Water source dynamics in a high altitude, glacierized watershed: Suyuparina-Quisoquipina, Southern Peru

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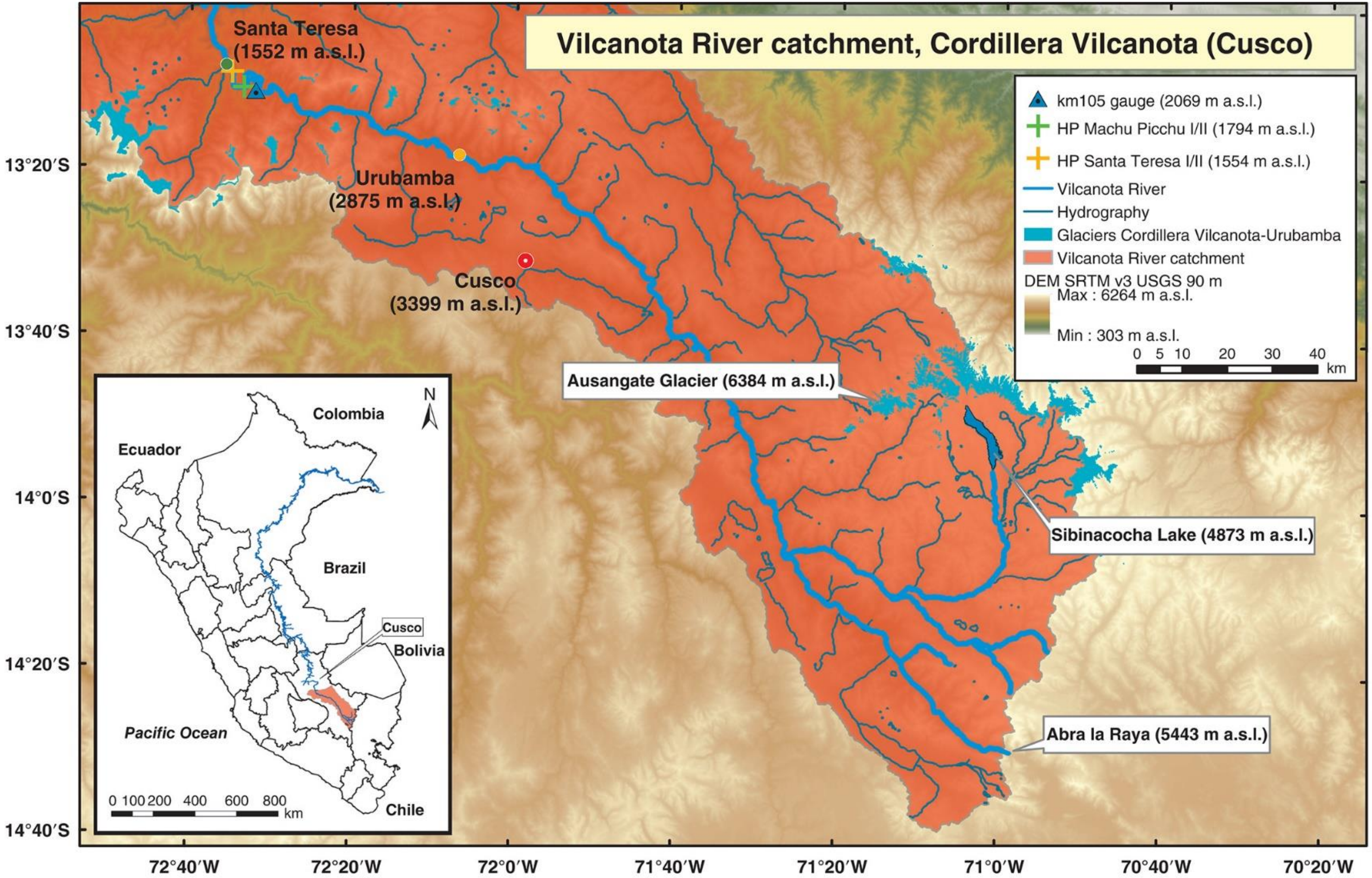


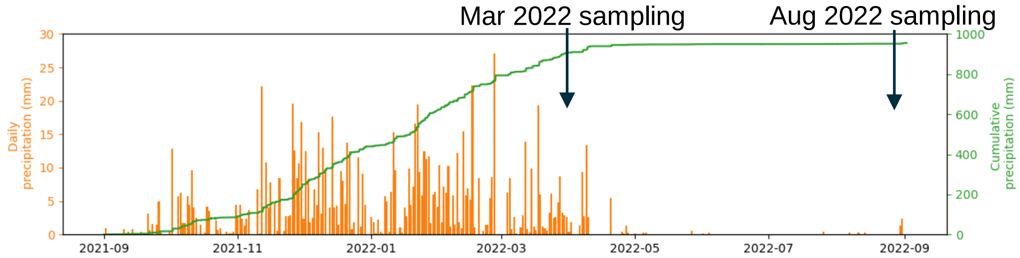
Drenkhan et al, 2015

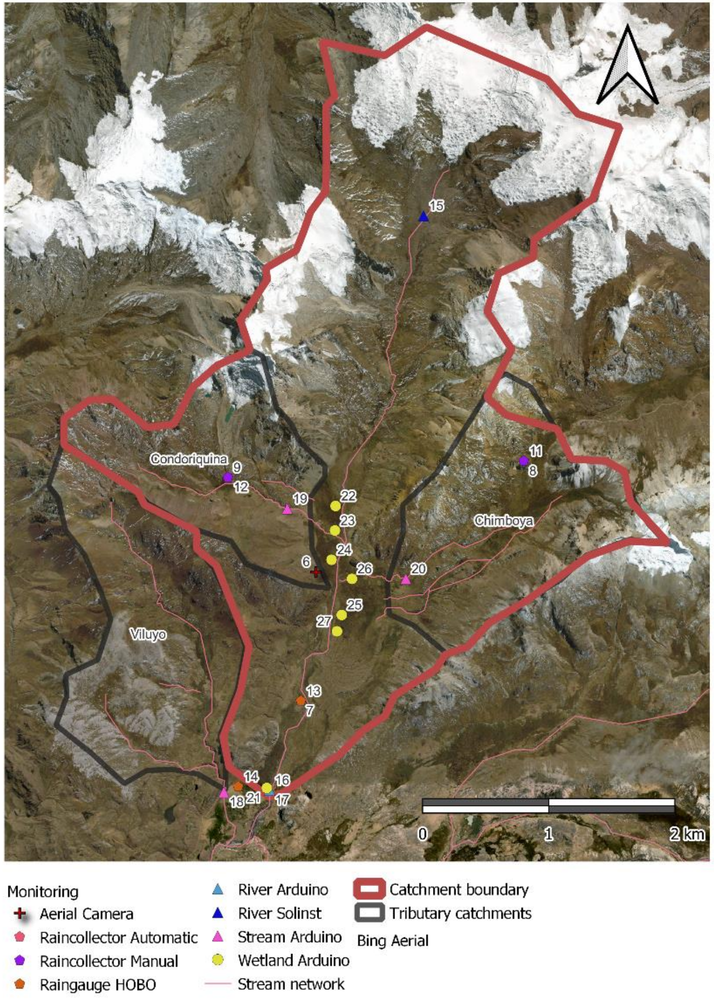
Introduction

- Tropical glacial retreat over the next century will have consequences for downstream water supplies in the Andes. In the Vilcanota-Urubamba river basin in southern Peru, glacial meltwater buffers water supply to downstream populations during the long April – September dry-season (Buytaert et al, 2017).
- Facing ongoing glacial decline, understanding the storage and release dynamics of other catchment stores is a key research question (e.g. Mark and Mckenzie, 2007; Hill et al, 2018)
- It has recently been hypothesised that the impact of glacier retreat extends beyond the immediate downstream melt river, and remote-sensing studies have linked differences in glacial melt contributions to changes in the prevalence of extensive high-altitude tropical wetlands, known as bofedales (Polk et al, 2017; Dangles et al, 2017).

Study area

- Suyaparina-Quisoquipina catchment, Vilcanota basin
- Recently expanded hydrometric monitoring (4 x stream level sensors, 2 x tipping bucket gauges, 7 x wetland wells, 3 x precipitation samplers)

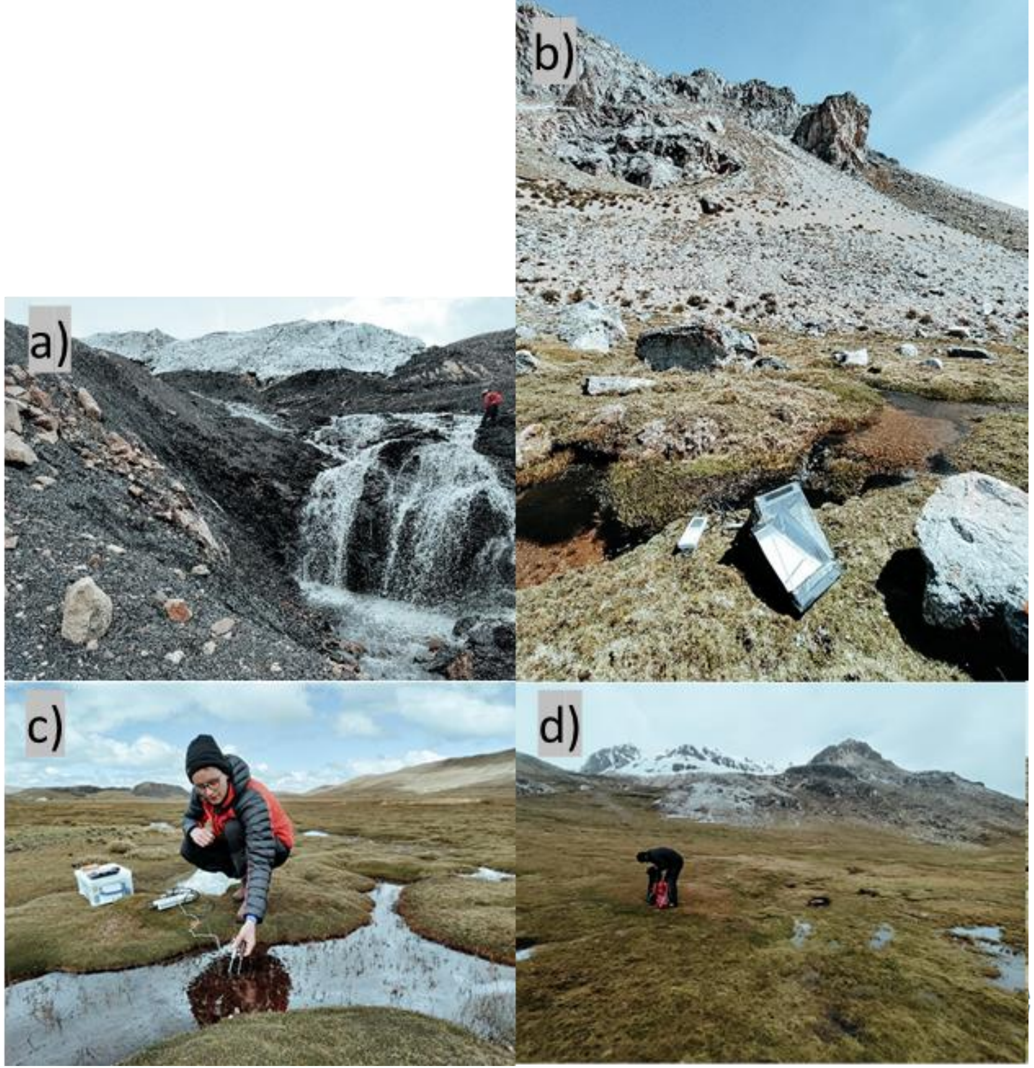




Research questions

In a glacierised, headwater catchment…

1. What are the spatio-temporal contributions of glacial melt and precipitation to stream discharge, and how important are intermediate stores for modulating the delivery of source waters?
2. To what extent are wetlands recharged by glacial melt?

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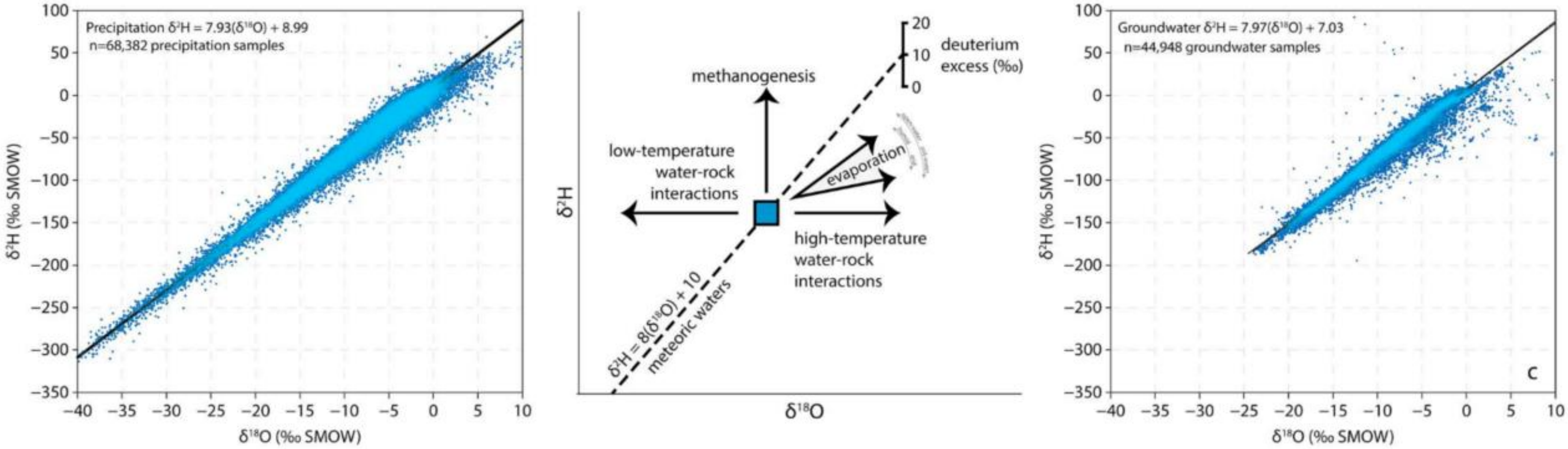
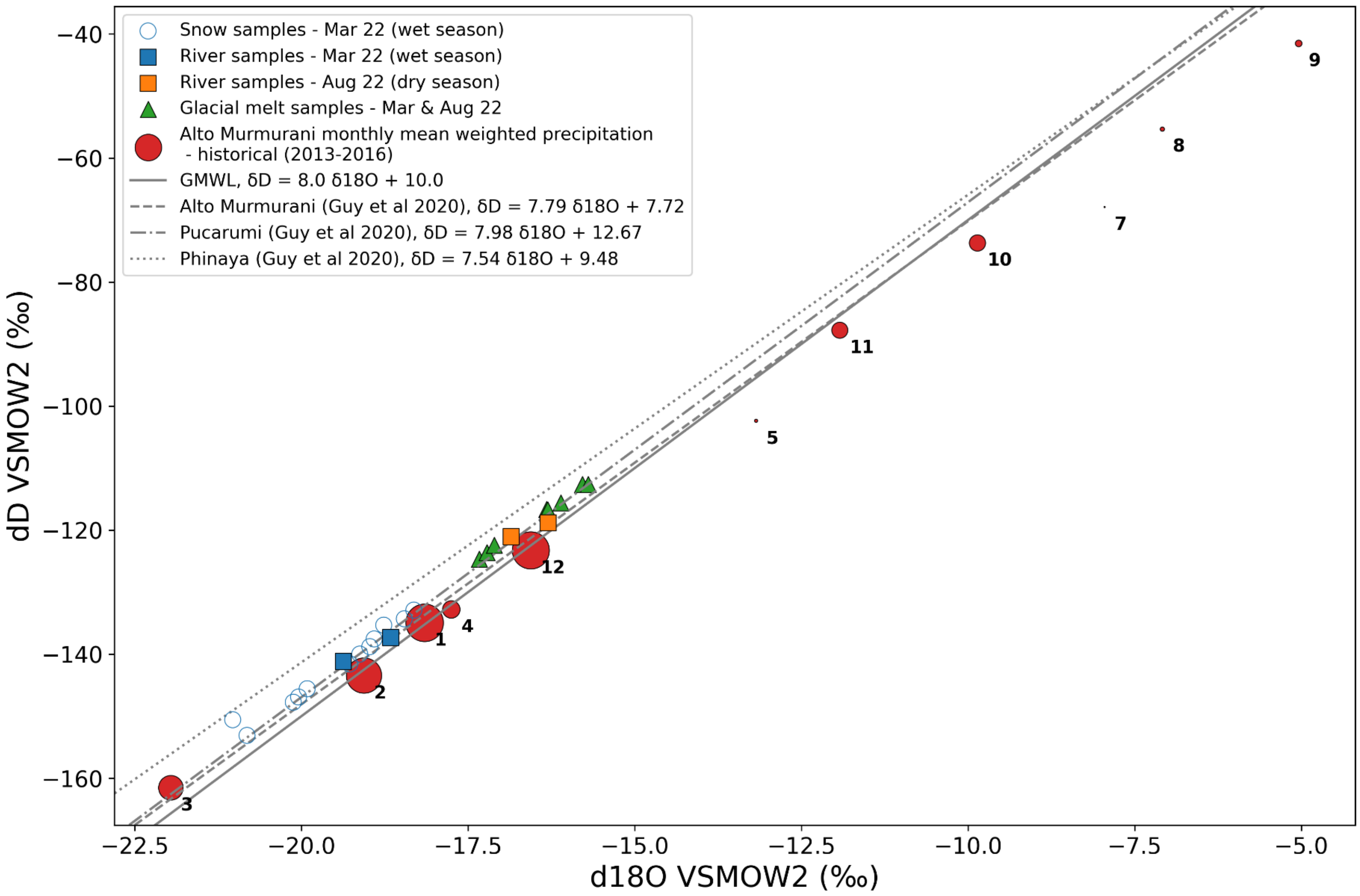
Background - stable isotopes



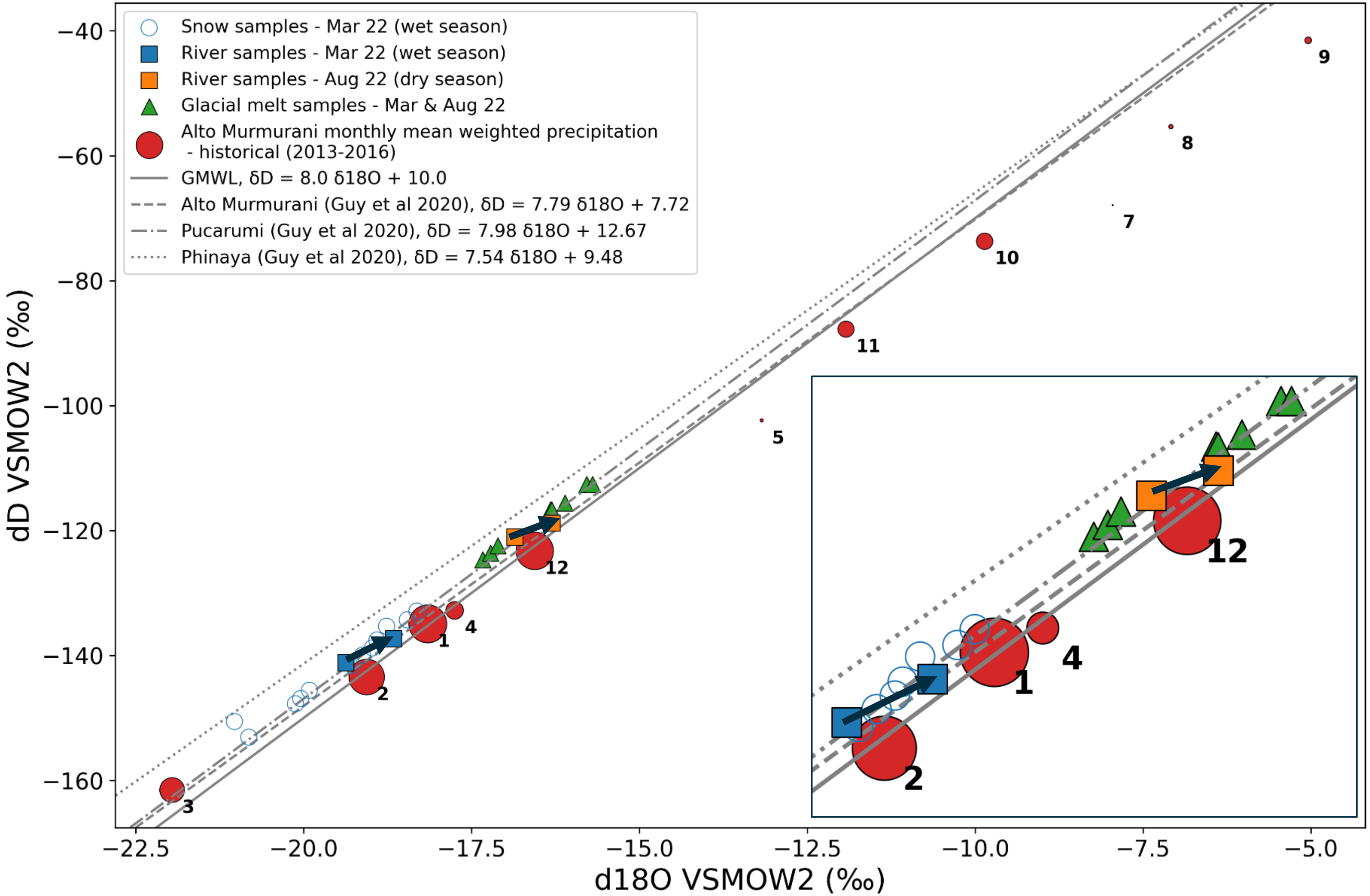
Jasechko et al, 2019

Results

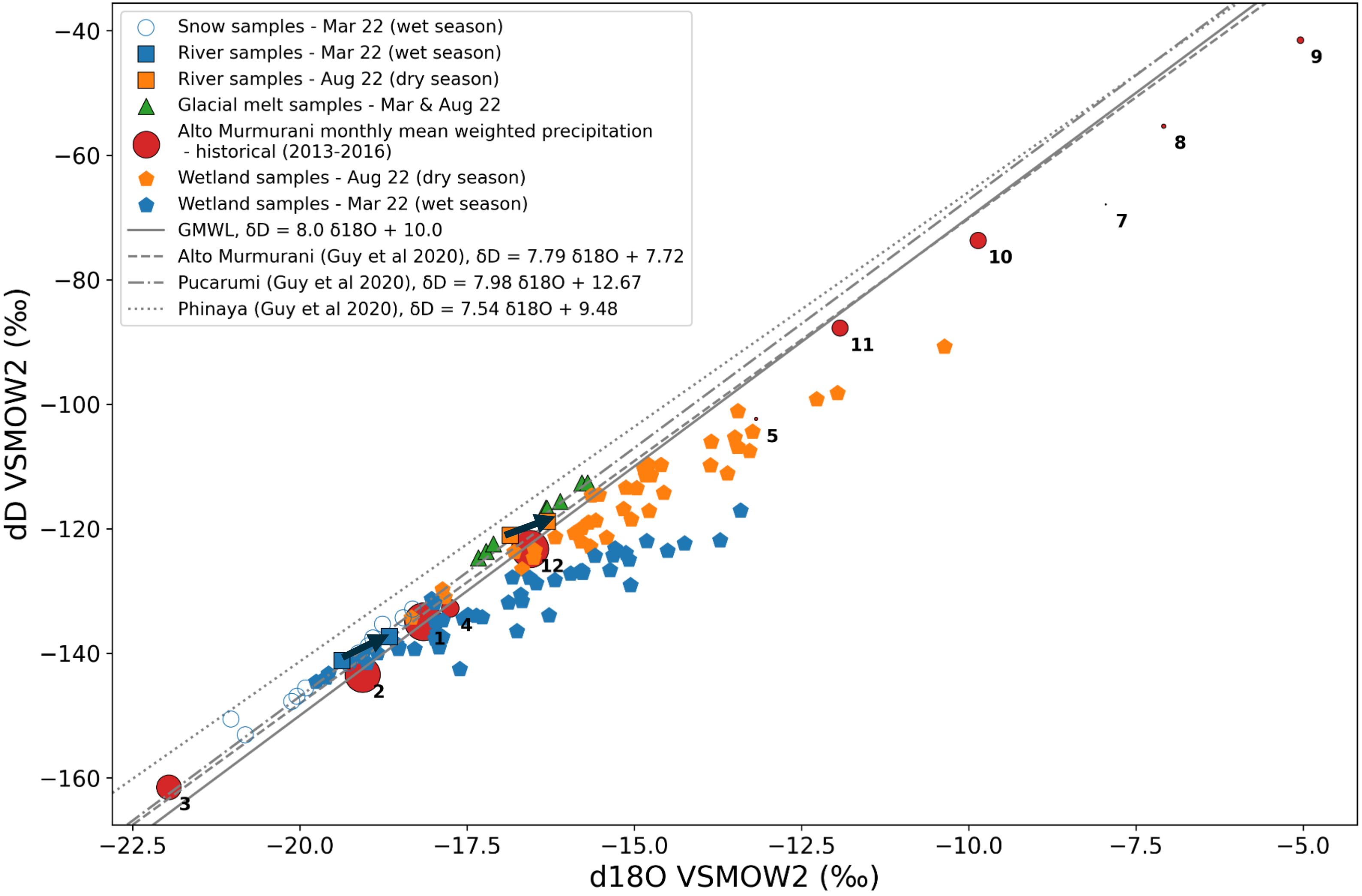
1a. Source water signatures



1a. Source water signatures



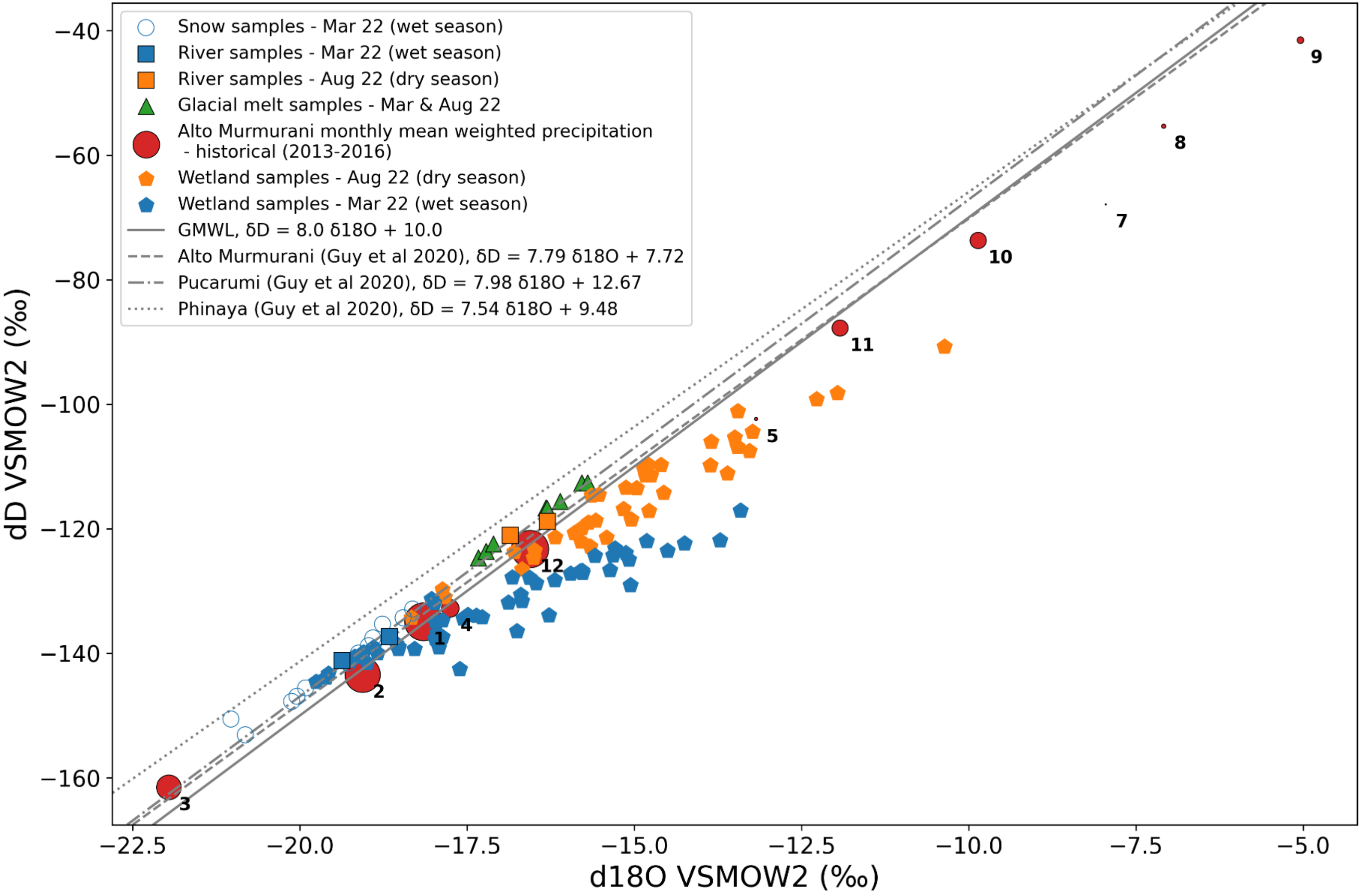
1b. Wetland samples



Low-cost precipitation autosamplers

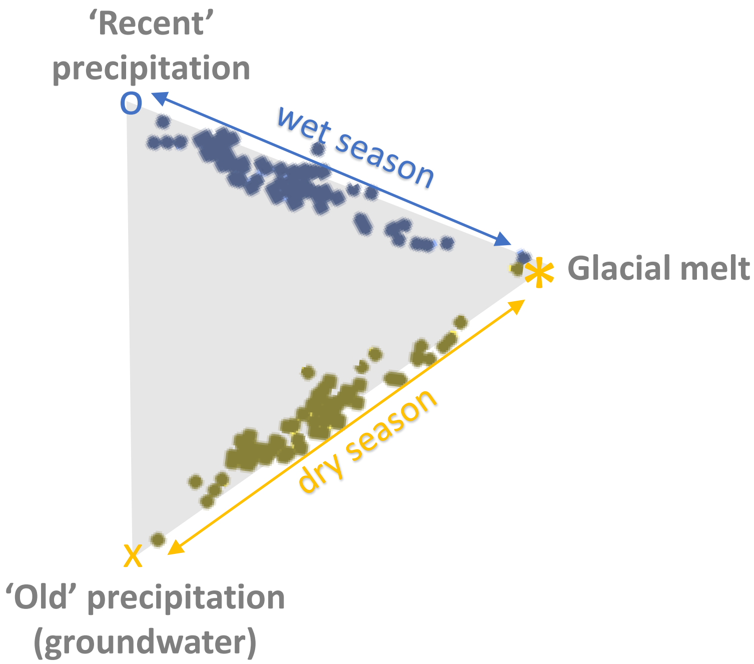
Precipitation autosampler design adapted from Michelsen, 2019

2a. Wetland samples



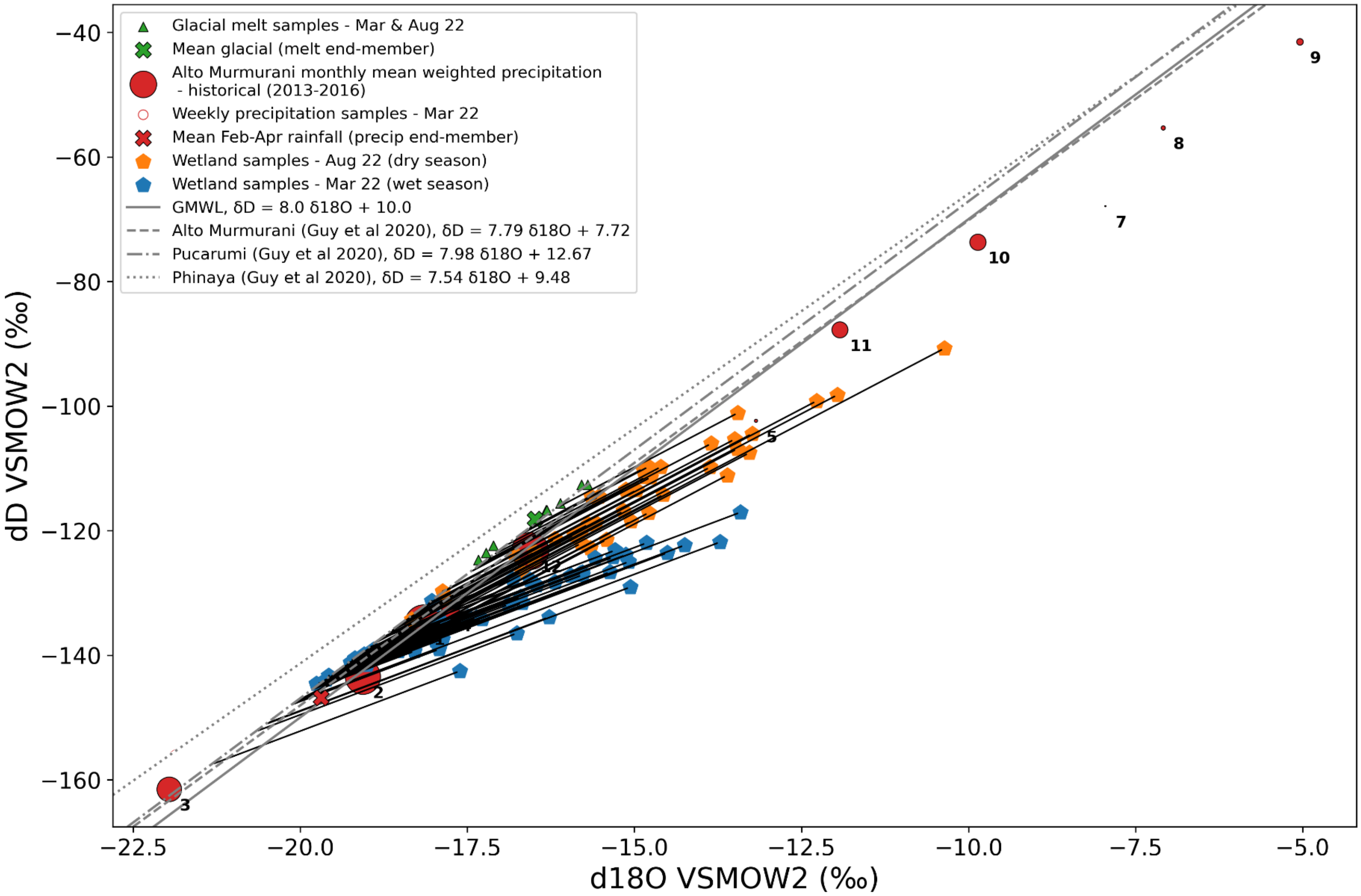
BGS

Water source conceptualisation

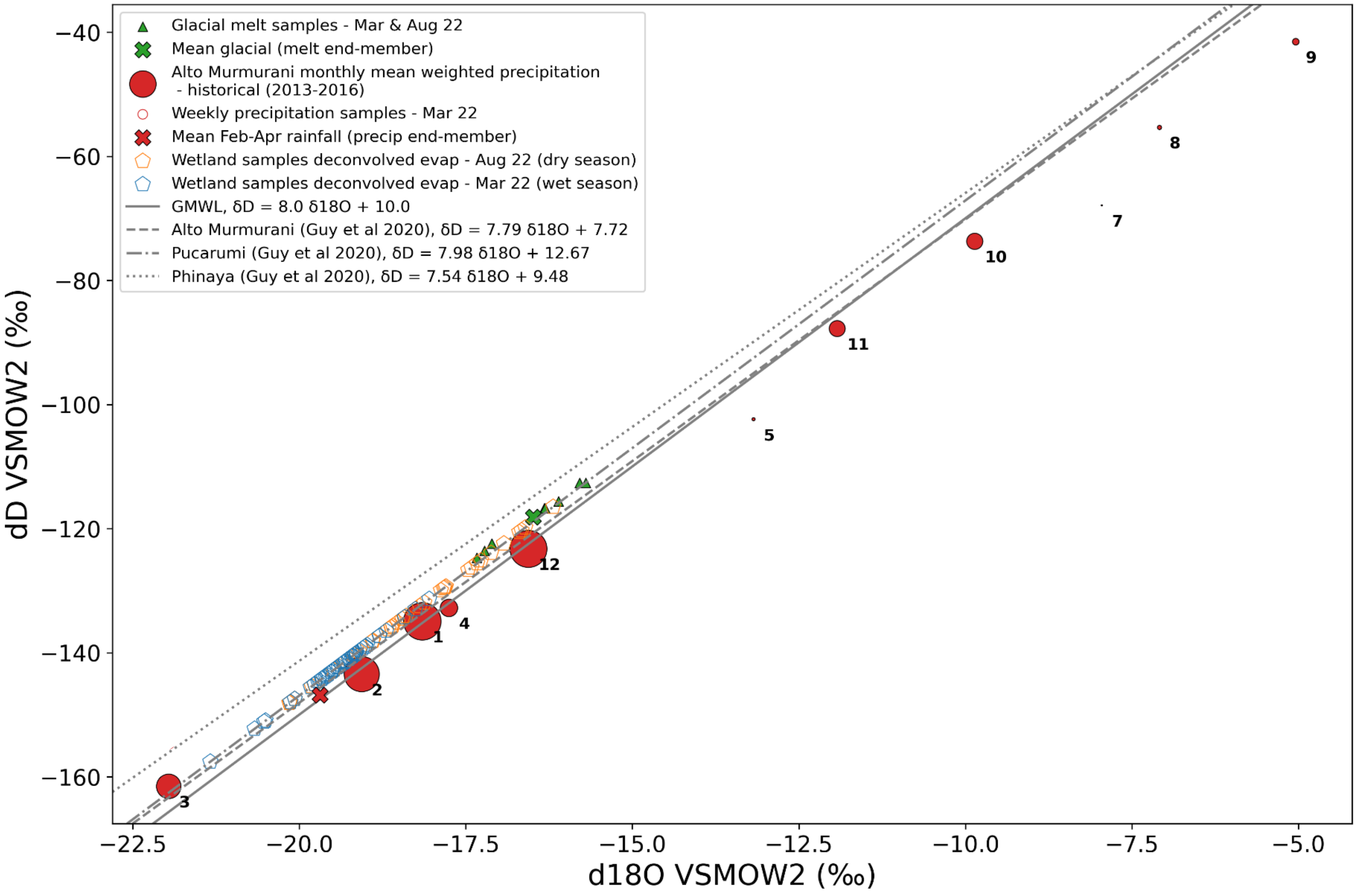


x = dry season groundwater spring topographically disconnected from a glacier
** = dry season melt from glacier snout*
o = 'Recent' precipitation end-member, where the time window is estimated by adjusting the integrating window of the weighted precipitation until a best fit is achieved with wet season wetland samples from areas topographically disconnected from glaciers

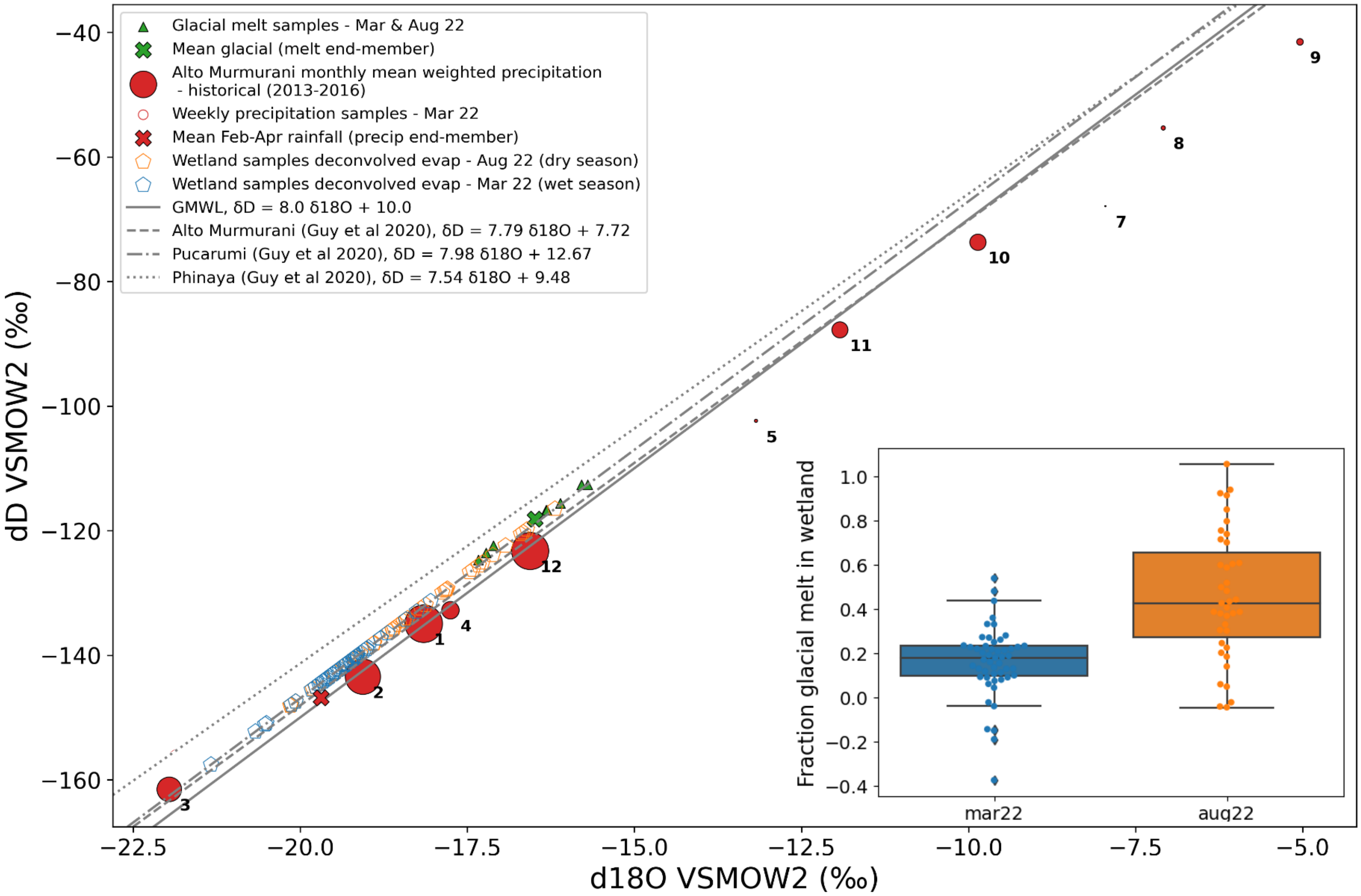
2b. Wetland samples – evaporation line



2c. Wetland samples – deconvolved evaporation



2d. Melt fraction in wetland



Summary

- Wetland water samples are evaporated in both the dry and the wet seasons
  - Evaporation lines with slopes of 4.0 in March 2022, and 5.6 in August 2022
- Initial evidence indicates that an evaporated 'wetland' signature may be imprinted on stream water
  - To confirm this finding, LMWL need to be derived for precipitation at different elevations within the catchment
- Initial evidence indicates a dry-season isotopic shift in wetlands toward the glacial melt end-member, however groundwater contributions may produce the same effect
  - As a next step, we will compare the inter-site isotopic variability to understand the importance of groundwater for the analysis