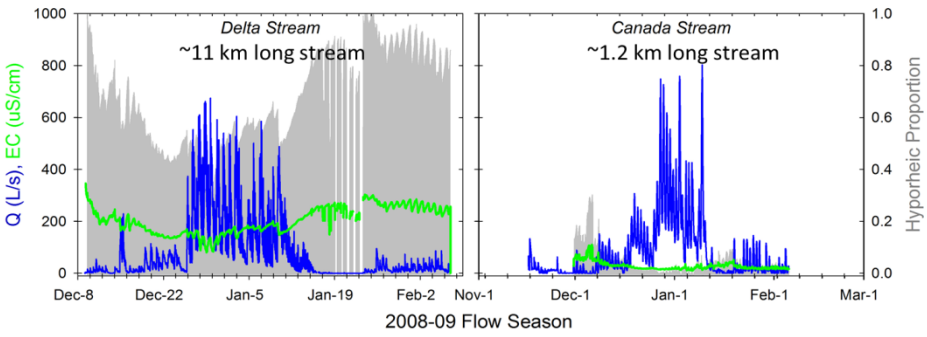

Fig. 1. Long and short stream discharge, electrical conductivity, and hyporheic influence plotted continuously through the 2008-09 flow season. Note that the long streams have stream water that has been more substantially influenced by hyporheic exchange than short streams.

Energy balance modeling across the landscape

We have completed extensive, complex modeling of meltwater generation on MDV glaciers, which included new representations of radiation influences on ice melt within 20 cm, but *below* the surface of the glacier (Hoffman et al., 2008; Hoffman, 2010). These results indicate that there is extensive shallow subsurface melt water generation across these glaciers. We propose modeling the impacts of hydrologic connectivity across the landscape by quantifying distributed changes in surface energy balance of wetted and dry soils. To inform this model and provide calibration data, we will be measuring time series of distributed surface temperatures in the 2013-14 field season using an infrared camera. An improved quantification of the impacts of changes to water distribution across the landscape will allow for an improved characterization of the associated ecological implications.

Landscape connectivity beyond stream channels

Flow records from our stream gauging network indicate that, on average, the last decade (2002-12) has been wetter than the previous decade (1993-01). As such, we have observed many 'water tracks' – wetted sediments across the landscape originating from snow and ice melt lacking obvious channels but that collect and redistribute inorganic solutes downslope (Levy et al., 2011). We recently mapped these wetted soil features across the Dry Valley landscape using high resolution remote sensing (Fig. 2). Our results indicate that these features cover less area than stream channels (Langford et al. in review), but may be important to transporting solutes across the landscape because concentrations of salts are several orders of magnitude higher in water tracks than in streams (Levy et al. 2011).

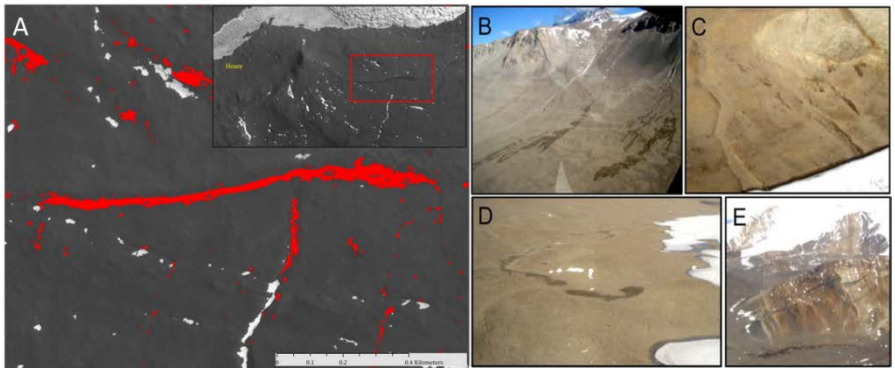

Fig. 2. (A) Remote sensing identification of wetted soils just south of the Canada Glacier in Taylor Valley, and (B-E) several examples of water tracks/wetted soils observed across the McMurdo Dry Valley landscape.