



Proyecto

Snow water equivalent, snow height and air temperature monitoring network for high mountain prototype based on open hardware development

Cristian Orrego
Ing. Computación
Director de proyecto

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Equipo

Cristian Orrego
Program Manager/Firmware Engineer



cristian.orrego@ceaza.cl

Adrián Gallardo
Hardware Engineer



adrian.gallardo@ceaza.cl

Francisco Vega
Hardware Engineer



francisco.vega@ceaza.cl

Diego Morales
Field Technician



diego.morales@ceaza.cl

Carlo Guggiana
Firmware Engineer



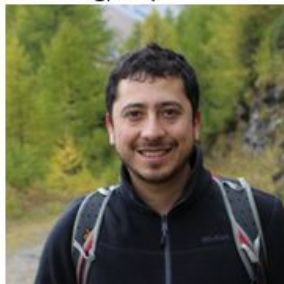
carlo.guggiana@ceaza.cl

Shelley MacDonell
Glaciologist



shelley.macdonell@ceaza.cl

Álvaro Ayala
Testing/Requirements



alvaro.ayala@ceaza.cl

Simone Schauwecker
Testing/Requirements



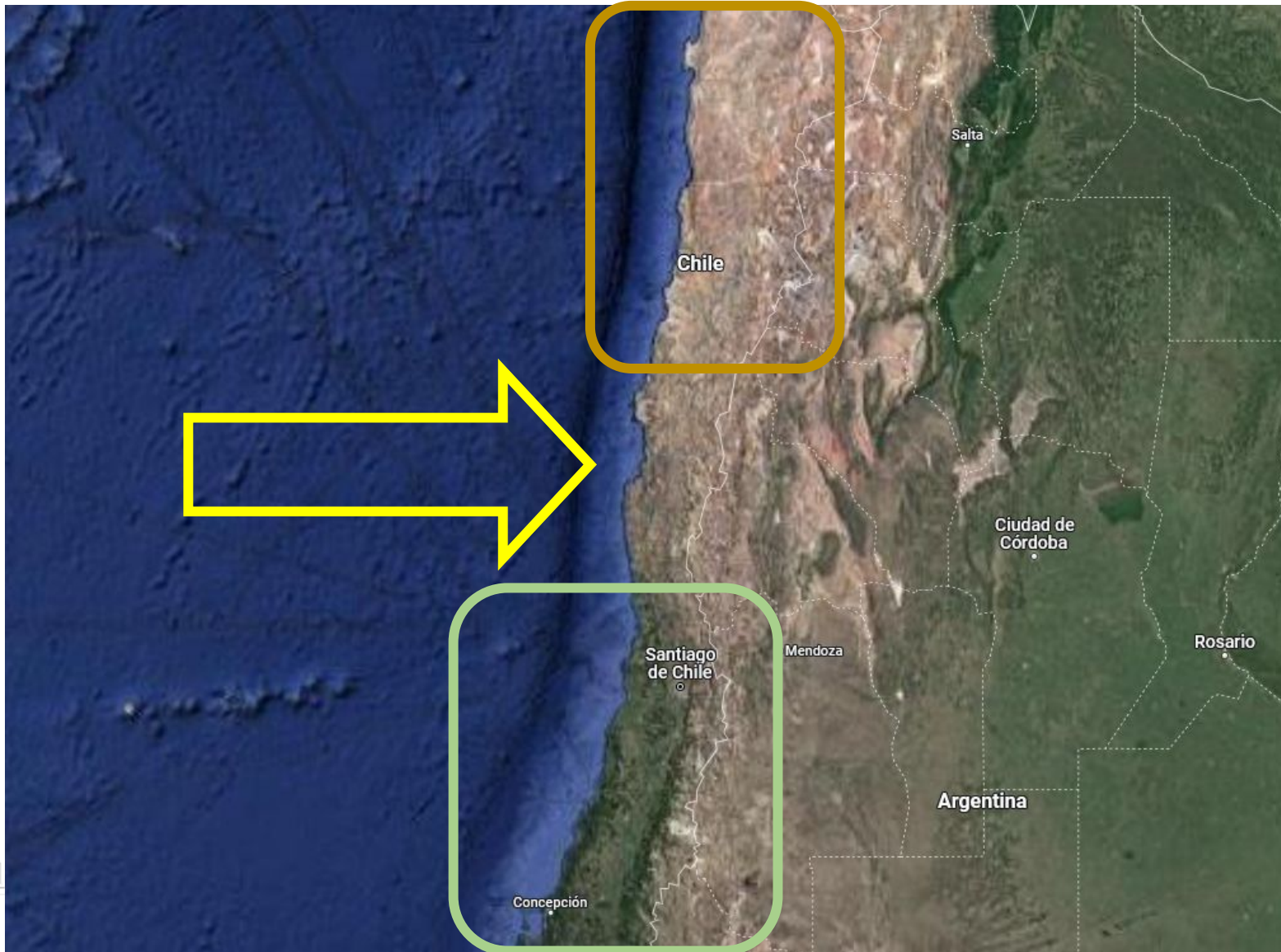
simone.schauwecker@ceaza.cl

Sebastián Alfaro
Testing/Requirements



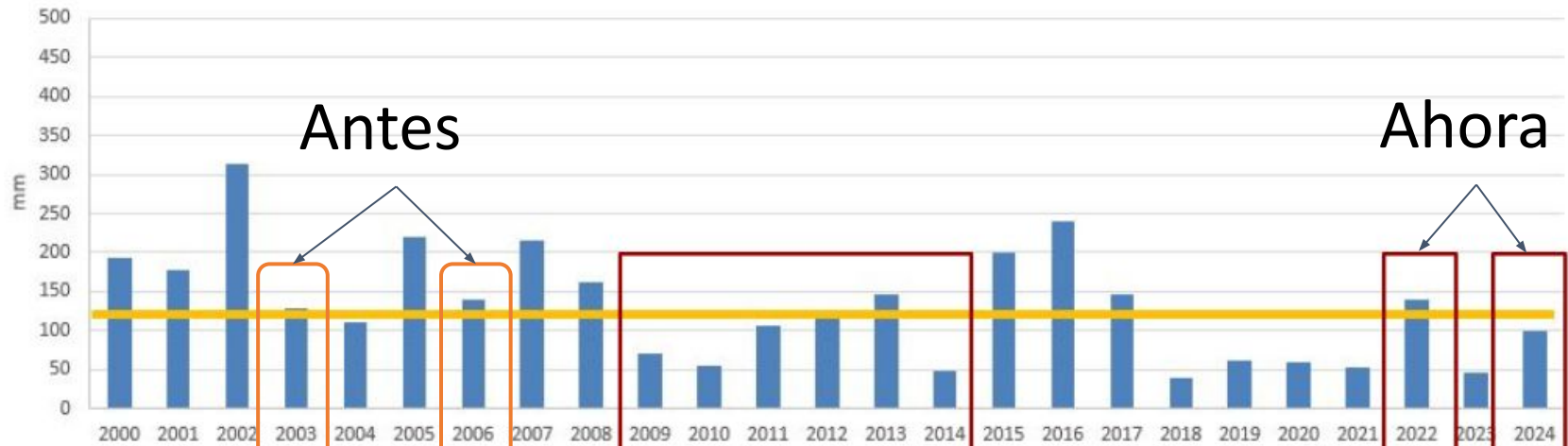
salfaro@inach.cl

Contexto: Zona de transición

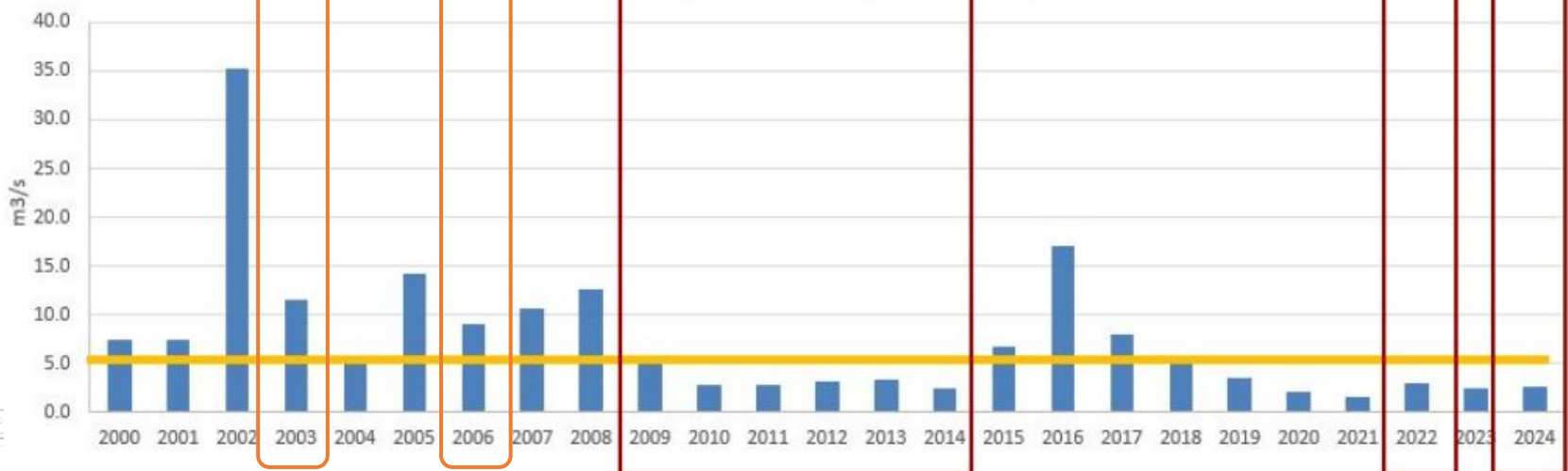


Contexto: Sequías y cambio climático

Precipitación anual en Embalse La Laguna (Elqui) [1964 - 2024]



Caudales Agosto - Marzo [2000 - 2024]



Impactos



Al fondo el embalse La Paloma, abajo de huertos secos, 'toconados' o arrancados de palto, cítricos, uva de mesa, etc.

Plan general y visión

Decisión: Cuanta agua se repartirá

¿Cuanta habrá disponible?



¿Cuanta agua hay y habrá en cordillera?



¿Cuanta agua/nieve hay en el punto X?

INFORMACIÓN

significado



MODELOS

relaciones
& patrones



DATOS

hechos

Sistemas de telemetría



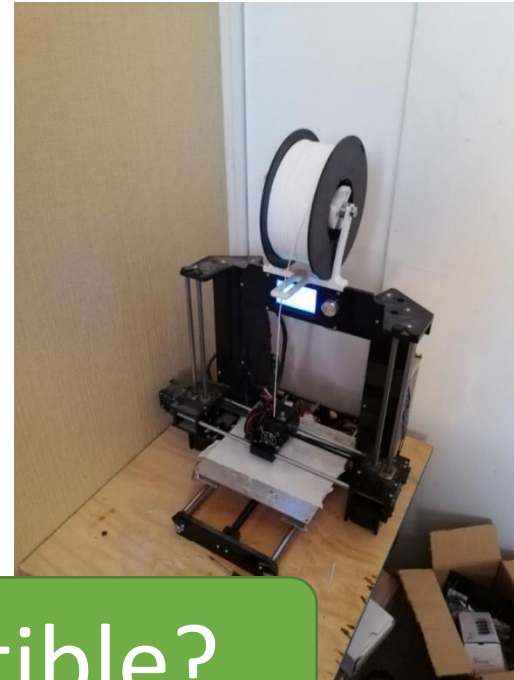
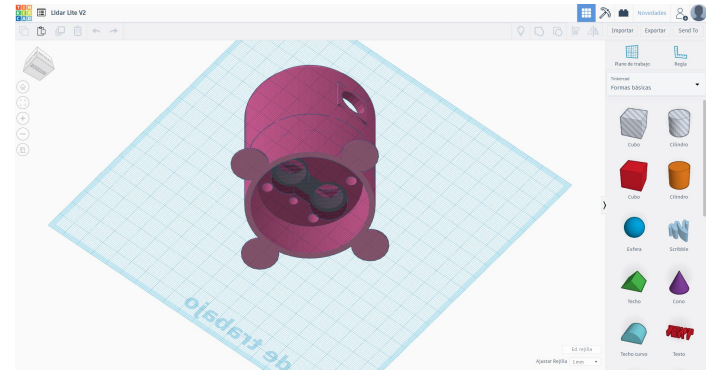
Etapla 1:

Factibilidad

(2015-2018)



Prototipos (2015-2018)



Es factible?

Prototipo 3: Pruebas terreno

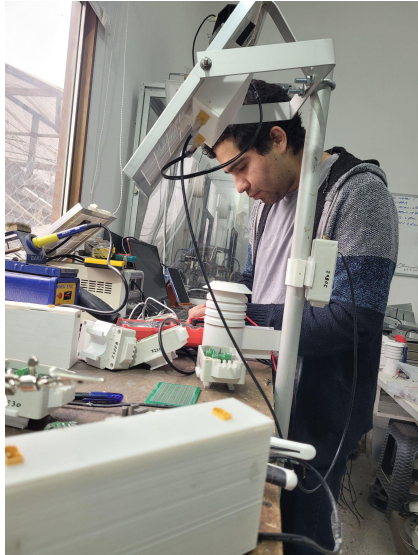
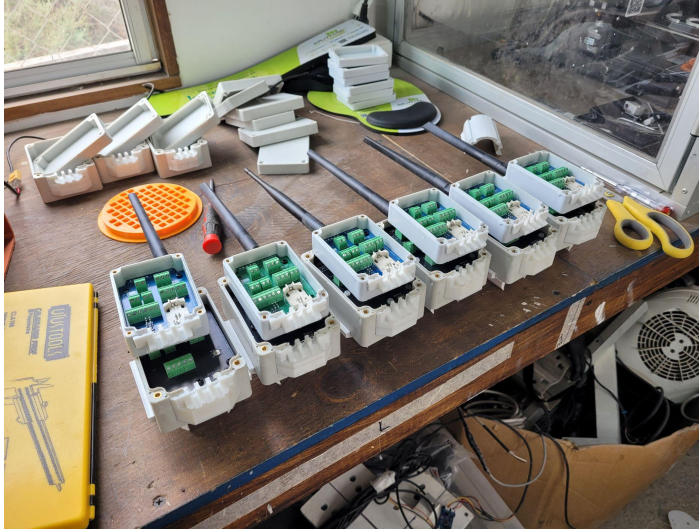
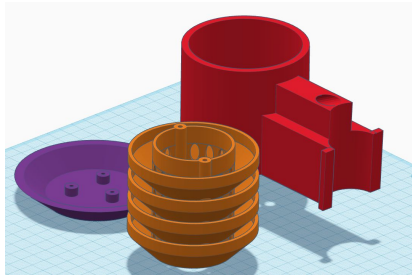


Si!!!!

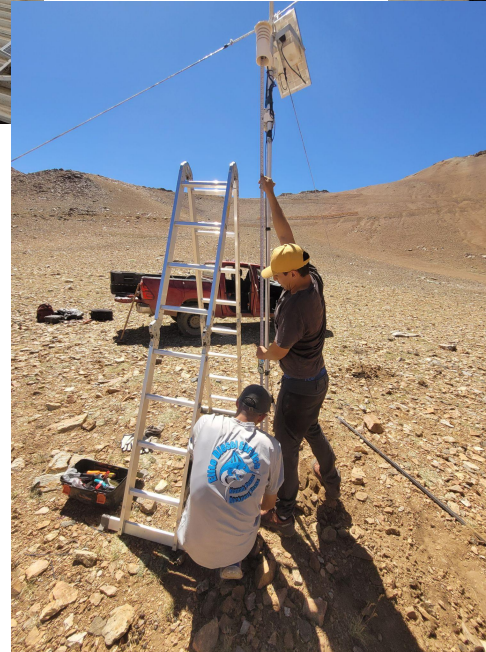
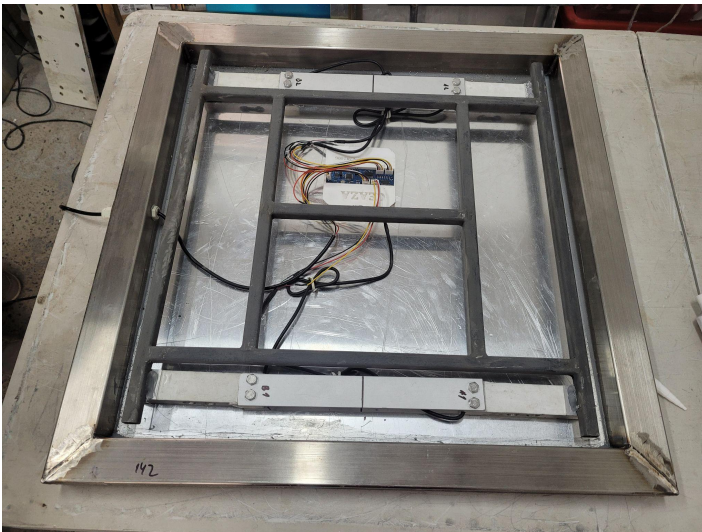
Etapas 2: Desarrollo electrónico (ANID-IDEA 2020)



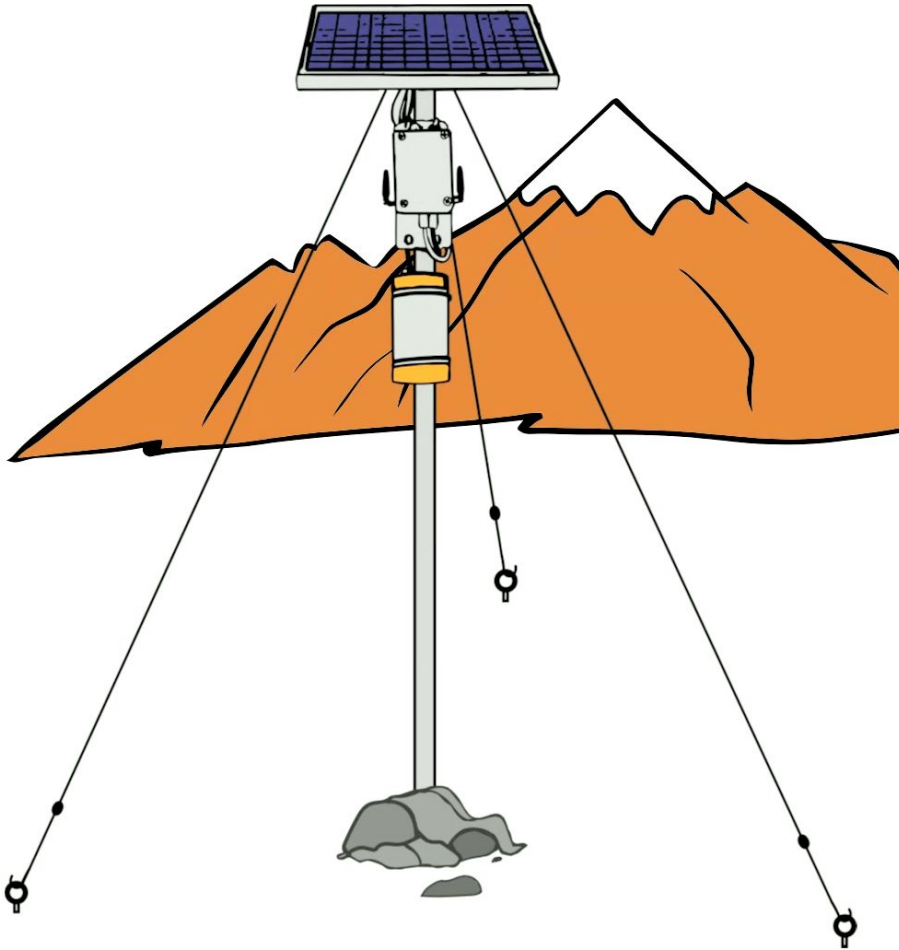
En que consiste: Diseño y taller



En que consiste: Pruebas



2020-2021: Nodos de altura (V4)



Bajo costo

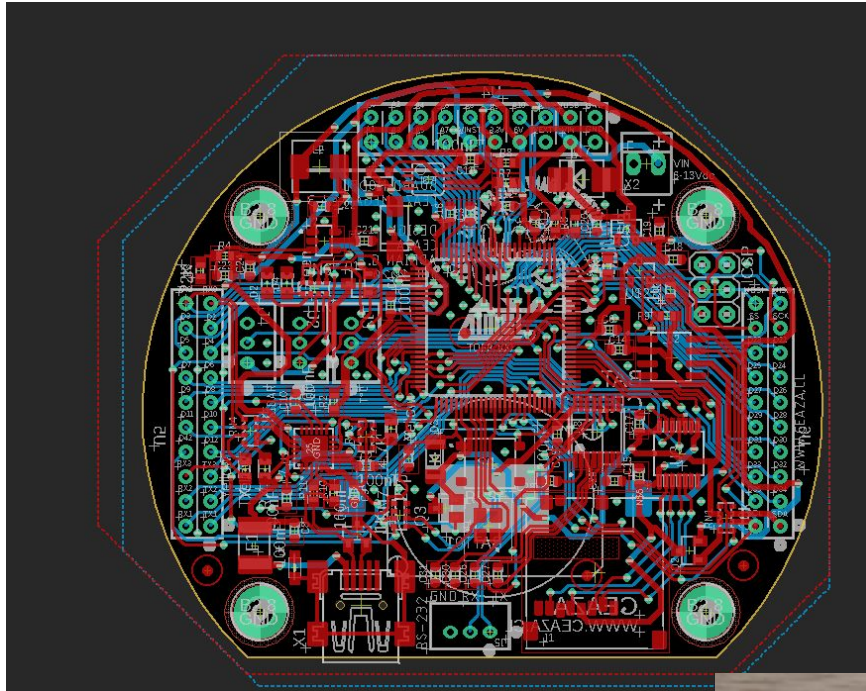
Bajo peso

Bajo tamaño

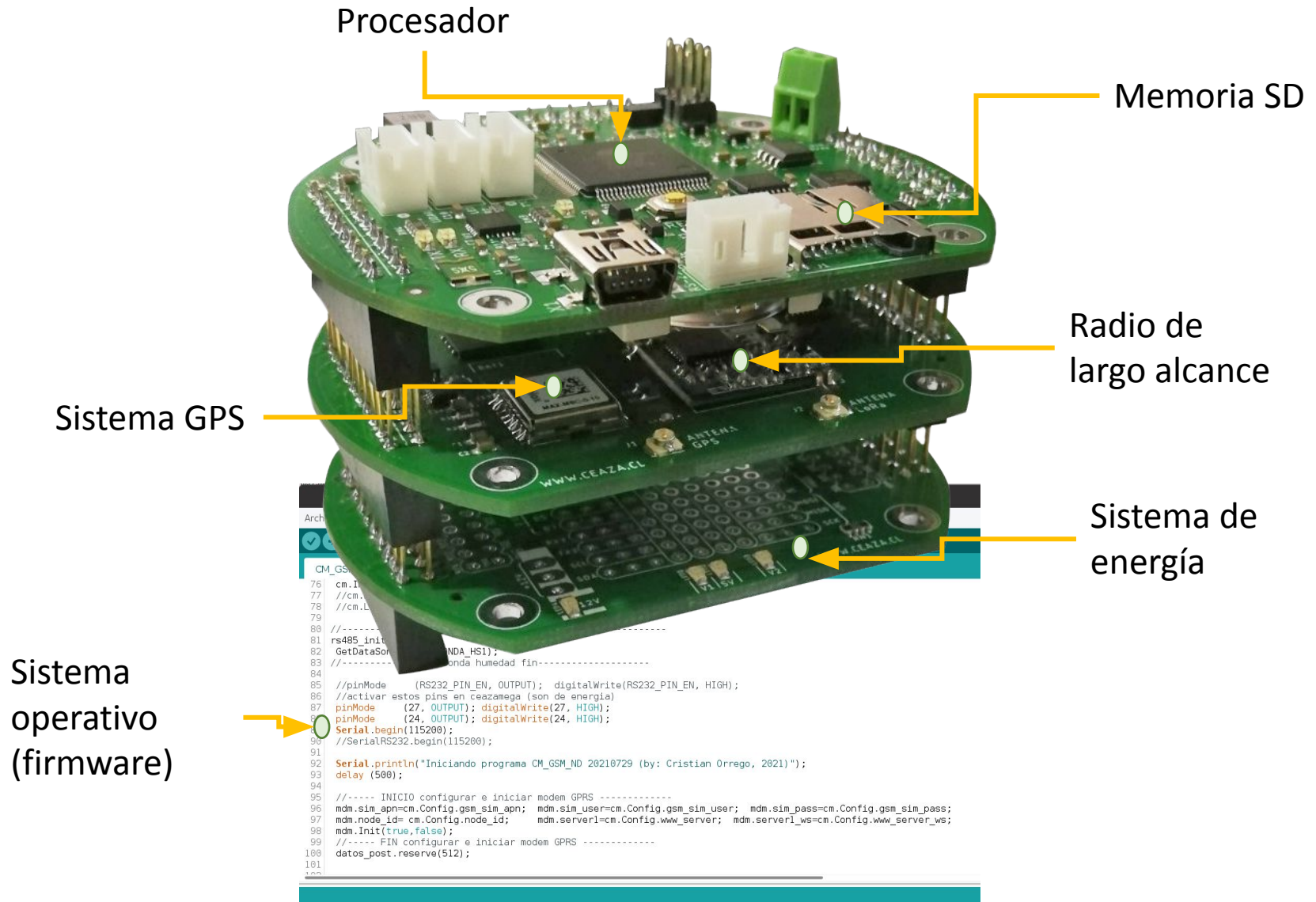
Bajo consumo

Sistemas a medida

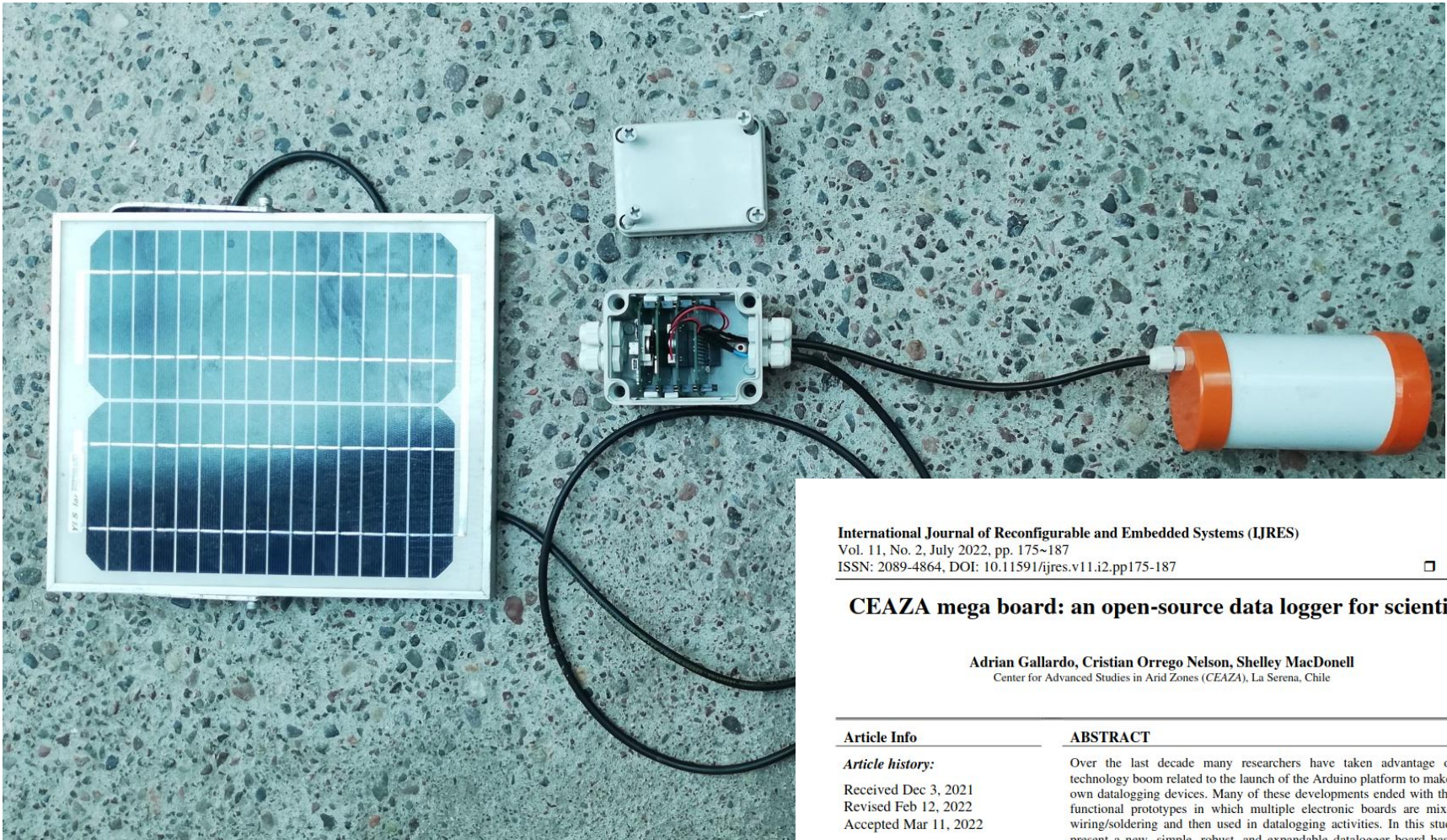
2020-2021: Nodos de altura, hardware



2020-2021: Nodos de altura, hardware



2021: Nodos de altura, fabricación



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□ 175

CEAZA mega board: an open-source data logger for scientists

Adrian Gallardo, Cristian Orrego Nelson, Shelley MacDonell
Center for Advanced Studies in Arid Zones (CEAZA), La Serena, Chile

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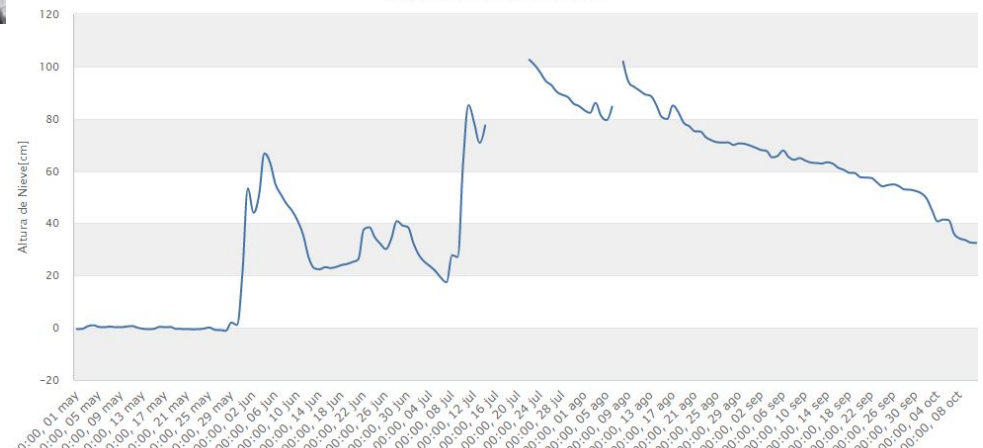
ABSTRACT

Over the last decade many researchers have taken advantage of the technology boom related to the launch of the Arduino platform to make their own datalogging devices. Many of these developments ended with the first functional prototypes in which multiple electronic boards are mixed by wiring/soldering and then used in datalogging activities. In this study we present a new, simple, robust, and expandable datalogger board based on maker's community integrations. Our datalogger board extends previous work in this area as we designed an Arduino Mega 2560 derivative integrated board that is compatible with existing developments but was also designed and implemented considering requirements such as low power consumption, expandability, and integration. Different tests were made so reliability in low temperatures and low energy needs are satisfied. It is expected that the scientific community can add this board to their tool set, as this board solves the energy problem and present an easy transition from

2021: Nodos de altura, pruebas



Gráfico de Altura de Nieve[cm]
Comparación de valores en Tascadero



2021: Nodos de altura, transferencia



Glaciología IANIGLA,
Glaciar Perito Moreno



Glaciología CEAZA,
Glaciar El Tapado



Etapla 3:

Mejorando los TRL

(ANID-IDEA, 2022-2024)



Desarrollo de hardware

Datalogger: El corazón del sistema



2018



2020
V0.5



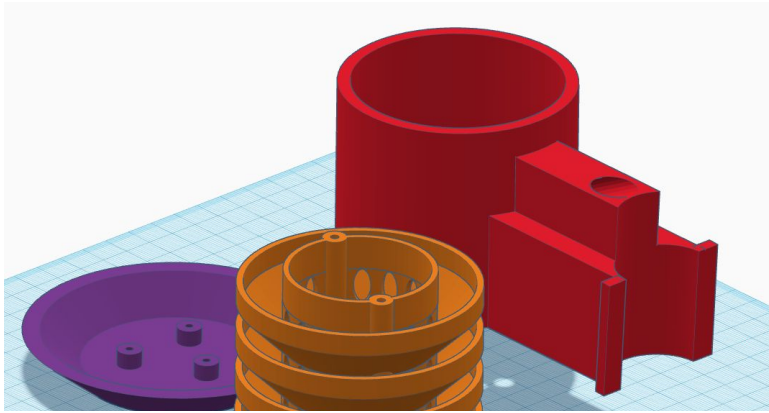
2022
V1.2

Nuevo diseño con:

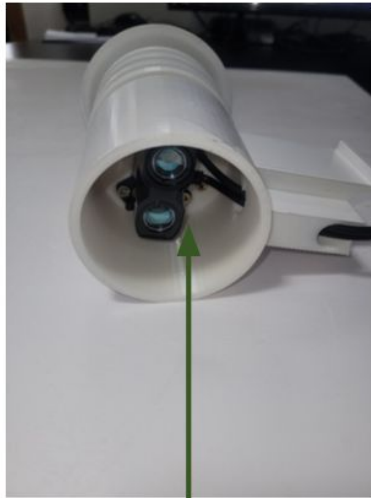
- Mejor interfaz física
- Cambio procesador
- Se agrega carcasa impermeable
- Memoria flash

Desarrollo de sensores y estructura

Sensores



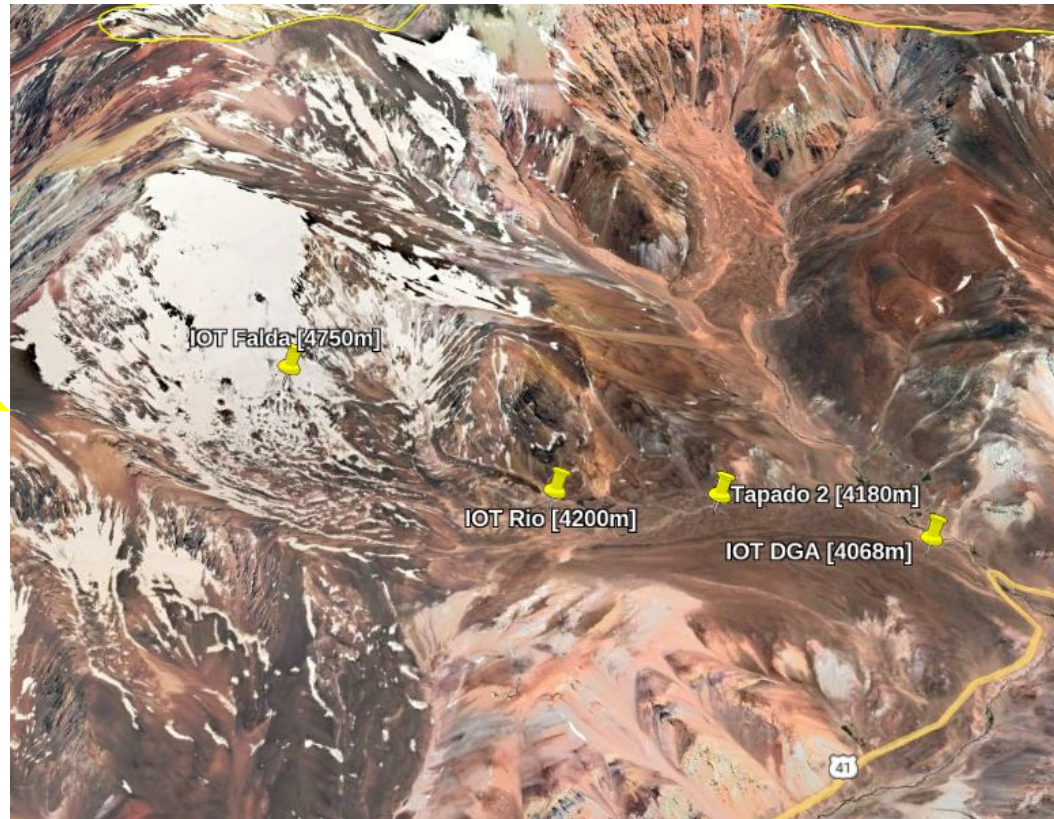
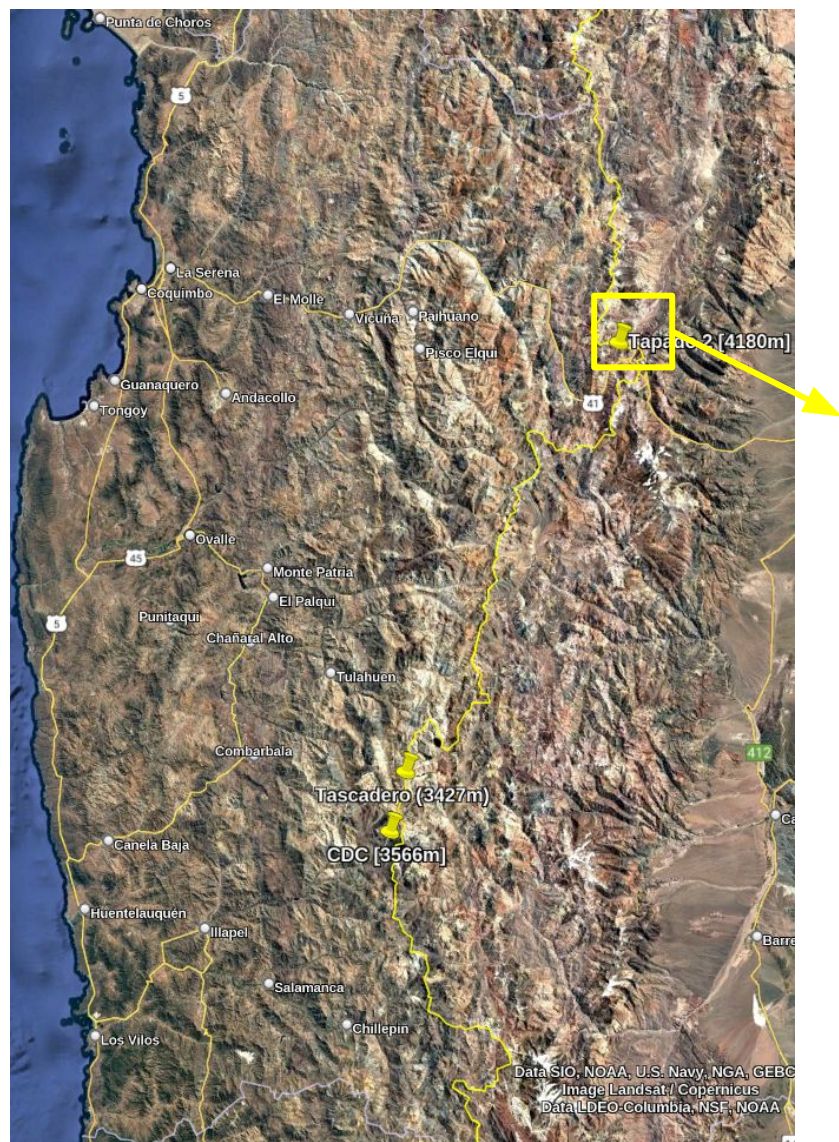
Temperatura



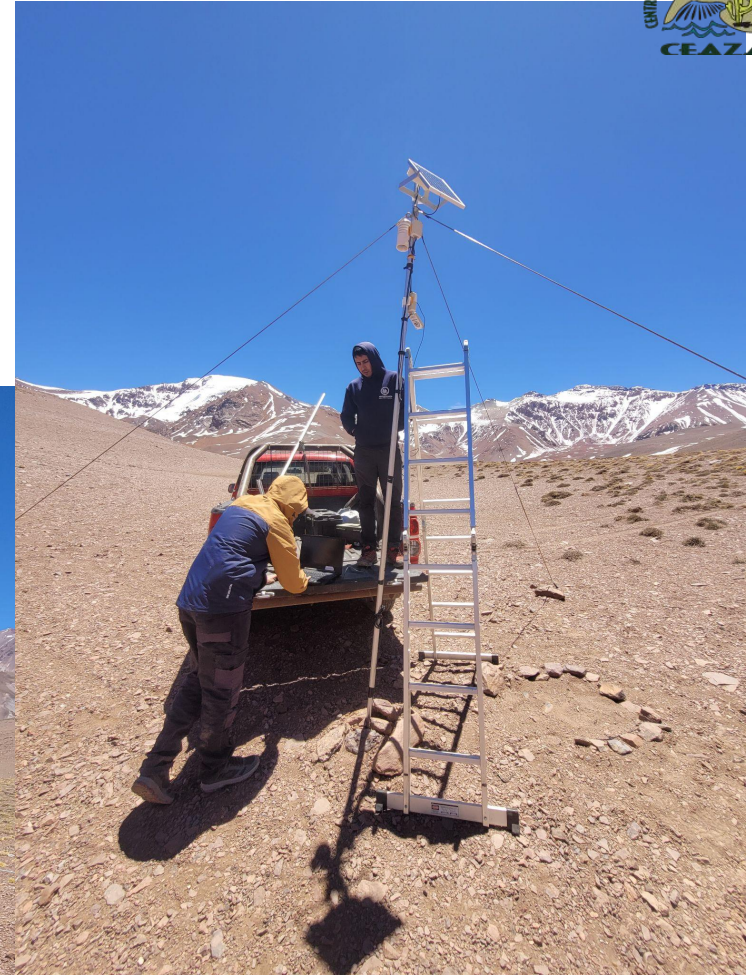
Altura de nieve



Red Elqui: Tapado

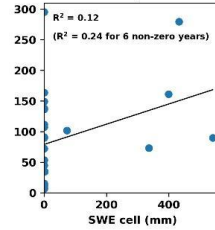


Red Elqui: Tapado

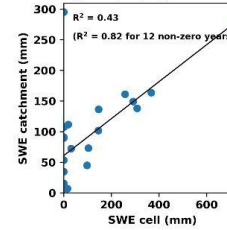


Red Elqui: Representatividad

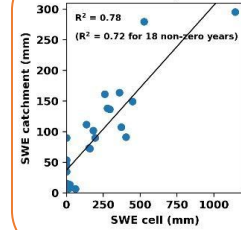
Estero Derecho, 3020.0 m asl.



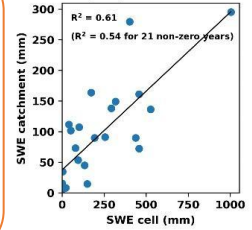
La Laguna [Elqui], 3209.0 m asl.



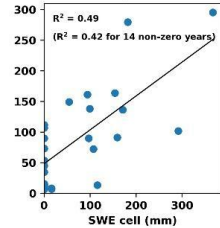
Llano de Las Liebres, 3565.0 m asl.



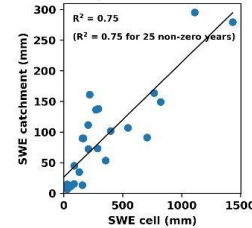
El Jote, 3660.0 m asl.



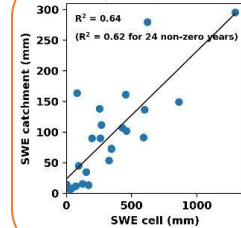
Los Corrales, 3982.0 m asl.



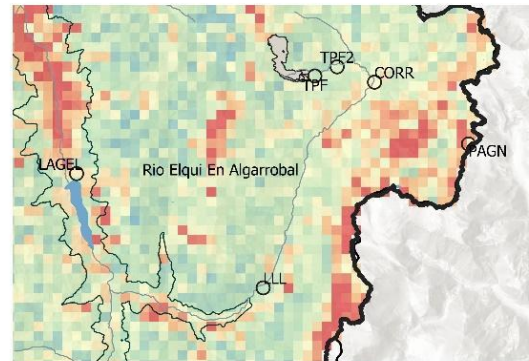
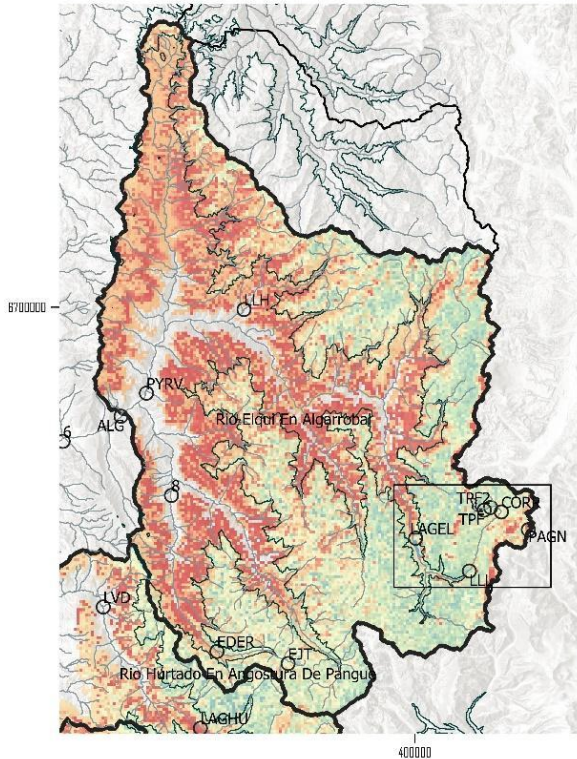
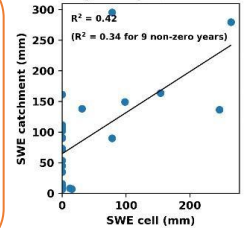
El Tapado, 4306.0 m asl.



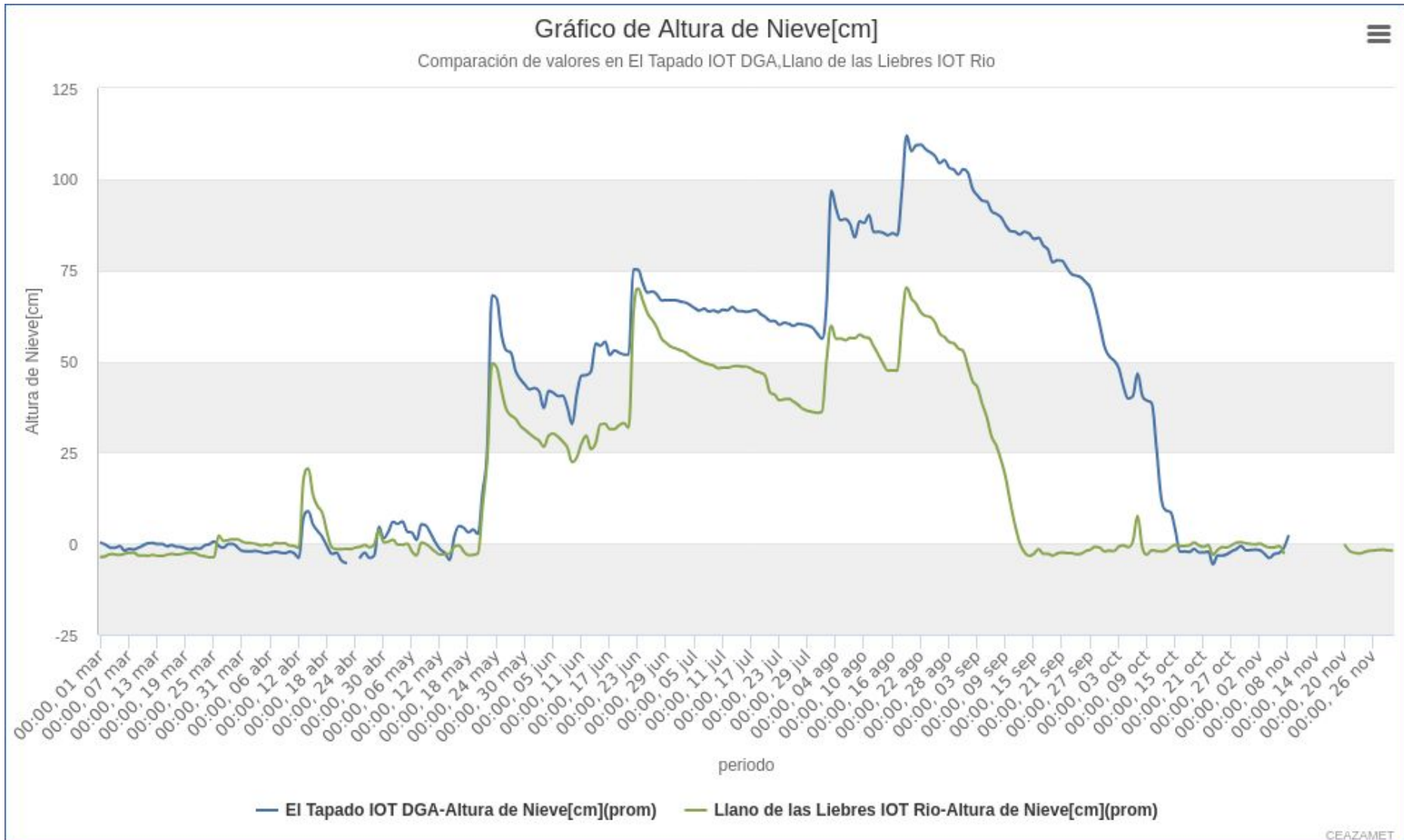
El Tapado 2, nan m asl.



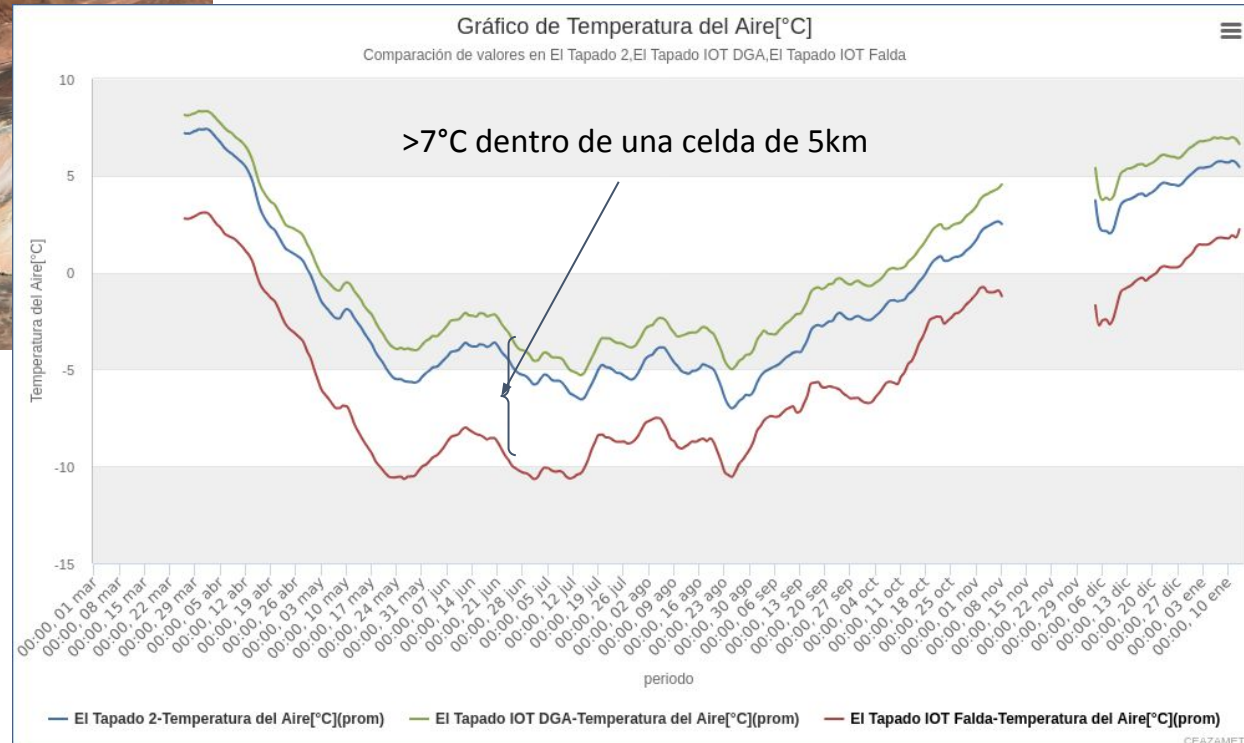
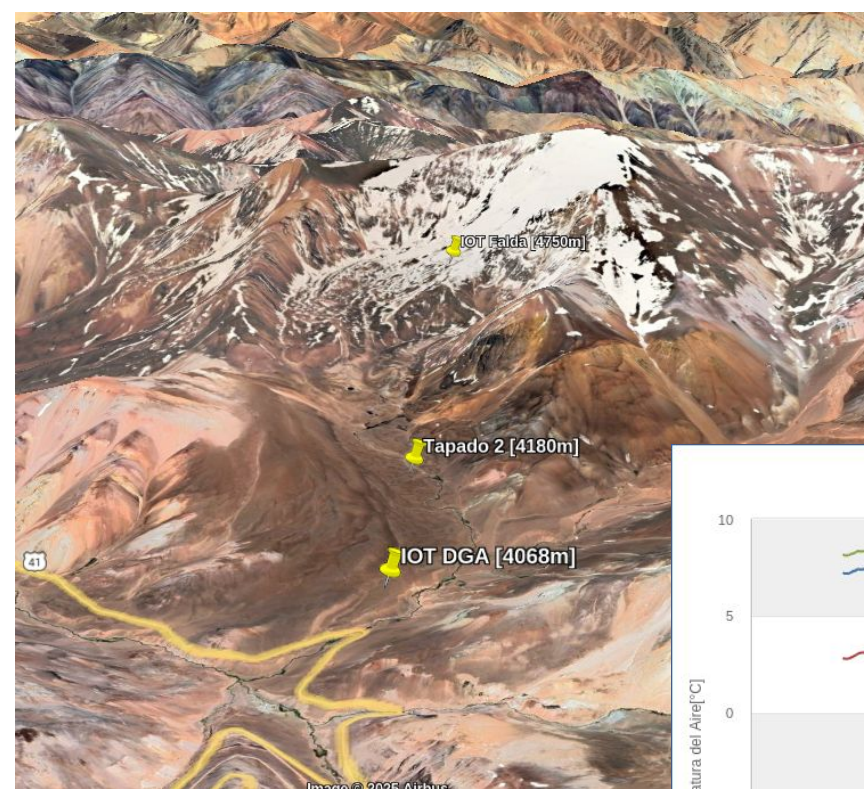
Paso Agua Negra, 4774.0 m asl.



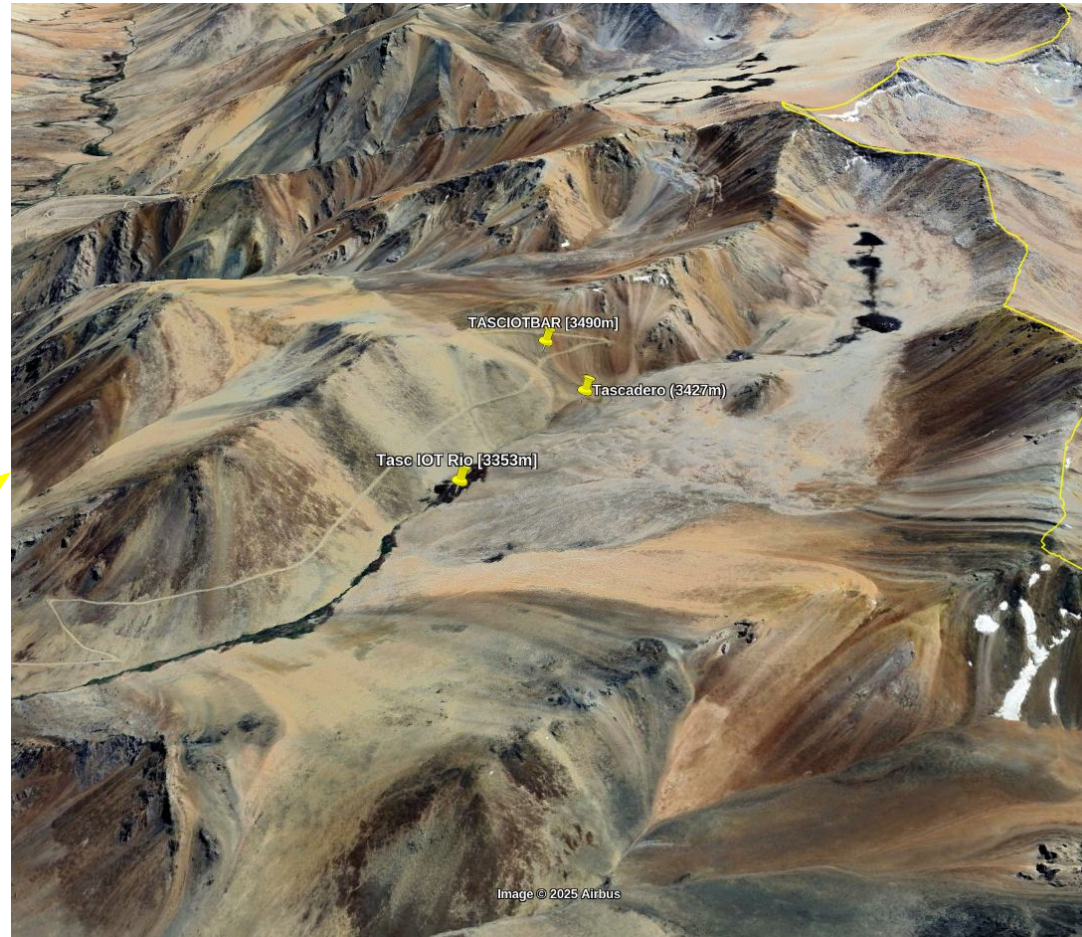
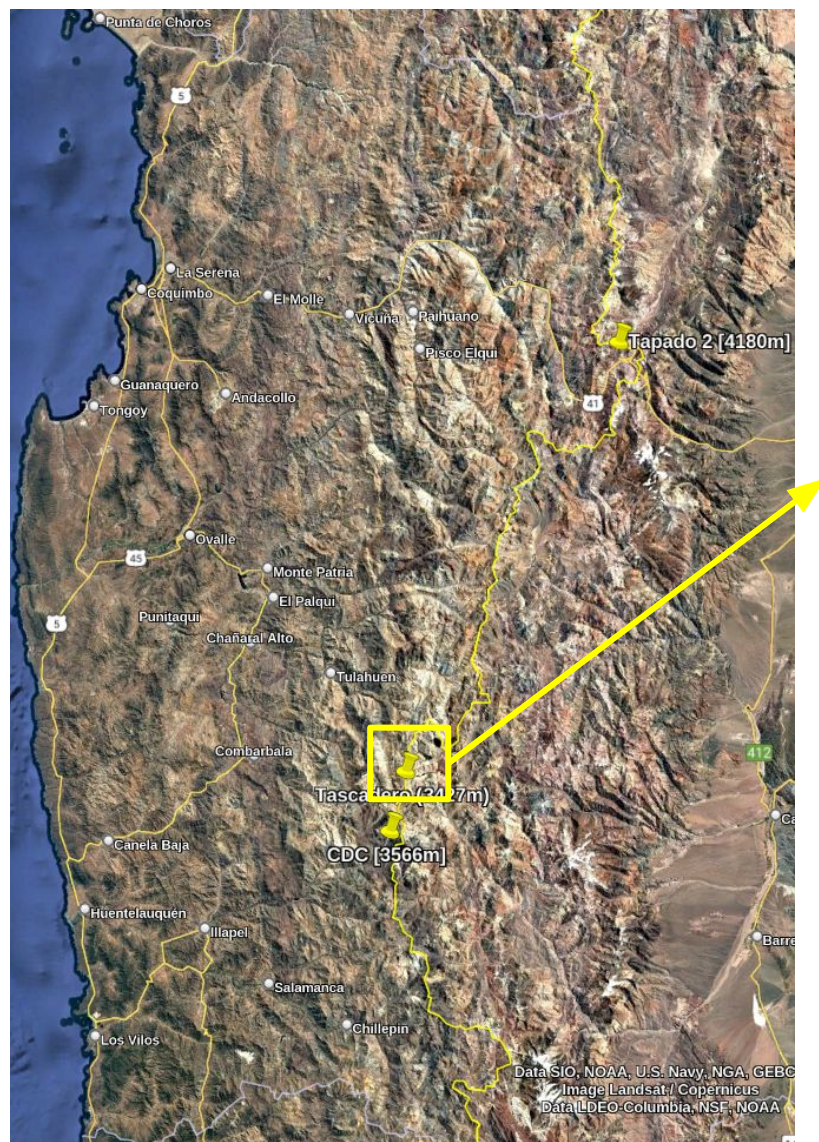
Red Elqui: Datos



Red Elqui: Datos



Red Limarí: Tascadero



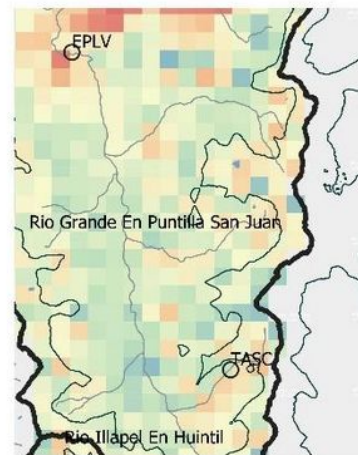
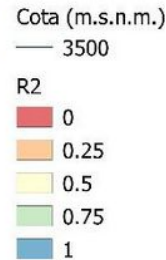
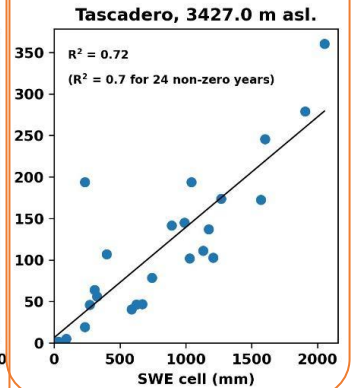
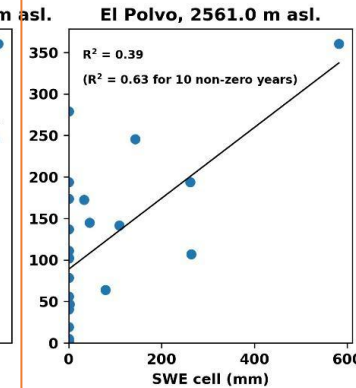
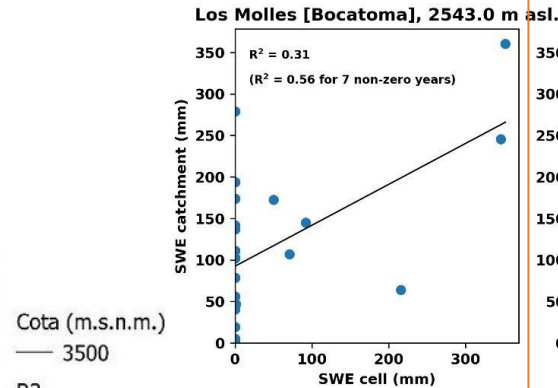
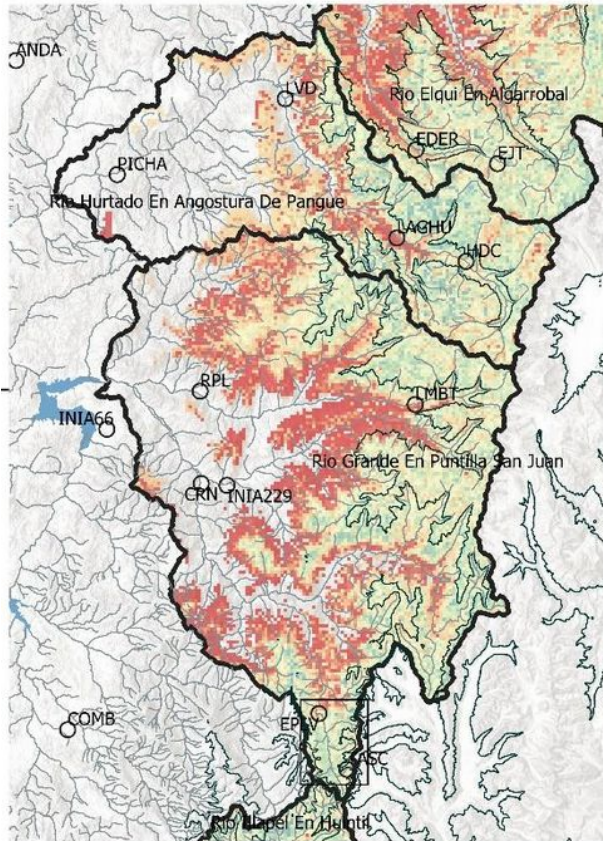
Red Limarí: Tascadero



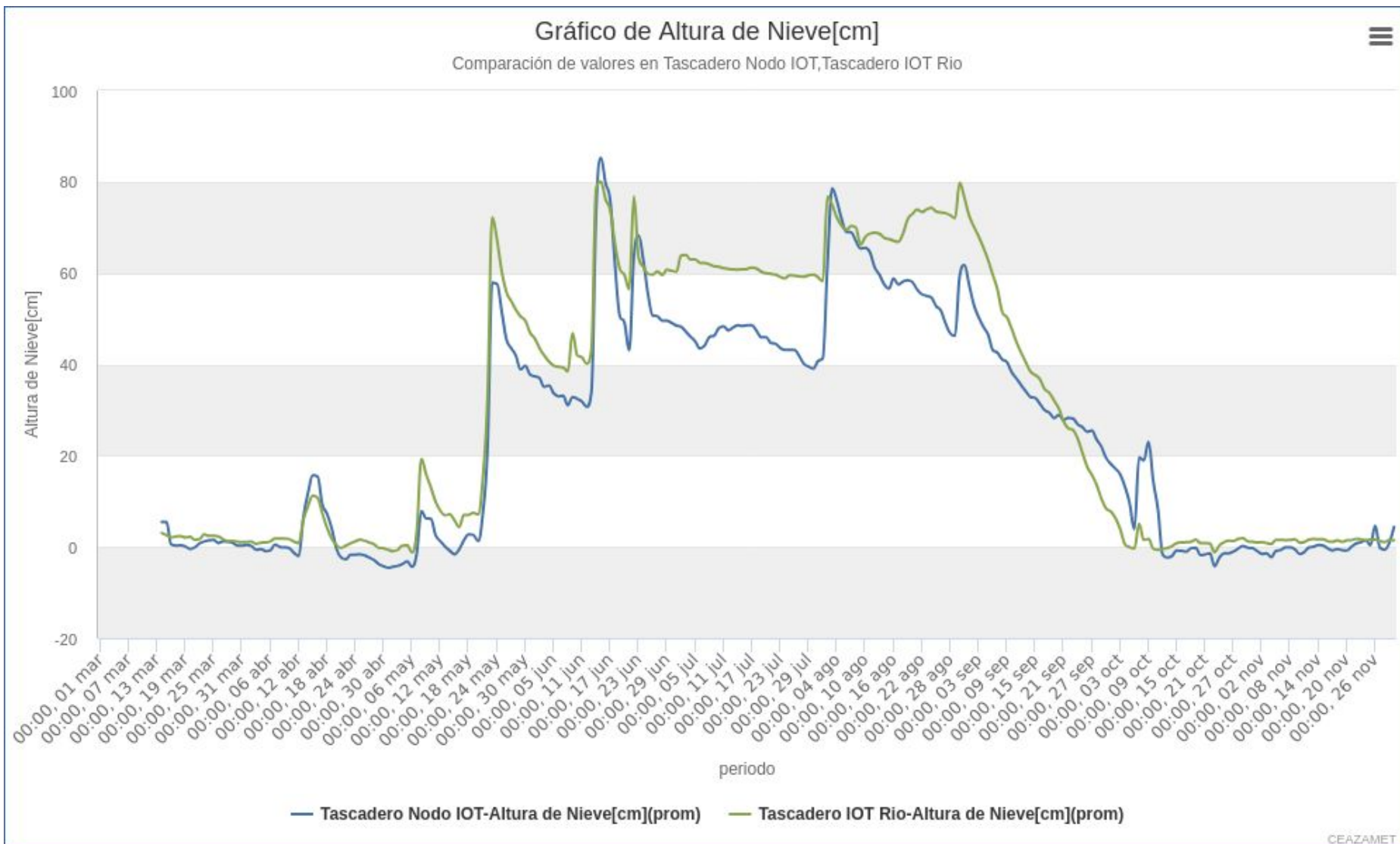
Red Limarí: Tascadero



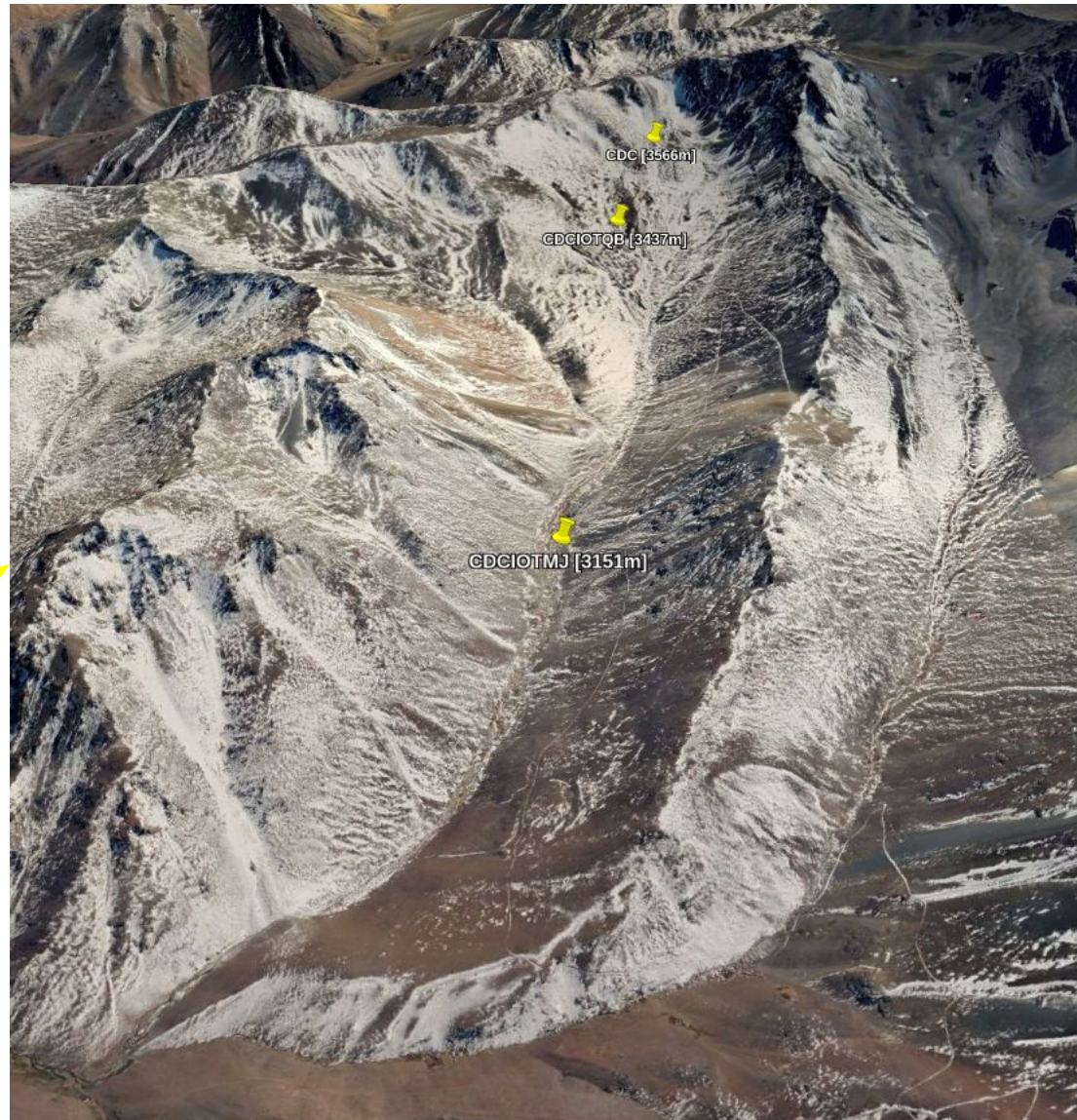
Red Limarí: Representatividad



Red Limarí: Datos



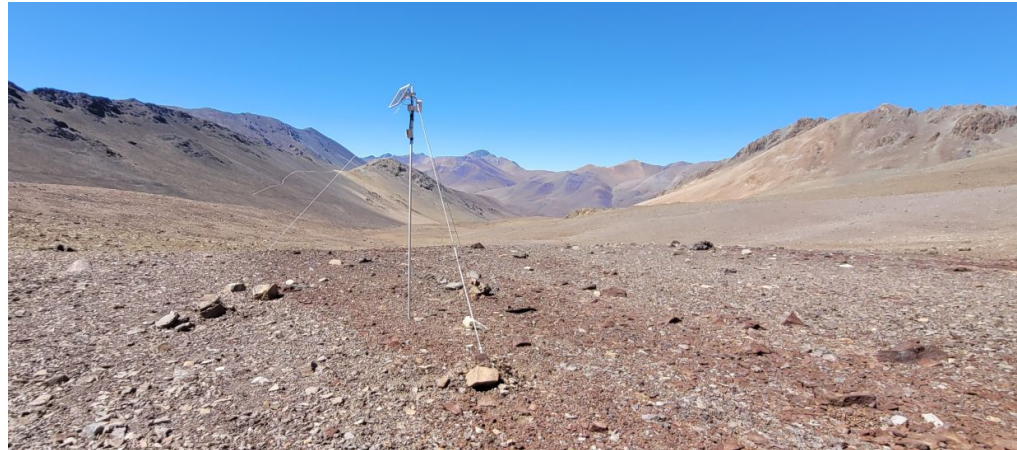
Red Choapa: Casa del Encanto



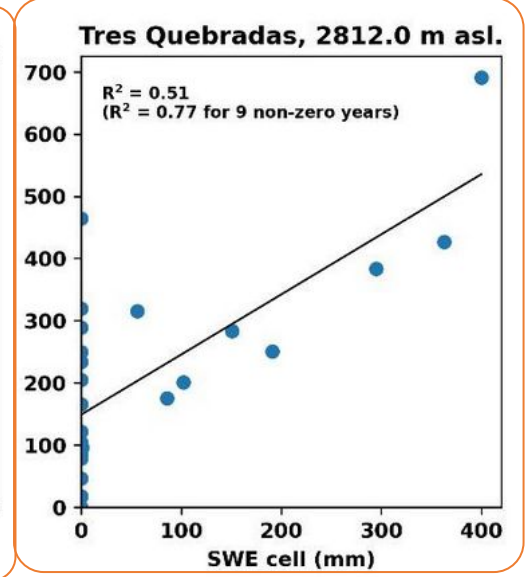
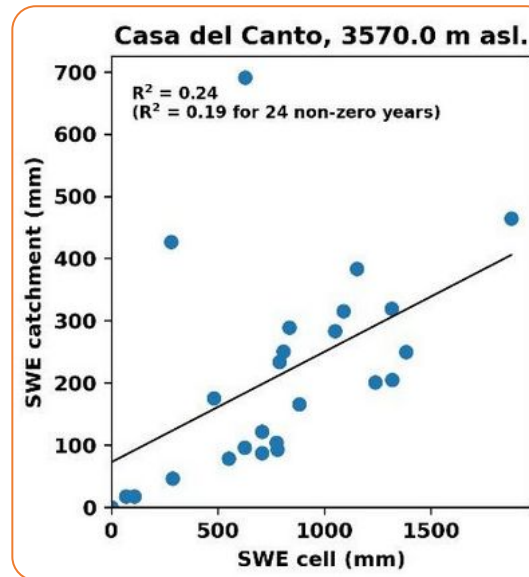
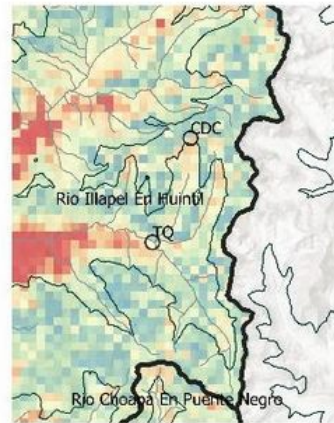
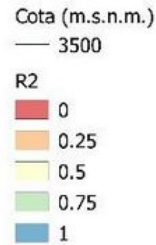
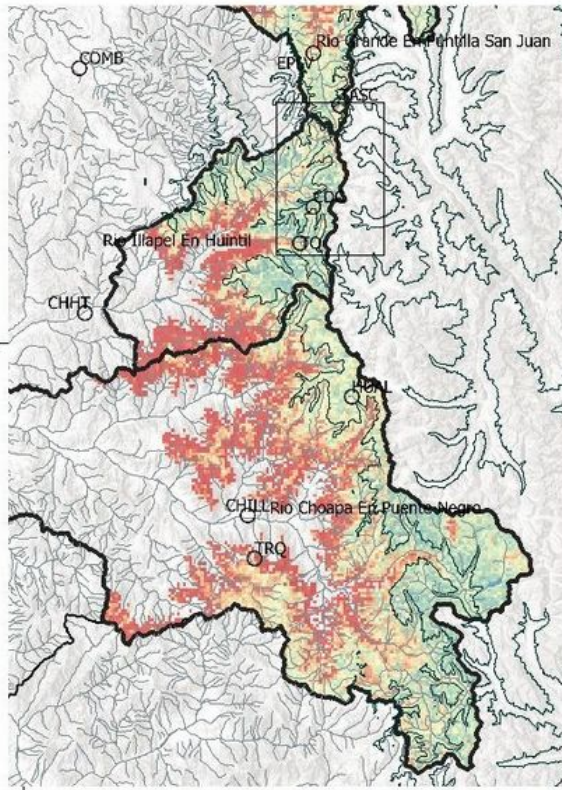
Red Choapa



Red Choapa



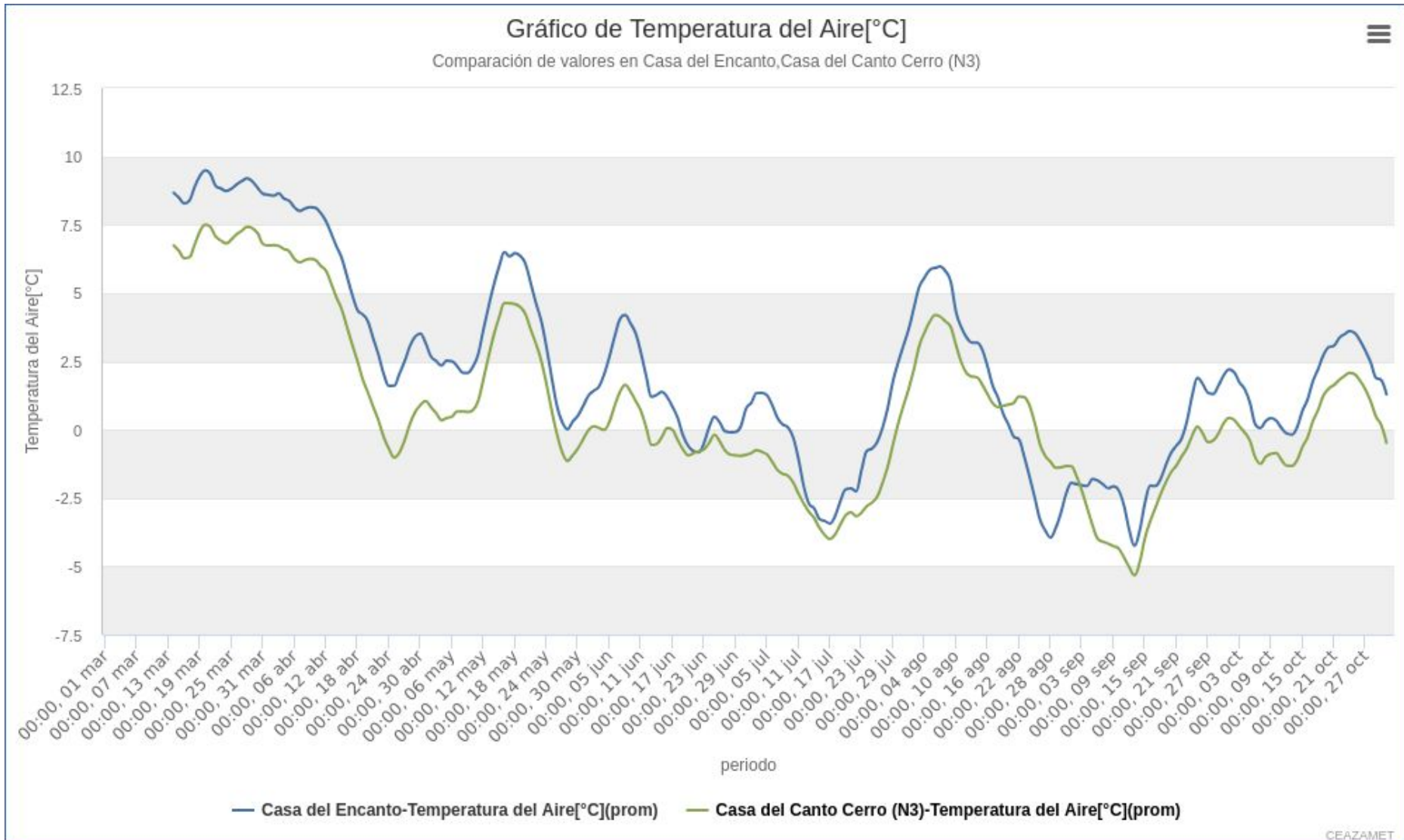
Red Choapa: Representatividad



Red Choapa: Datos



Red Choapa: Datos

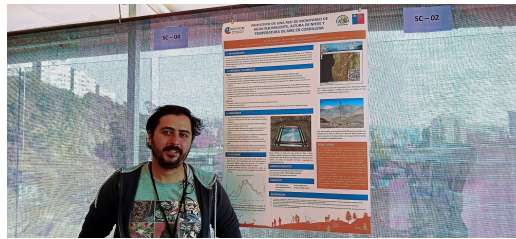


Otros resultados

Congreso CC CRUV, 2023



SOCHICRI, 2023



Talleres U.Canterbury, NZ, 2024



Radio Universitaria, 2024



Congreso Futuro, Coquimbo, 2025



Capacitación UPLA, 2025



Labs. abiertos CEAZA, 2024



Academia PAR explora, 2024



Presentación Ing.Ambiental, 2024



Futuro: lo posible

1. Proyecto actualmente postulado en donde incorporaríamos los nodos al sistema CEAZAmet de largo plazo
2. Implementar planes de monitoreo en las cuencas que permita financiar básicamente el desarrollo (con aprox. 60MM\$/año estaría asegurado [con aportes CEAZA]).
3. Todavía a los nodos le falta un par de años de desarrollo
4. Se pueden hacer redes para subcuencas e integrar con modelación
5. Largo plazo: alimentar modelos de caudales e incorporar los pronósticos al servicio
6. Insistir en diseño de sensores de precipitación y agua equivalente





Gracias por el apoyo a las 3 Juntas de Vigilancia y por participar de esta instancia

Consultas?



Junta de Vigilancia
Río Grande y Limarí
y sus afluentes



JUNTA DE VIGILANCIA



RÍO ILLAPEL
Y SUS AFLUENTES