

From hydrological to ecohydrological monitoring in alpine basins: assessing the impacts of cryosphere degradation

Nacho López-Moreno and Cryopyr team





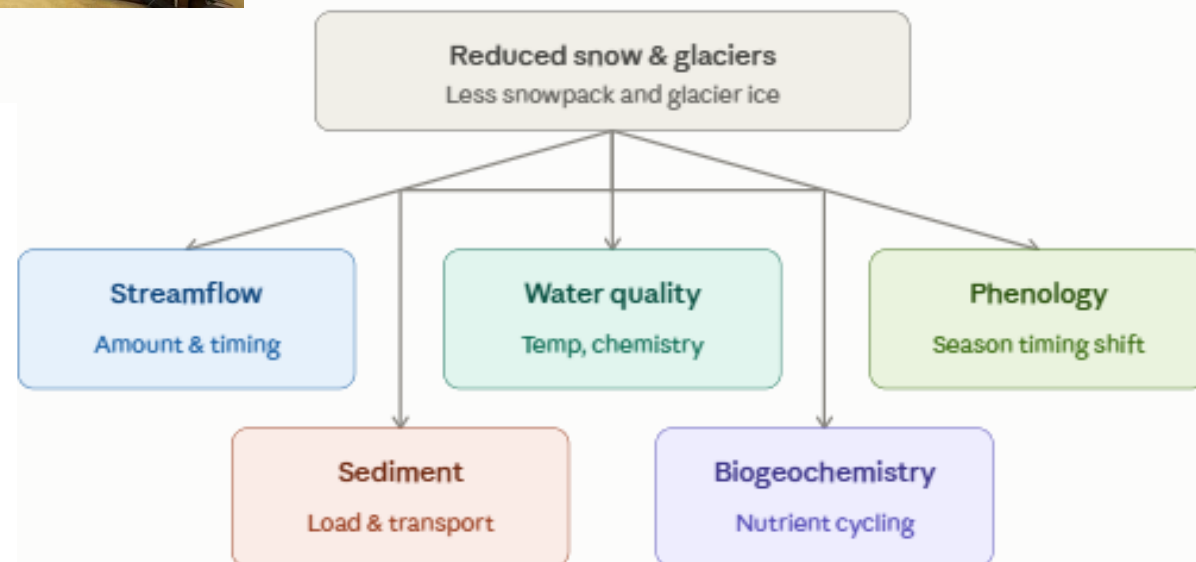
Side-Event 20: Integrated Observation and Prediction Systems for the Cryosphere

Date 19 March 2026

Time: 16:00-17:30 (CET)

Room VII, UNESCO Headquarters

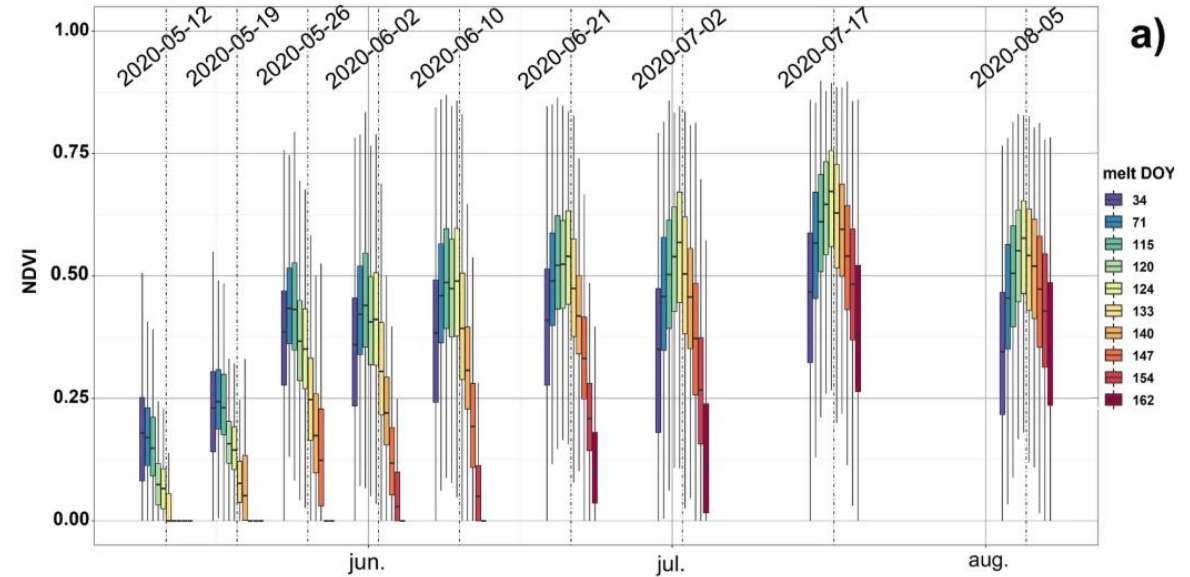
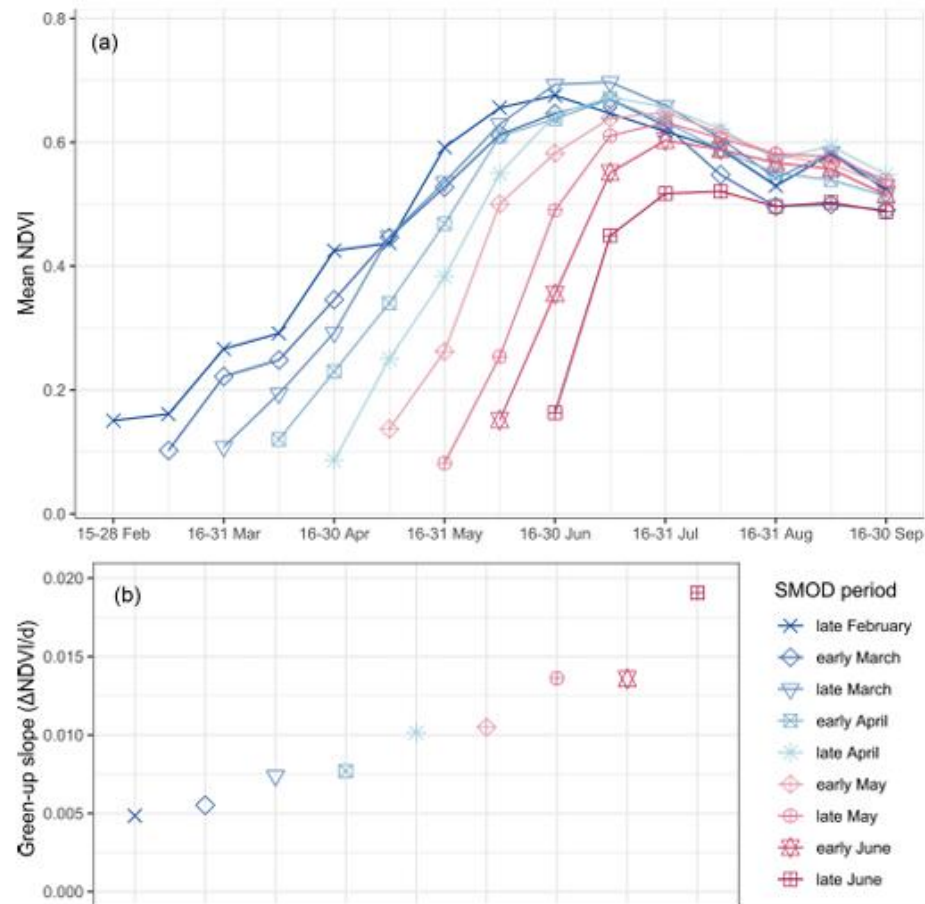
Organizers: John Pomeroy, James McPhee, Dhiraj Pradhananga, Ignacio Lopez-Moreno, Zoe Johnson



scientific reports

Intermediate snowpack melt-out dates guarantee the highest seasonal grasslands greening in the Pyrenees

J. Revuelto , D. Gómez, E. Alonso-González, I. Vidaller, F. Rojas-Heredia, C. Deschamps-Berger, J. García-Jiménez, G. Rodríguez-López, J. Sobrino, R. Montorio, F. Perez-Cabello & J. I. López-Moreno

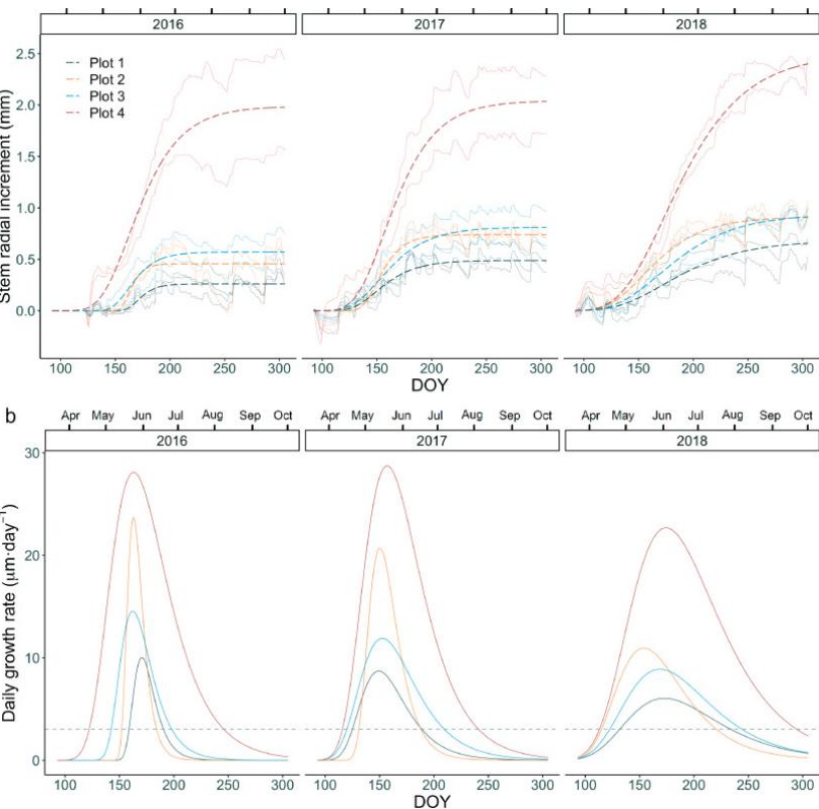


Biogeosciences

Snowmelt timing constrains green-up but not peak productivity in alpine grasslands of the western Pyrenees

Pablo Domínguez-Aguilar , Jesús Revuelto, Simon Gascoin, and Juan I. López-Moreno

Detecting snow-related signals in radial growth of *Pinus uncinata* mountain forests

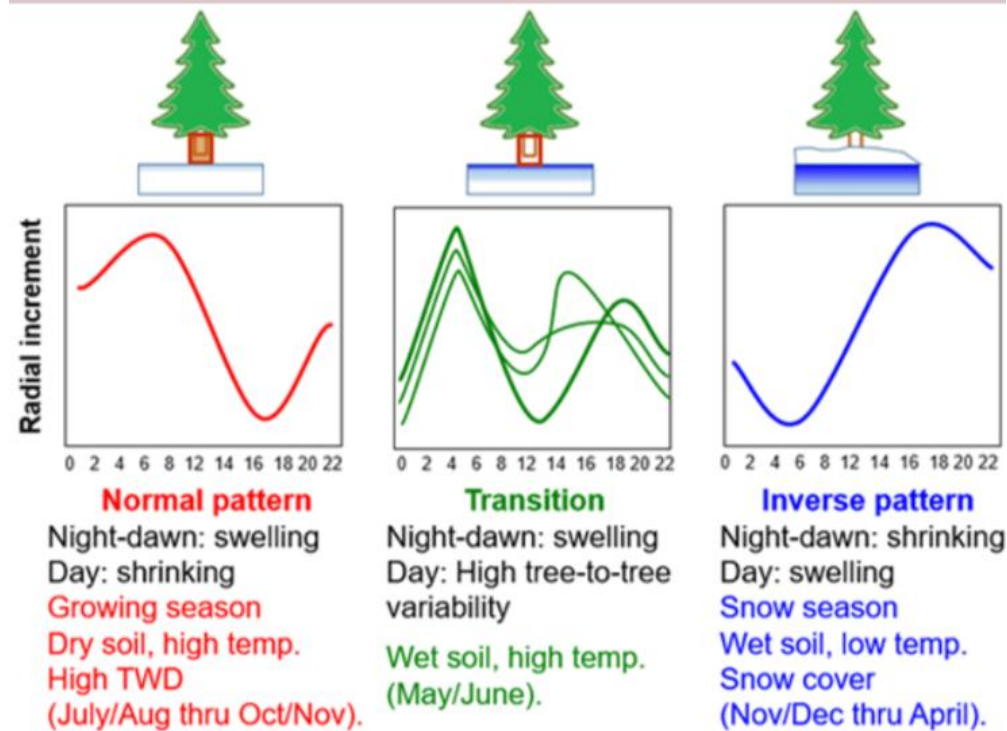


Biogeosciences

Research article |

A shift in circadian stem increment patterns in a Pyrenean alpine treeline precedes spring growth after snow melting

Helen Flynn , J. Julio Camarero, Alba Sanmiguel-Vallelado, Francisco Rojas Heredia, Pablo Domínguez Aguilar, Jesús Revuelto, and Juan Ignacio López-Moreno

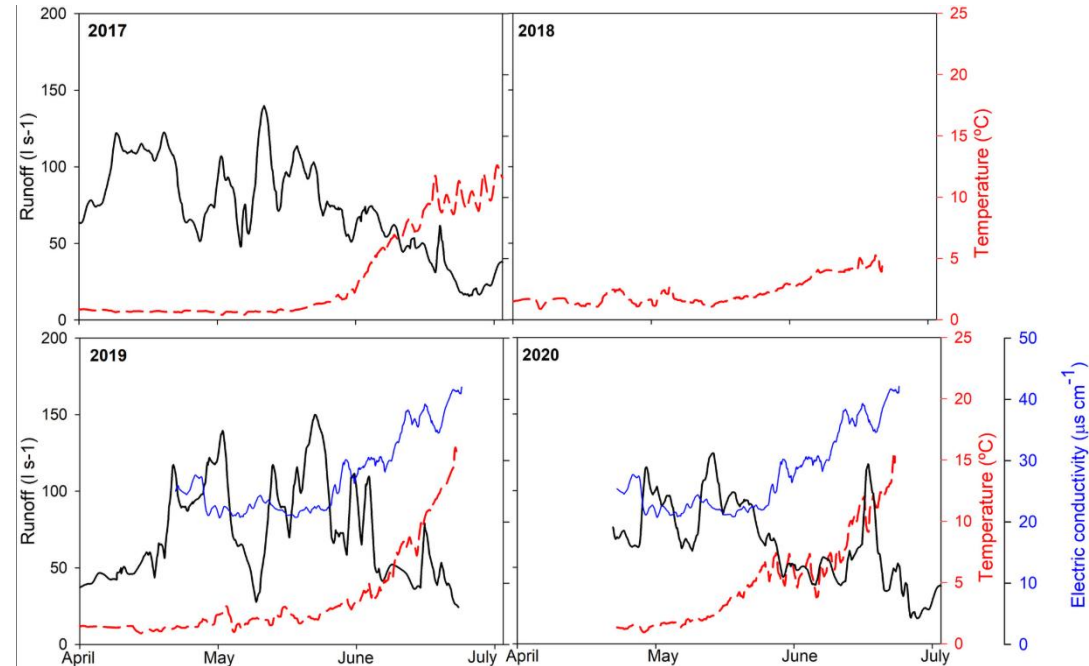
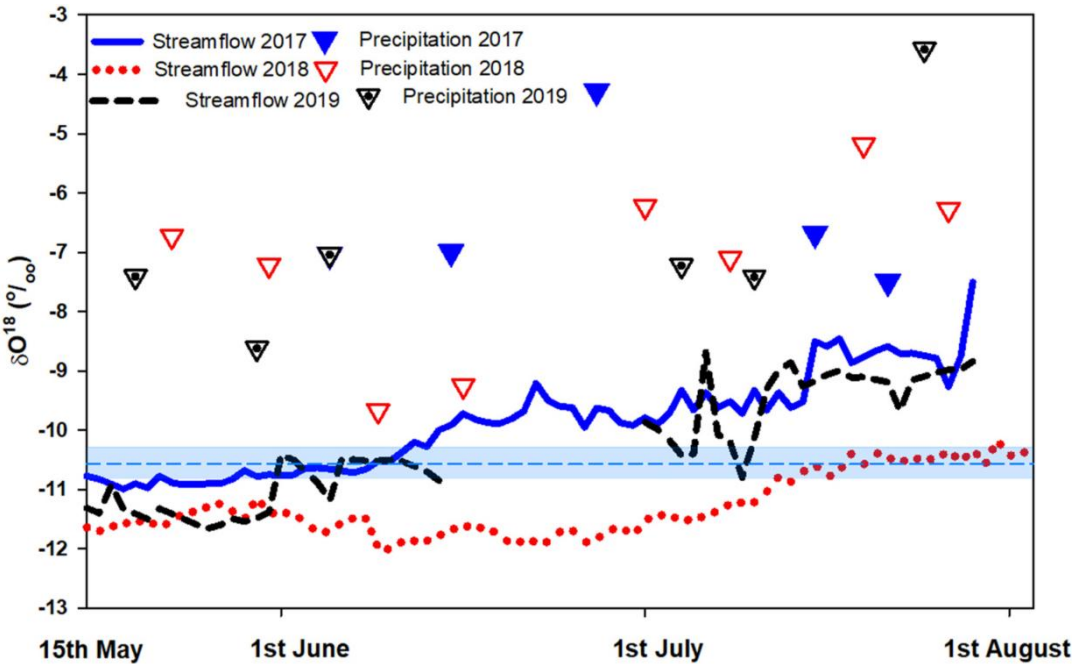
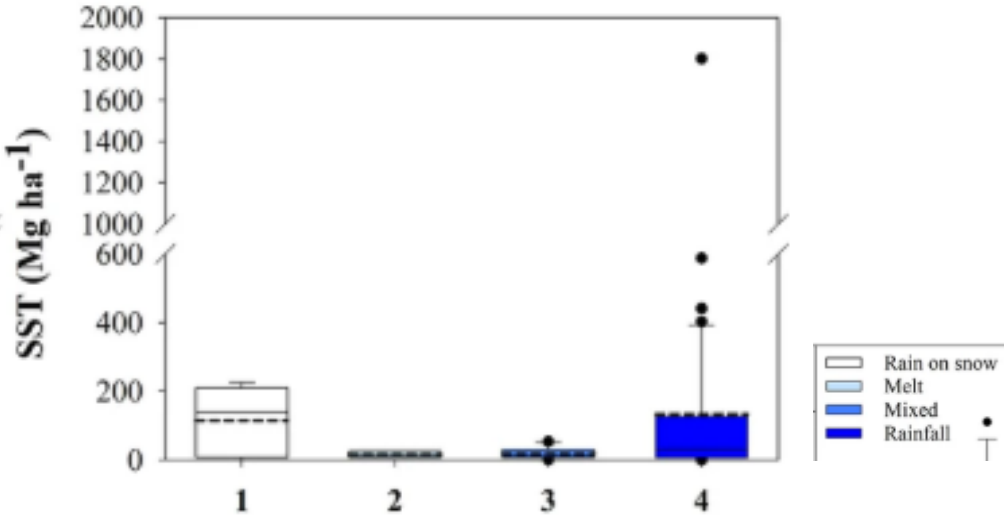


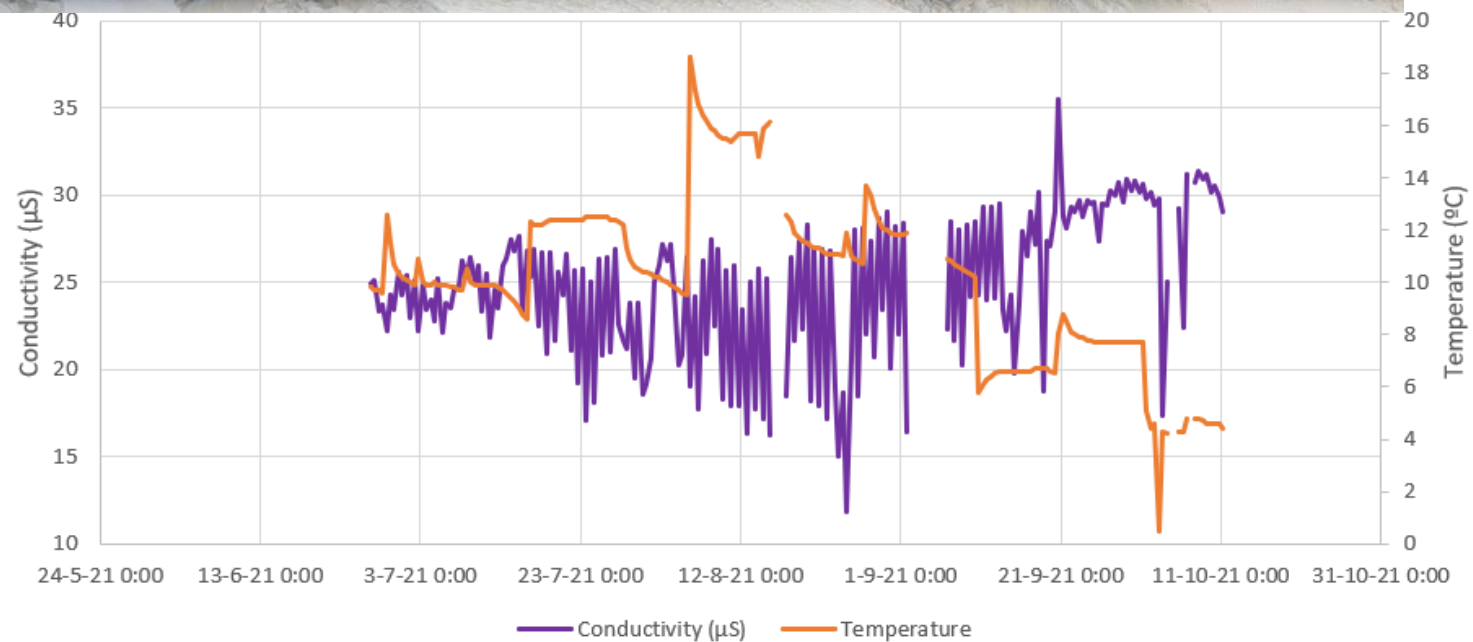
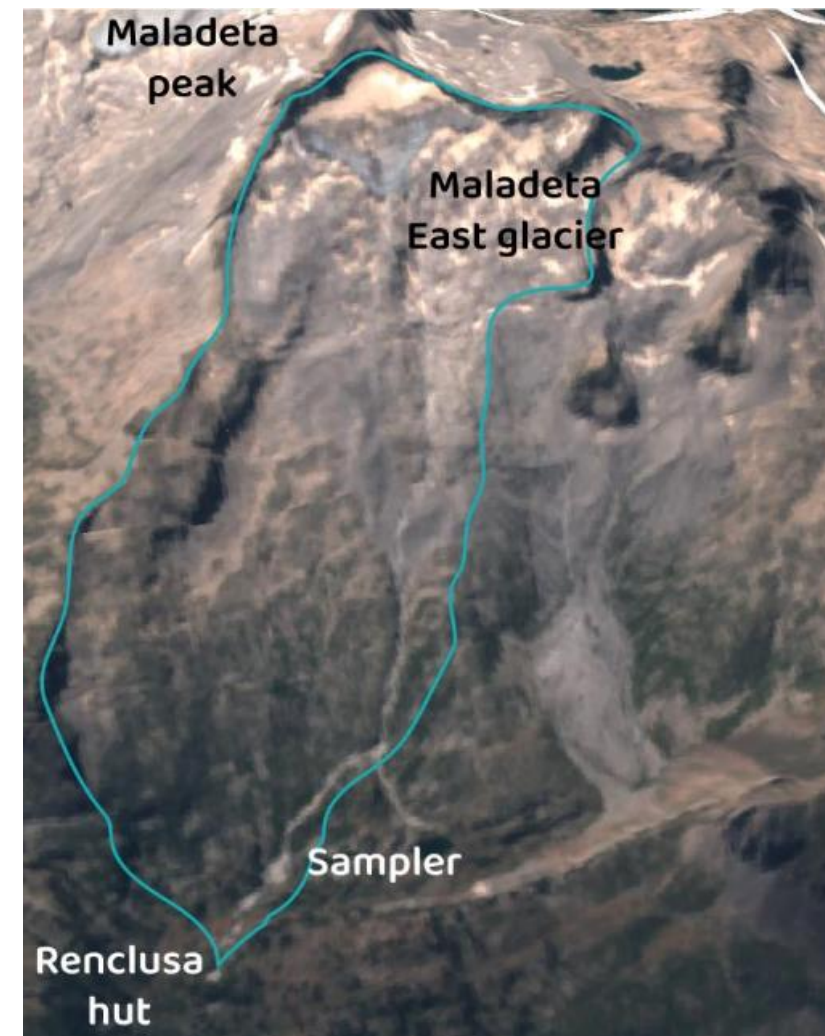
Hydrological dynamics of snowmelt induced streamflow in a high mountain catchment of the Pyrenees under contrasting snow accumulation and duration years

J. I. López-Moreno, J. Revuelto, E. González-Alonso, E. Izagirre, F. Rojas-Heredia, C. Deschamps-Berger, J. Bonsoms, J. Latron

Mediterranean Geoscience Reviews

The hydrological response of melting ephemeral snowpacks compared to winter rainfall events in a mid-mountainous Pyrenean catchment





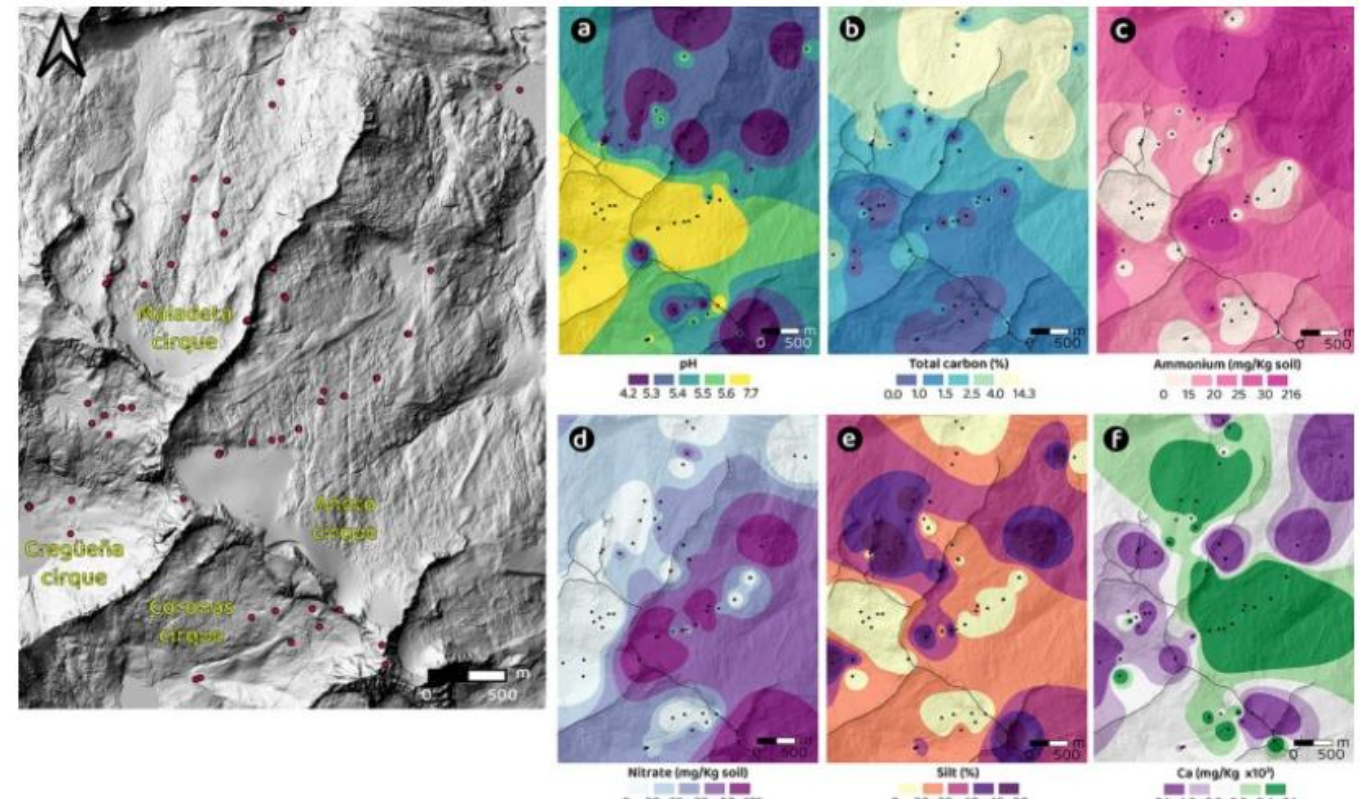
Study of soils and vegetation growth in deglaciated zones. Collado Maldito 3255 m a.s.l.



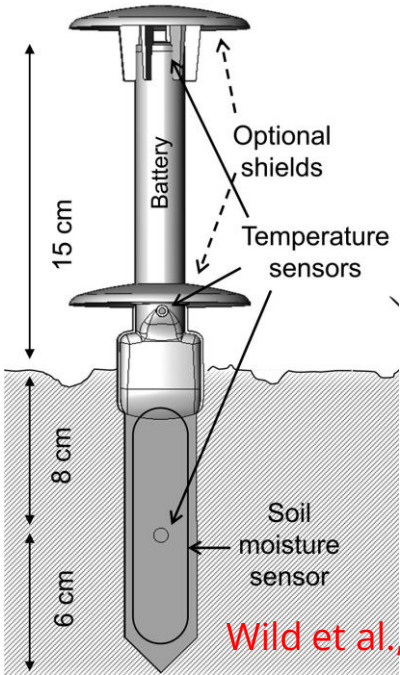
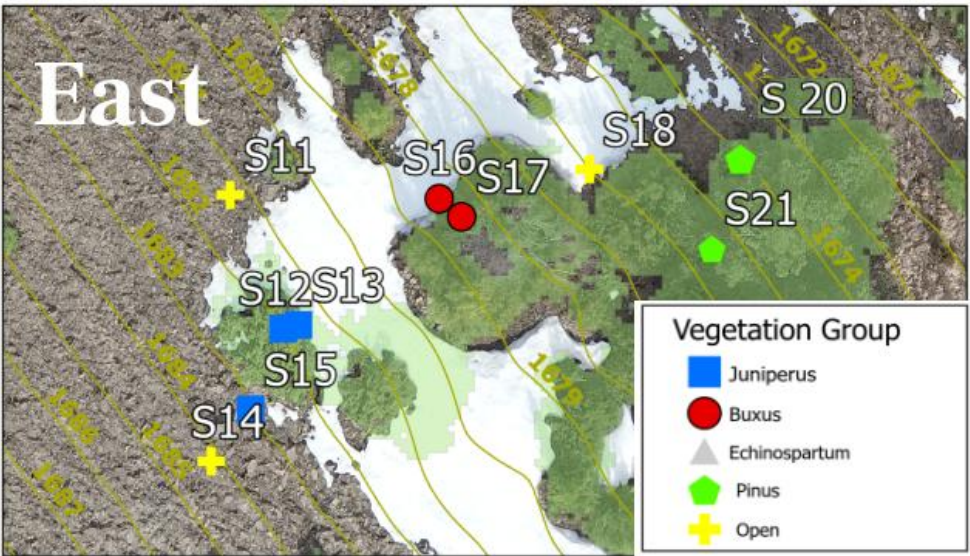
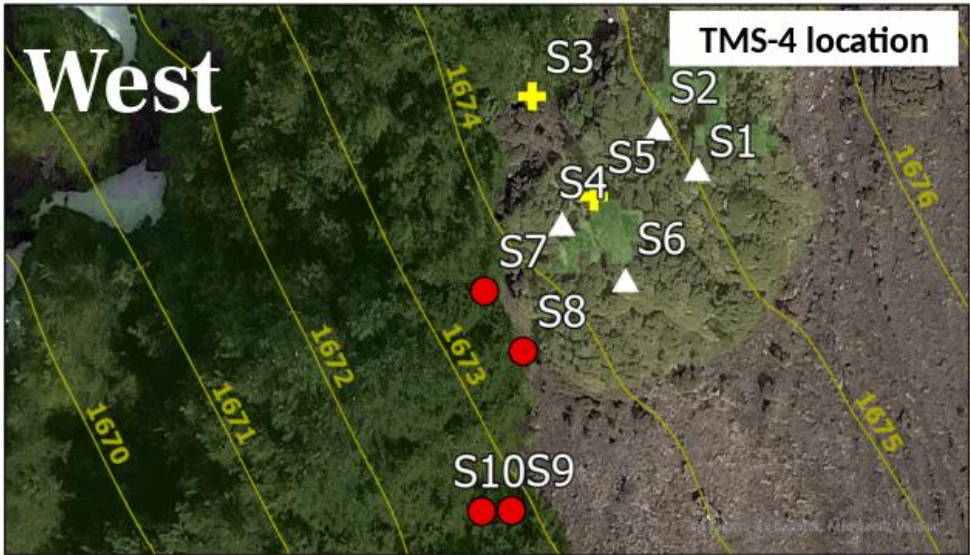
Incipient soils: New habitats in proglacial areas of the Maladeta massif (Central Pyrenees)

Ixeia Vidaller ^a  , Xosé Luis Otero ^b, José Mariano Igual ^c, Gabriel Nuto Nobrega ^d, Tiago Osorio Ferreira ^e, Ana Moreno ^a, Juan Ignacio López-Moreno ^a

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Distributed soil temperature and moisture



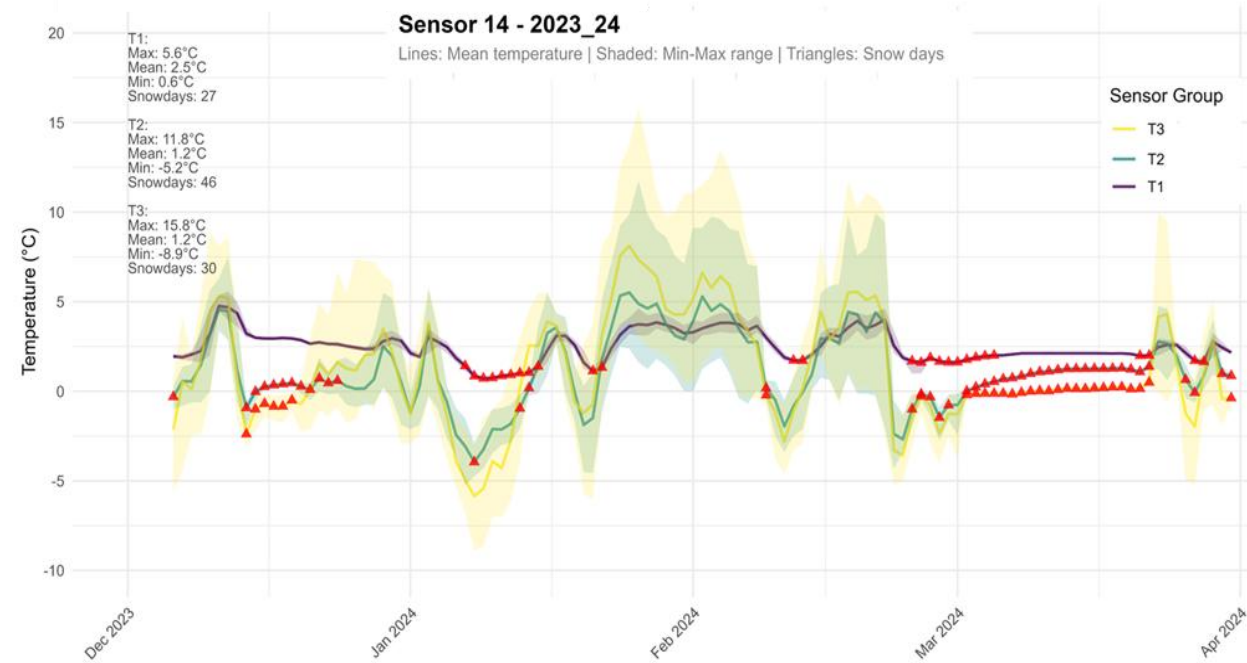
- 21 loggers - DJFM months from 2022 – 2025 (15-min data)
- Resolution: 0.0625° C
- Accuracy: $\pm 0.5^{\circ}\text{C}$

Type	East	West
<i>Juniperus</i>	3	2
<i>Buxus</i>	3	4
<i>Echinospartum</i>	0	4
<i>Pinus</i>	2	0
<i>Open</i>	3	0
Total	11	10

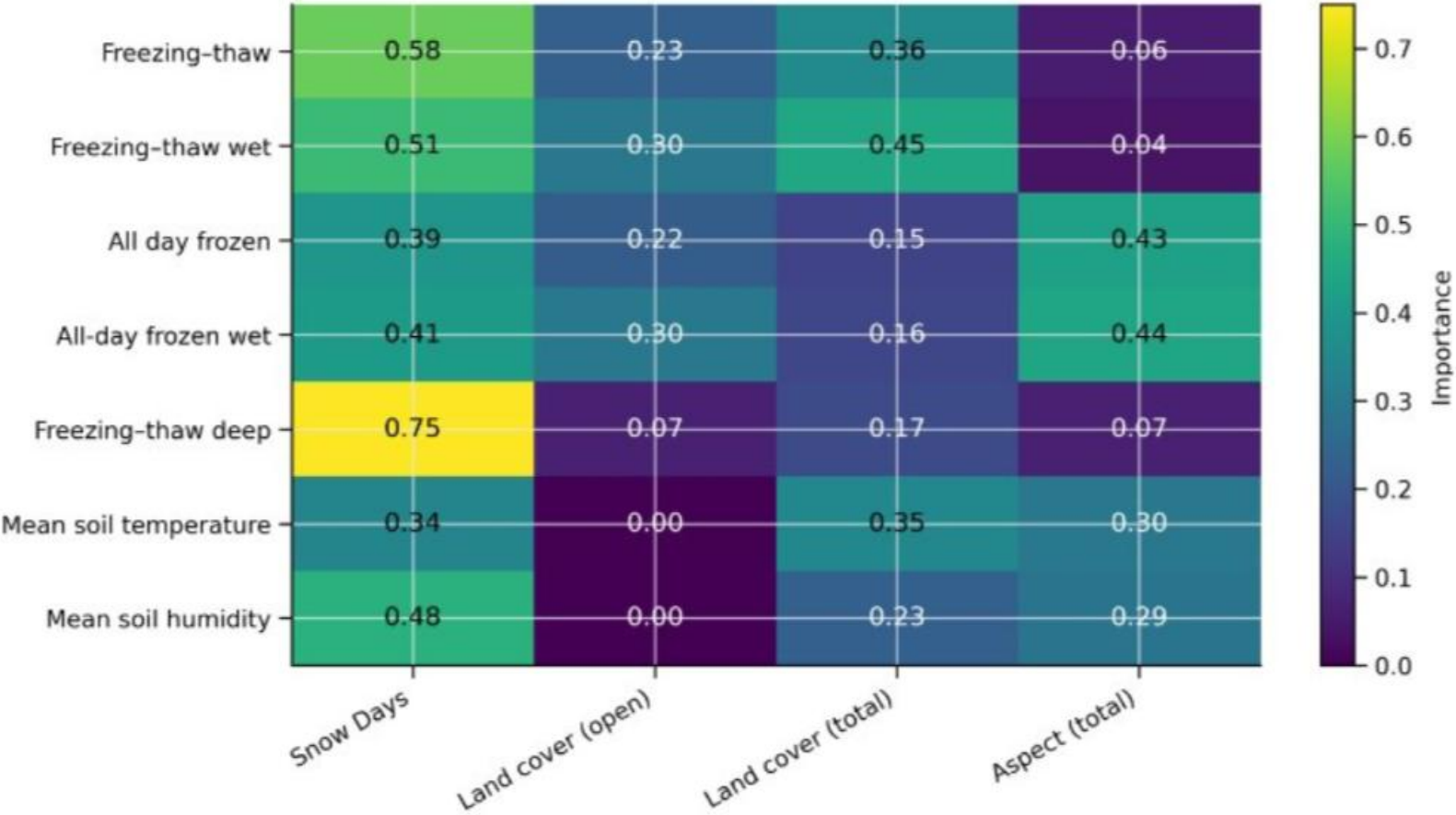
2 Distributed soil temperature and moisture

Computed metrics

- Average, max and min T (°C)
 - Soil Moisture (vol/%s)
 - Days with snow cover (Temp 0-2°C/daily oscillation<2°C)
 - Days of Frozen soils (all-day T<0°)
 - Freeze-thaw cycles (all and wet days)
 - Intense freeze thaw cycles (all and wet days)
- *wet days: Soil moisture>50%



Random forests to simulate T and Humidity variables from snowdays, land cover and aspect



Snow duration is the main driver of freezing–thaw processes, especially in deeper soils. Aspect becomes more important under persistent freezing, while land cover has a secondary but consistent influence. Overall, model performance is moderate.

CRYOCHANGE

Environmental impacts of cryosphere degradation
across a macro geographical gradient



T1. Cryosphere changes



T2. Soils (temp. & moisture)

T3. Water resources

T4. Vegetation

T5 & 6. Soils Biochemistry

T7. Geomorphology

T8. Global modeling

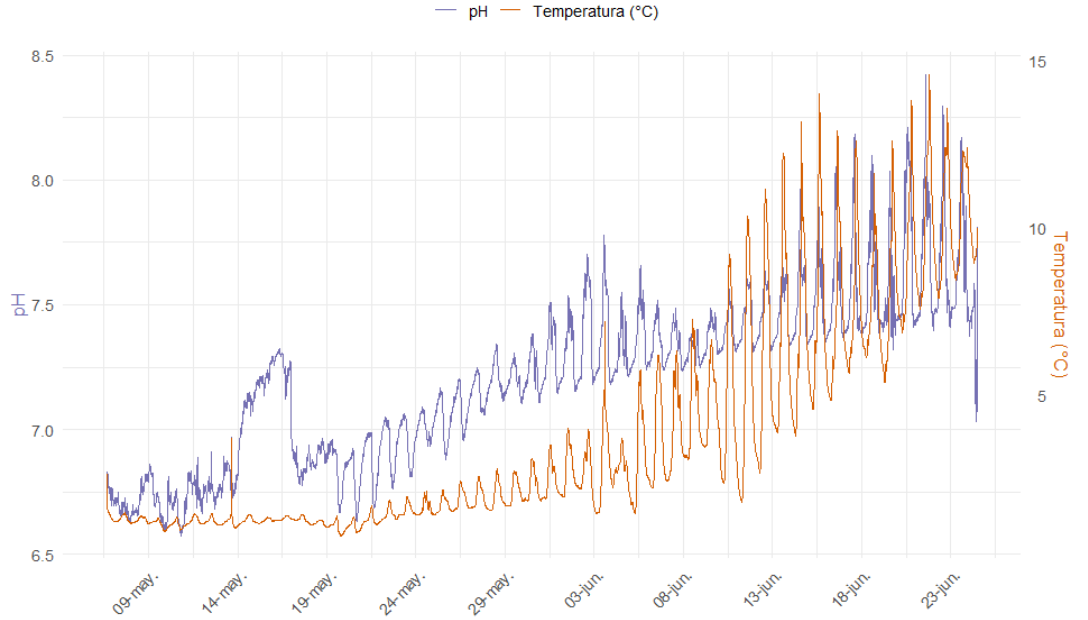
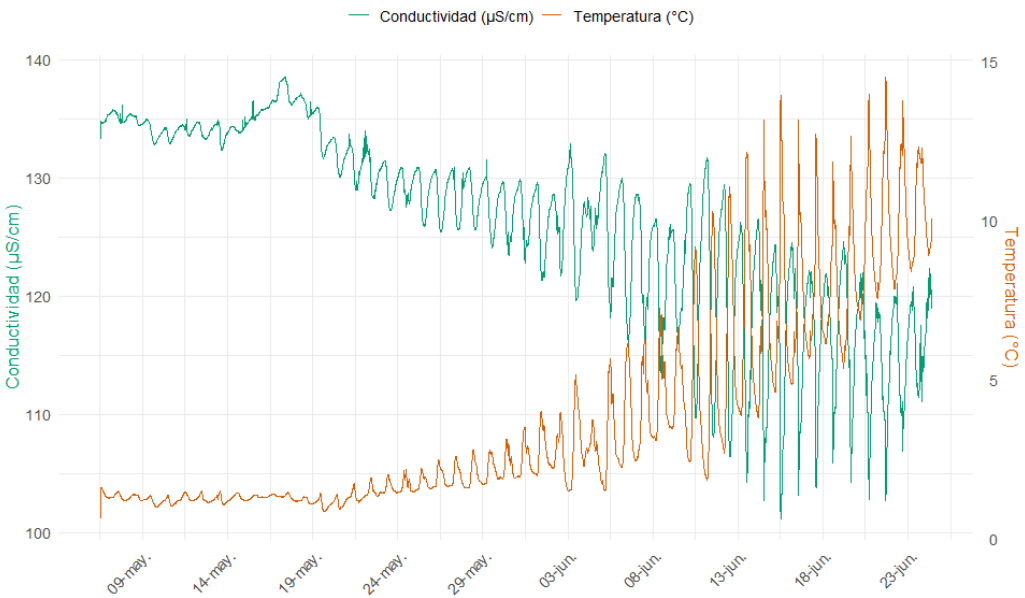
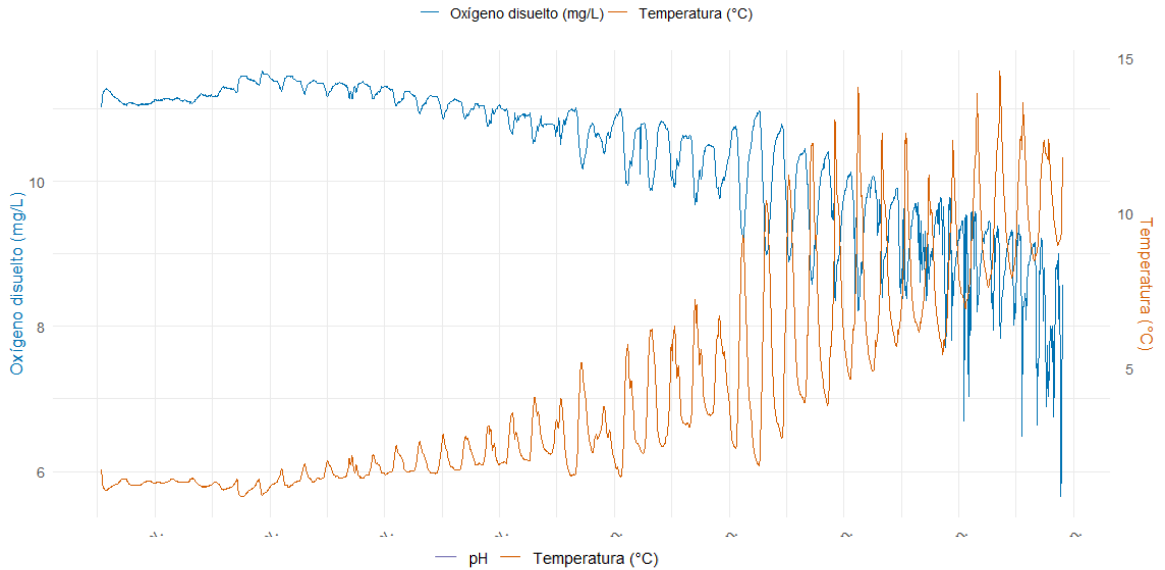
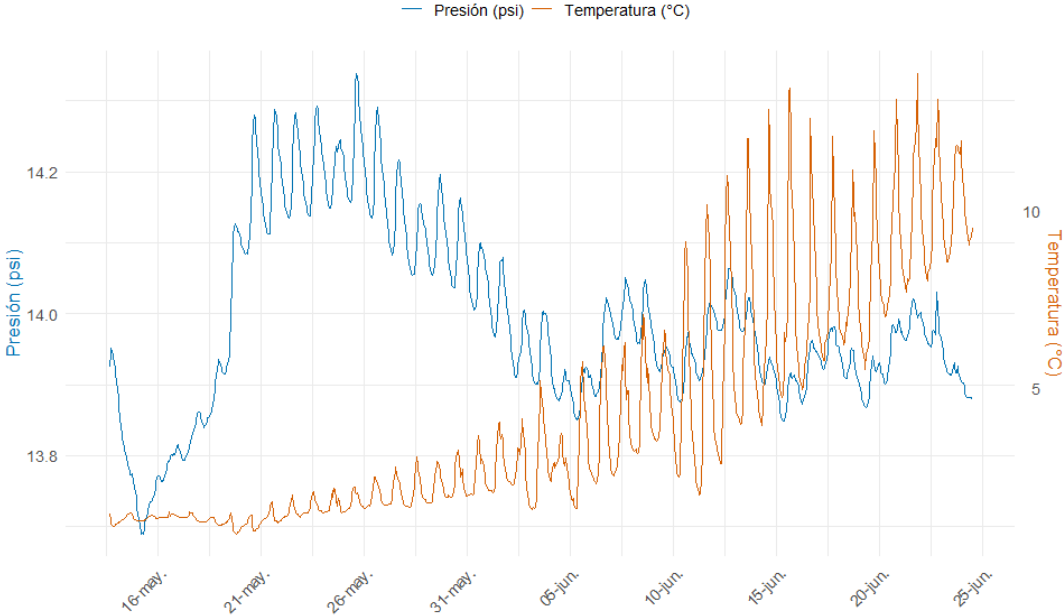
T9. Outreach &
dissemination

- O1:** Update the current status and recent changes in snow, glaciers, permafrost, and seasonal frost.
- O2:** Study how cryosphere changes affect soil moisture and temperature.
- O3:** Analyze how snow and glacier melt influence streamflow quantity, timing, and water quality (temperature, dissolved oxygen, pH, dissolved carbon).
- O4:** Investigate how changes in snow cover affect plant growth and seasonal cycles.
- O5:** Assess how snow variability and droughts impact soil properties and carbon storage and carbon cycle.
- O6:** Study soil formation and vegetation recovery in newly deglaciated areas.
- O7:** Monitor erosion, land degradation, and sediment transport in cold environments.
- O8:** Evaluate how the project's methods and results can be applied worldwide

Instalation of sensors of water temperature, disolved oxigen, pH and turbidity in Izas and Maladeta glacier

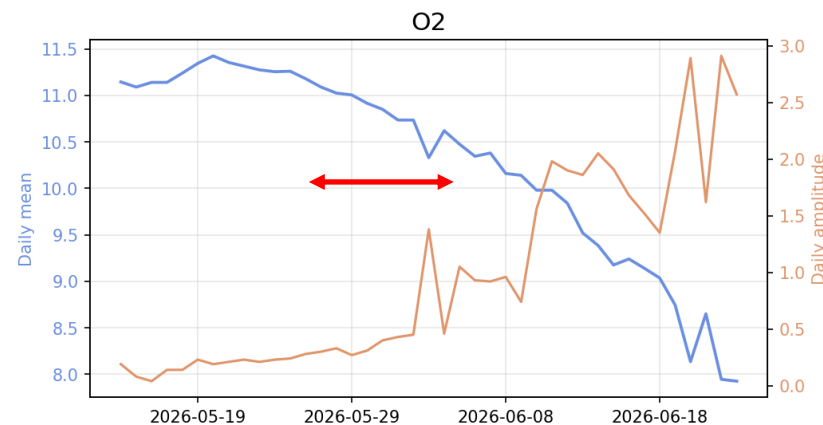
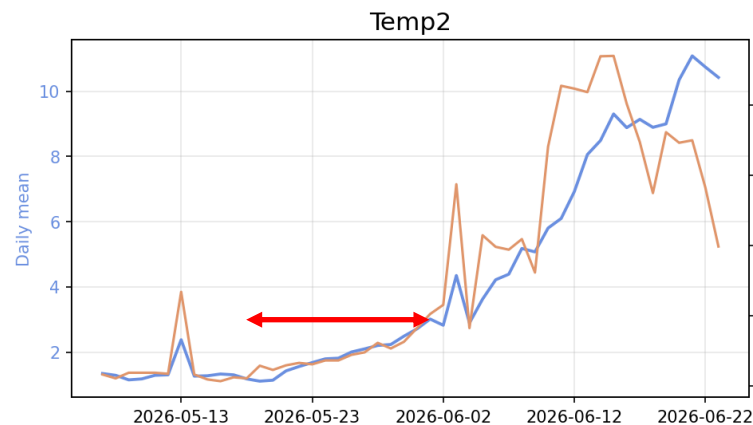
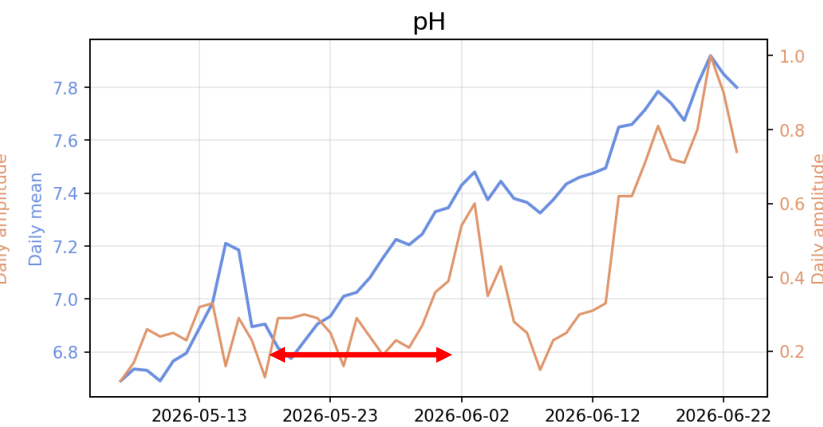
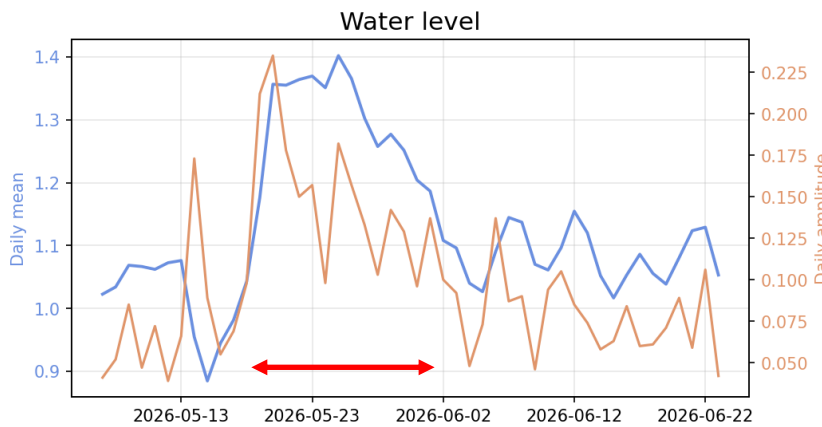
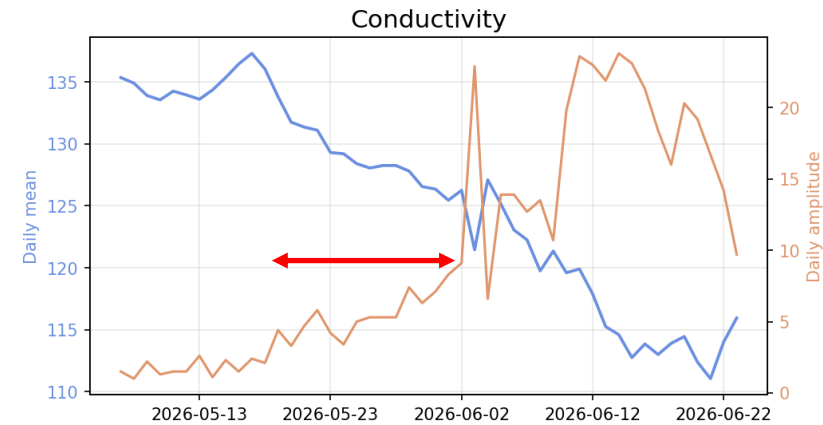
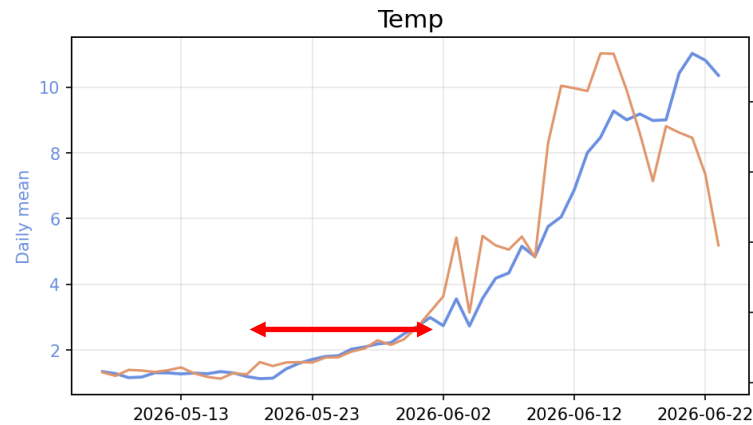


10 min. Series of water level, temperature, dissolved oxigen, pH and in Izas

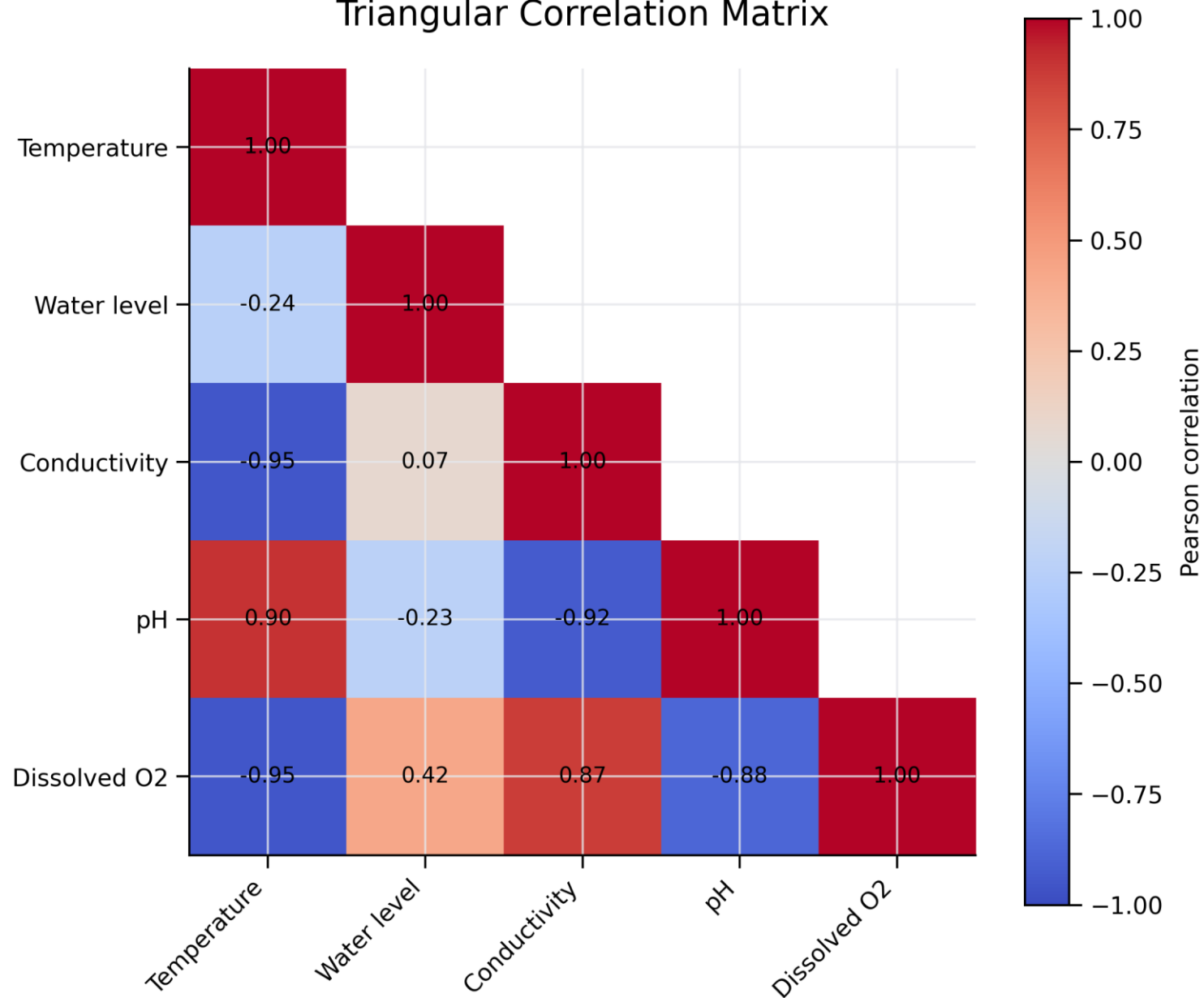


Temporal evolution of daily mean value and amplitude (Max - Min)

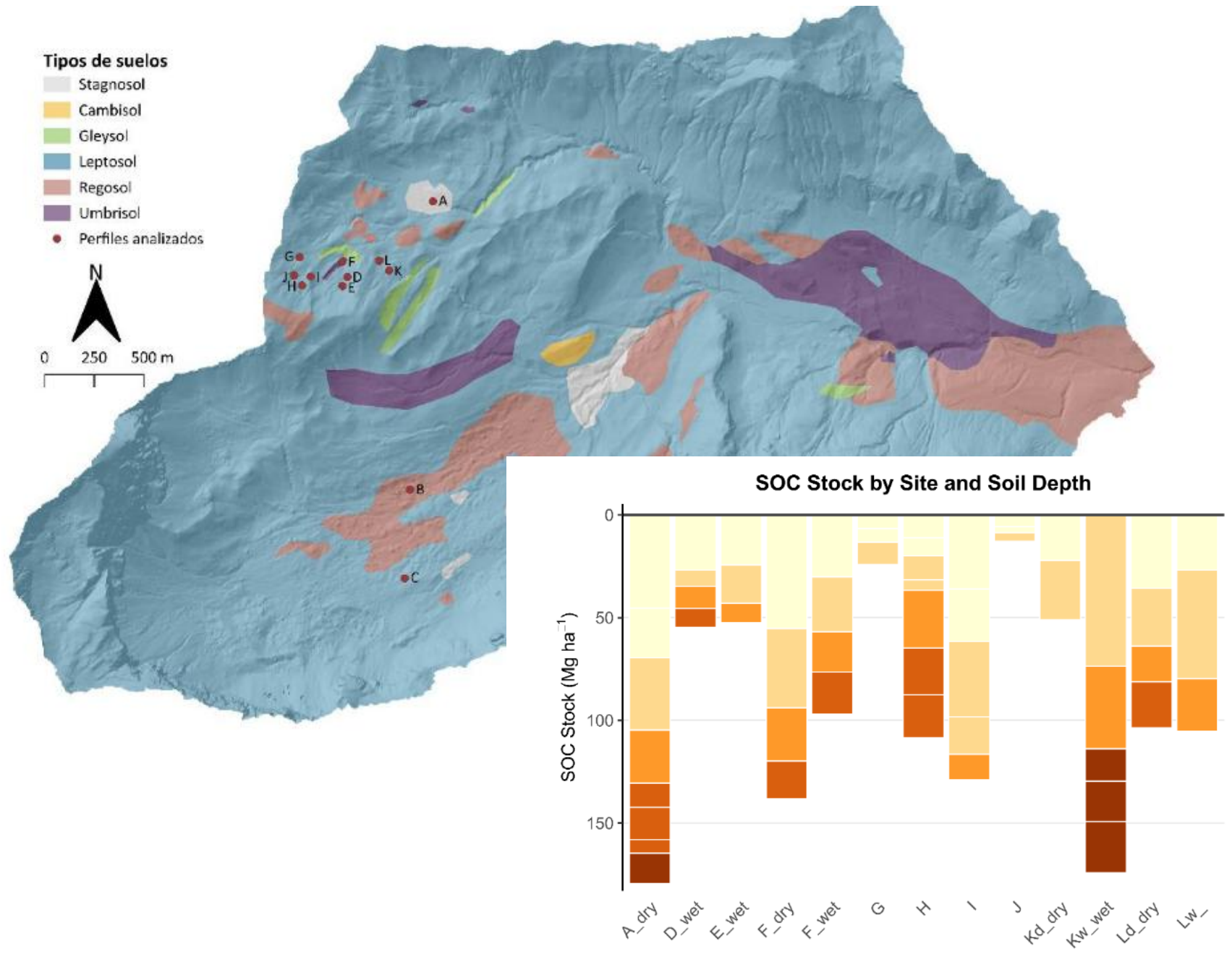
Mean Daily amplitude

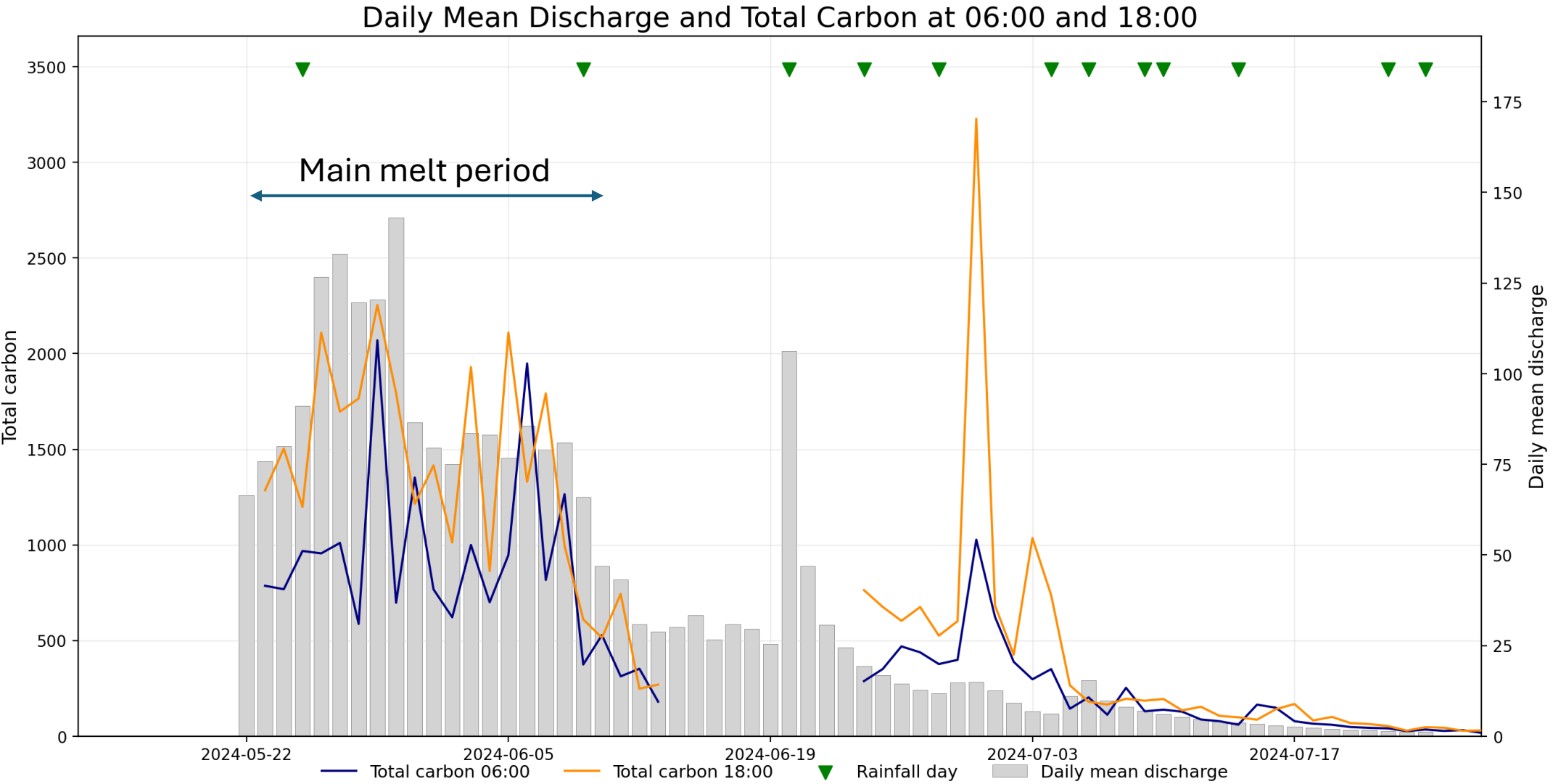


Triangular Correlation Matrix

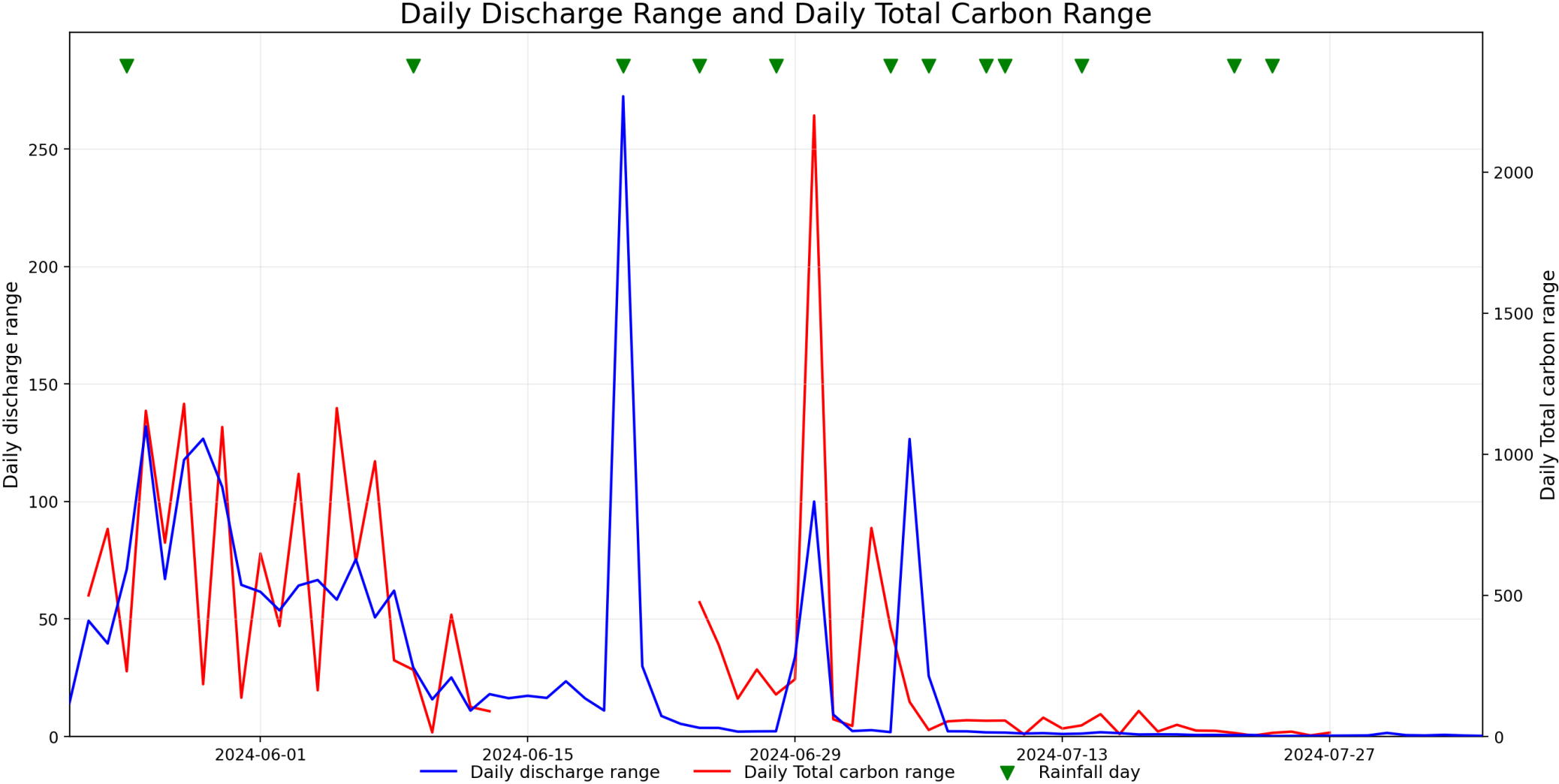


Carbon stock in Izas catchment





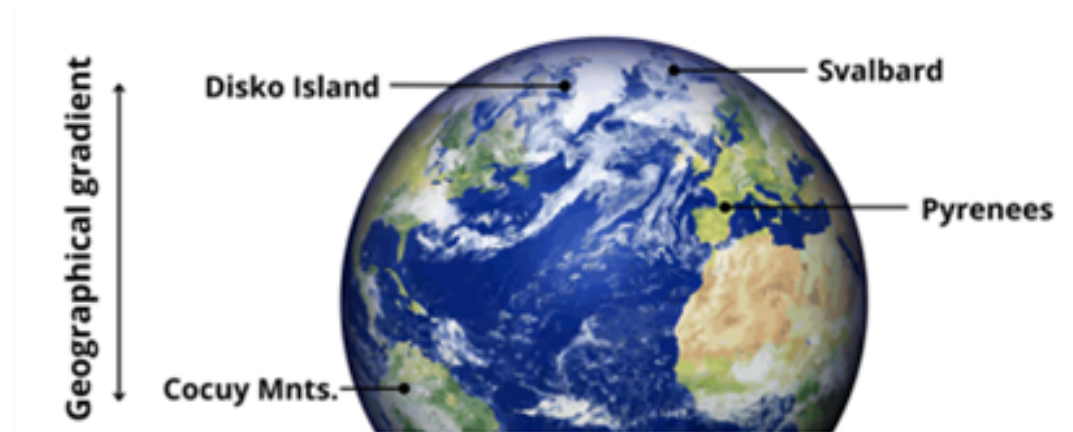
Carbon stock in Izas catchment



Next steps:



- Increase monitoring in Pyrenees: first focus on water temperature
- Monitor and sample new areas in Colombia and the arctic in an homogeneous manner
- Apply/develop models for water temperature, pH and DO
- Check INARCH sites to see where this information is collected and assess the possibility of making common analyses-sensitivity simulations



Thanks!

