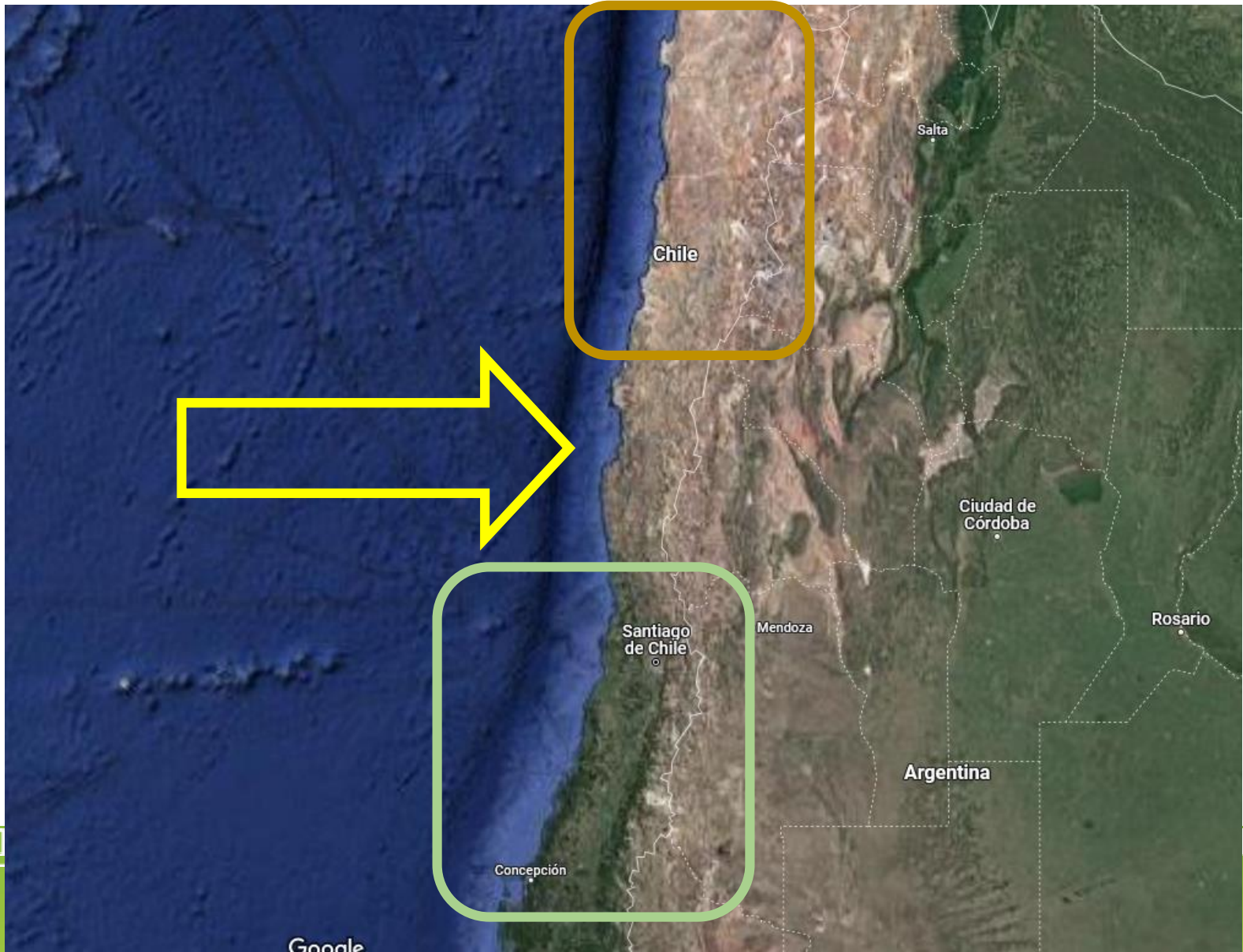




# Desarrollo de tecnologías para la telemetría nival

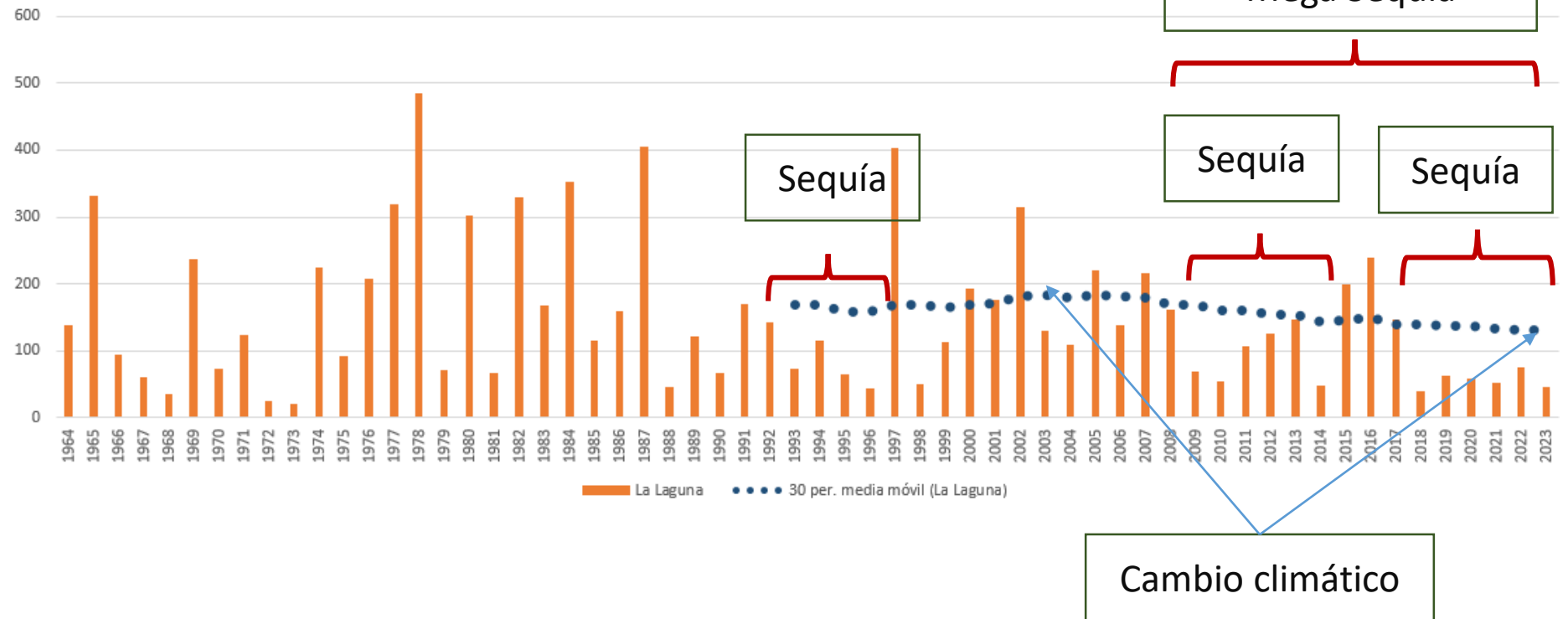
Cristian Orrego  
Ing. Computación  
Coordinador grupo CEAZAmet

# Contexto: Zona de transición



# Contexto: Sequías y cambio climático

Precipitación en Embalse La Laguna (Elqui)  
1964-2023

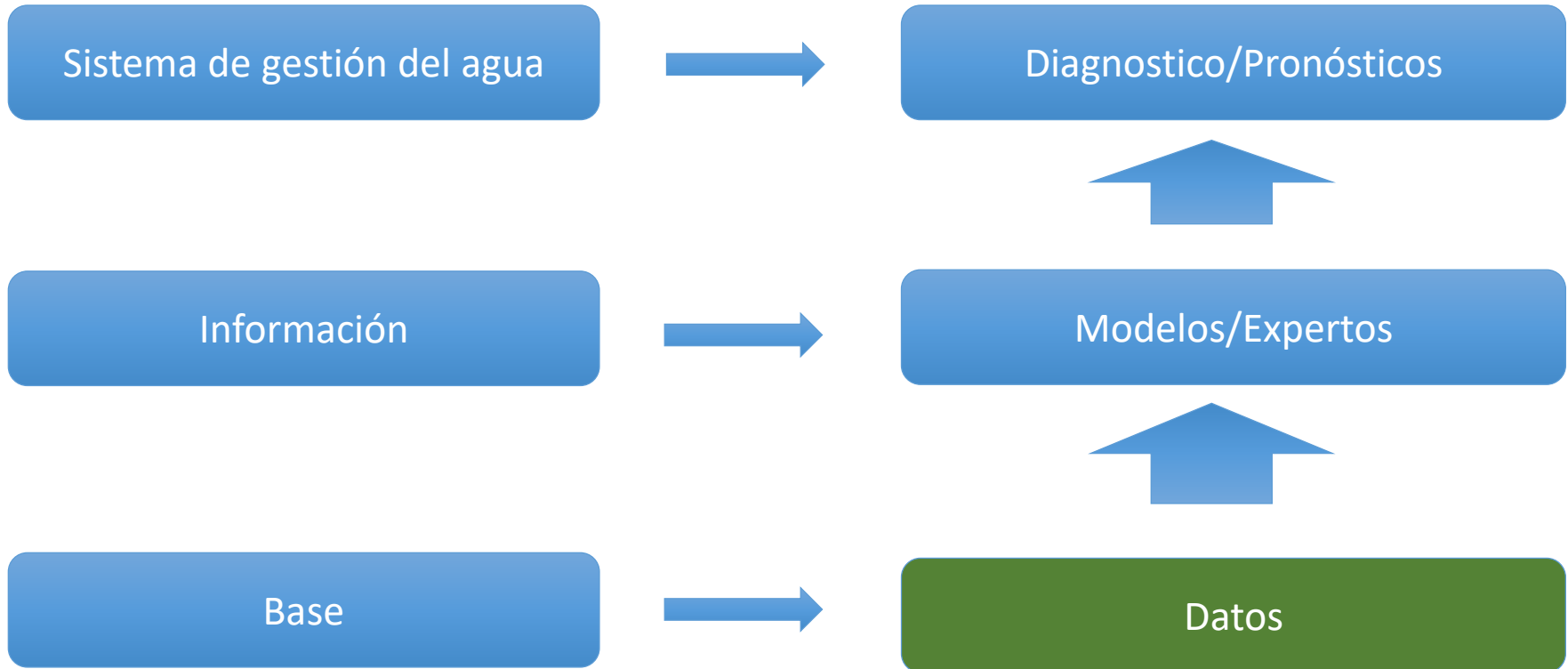


# Impactos



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

# Problema general



# CEAZAmet y monitoreo en altura

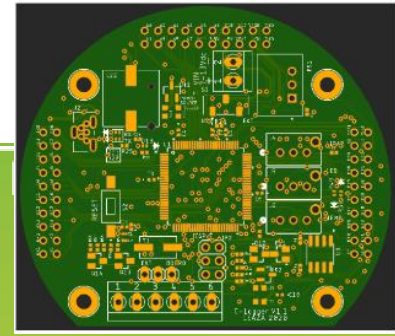
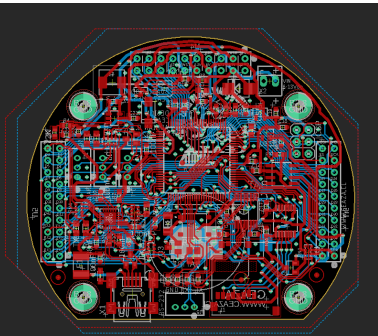
Esto es difícil y caro!!  
Pero necesitamos mas



# Propuesta (2015 – 2023)



Expansión de la red de  
telemetría mediante el  
desarrollo local de hardware  
avanzado



# Sistemas de telemetría



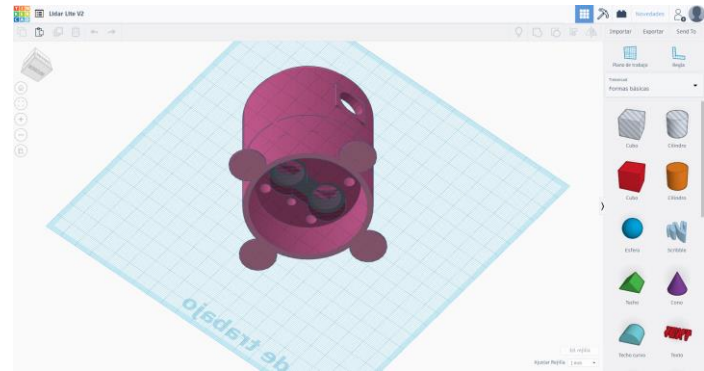
# **Etapla 1:**

# **Factibilidad**

# **(2015-2018)**



# Prototipos (2015-2018)



Es factible?

# Prototipo 3: Pruebas terreno



Si!!!!

# **Etapla 2:**

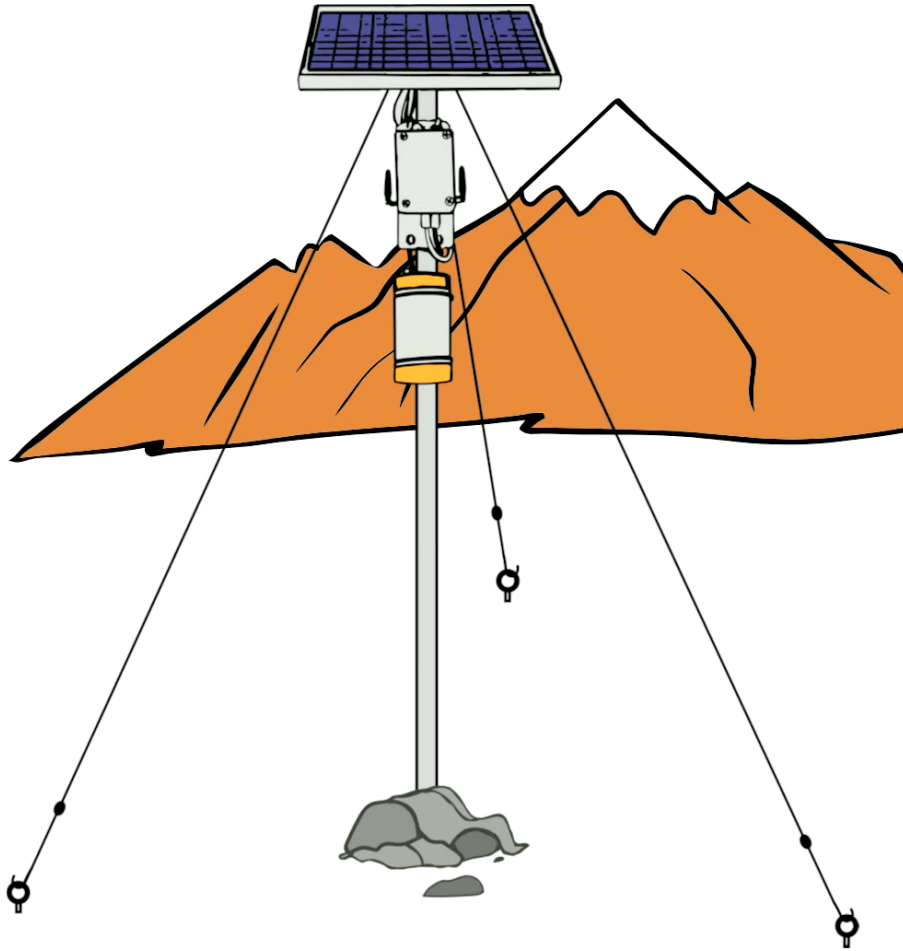
# **Desarrollo**

# **electrónico**

# **(ANID-IDEA 2020)**



# 2020-2021: Nodos de altura (V4)



Bajo costo

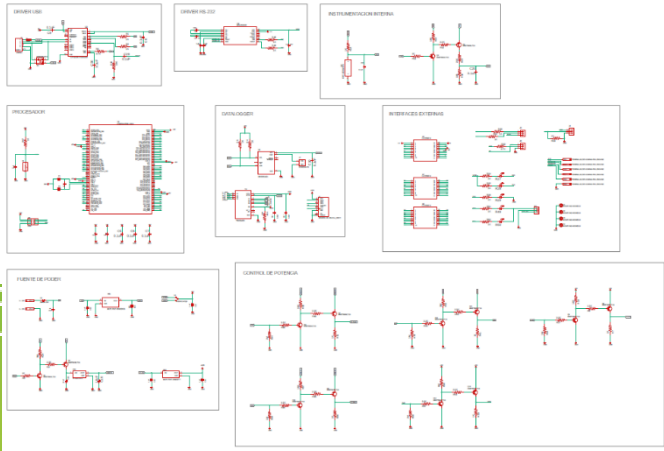
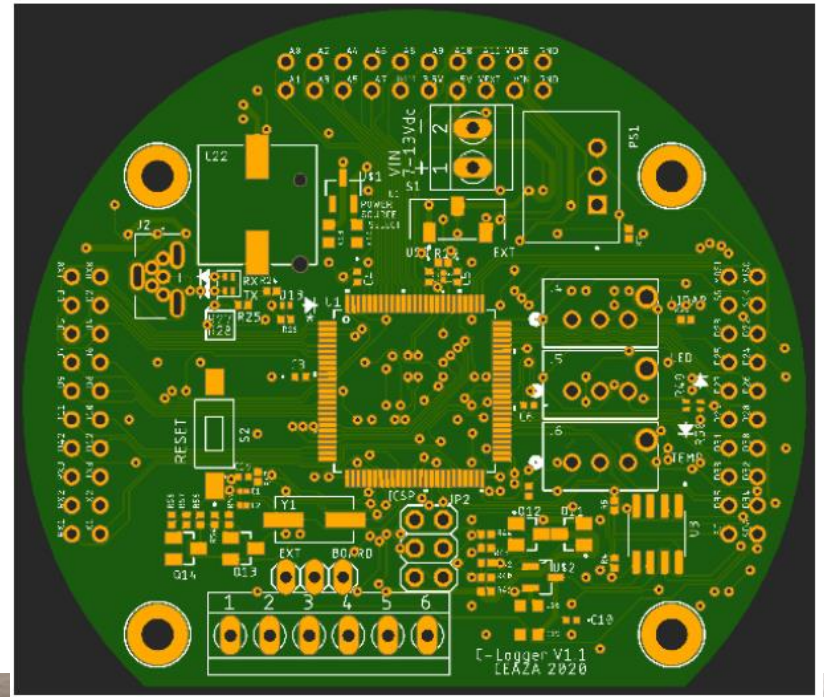
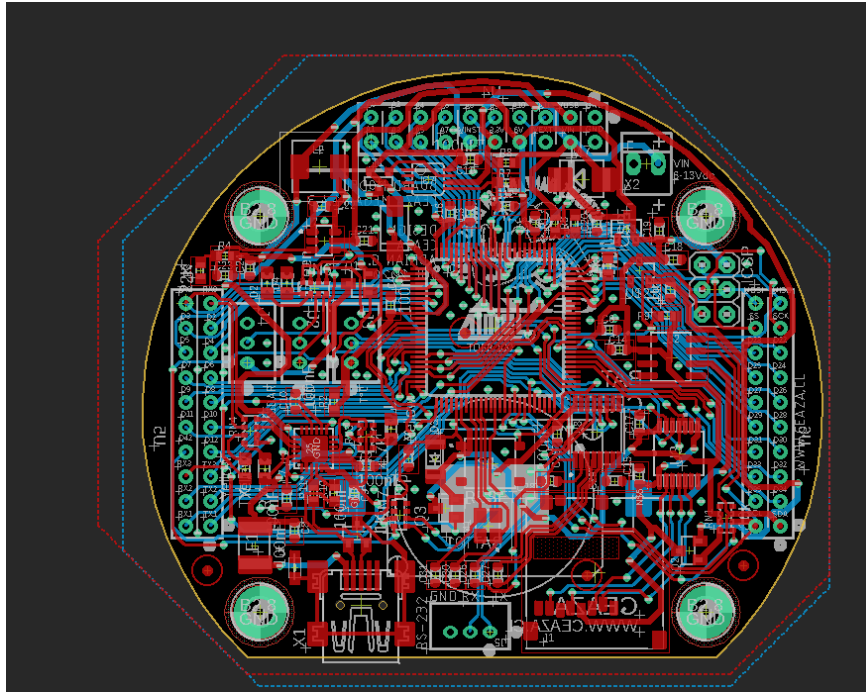
Bajo peso

Bajo tamaño

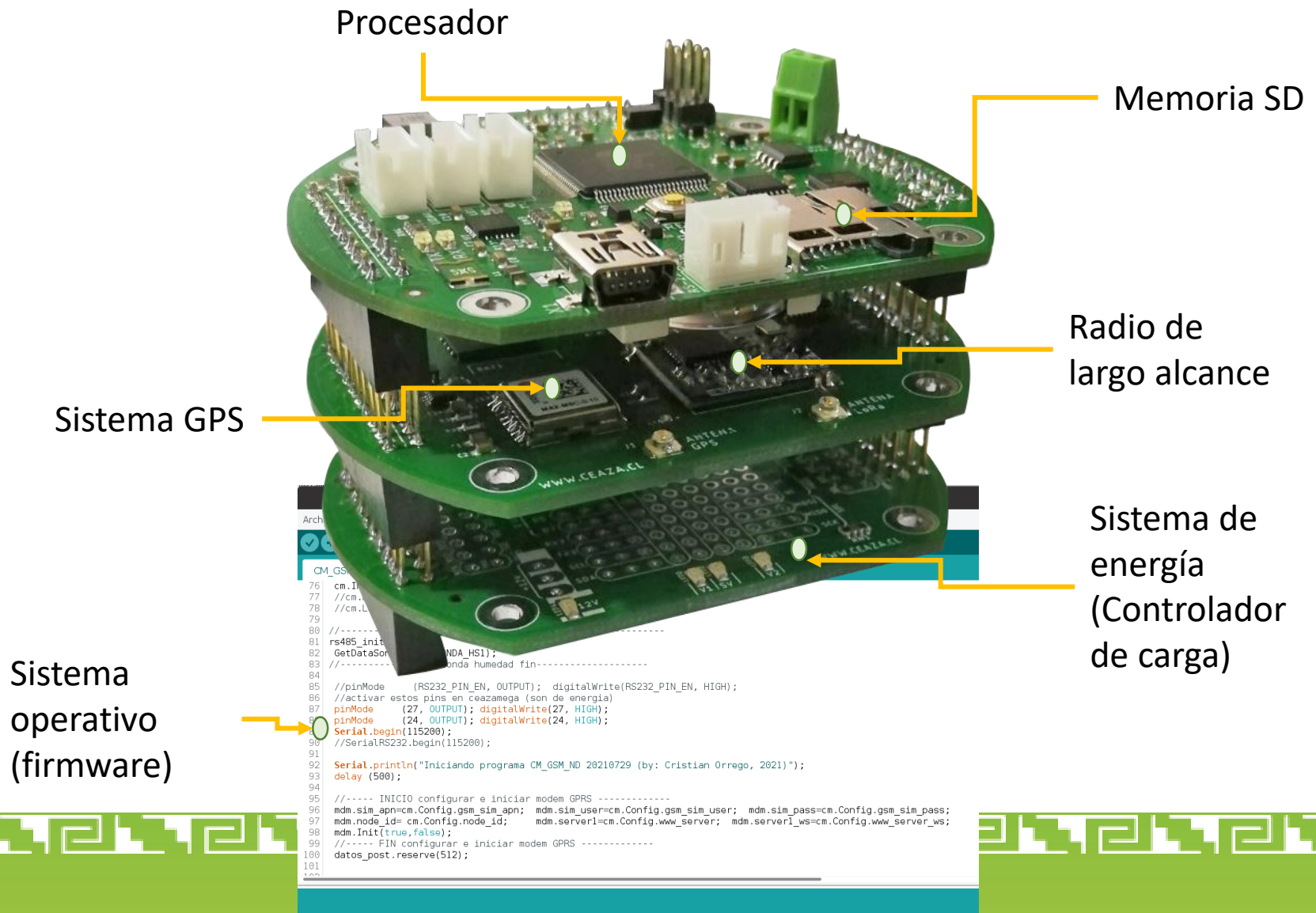
Bajo consumo

Sistemas a medida

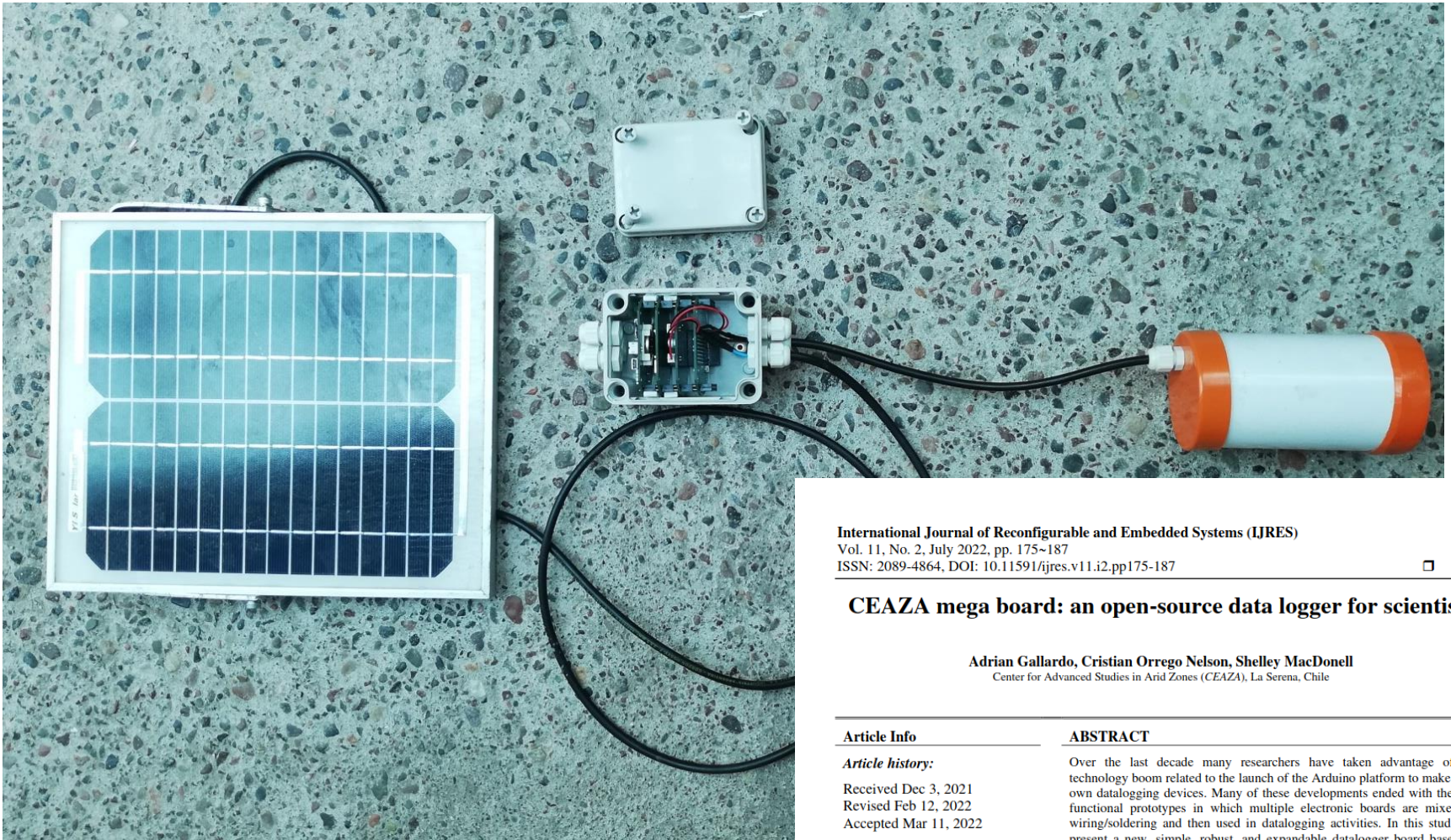
# 2020-2021: Nodos de altura, hardware



# 2020-2021: Nodos de altura, hardware



# 2021: Nodos de altura, fabricación



International Journal of Reconfigurable and Embedded Systems (IJRES)  
Vol. 11, No. 2, July 2022, pp. 175~187  
ISSN: 2089-4864, DOI: 10.11591/ijres.v11.i2.pp175-187

□ 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

### Article Info

#### Article history:

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Revised Feb 12, 2022  
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#### Keywords:

Arduino  
Climate change  
Data logger  
Embedded system  
Environmental monitoring  
Open source  
Science

### 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 handmade logger integrations.

*This is an open access article under the CC BY-SA license.*

# 2021: Nodos de altura, pruebas

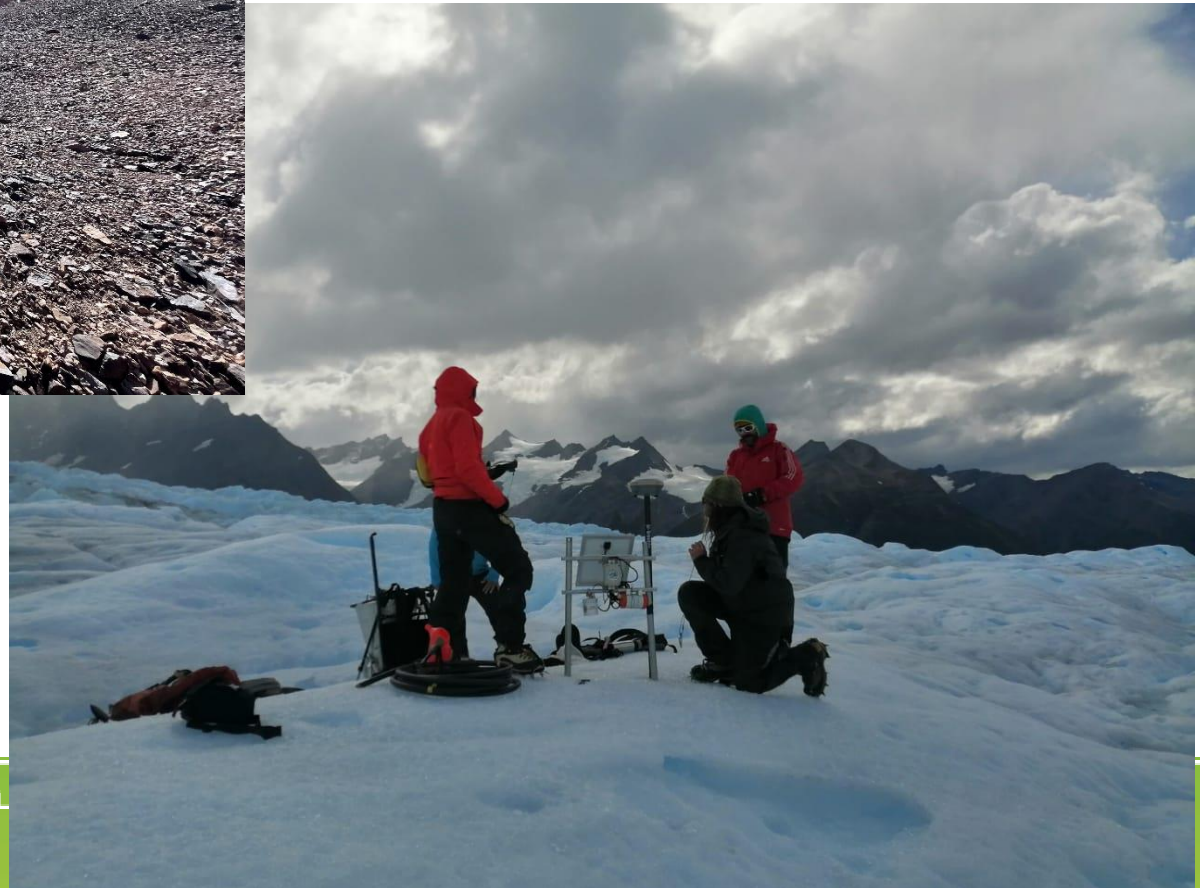


# 2021: Nodos de altura, transferencia



Glaciología IANIGLA,  
Glaciar Perito Moreno

Glaciología CEAZA,  
Glaciar El Tapado



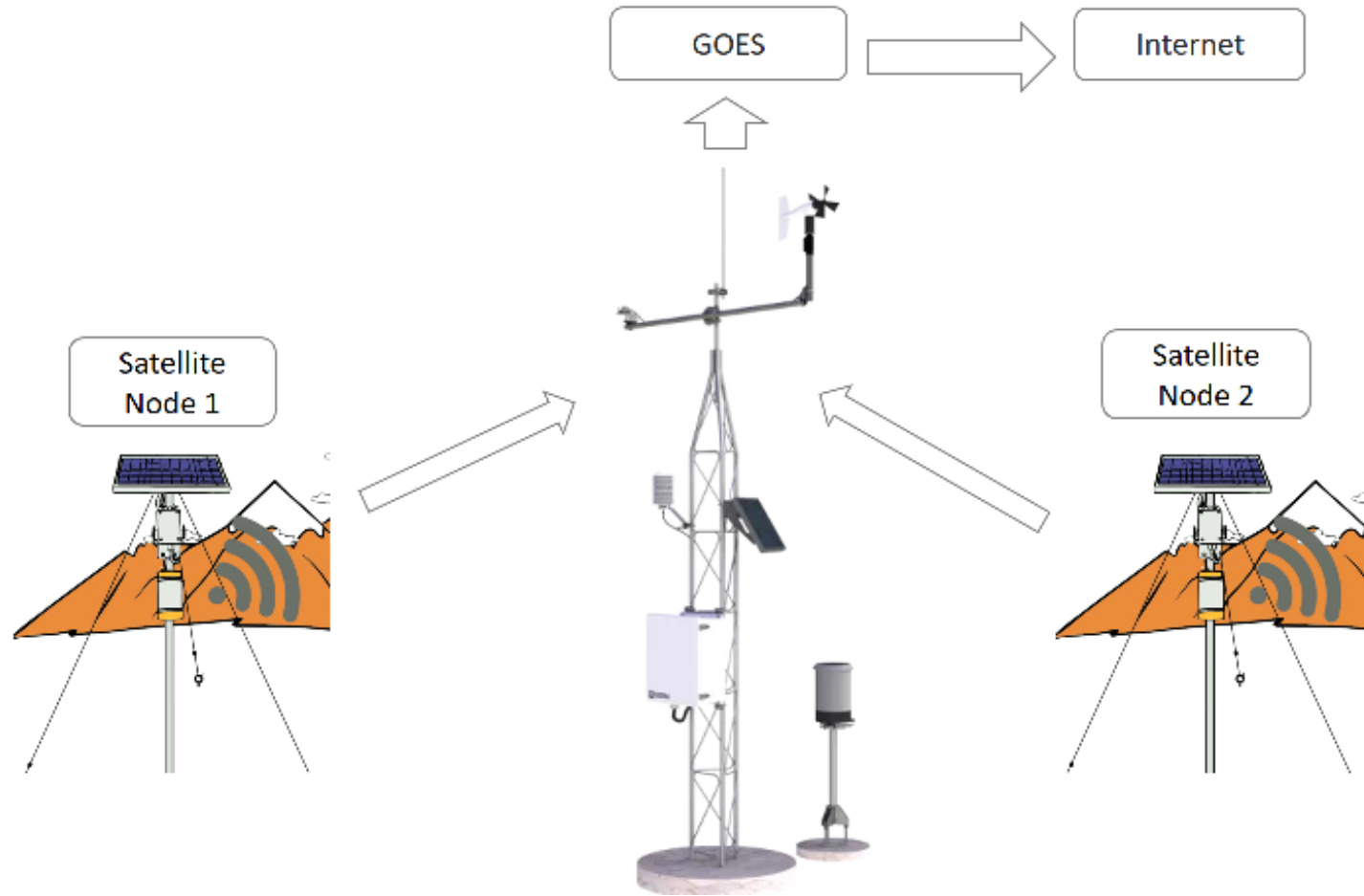
# **Etapla 3:**

## **Mejorando los TRL**

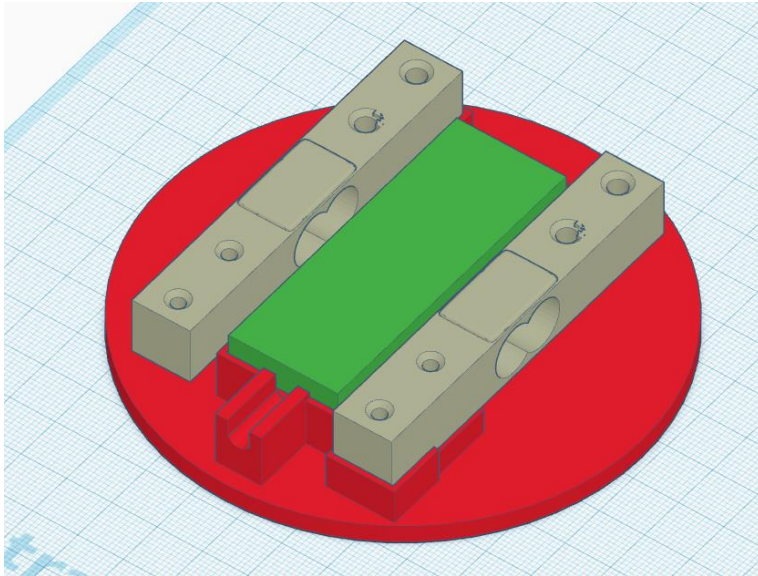
### **(ANID-IDEA, 2022-2024)**



# Objetivo: Red nival de bajo costo



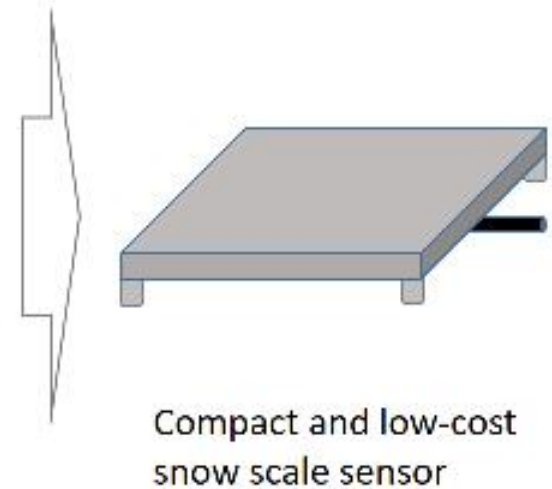
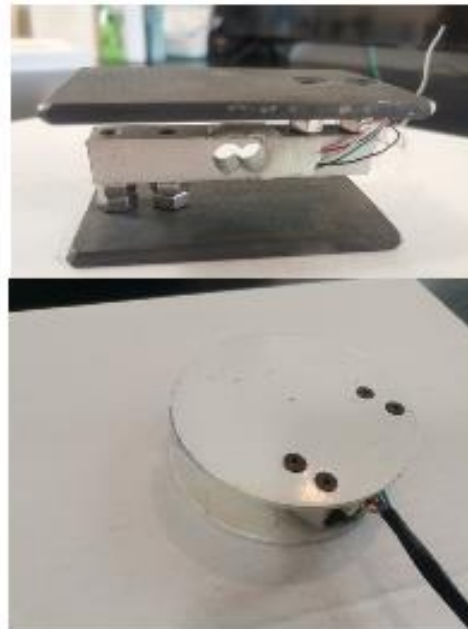
# Desarrollo de sensores



Technological development of Snow Scale Sensor

Proof of concept  
(2020-2011)

CEAZAscale V1  
(2022/25)



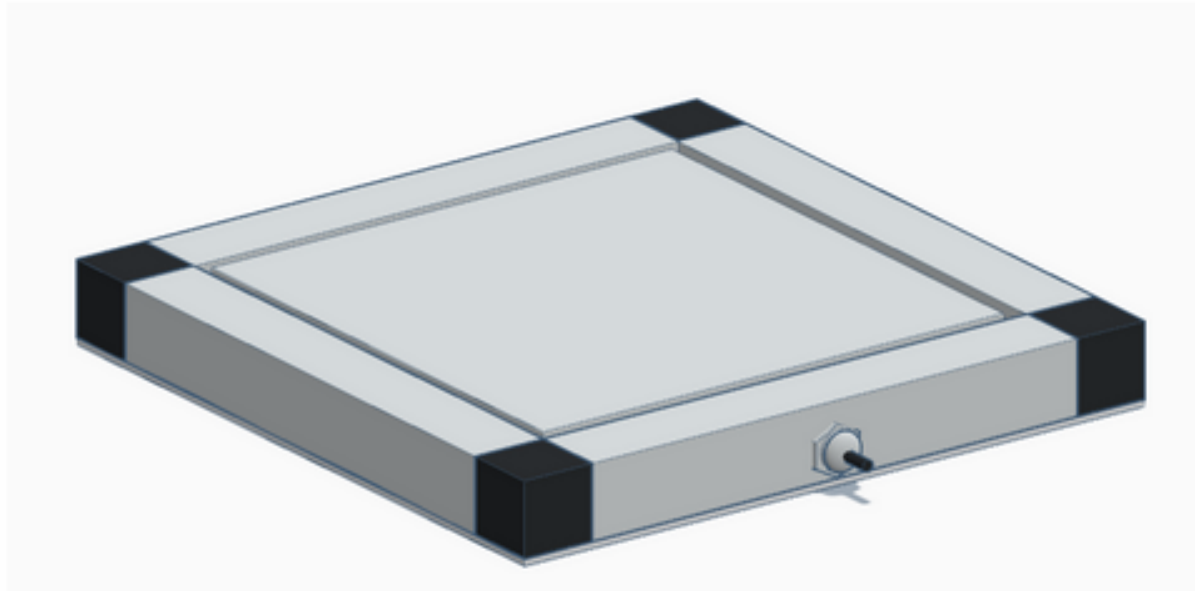
# Armado



# Desarrollo de sensores

## **SnowScale Mini V0.3**

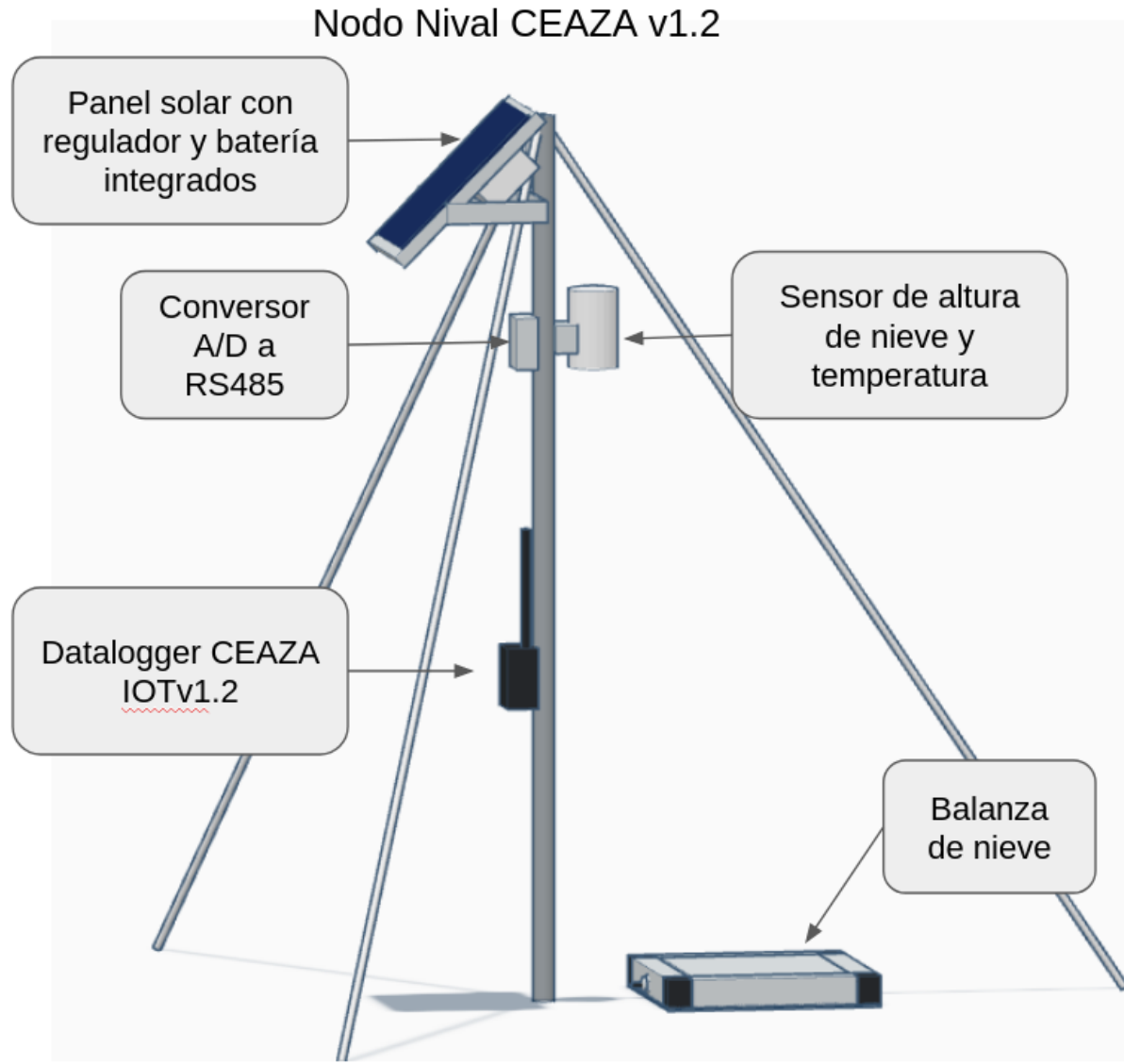
SWE Sensor



This prototype is a Mini SnowScale of measuring area of 25x25cm. Can be used in any situation where conventional Snow Scales are not feasible (budget or space constraints)

Energy efficient and RS485 communications. Atmel 328P SoC based and 0 to 40kg weight capabilities.

# Sistemas integrados



# Instalación



# Datos

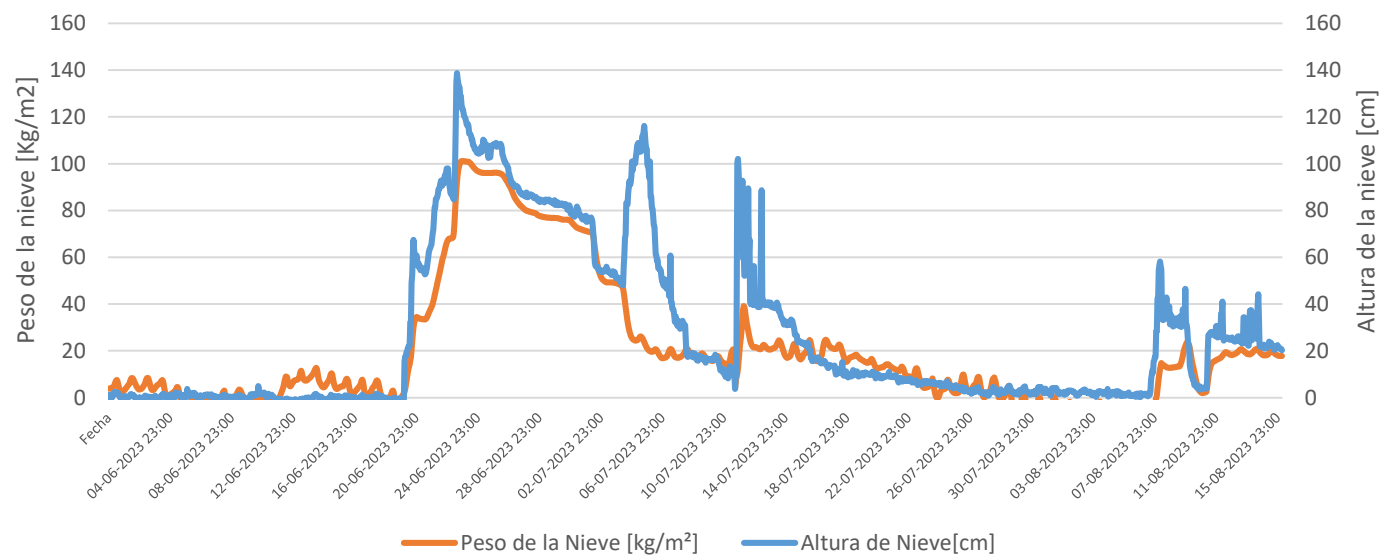
## Nodo en falda de glaciar El Tapado

Altitud: 4500 m.s.n.m.

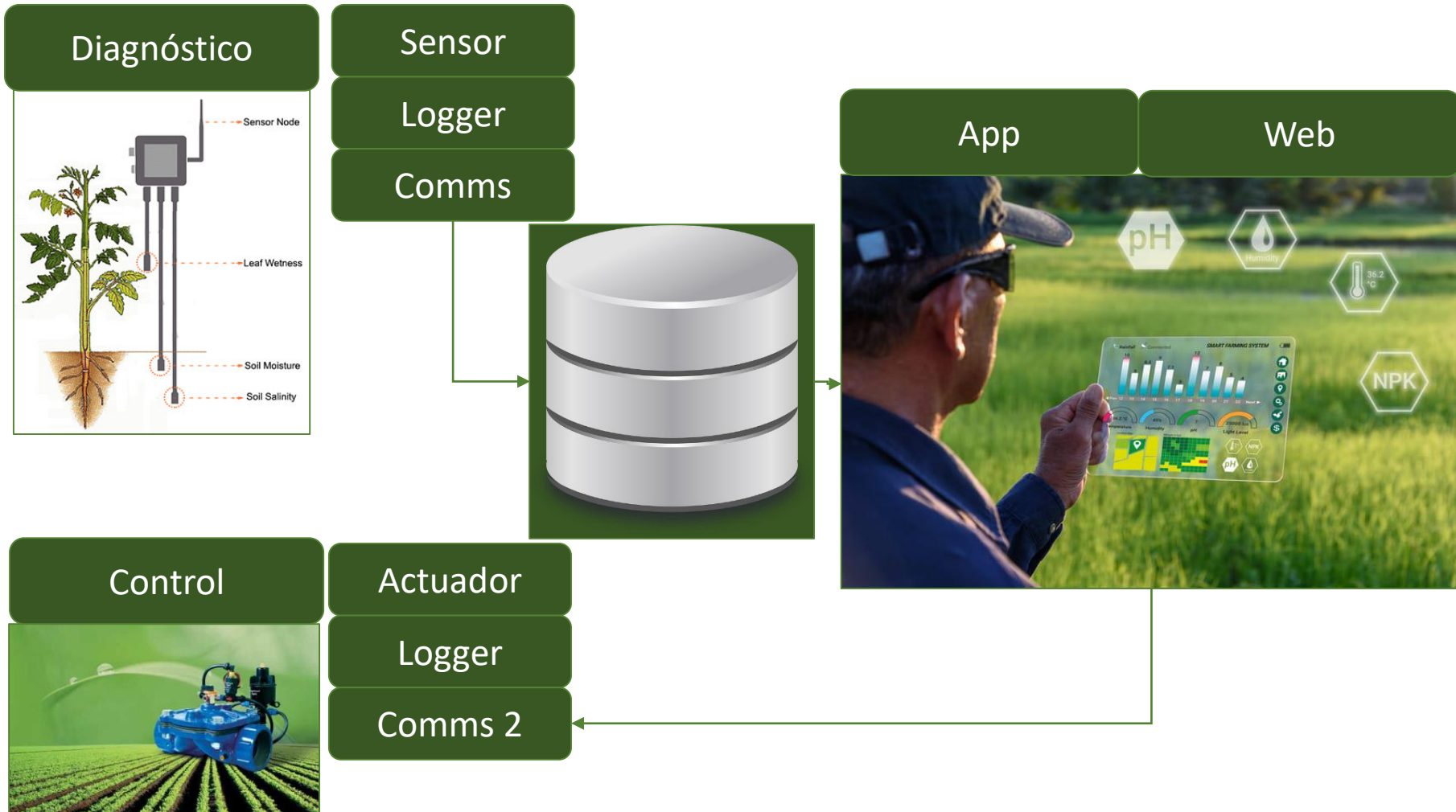
Equipamiento: Datalogger, panel solar, altura de nieve,  
balanza de nieve, termómetro (**no operativo**)



Nieve acumulada en nodo Glaciar El Tapado Junio / Agosto 2023



# Y también para el agro (IoT)..



Desde la mirada del pequeño agricultor

Fin...