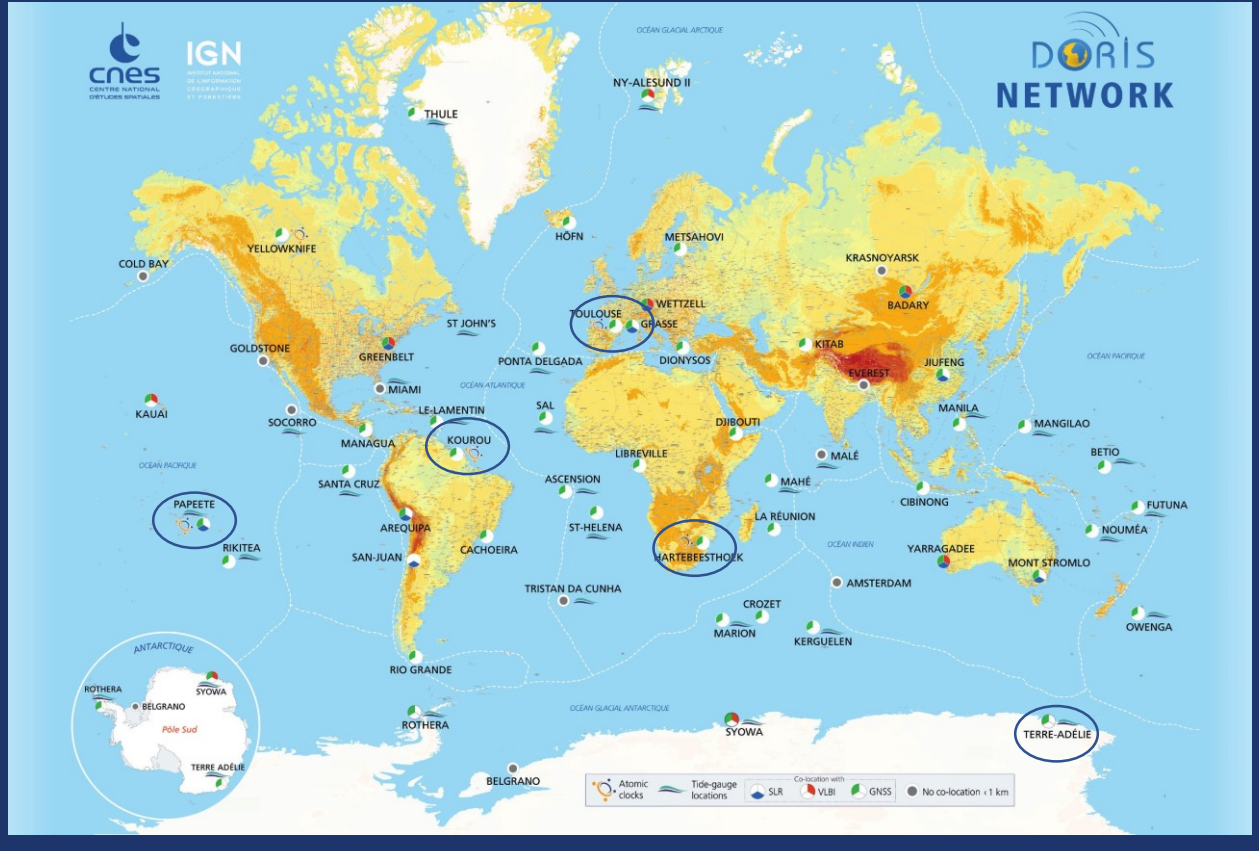
31/10/2022

DORIS : A new Time and Frequency reference for the DORIS beacons

Michel VIVIES / CLS – David VALAT / CNES

Vincent GARCIA / CNES – Grégory HAREL / TIMELINK

TIME AND FREQUENCY REFERENCE NEED



TIME AND FREQUENCY REFERENCE REQUIREMENTS

REQUIREMENTS

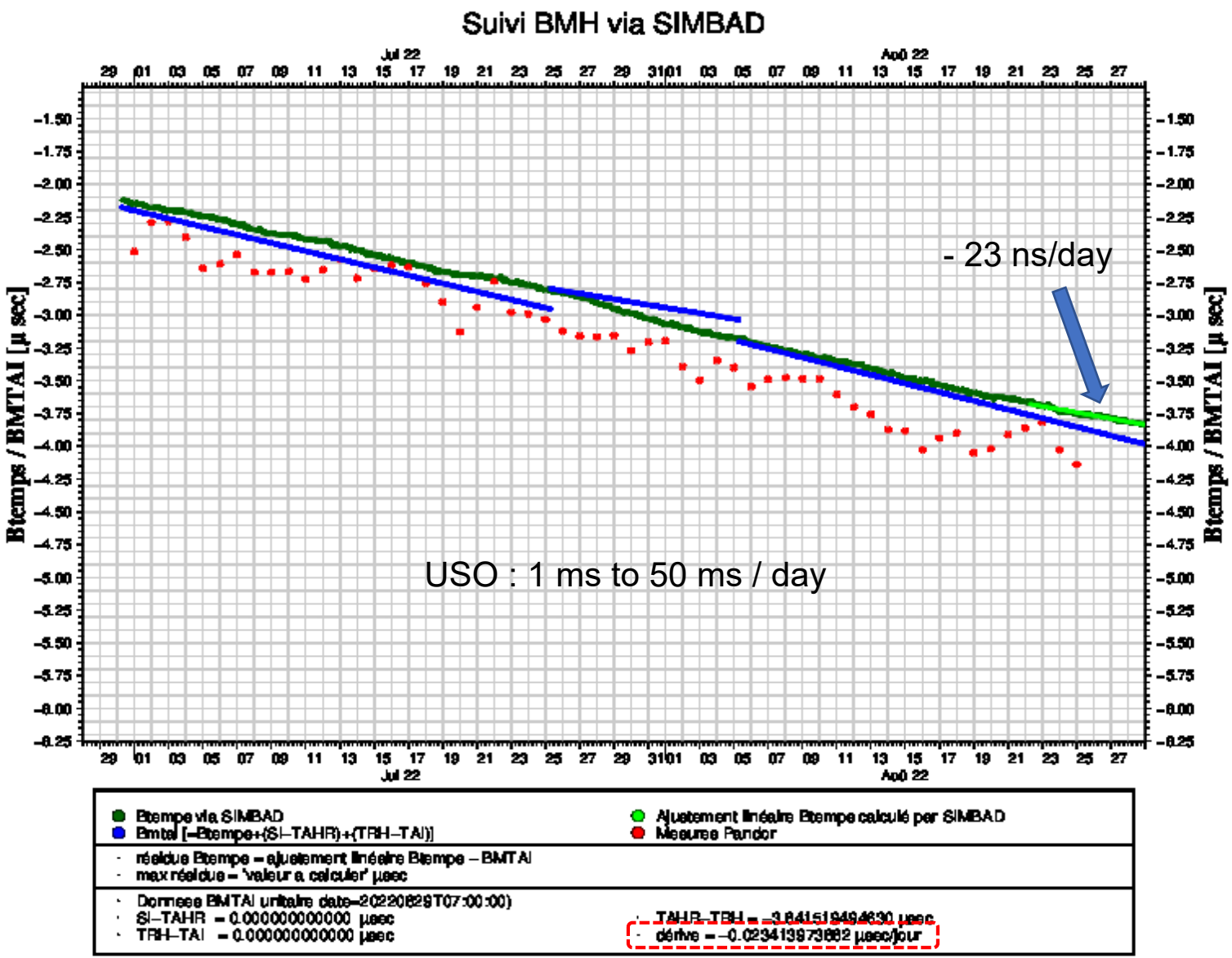
- Medium term stability DORIS <= $7.5 * 10^{-13}$ for 99% of time for B3rd G
  <= $1.0 * 10^{-12}$ à 99% of time for B4th G

  10°C/h in all the temperature delta for operation

- Temporal stability : drift < 30 nano sec / day (BTEMP)

  → accuracy of 5 MHz frequency

TIME A


Suivi BMH via SIMBAD
Jul 22
Aoû 22
Btemps / BMTAI [µ sec]
- 23 ns/day
USO : 1 ms to 50 ms / day
Btempe via SIMBAD
Bmtai [=Btempe+(SI-TAHR)+(TBH-TAI)]
Ajustement linéaire Btempe calculé par SIMBAD
Mesures Pandor
- réeldue Btempe = ajustement linéaire Btempe - BMTAI
- max réeldue = 'valeur a calculer' µsec
- Donnee BMTAI unitaire date=20220629T07:00:00)
- SI-TAHR = 0.000000000000 µsec
- TBH-TAI = 0.000000000000 µsec
- TAHR-TBH = -3.8415194994630 µsec
- dérive = -0.023413973882 µsec/jour

CURRENT SITUATION

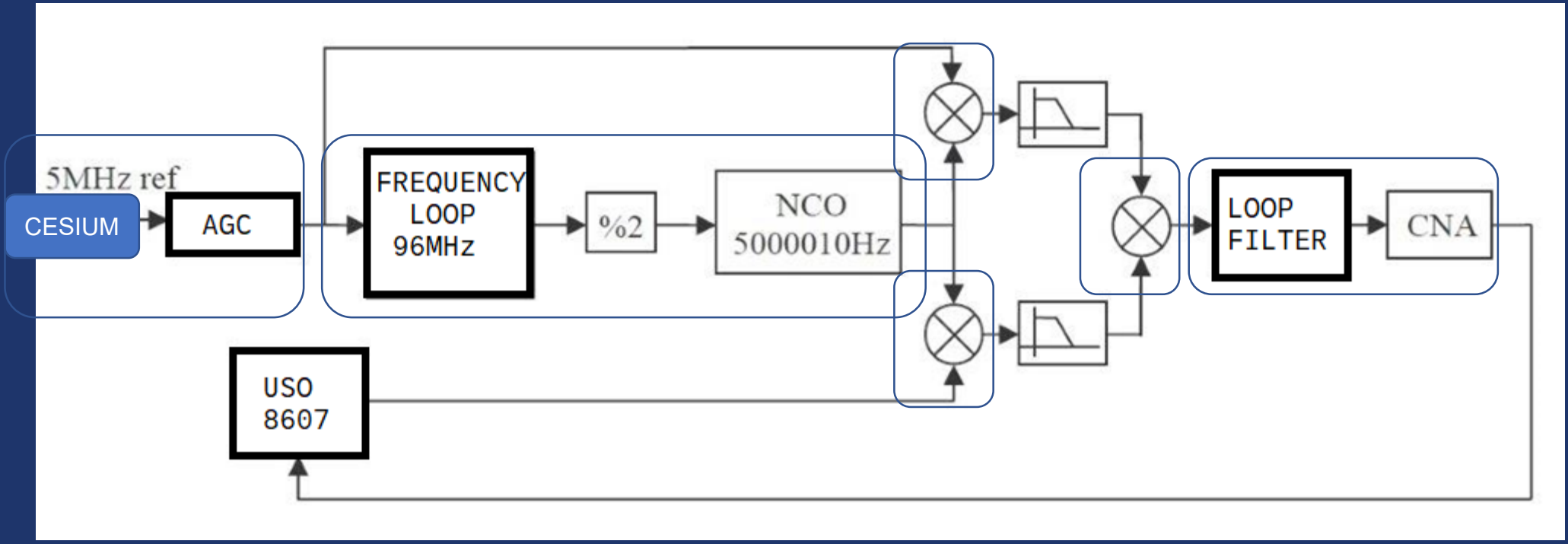
- **1 frequency reference with DORIS medium term stability**
  - USO : OSCILLO QUARTZ OSA 8607

Disciplined on

- **1 precise frequency reference**
  - Atomic clock Césium : SYMMETRICOM 4310B

Servo Rack OSA

SERVO PRINCIPLE



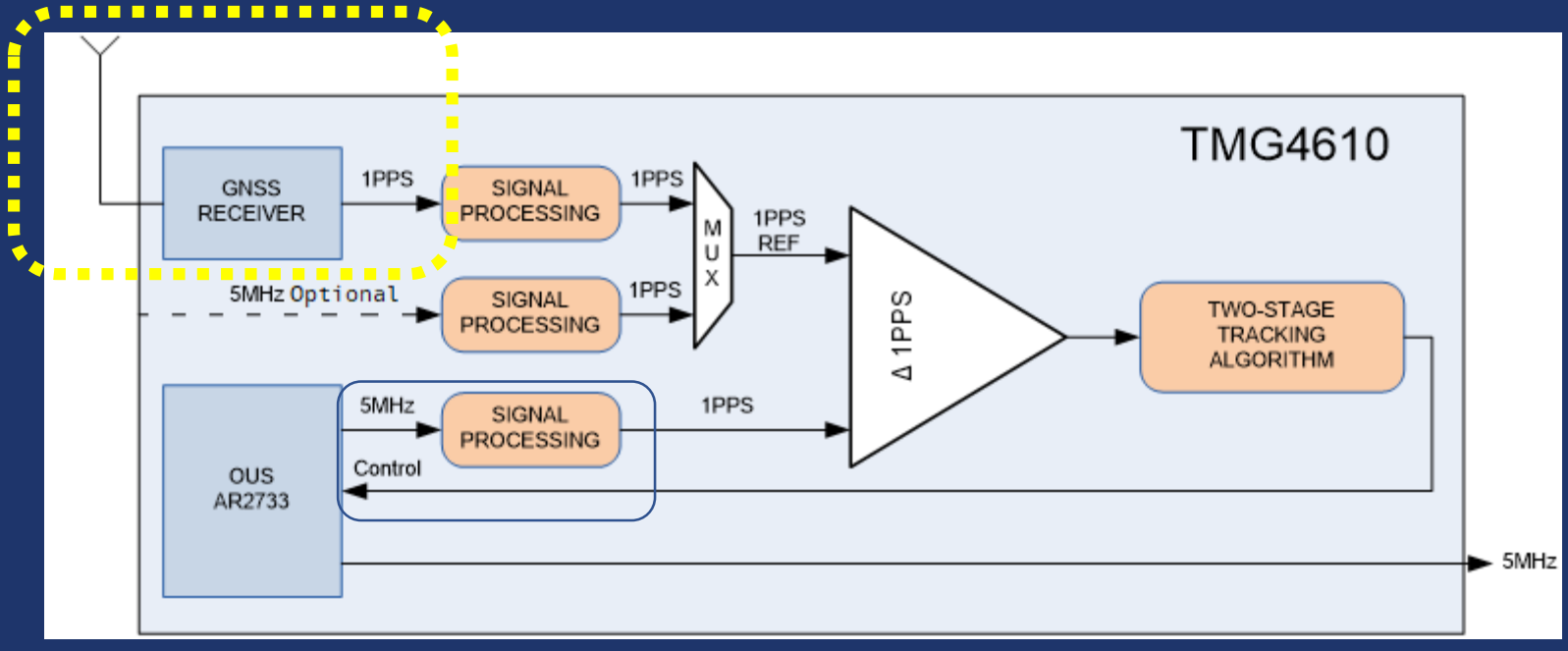
USO 8607 is no longer available

The Cesium is expensive + shipping difficulties

A NEW TIME AND FREQUENCY REFERENCE

- **1 embedded Equipement with the required performance : TMG 4610**
  - no more USO type OSA 8607BM
  - The new USO comes from AR electronique. T° control ☹.
  - GNSS stability

TMG 4610 : CLOCK SERVO + GNSS

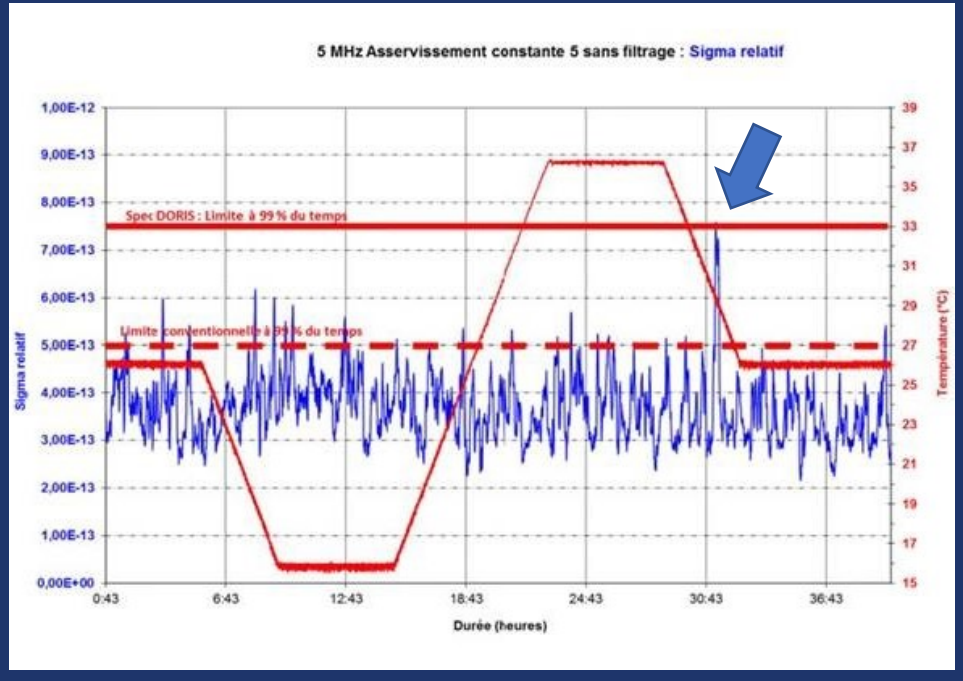


- The servo / disciplined is realized with time provided by the GNSS (GALILEO/GPS)

DEVELOPMENT CYCLE OF TMG 4610

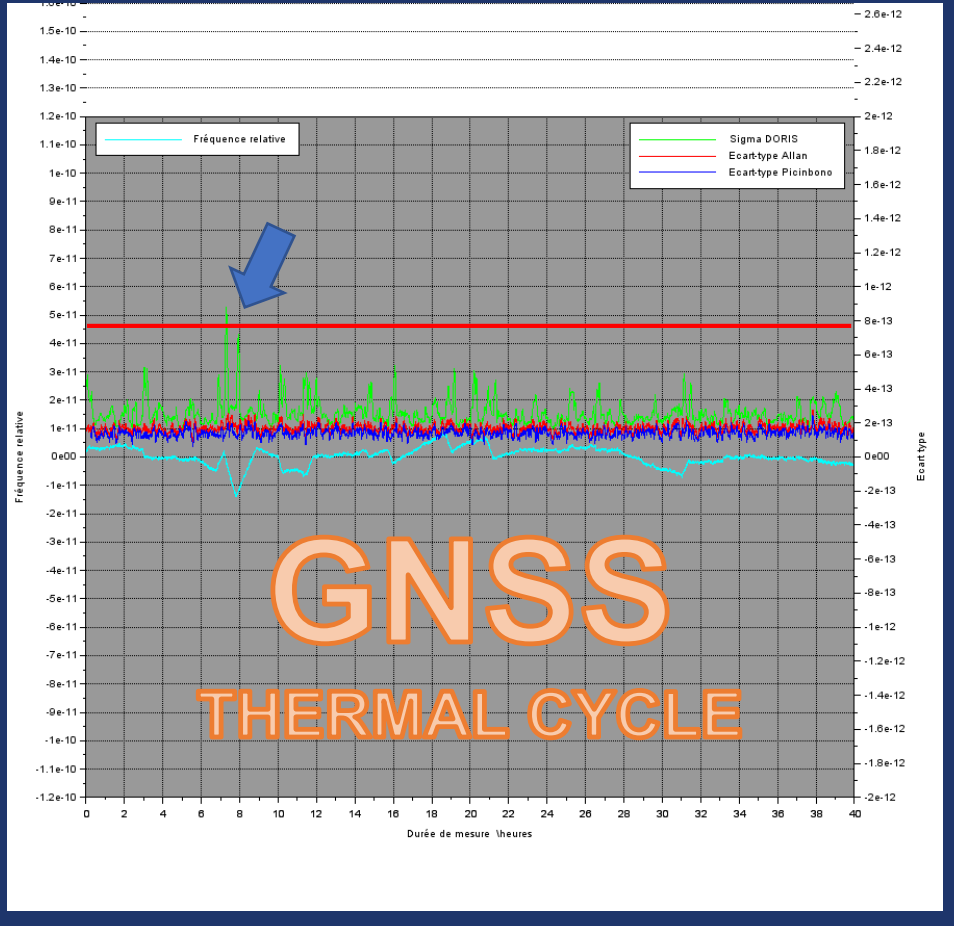
- All the measures have been made in Time & Frequency facilities in CNES.
- Fine-tuning of the servo algorithm
- A total of 33 RUNs of 40 hours for more than 6 months.

SERVO RACK OSA versus TMG 4610 with GNSS



TA OSA

THERMAL CYCLE



NEXT STEPS - LONG TERM TRIALS

- **Started september 2022 – trial campaigns to do :**
  - Performances with Cesium servo
  - Performances with GNSS servo

- **Commissionning preparation**

- **Beginning of 2023 – checking the performances of the 2nd and 3rd TMG.**

Starting in the operationnal network in 2023.

TMG 4610 – IMPROVEMENTS 2023-2024

- Use of internal temperature sensor to enhance the servo algorithm
- Use of another type of USO : RAKON HSO 14
- Software improvements