2016 Snow Melt in the NGEE-Arctic Teller Research Watershed

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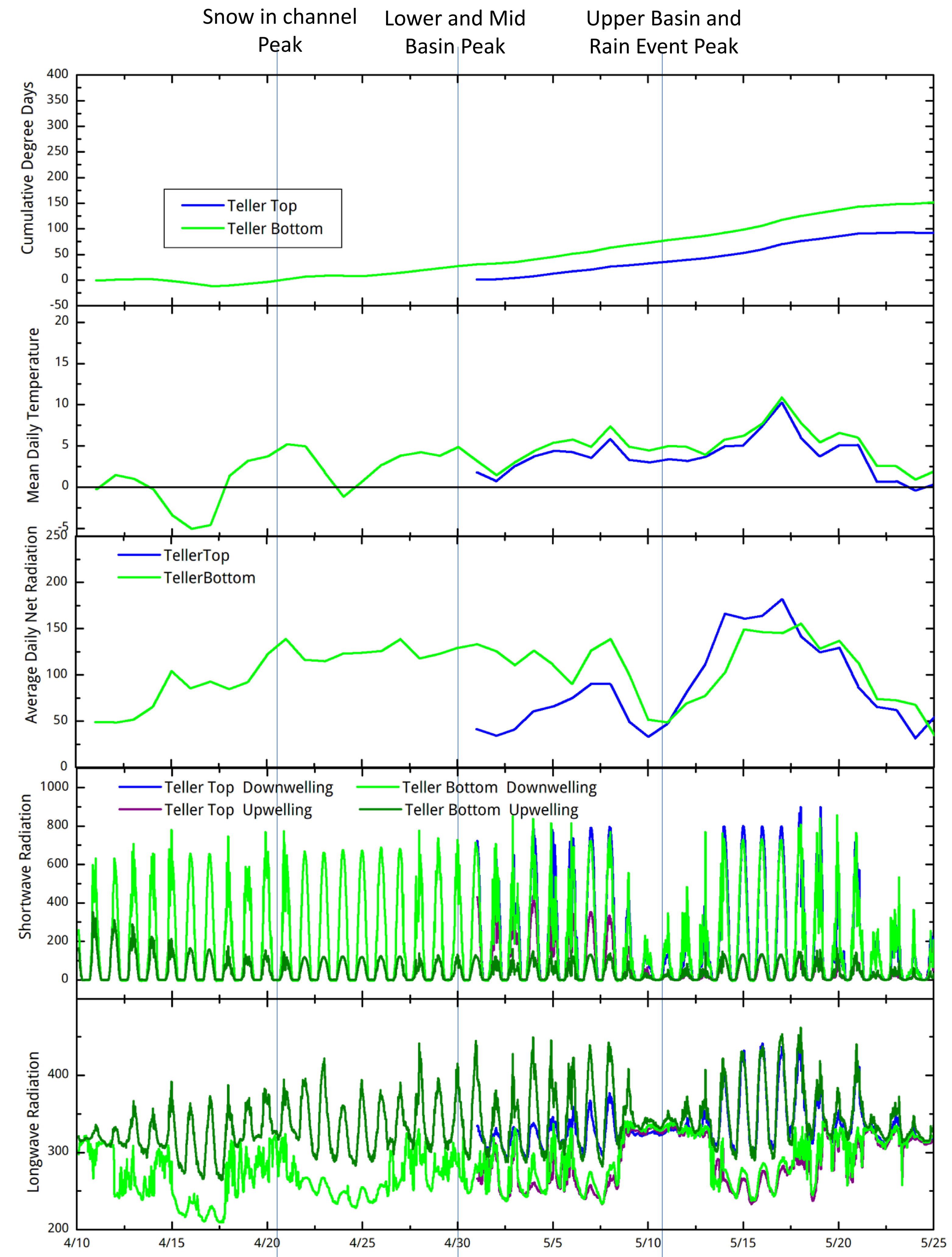
In April 2016, daily transects were made across the Teller Road Basin to begin the several year process of characterizing the largest event in the northern hydrologic year: snow melt. This year was an experiment to see how much could be accomplished (a full suite of time intensive measurements) during this interval. First crew consisted of Bob Bolton, Cathy Wilson, Lily Cohen, and Bob Busey.

The first trip was used to quantify spatial variability of the snow across the research basin. The first task focused on setting up the snow survey course and a first attempt at looking at variations across the snowpack: both snow depth and density. Bulk density, average of the pack, and stratified density, layer to layer variability, were sampled across the watershed. The snow courses ranged from 200 meters to 800 meters across. Snow depth was measured every 1 to 20 meters depending on the transect and aspect.

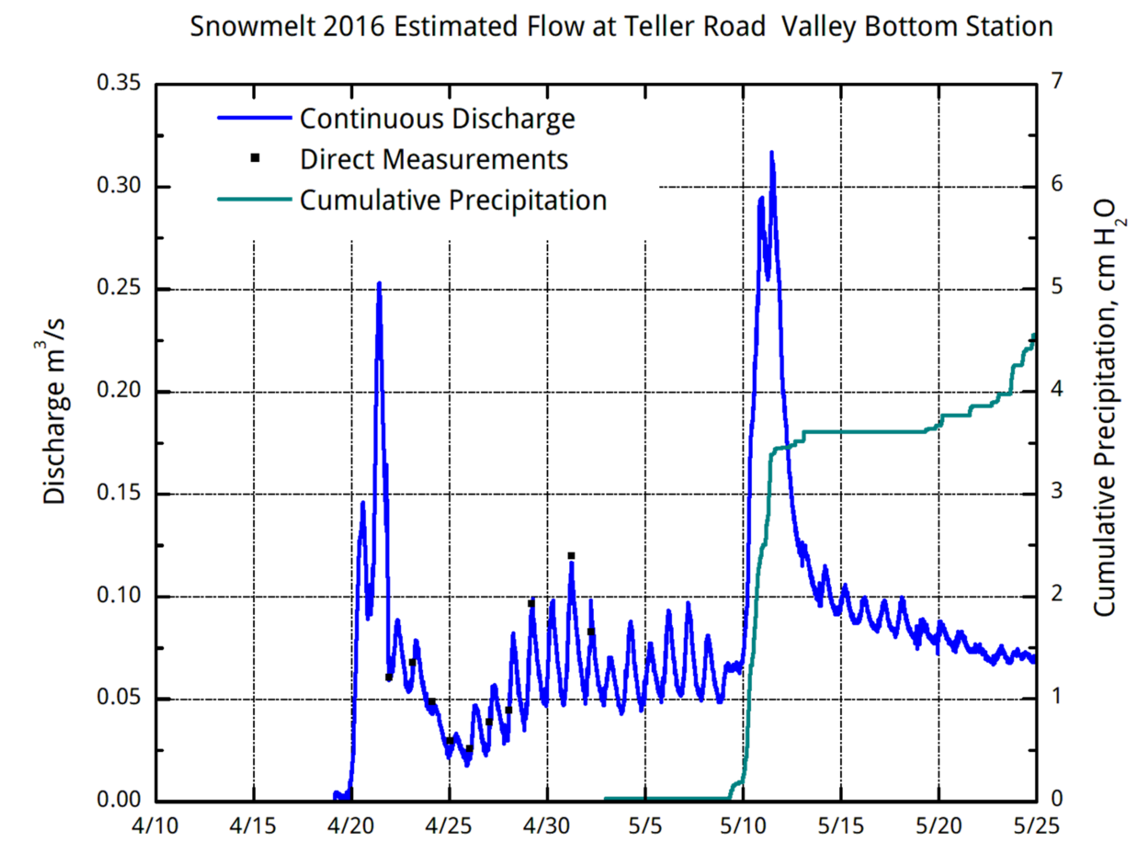
This spring was unusually warm and by the end of the first trip, a trickle of water was flowing down the creek towards the Sinuk river. At the conclusion of the week, a minimum amount of instrumentation was placed at the bottom of the watershed to establish continuous monitoring. A pair of pressure transducers measured surface water depth in the creek and on the land, a complementary suite of micrometeorology sensors: 4 component net radiation, air temperature, relative humidity, continuous snow depth, and a vertical temperature array placed into a snow drift for later estimating thermal conductivity. The start of snow melt coincided with the end of the first visit.

The second trip commenced on the 21st of April. Go Iwahana joined Bob Busey in taking measurements. The entire 8 kilometer snow course established in early April was measured daily. Snow depth and density were sampled as well as water samples for geochemistry. The day concluded with a discharge measurement at the valley bottom instrumented site.

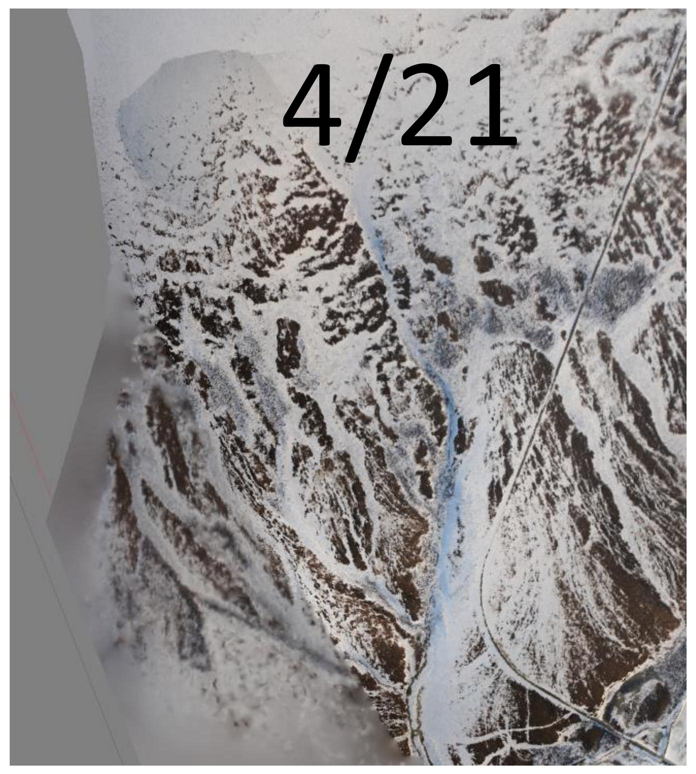


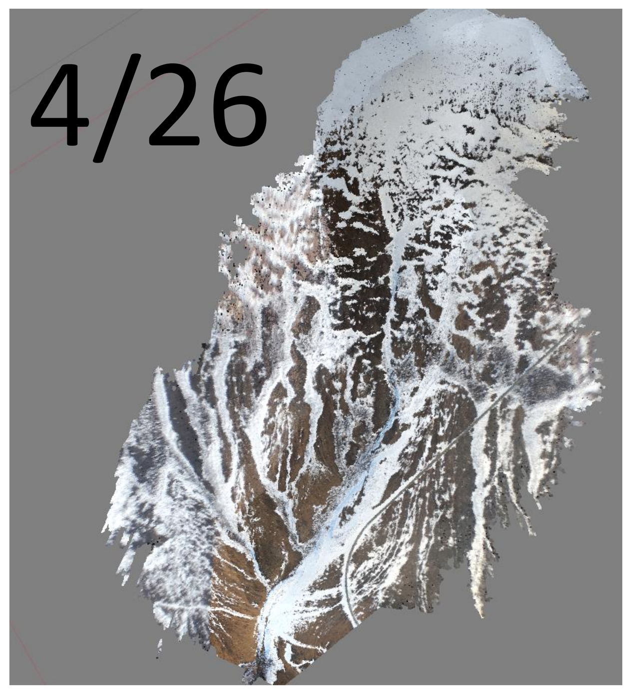
The top three graphs above show similarities in the energy balance at the top and bottom of the watershed as snowmelt progressed. Snow at the valley bottom site finished melting soon after we returned in late April. The exposed ground surface led to higher net radiation until the rain event on 5/9 to 5/12. Cloudy skies are seen clearly in the similar long wave radiation values top and bottom over those dates. This rain increased surface runoff into the creek for the annual maximum.

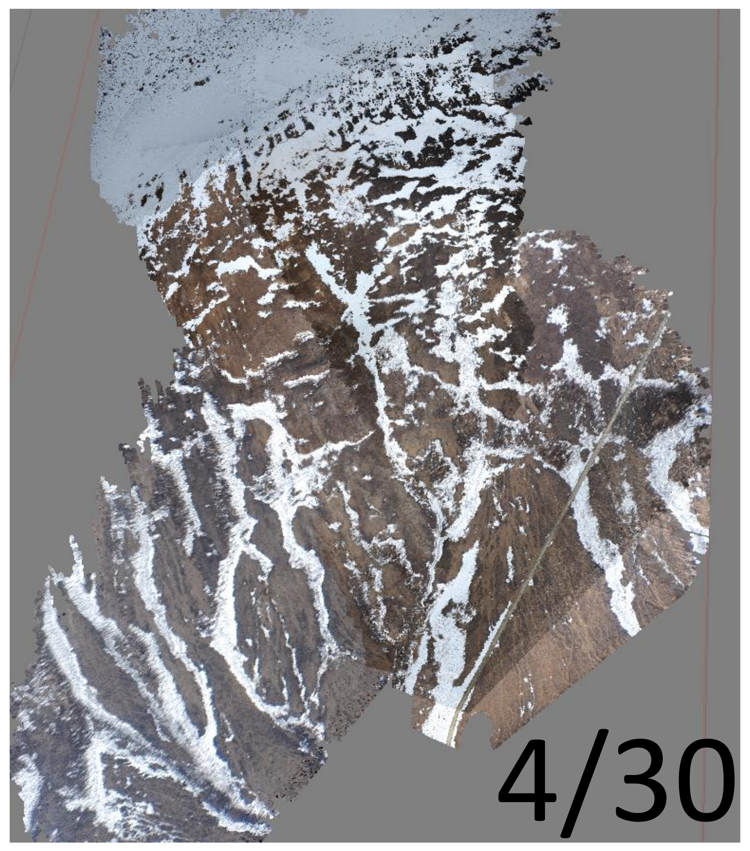
Above, water level in the creek is measured early in the second visit. To the right, estimated discharge in the creek during snow melt. There is a large error associated with the first high flow on the 4/20. At that point flow was quite restricted by snow in the channel. This reduced stream velocity. Consequently our initial model over predicts these early volumes. After the mid-basin peak on 4/29 temperatures cooled a bit and the rate of ablation slowed. The 5/8 to 5/12 peak is driven by rain melting the remaining snowpack at the top of the watershed. In future years, with more direct measurements of flow during break up, the relation ship between water level and discharge will be better constrained and will aid us in up-scaling to basin-wide variation in water balance.

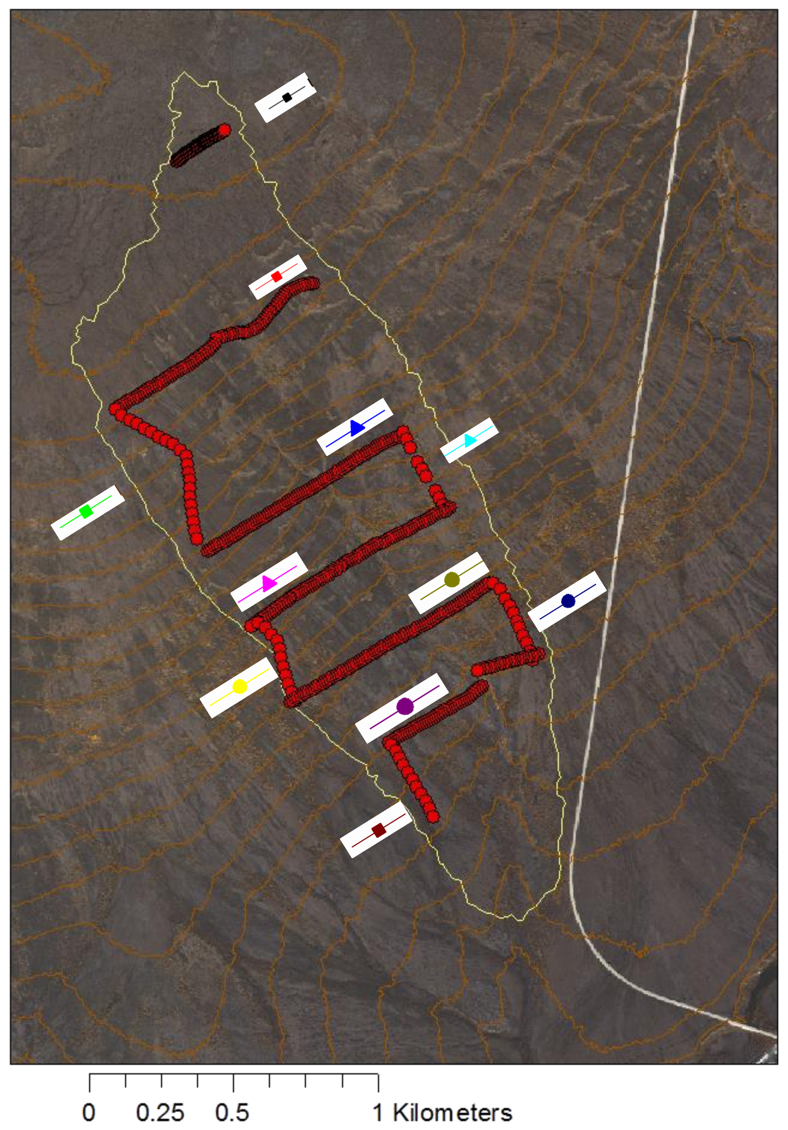


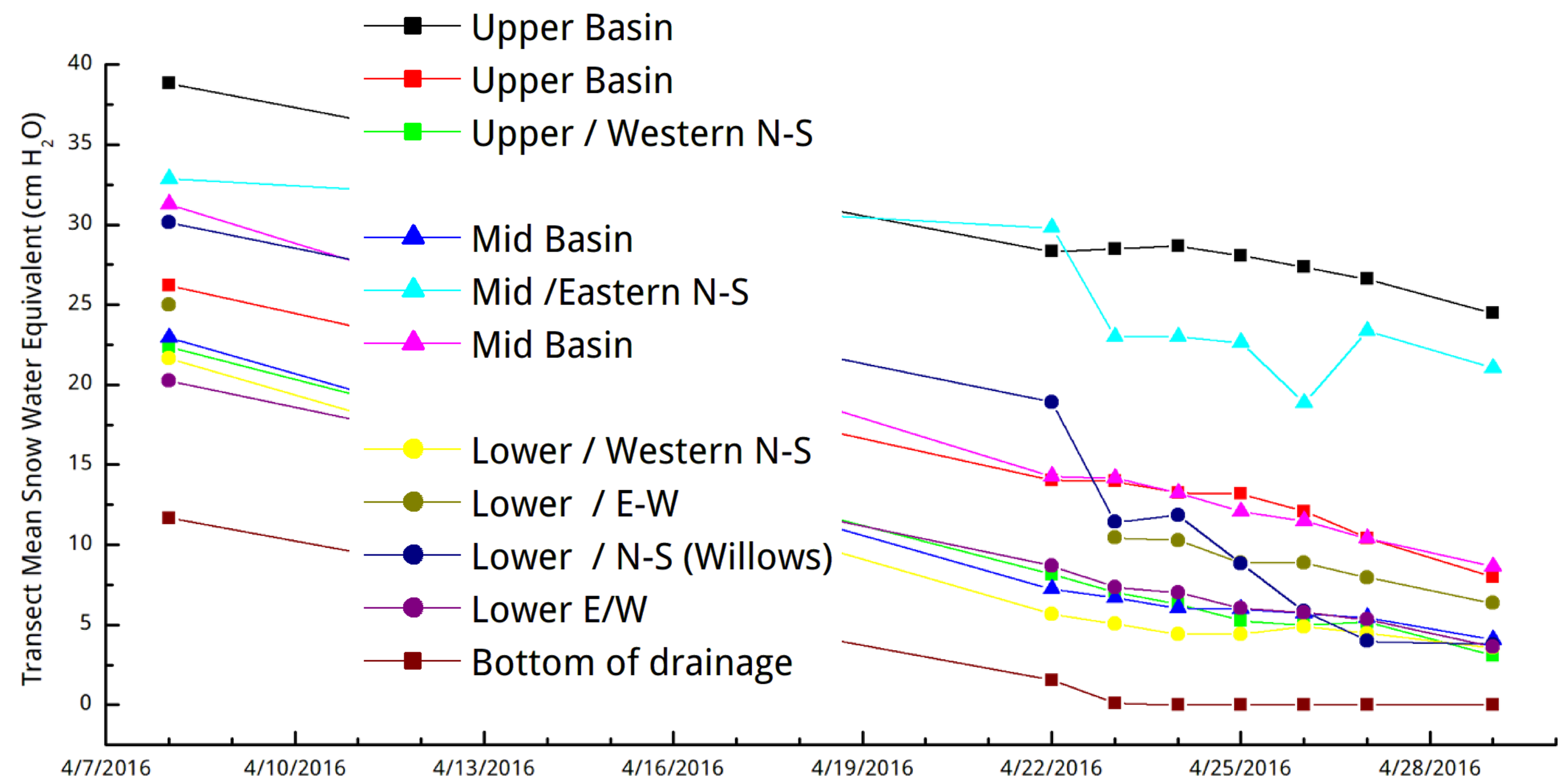
This series of photos and photo reconstructions was a bit of an experiment to see if oblique photography from the helicopter used for site access is useful in quantifying variability across the landscape. We plan to augment ground measurements using this remotely sensed data in 2017. April 21 was the first day of flying on the second trip.











Above left is a World View 2 image with outline of the Teller Road Basin extents. The red dots outline the snow course established in early April and then transited daily during ablation. The related figure to the right shows variation in estimated snow water equivalent (SWE) for each transect. To quantify SWE, bulk density, measured at several representative points on the landscape, is combined with snow depth data from each transect. As the melt progressed it became difficult to repeat measurements in the same location (+-0.5 meter). Due to high variation in micro-topography at that scale, a transect mean SWE is reported here rather than individual points. As can be seen, most early melting occurred at lower elevations. The willows on the road side of the drainage, which accumulate blowing snow over the winter, extend the snow season a few days on the perimeter, as well.

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