

# Preliminary results from the Upper Renegado River (Valle Hermoso) Catchment: fieldwork and modeling activities

Sebastián A. Krogh<sup>1</sup>, Anelim Bernal<sup>1</sup>, Bastián Morales<sup>1</sup>, and James McPhee<sup>2</sup>

<sup>1</sup> Universidad de Concepción, Chile

<sup>2</sup> Universidad de Chile, Chile

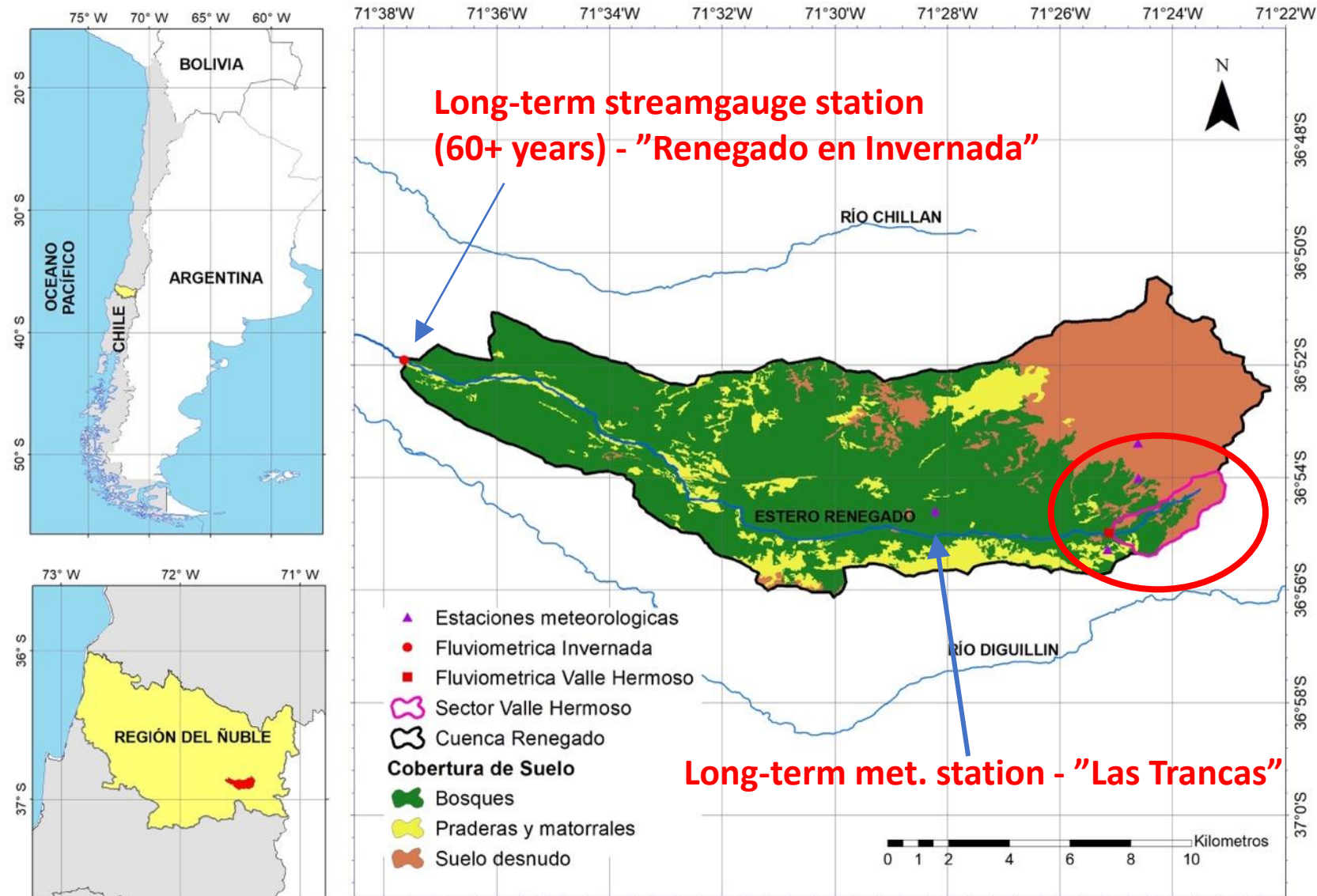


# AGENDA

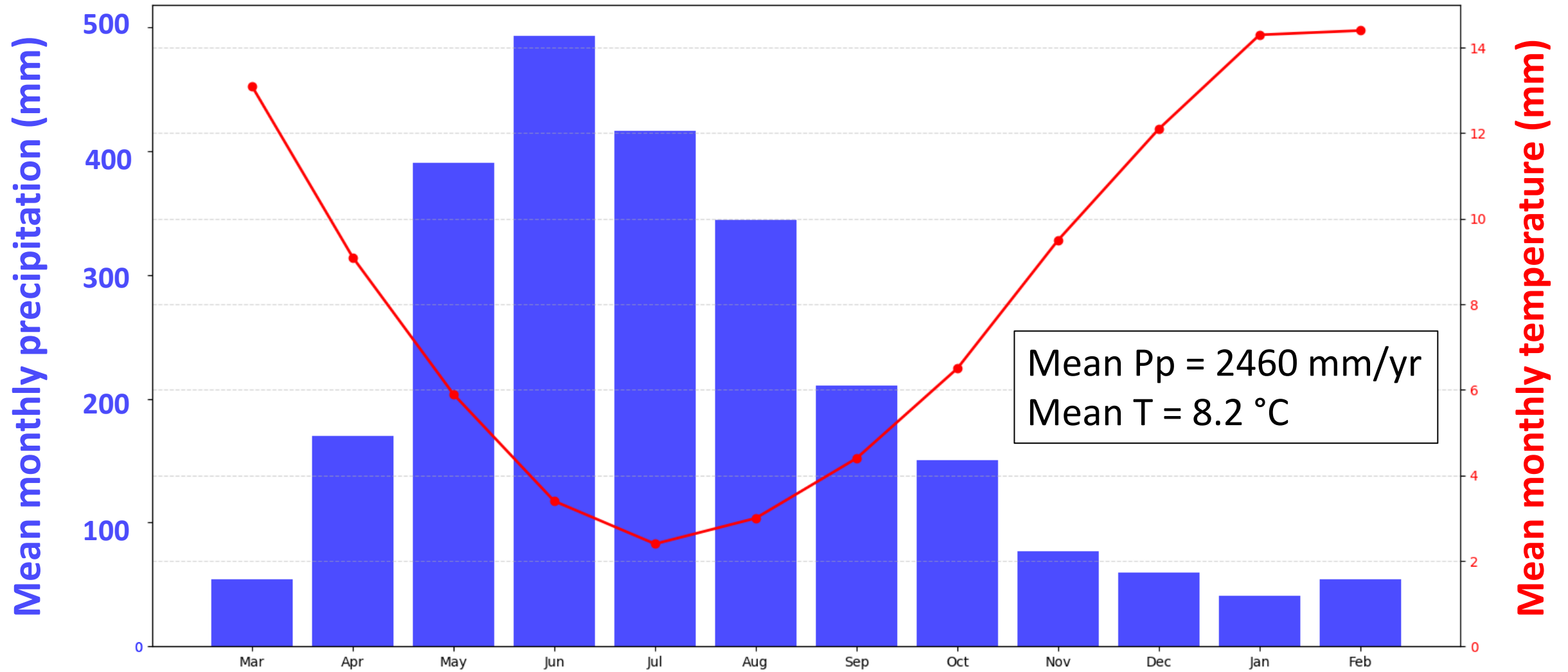
- Quick overview to the Upper Renegado Creek Catchment (Valle Hermoso)
- Instrumentation and fieldwork activities 2022-2023 seasons
- CRHM model configuration and preliminary results

# The Upper Renegado Creek Catchment (Valle Hermoso)

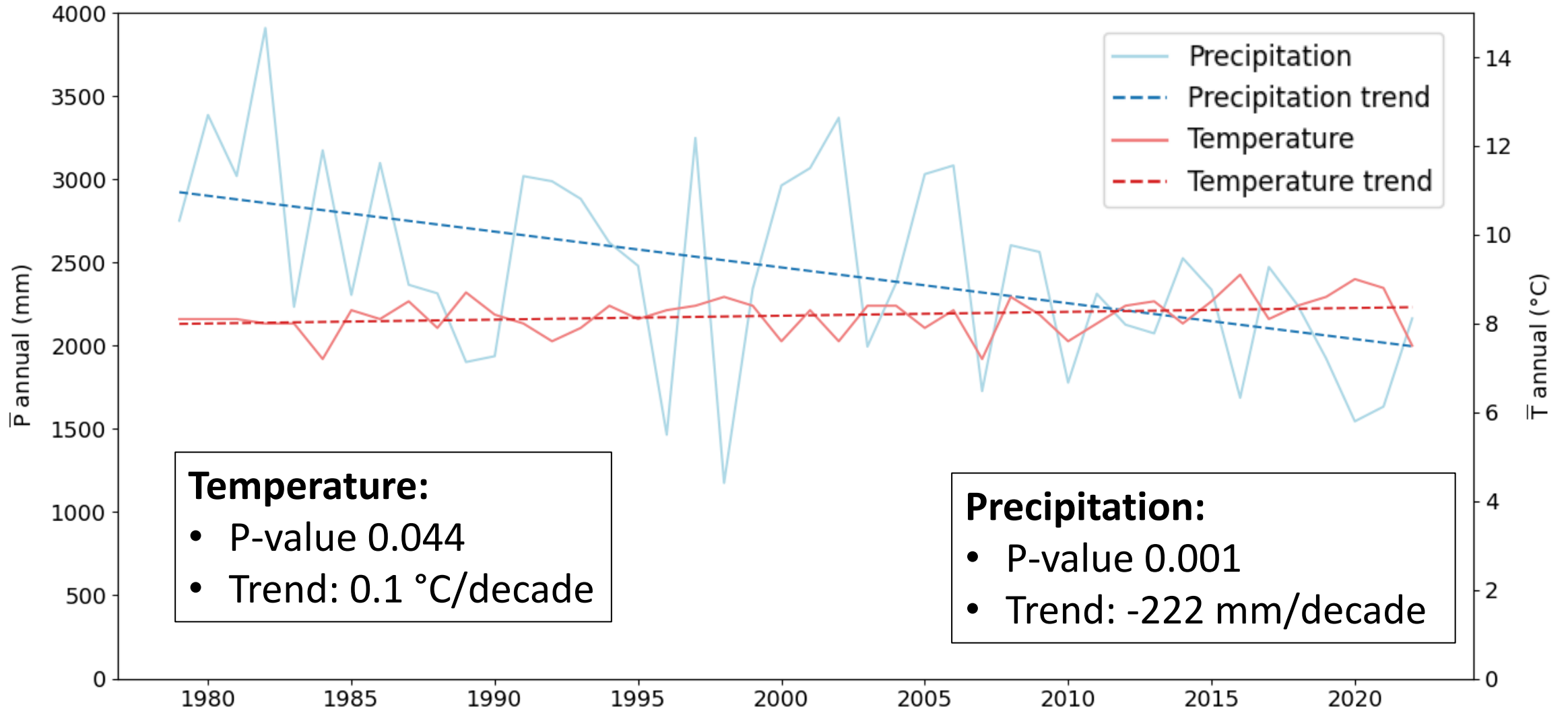
- Located in the Central-South region of Chile ( $36^{\circ}54'S$ )
- At the southwestern slopes of the **Nevados de Chillán Volcanic Complex**
- Headwater of the Itata River Catchment – provides water resources to ~480,000 people – **Agriculture**
- **Nearby sky resort – recreational value**



# Climatology: 1979-2022



# Meteorological Trend Analysis

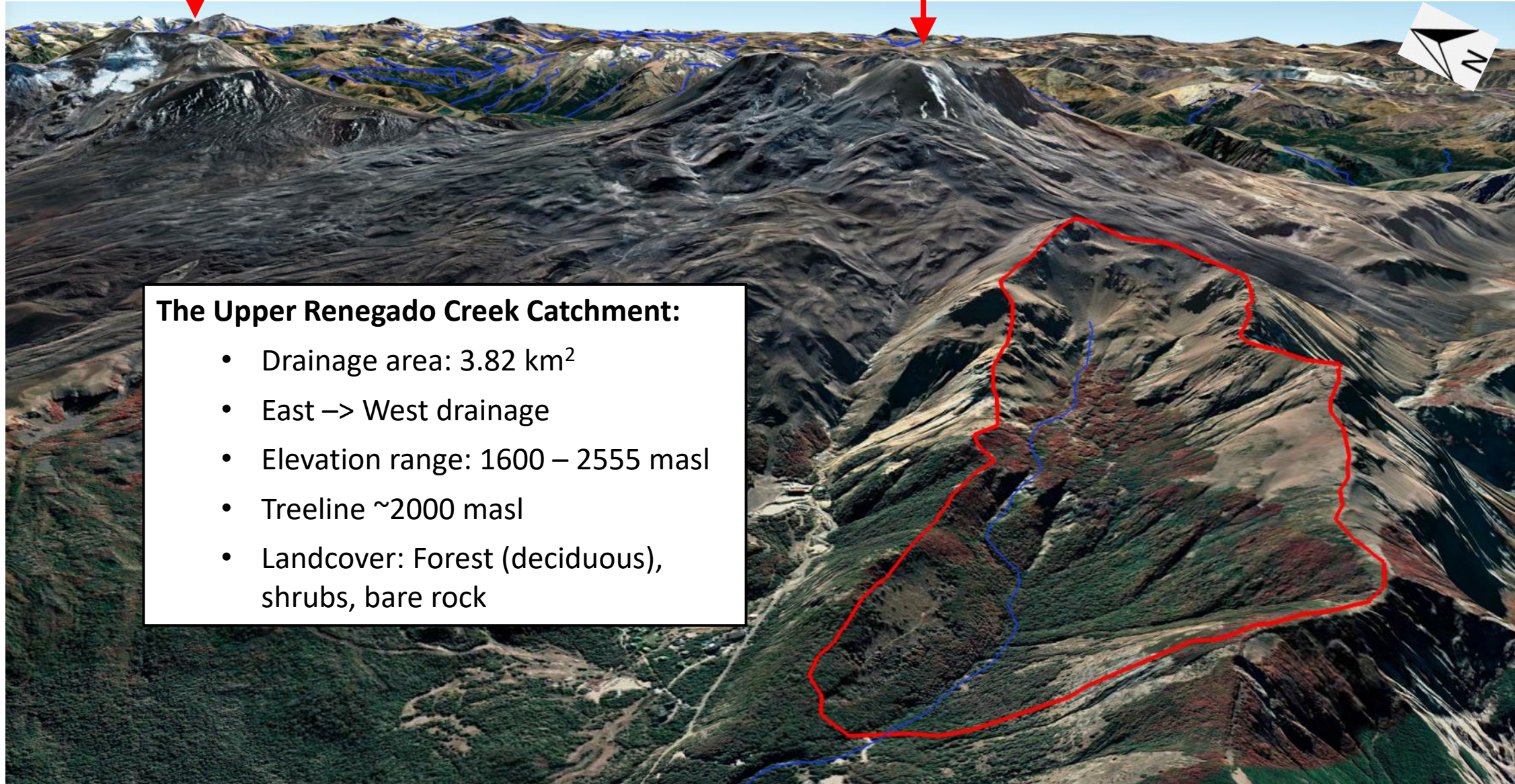




# NEVADOS DE CHILLÁN

## VOLCANO

## VOLCAN CHILLÁN



### The Upper Renegado Creek Catchment:

- Drainage area: 3.82 km<sup>2</sup>
- East → West drainage
- Elevation range: 1600 – 2555 masl
- Treeline ~2000 masl
- Landcover: Forest (deciduous), shrubs, bare rock

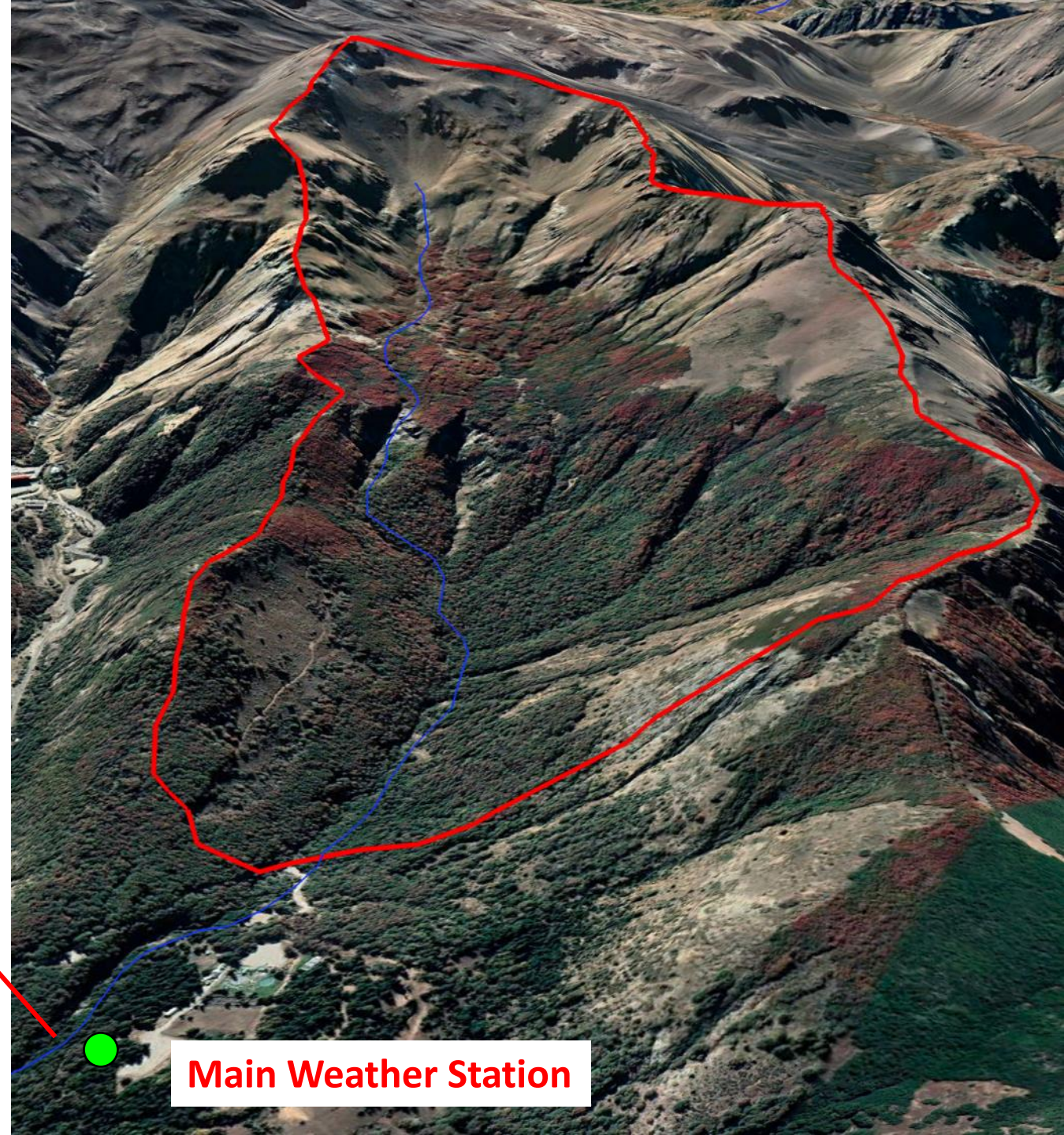


# Current Instrumentation /Activities



- Net Radiometer
- Windspeed and direction
- Air temperatura and Humidity
- Snowdepth
- Snow Scale\*
- Pluvio\*

\*technical issues



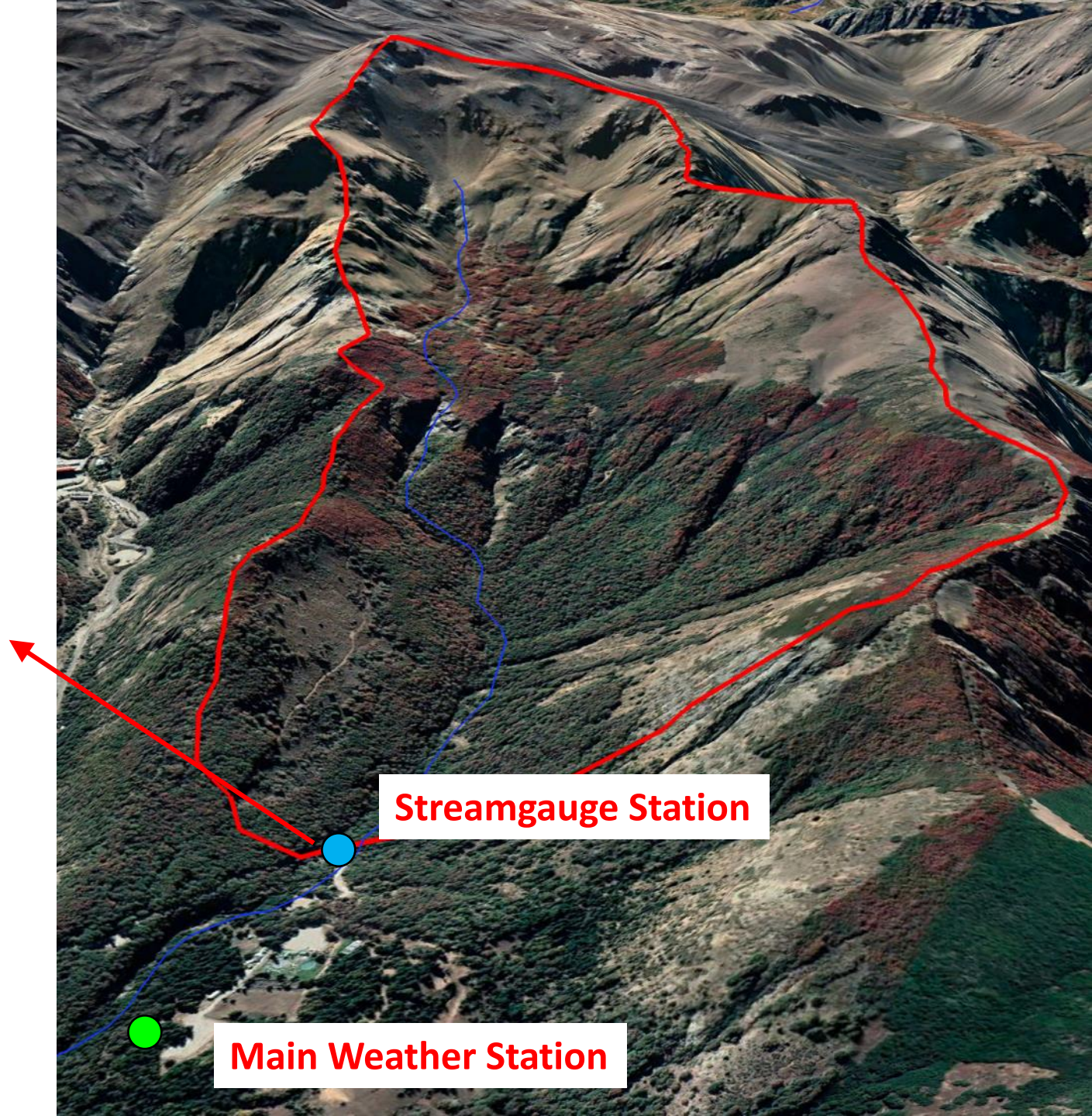
**Main Weather Station**



# Current Instrumentation /Activities



~Montly gauging

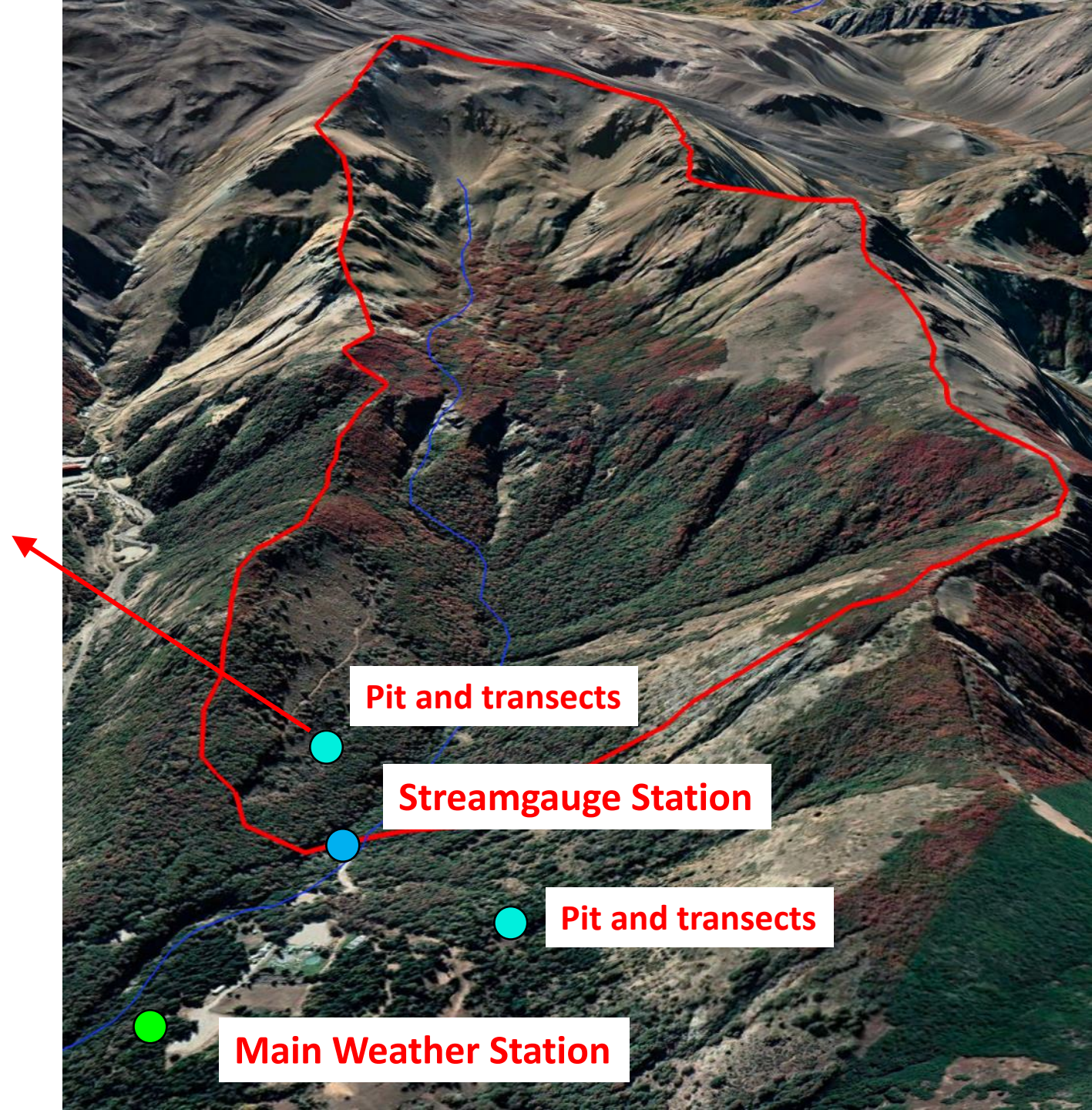




# Current Instrumentation /Activities



- Snow pits (open)
- Snow transects (depth only) > under the canopy and open
- North facing vs south facing



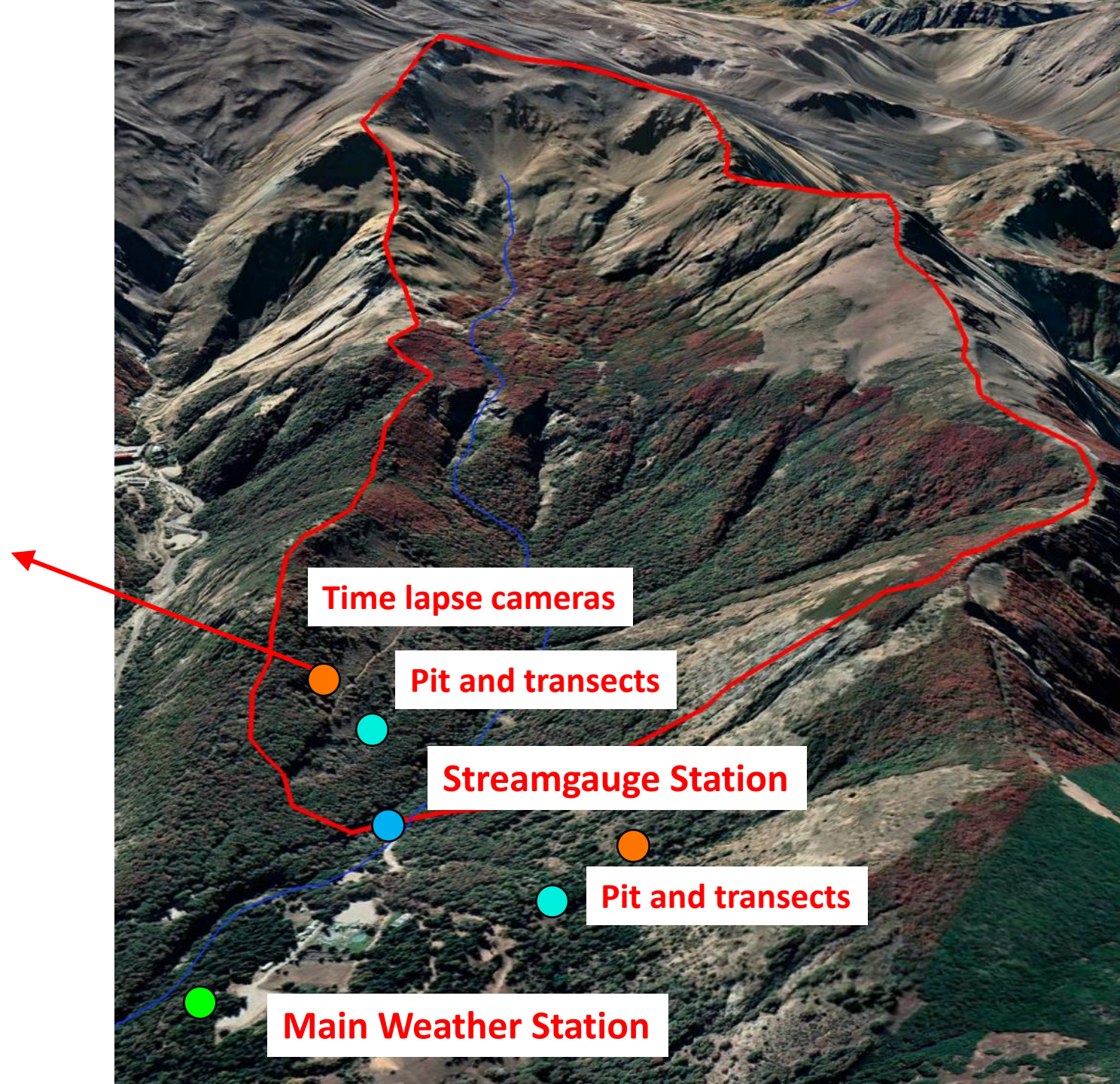


# Current Instrumentation /Activities



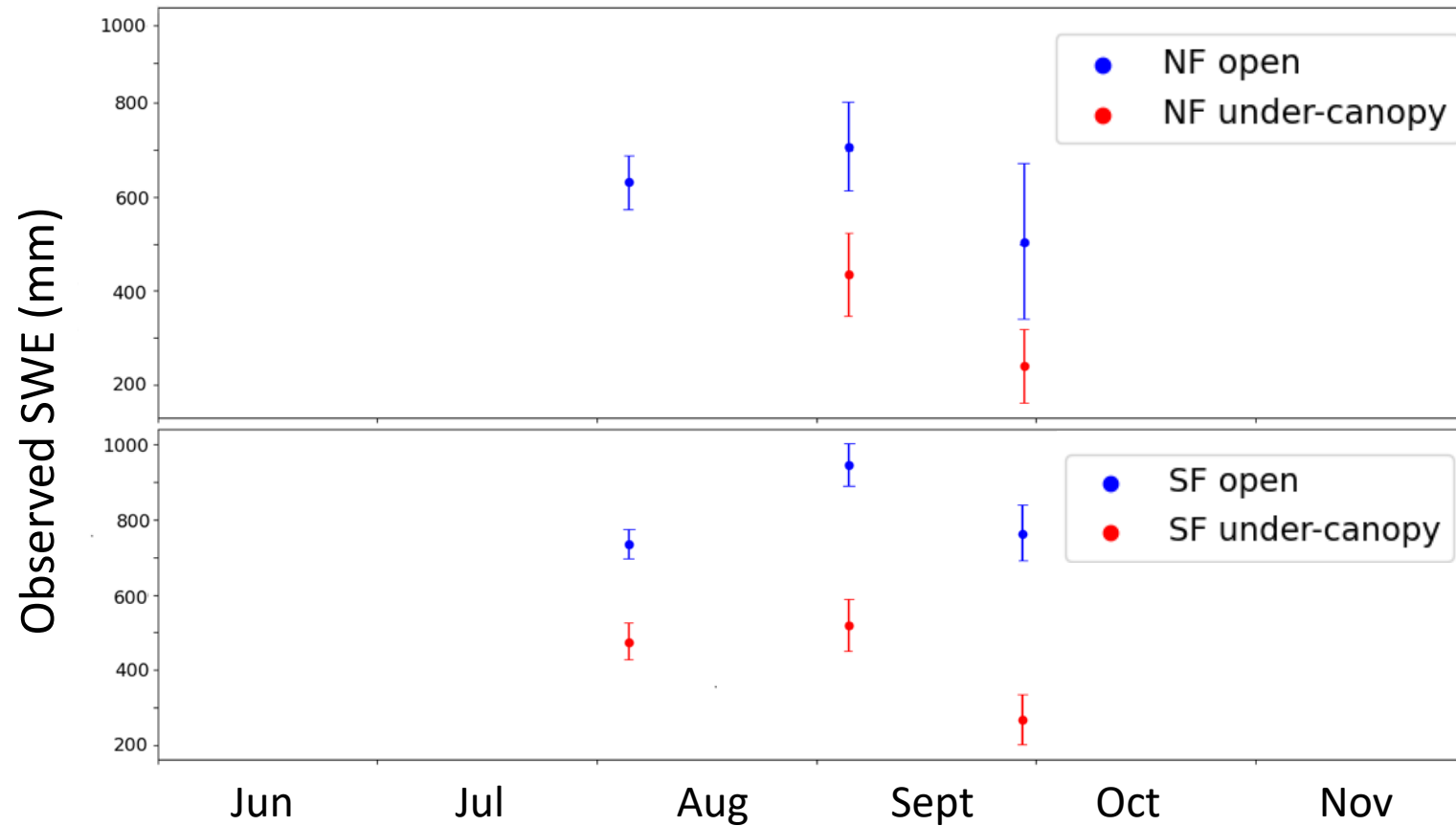
**2023:**

- 3-hourly
- Open vs under canopy
- Snow transects: under the canopy and open
- North facing vs south facing





# Observations from the 2022 Winter season

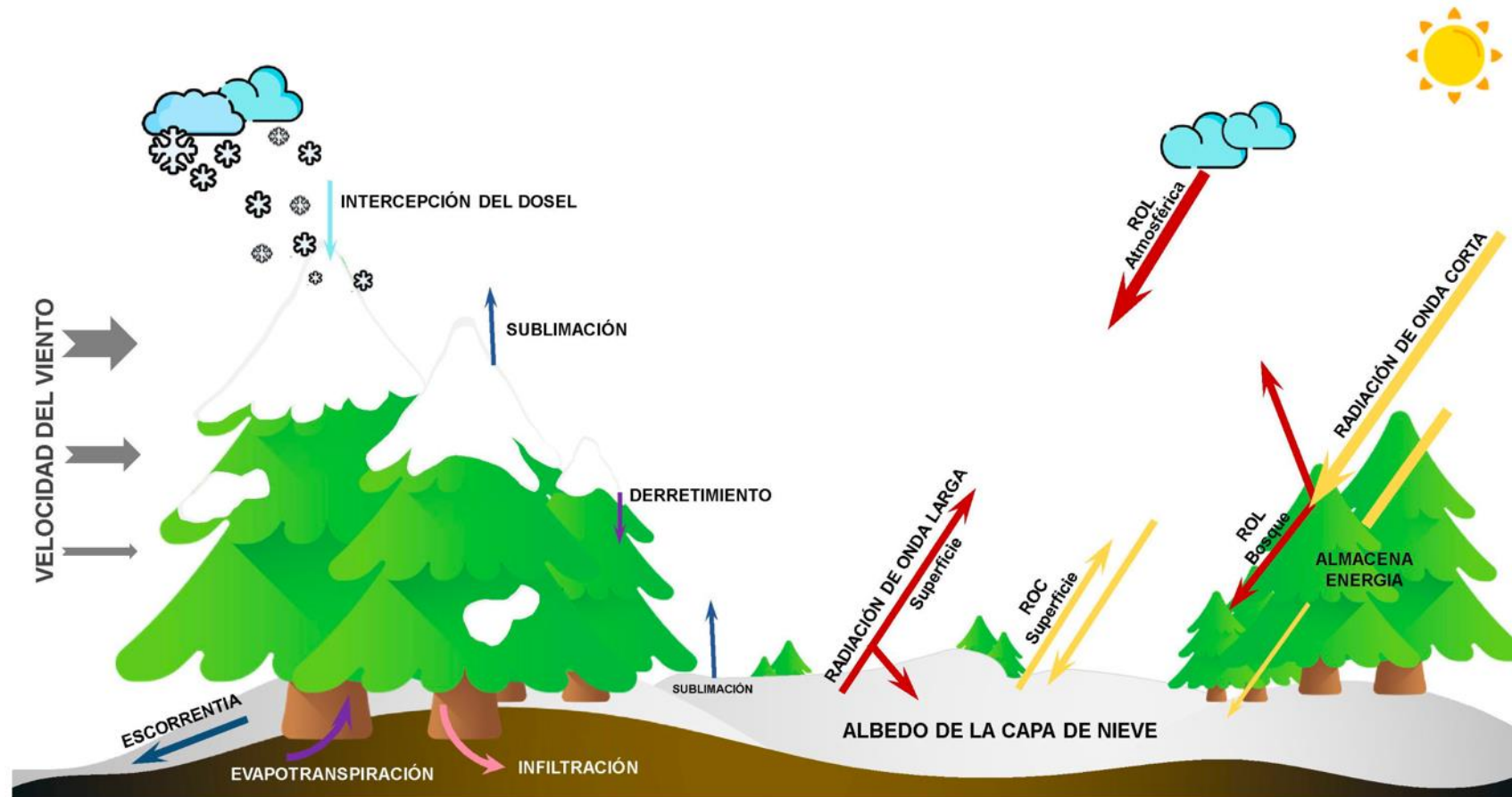


- North-facing slope (sunny side) has about 30% less peak SWE (similar elevation)
- Open site has 48% about more snow accumulation than in the open

\*SWE under the canopy was calculated assuming the same density as in the open

# Current Modeling Activities

**Guiding question:** How much does tree coverage and slope orientation affect snowpack dynamics in the southern Andes? – Impacts downstream under different years and projections



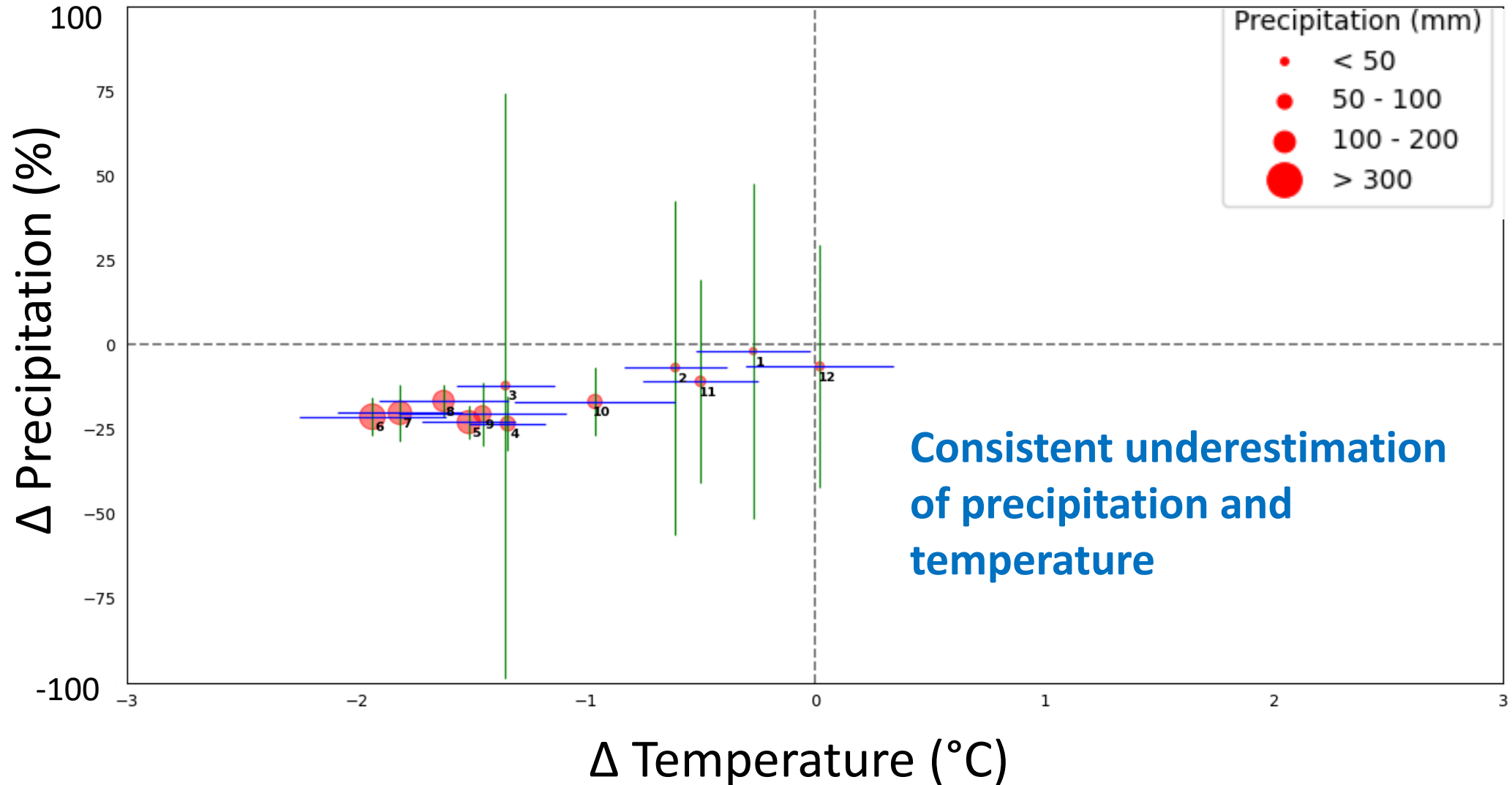
Schetch: Anelim Bernal



# Current Modeling Activities

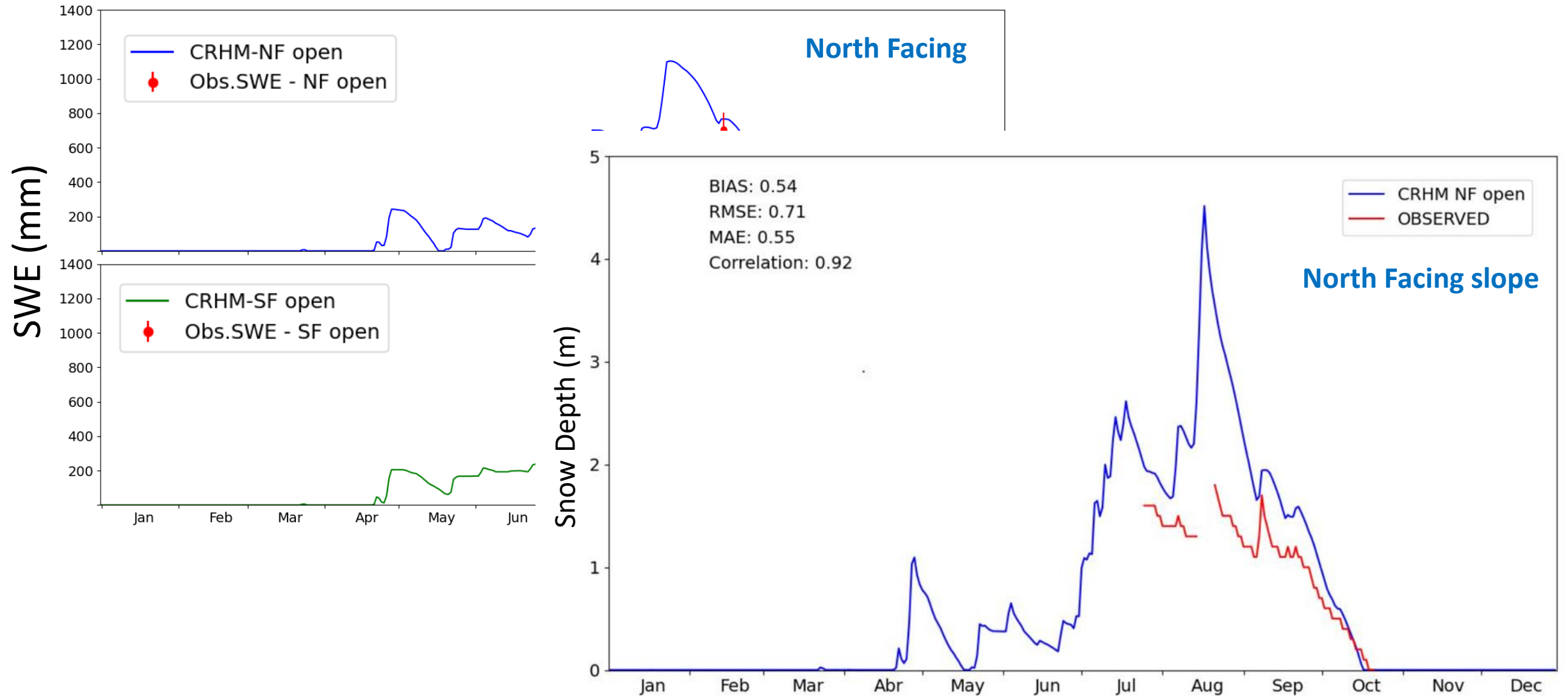
- CRHM model set up at point-scale (4 HRU)
- Open vs under the canopy
- South facing vs north facing
- Preliminary 2022 Winter season validation
- Long-term simulation forced with bias-corrected ERA5-Land meteorology: pp, temp, u ,rh, SW, LW

# ERA5-Land (~10-km) vs observed data: monthly bias

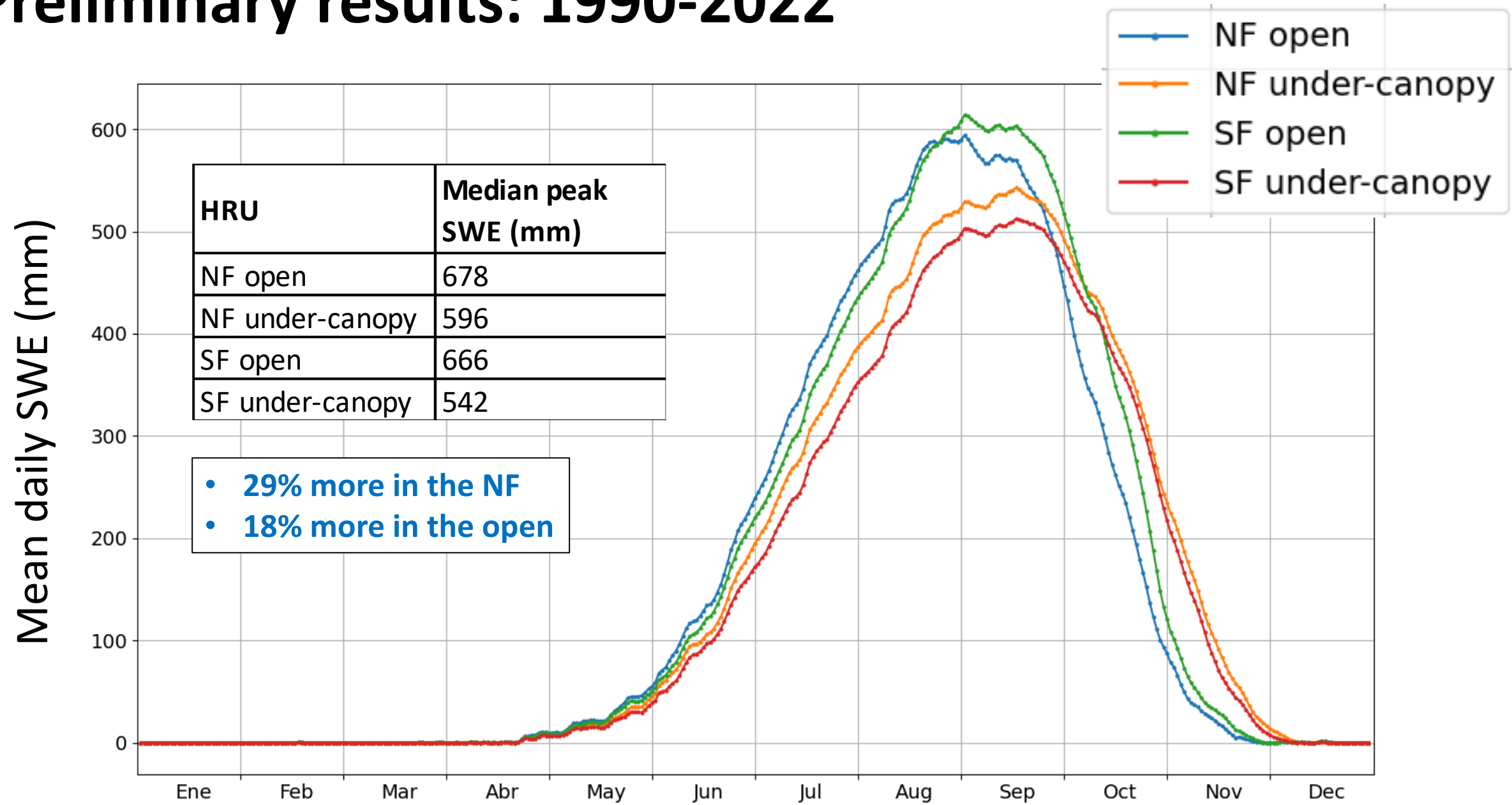




# 2022 winter season SWE Validation

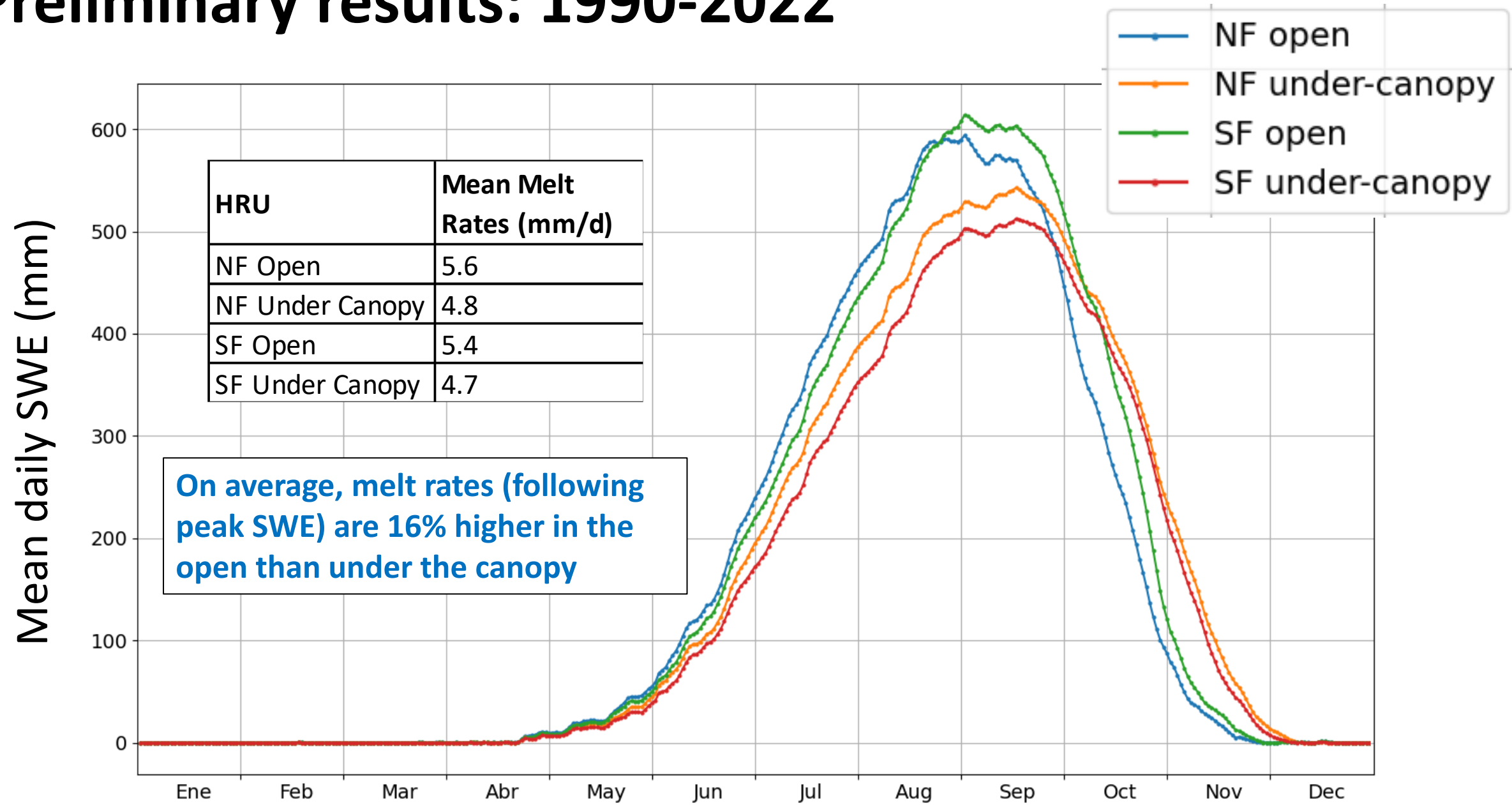


# Preliminary results: 1990-2022

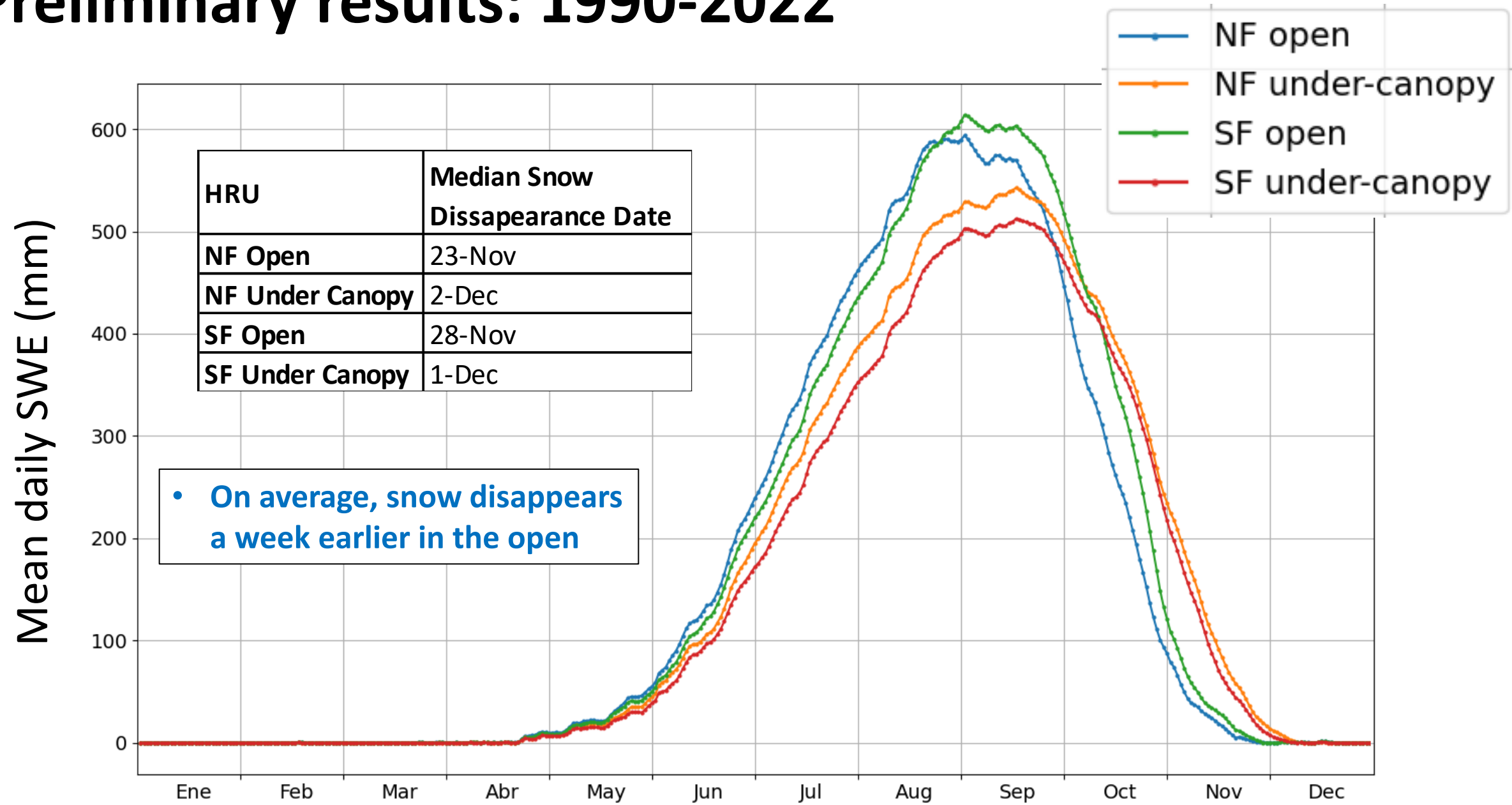




# Preliminary results: 1990-2022



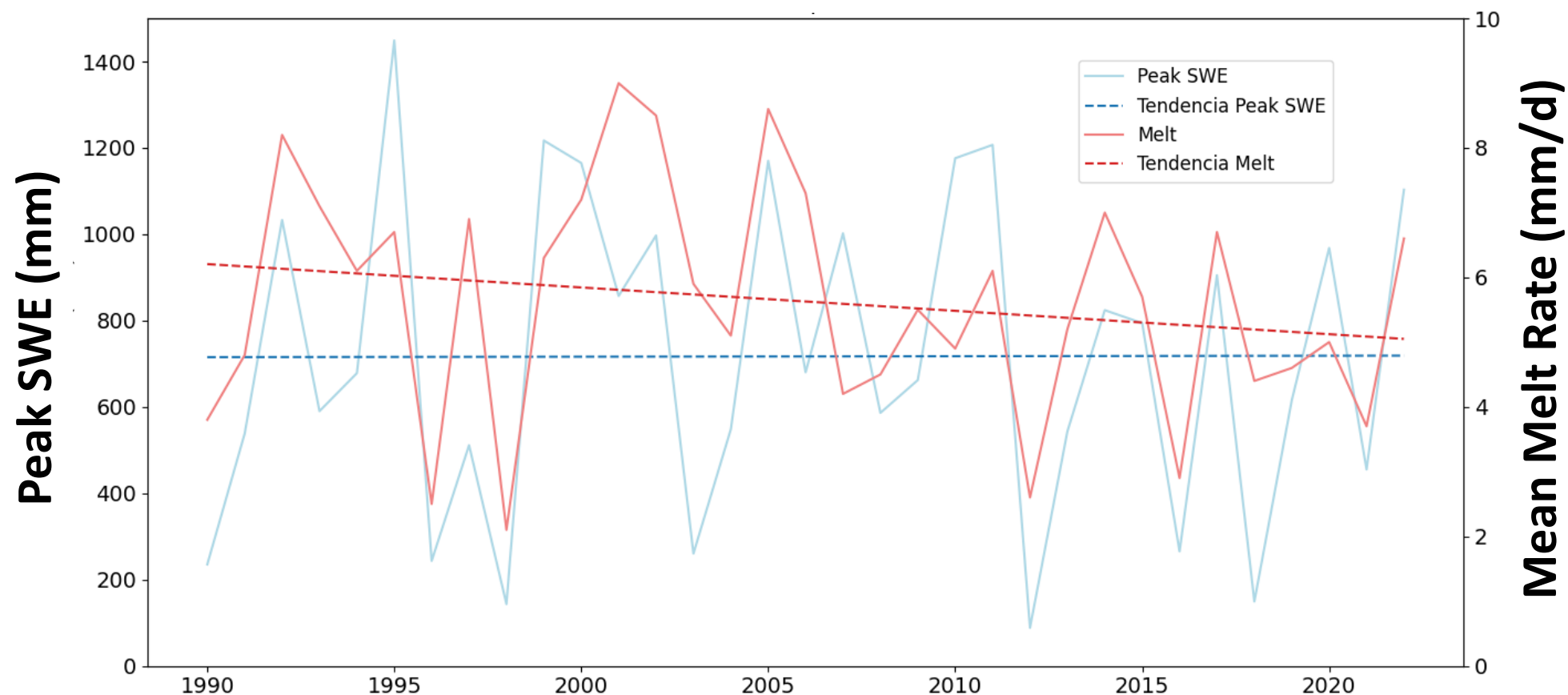
# Preliminary results: 1990-2022





# Trend analysis shows **NO SIGNIFICANT TREND** for peak SWE and melt rates ( $p\text{-value} > 0.05$ )

## Example for the North Facing - Open



# Conclusions

- CRHM was able to **reasonably represent peak SWE and snow disappearance date** north- and south-facing slopes
- Apparent **under estimation of canopy interception and sublimation rates (2022 season)** – more parameter exploration and observations for testing different conditions
- Significant differences between open and under canopy SWE (18% average) similarly to previous studies (Huerta et al., 2019)
- **Despite warming and drying trends, no trend in peak SWE nor melt rates were found**



# Moving Forward

- Incorporating elevation variability into the snowpack variability analysis
- Move toward a full hydrological implementation (streamflow) to understand water partitioning and how it might change in warmer climate



Thanks!