

## BACKGROUND

Dissolved organic carbon (DOC) is proportionally the largest form of carbon to be exported from streams and represents a large quantity of total carbon exported from Arctic catchments. The projected deepening of thaw depth in permafrost regions due to an increase in air temperature may have a significant effect on the amount of DOC exported from these systems. In addition to these predicted changes, slope facing aspect has a large influence on DOC production and the hydrological flow paths controlling the export of DOC from these systems.

## OBJECTIVES

Sampling of DOC and stable water isotopes was undertaken throughout 2014 to help identify the dominant flow paths and sources of DOC in an arctic catchment characterised with an active permafrost soil, with the specific aims to:

1. Utilise stable water isotopes to help understand flow paths and sources of water and consequently trace DOC within the catchment.
2. Examine spatial and seasonal trends of stable water isotopes and DOC.

## STUDY SITE

Trail Valley Creek is an arctic catchment located in the Northwest Territories, Canada.

- Catchment area: 1 km<sup>2</sup>
- Annual mean temperature: -9.8°C.
- Mean annual precipitation: 200 mm (50% snow)
- Soil consists of an organic layer (10 – 50 cm) overlying a clay-rich mineral layer.
- Catchment is dominated by raised mineral hummocks and ice-wedge polygons

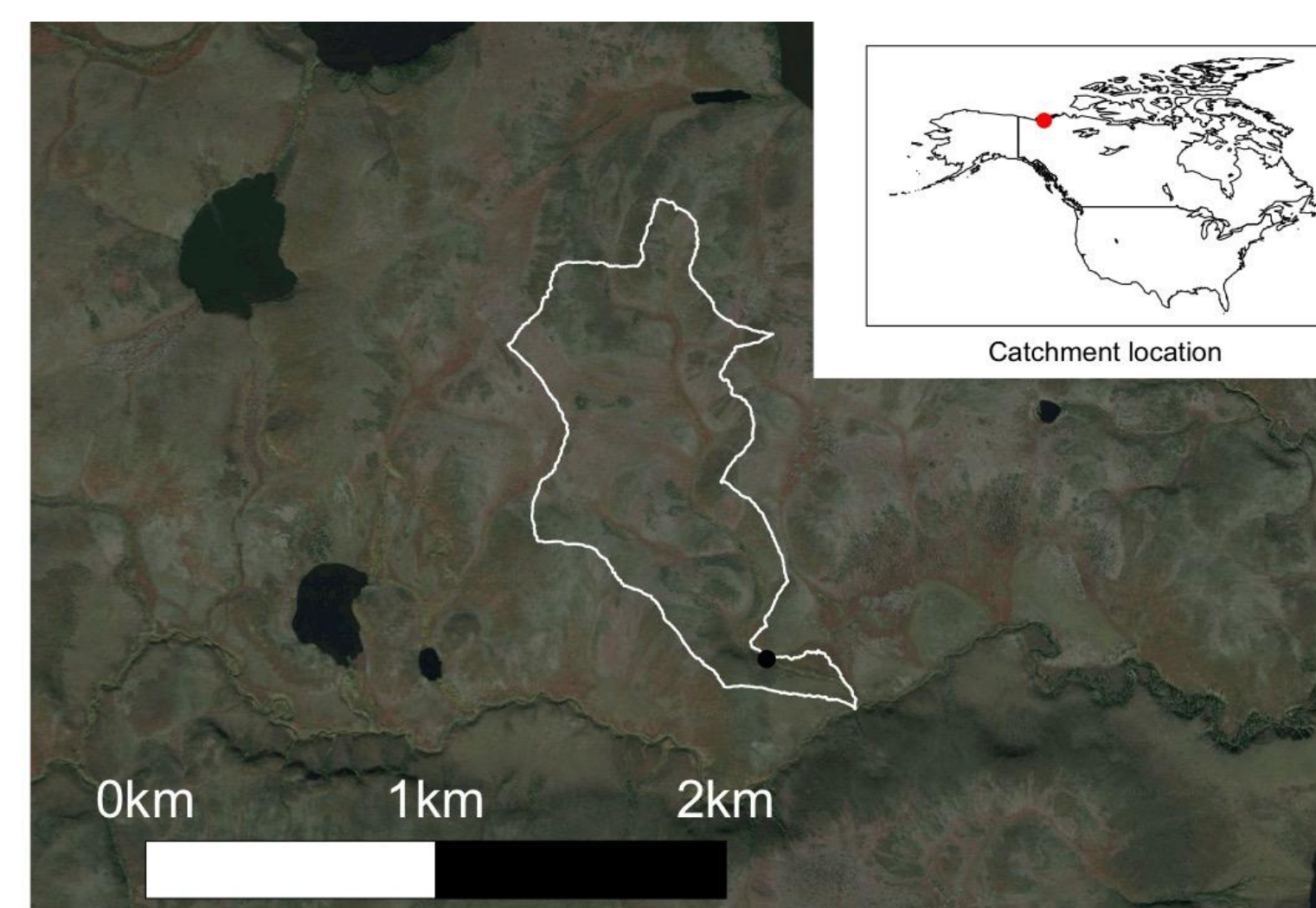


Figure 1. Study catchment with stream gauge.

## STABLE WATER ISOTOPES

- Active layer thaw depth has a large effect on runoff, increasing runoff responses in spring.
- The precipitation isotopes show a large variability throughout the year.
- Stream water isotopes are very depleted during spring due to snow dominant sources and are fairly stable during summer



Figure 2. Precipitation, stream discharge and stable water isotopes during 2014.

## SOIL WATER

- Large variation between north and south facing slopes throughout the year
- Little variation of deuterium with soil depth
- Strong influence of snow melt seen on the north facing slopes

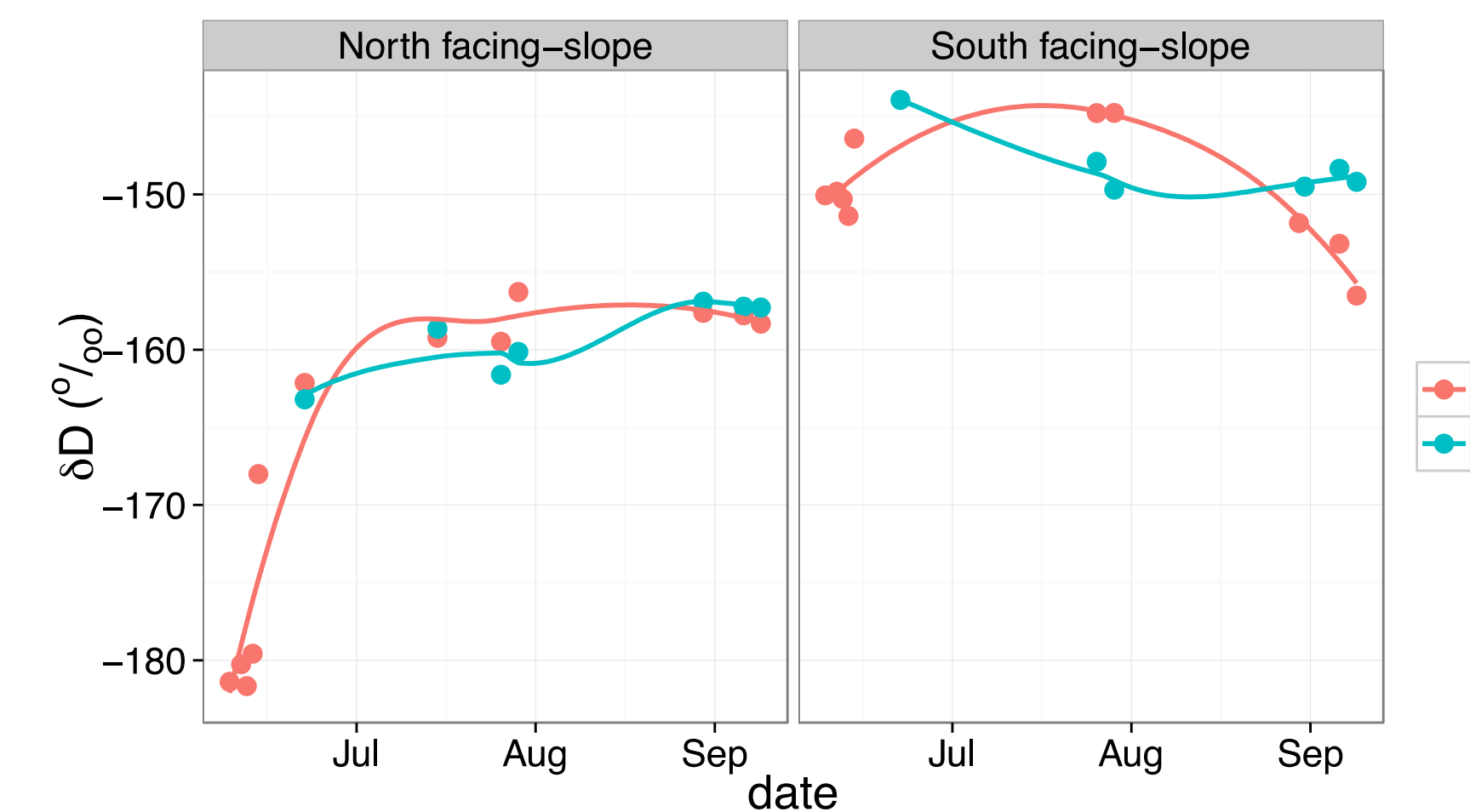


Figure 3. δD of soil water at two depths on a north and south facing slope

## SOURCE DIFFERENCES

- Most samples fall along the GMWL. Variation from the line provides valuable information on catchment processes (e.g. evaporation)
- Stream water samples have a very similar signature to soil water with little deviation from the global meteoric water line
- Rainfall samples are the most enriched, whilst snow melt samples are the most depleted isotopic signatures

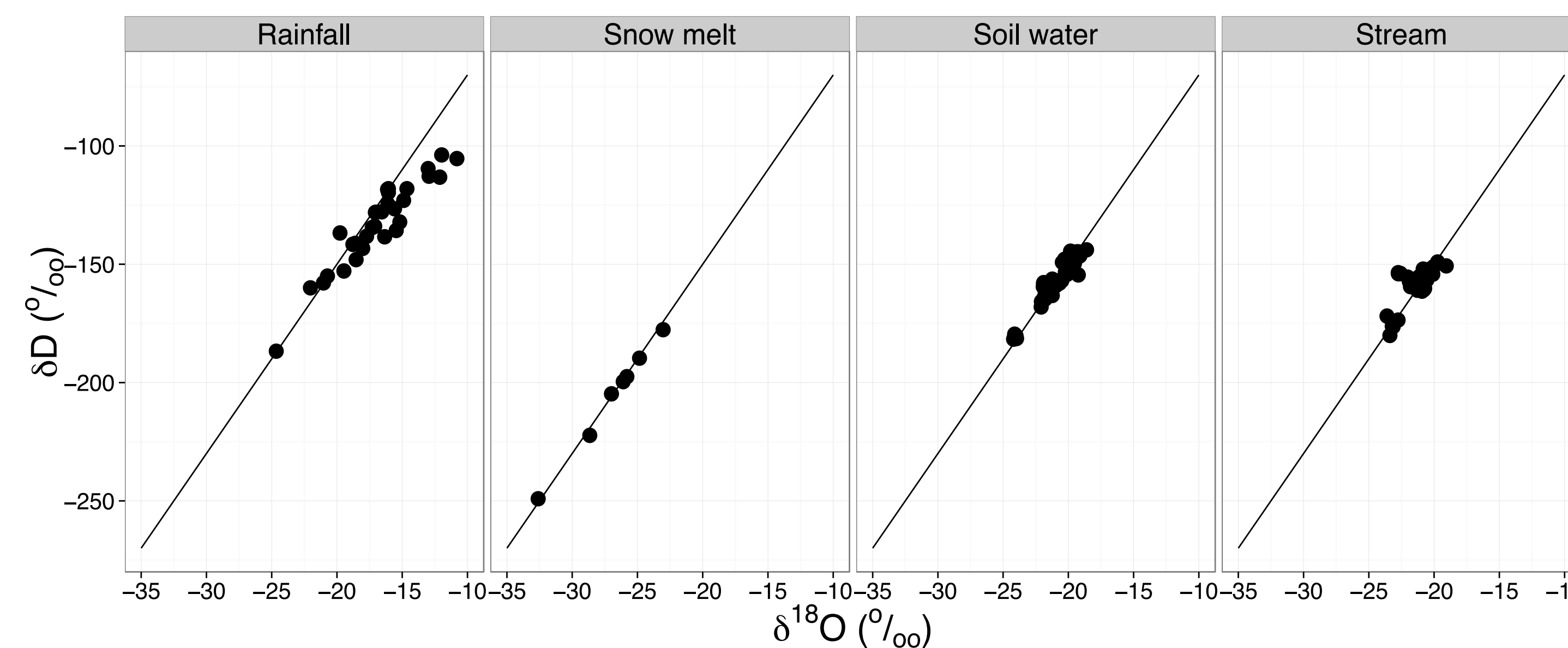


Figure 4. δD plotted against δ¹⁸O for all water sources with GMWL line

## DISSOLVED ORGANIC CARBON

- DOC concentrations were low after spring melt event.
- Concentrations increase after the spring melt event, as the active layer deepens and DOC production increases.
- The highest DOC concentrations occur in mid summer in conjunction with maximum air temperatures
- DOC concentrations decrease in late summer as temperatures decrease.

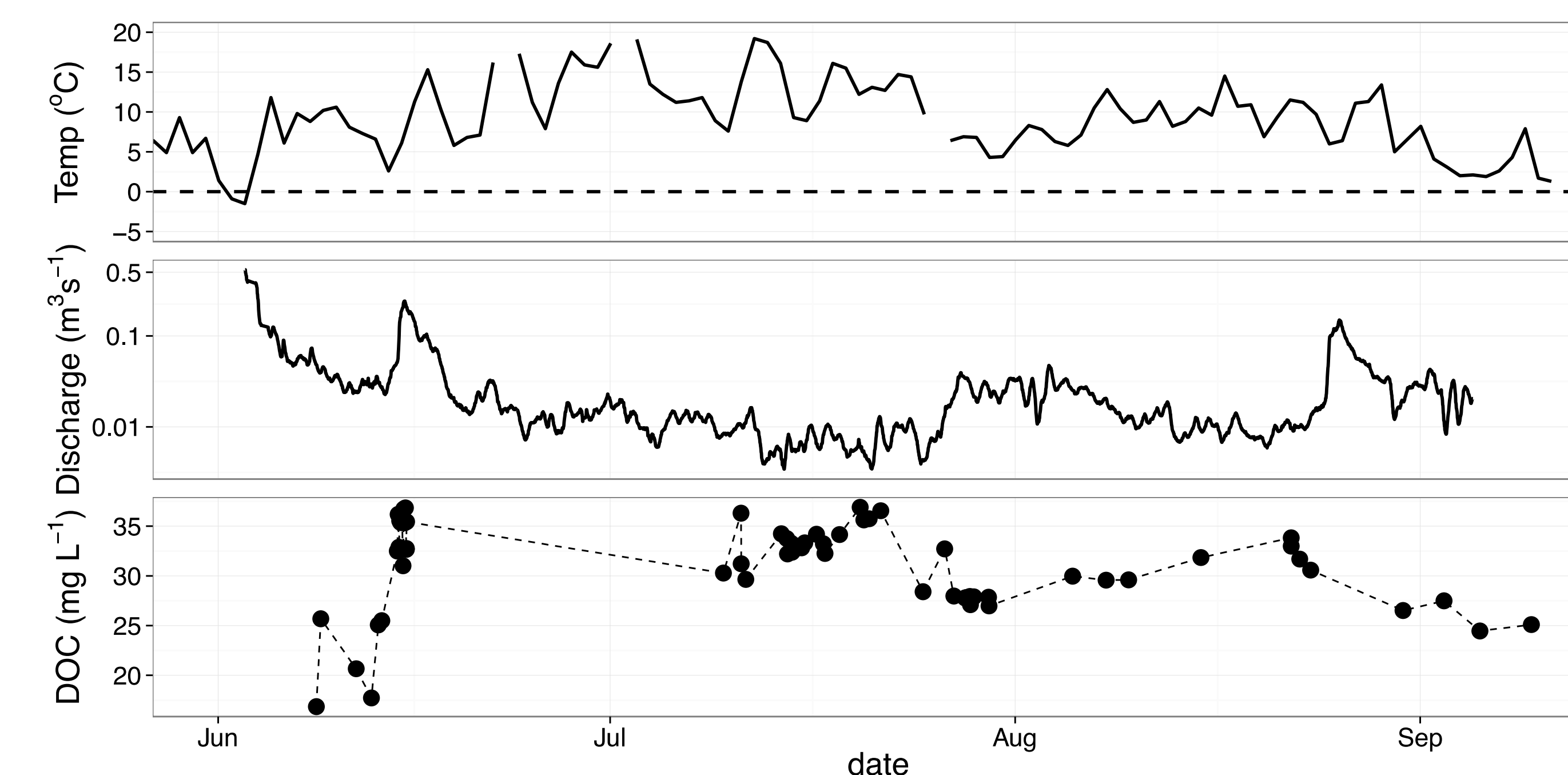


Figure 5. Air temperature, stream discharge and stream DOC throughout the thaw period, 2014.

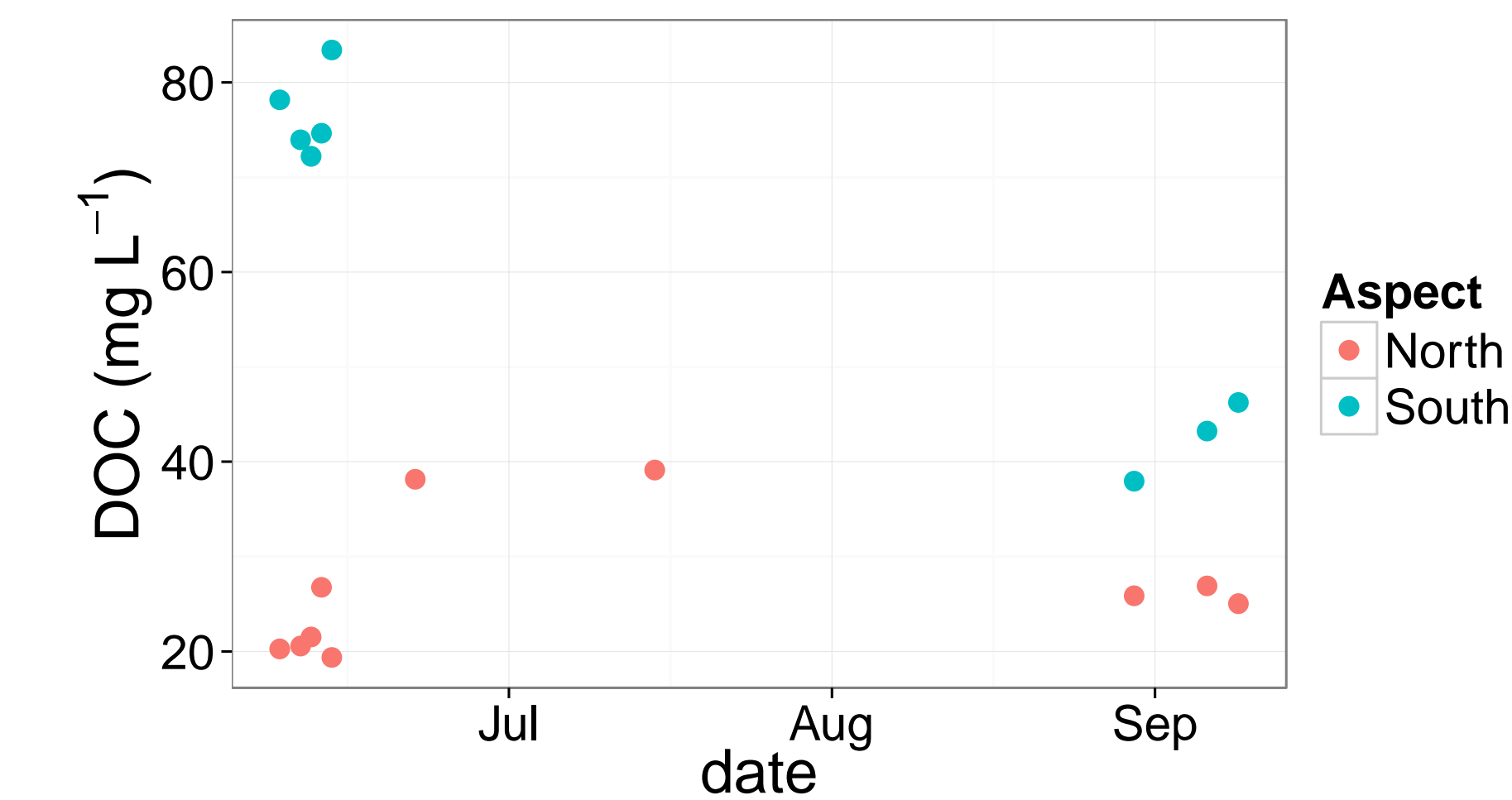


Figure 6. δD of soil water at two depths on a north and south facing slope

## SOIL WATER DOC

- The south facing slope has a much larger concentration in spring.
- The concentrations indicate stream water DOC is a mixture of the two slopes.
- The differences between the slopes is greatly reduced in late summer.

## SPATIAL TRENDS

- Snow melt from late lying snow packs on north facing slopes is shown in both the DOC and stable isotopes and at the same sites in June.
- Both DOC and isotopes show a mixture of both slopes in all locations of the catchment.
- Late summer stream water isotopes are much more enriched, indicating a dominant soil water source.

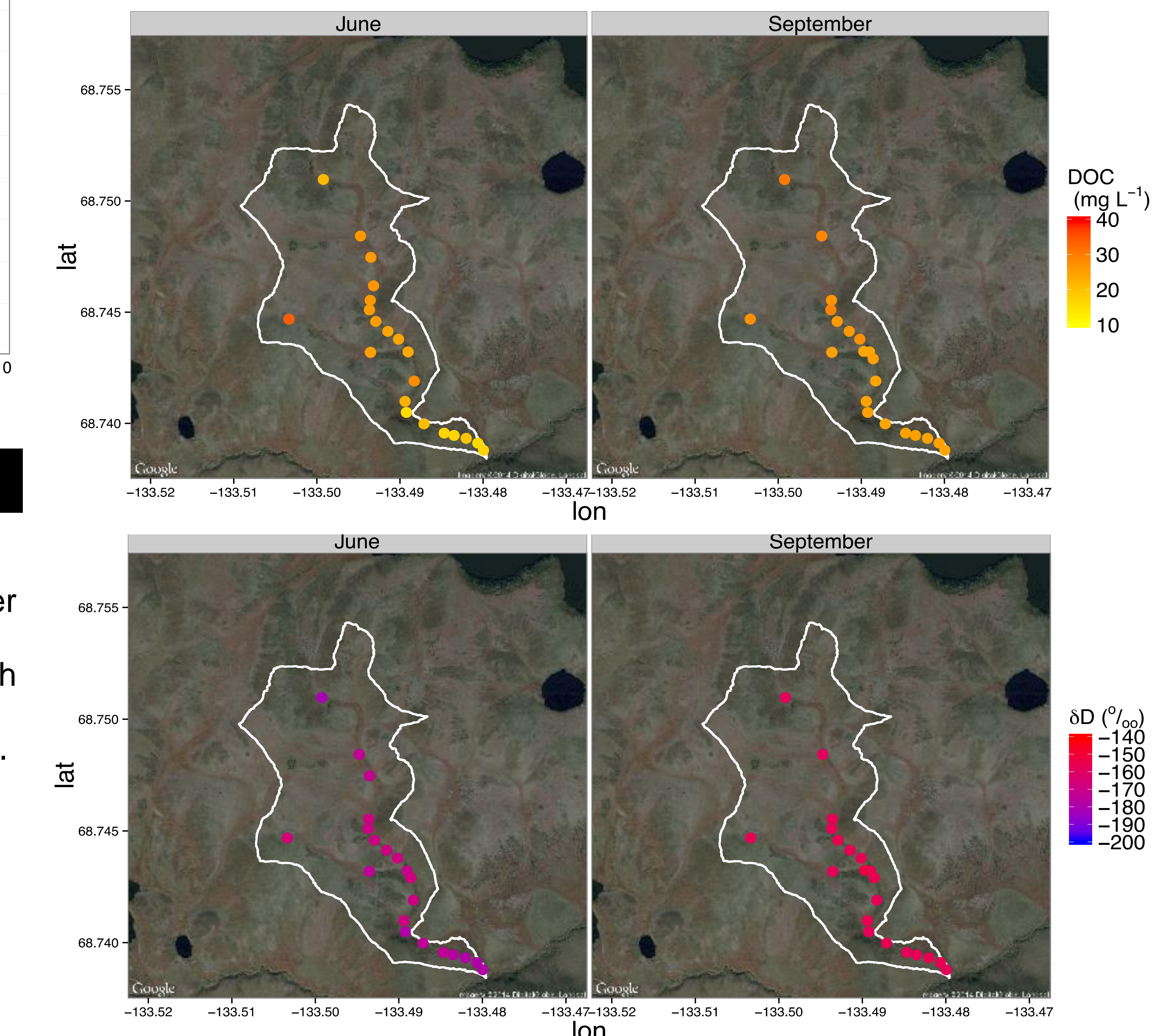


Figure 7. Spatial samples of DOC and δD collected in June and September.

## CONCLUSIONS

1. Deuterium provides valuable information on the flow paths and sources of water in the catchment.
2. Slope facing aspect has a large influence on DOC and stable water isotopes throughout the year.

## ACKNOWLEDGEMENTS

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