A ship-based network for GNSS-meteorology over the northwestern Mediterranean Sea

Andrea Antonini, Alberto Ortolani, Aldo Sonnini, Massimo Viti, Luca Fibbi, Simone Cristofori, Simone Montagnani

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Laboratory for Monitoring and Environmental Modelling
for the sustainable development

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PROJECTS FINANCING THIS WORK

INTERREG Project aimed at improving the capacity of Tuscany, Sardinia, Liguria, Corse, PACA institutions to jointly prevent and manage flood risk

Implementation of a GNSS-meteo infrastructure over sea

PROTERINA 3 ÉVOLUTION

IL TERZO PASSO NELLA PROTEZIONE DEL TERRITORIO DAI RISCHI NATURALI: L'EVOLUZIONE PARTECIPATA NELLA GESTIONE DEI RISCHI DERIVANTI DALLE ALLUVIONI
LA TROISIÈME ÉTAPE DE LA PROTECTION DU TERRITOIRE CONTRE LES RISQUES NATURELS: L'ÉVOLUTION PARTICIPATIVE DE LA GESTION DES RISQUES DÉRIVANTS DES INONDATIONS

PROFUMO

Preliminary assessment of Route Optimisation for FUel Minimisation and safety of navigatiOn

Gathering data using ships as distributed GNSS-meteo network

Assimilation in numerical weather prediction models

High definition and customized weather products

Re-routing, Navigation assistance, Fuel Minimisation

forship

GRIMALDI LINES

Ship owners who have made the fleets available

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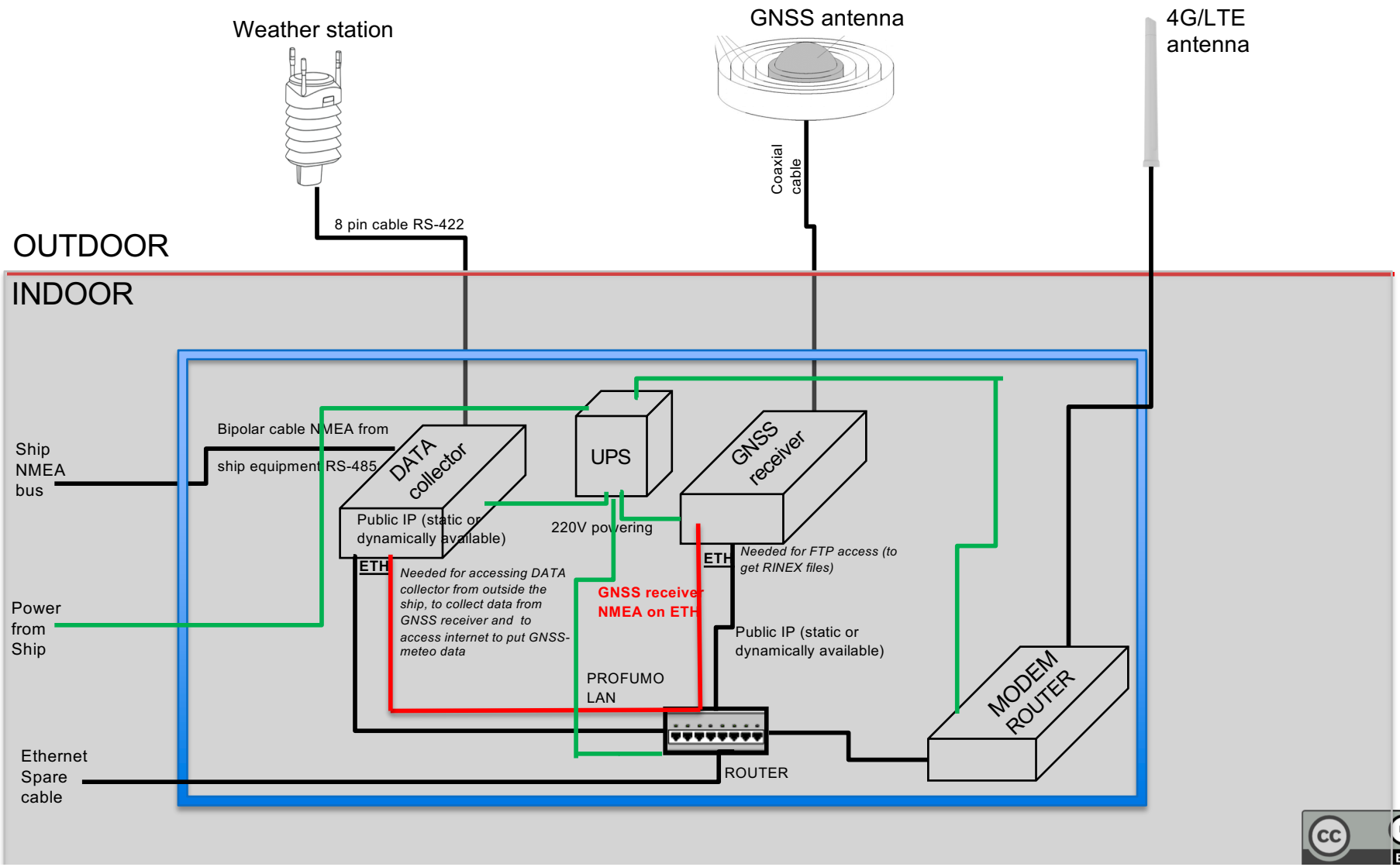
SHIP GNSS-METEO EQUIPMENT ARCHITECTURE



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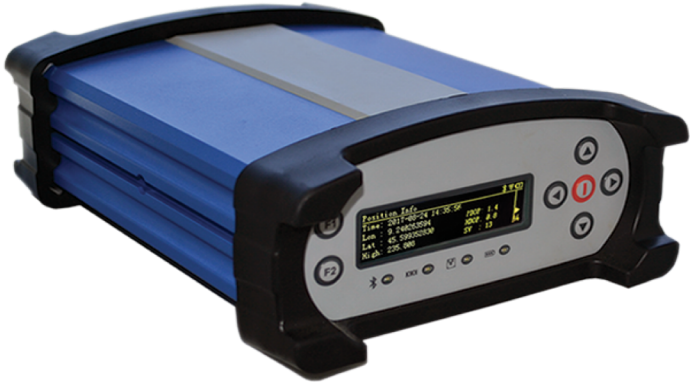
GNSS ANTENNA AND RECEIVER

STONEX CGX601A 3D CHOCKE RING ANTENNA



RECEIVER STONEX SC2000 (GPS, GLONASS, BEIDOU, GALILEO, QZSS, IRNSS, and SBAS)

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WEATHER STATION

Vaisala model WXT536
Wind direction and speed
Pressure
Temperature
Humidity
Precipitation (Rain Hail)

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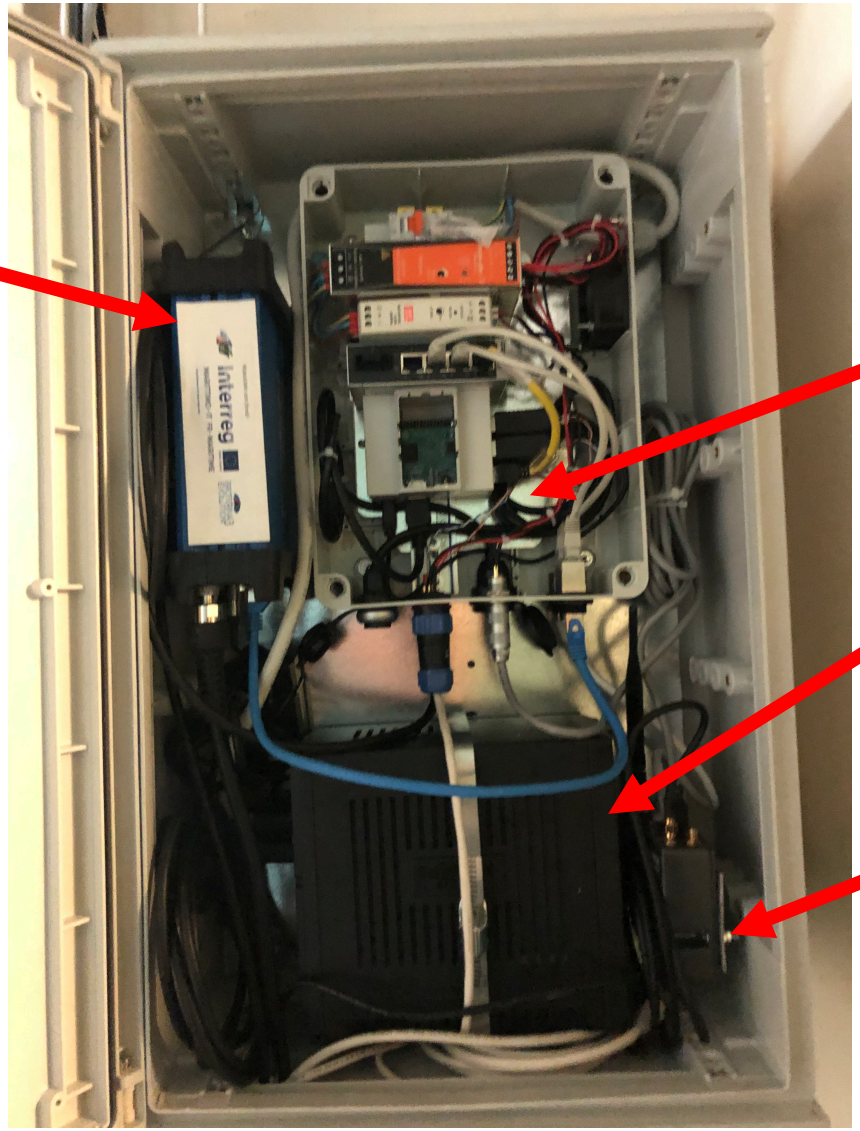
CONTROLL BLOCK – ONBOARD THE SHIP



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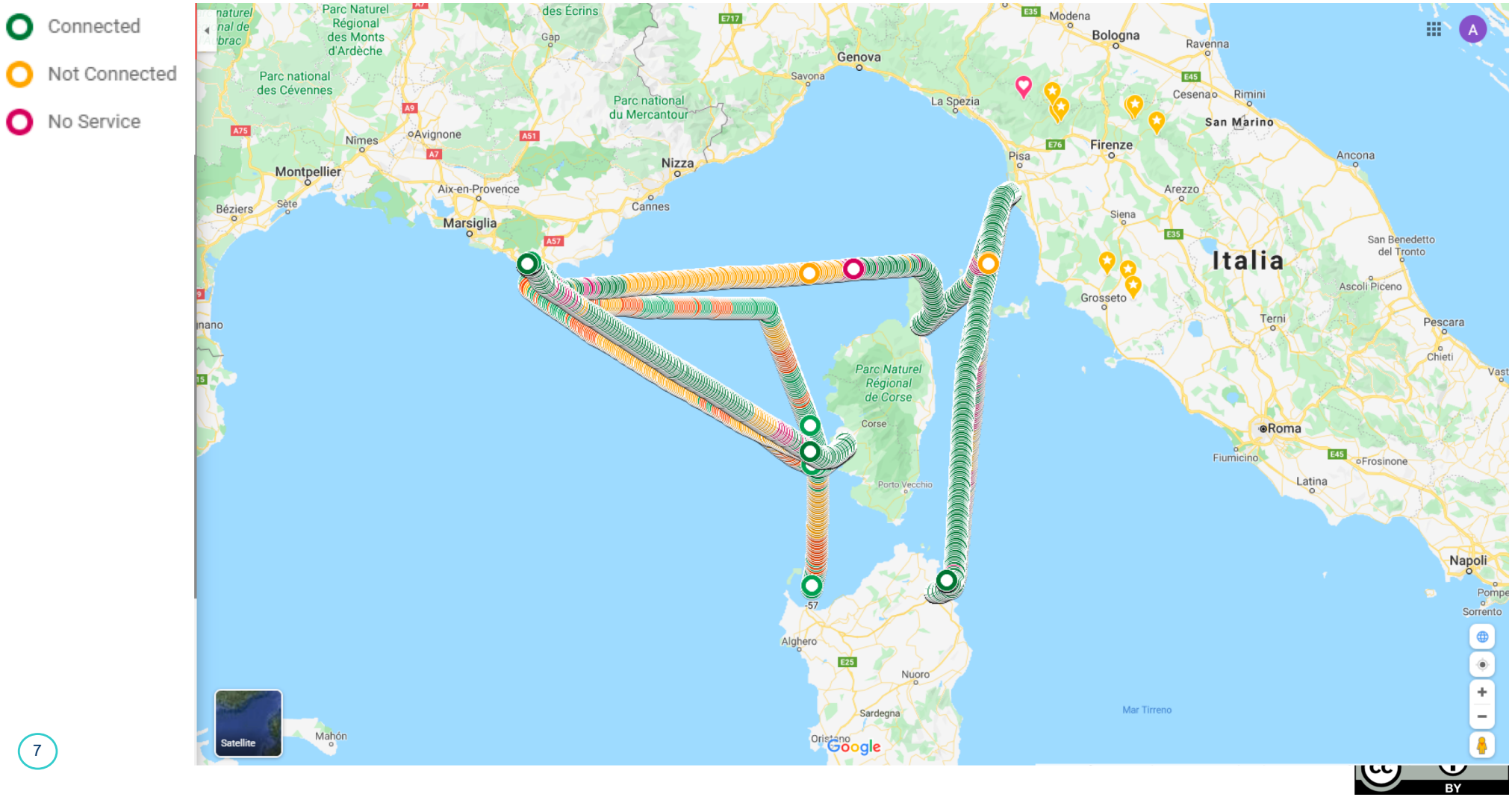
4G CONNECTIVITY OF THE SHIPS



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DESCRIPTION OF DATA PROCESSING

- Data are collected from sensors on board of ships
- Preliminary corrections (e.g. wind correction) are made by the on board control system
- Data collected from weather station and GNSS system are hourly sent to the ground processing centre
- SP3 ultra rapid ephemeris data from CODE centre and high resolution RINEX data from some IGS fixed stations (mate, ajac, m0se) are downloaded at the ground processing centre.
- ZPD are computed starting from six-hourly aggregated data using two different software: TRACK (developed by MIT) and gLAB (developed by UPC)

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GNSS DATA PROCESSING SOFTWARES

gLAB: Processing of GNSS receiver data in the Float-PPP(Precise Point Positioning) configuration, based on a single receiver and allowing to reach centimetre level accuracy in static conditions and decimetre level accuracy in kinematic conditions.
The main processing features:

- Use of GPS, GLONASS and GALILEO constellations
- Forward Kalman filter
- ZPD every 15 minutes

TRACK: Is a GPS differential phase kinematic positioning software, based on one fixed station and one or more moving receivers.
The main processing features:

- Use of only GPS constellation
- Forward Kalman filter smoothing
- ZPD every second

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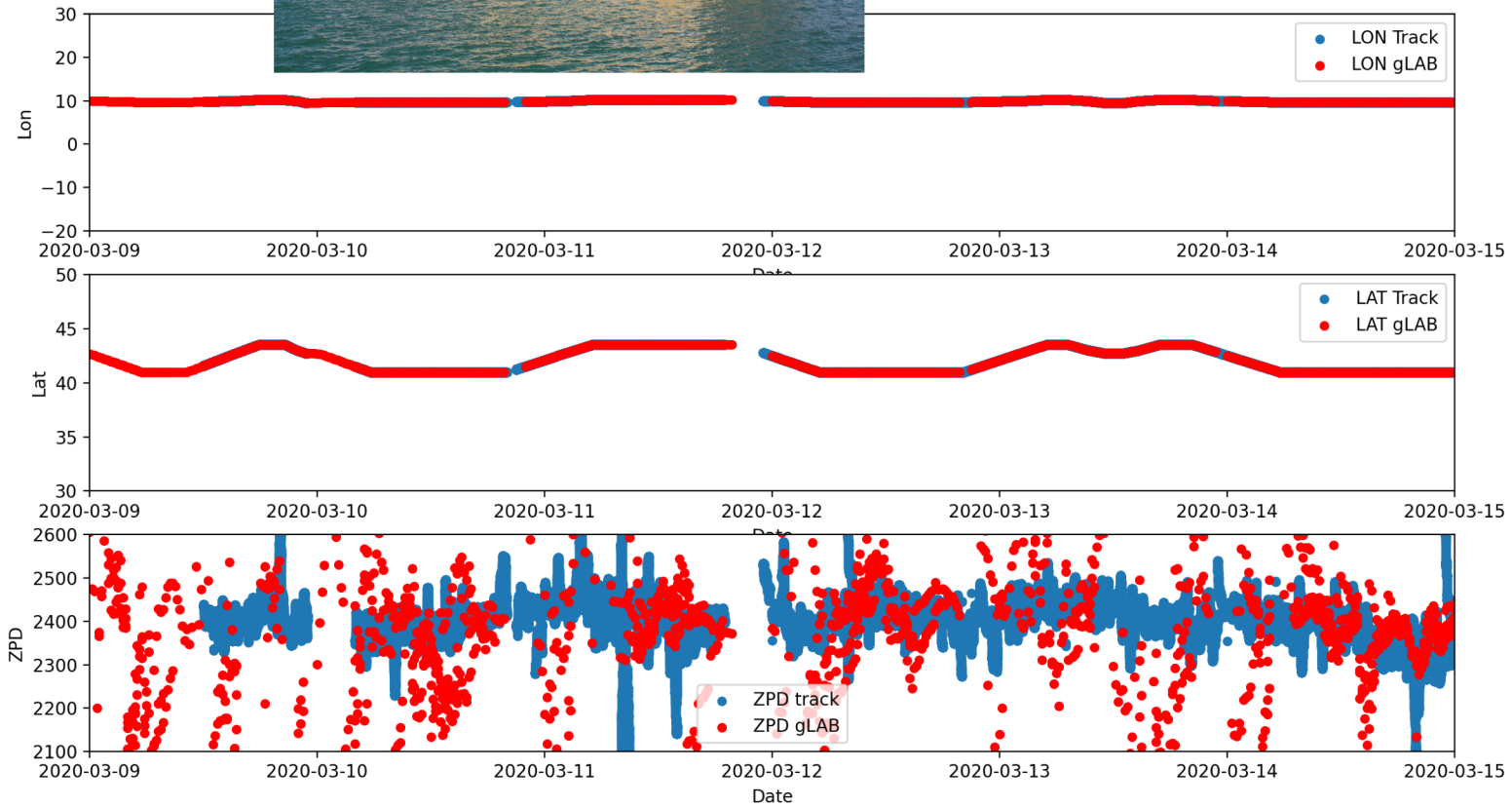
ZPD FROM MEGA EXPRESS ONE



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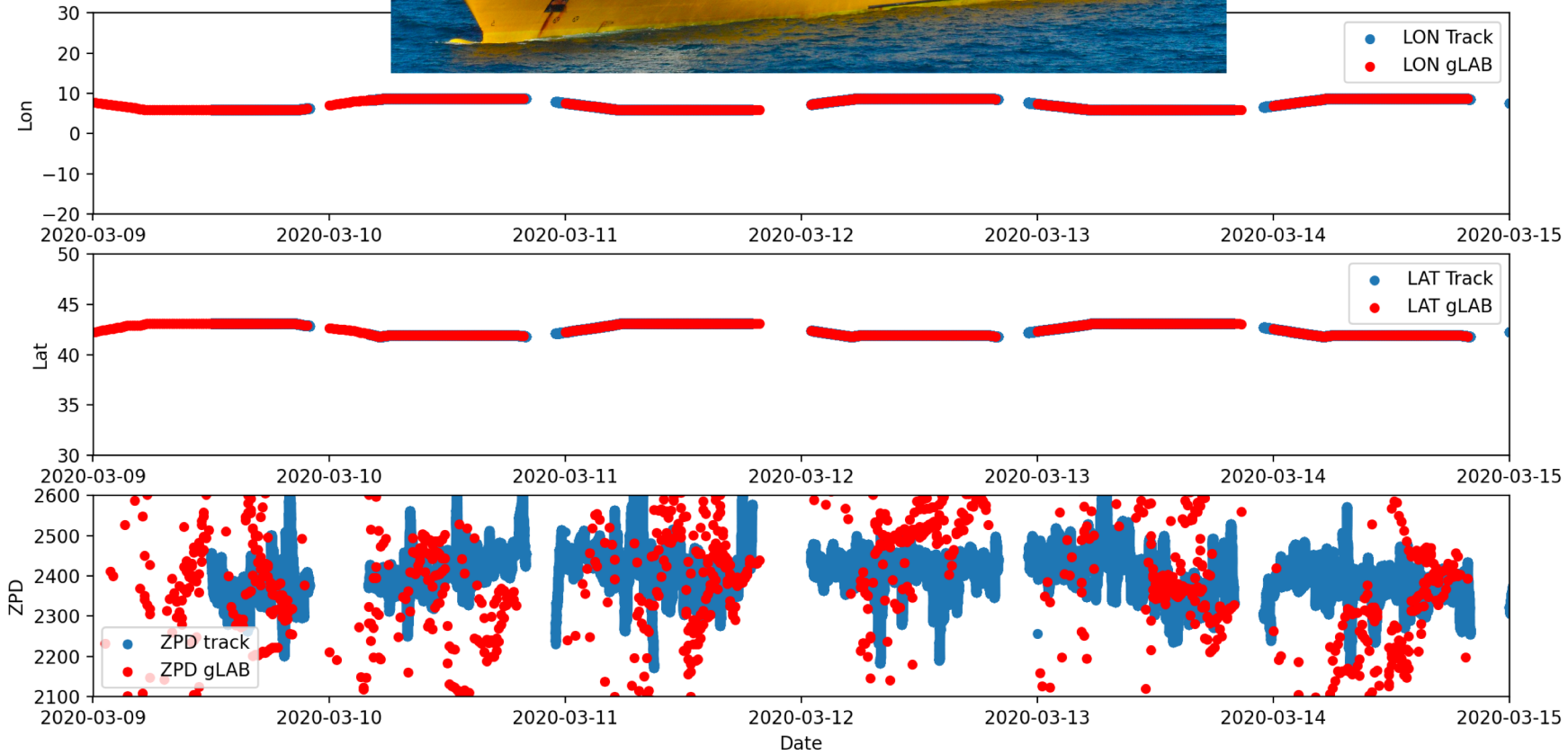
ZPD FROM MEGA EXPRESS THREE



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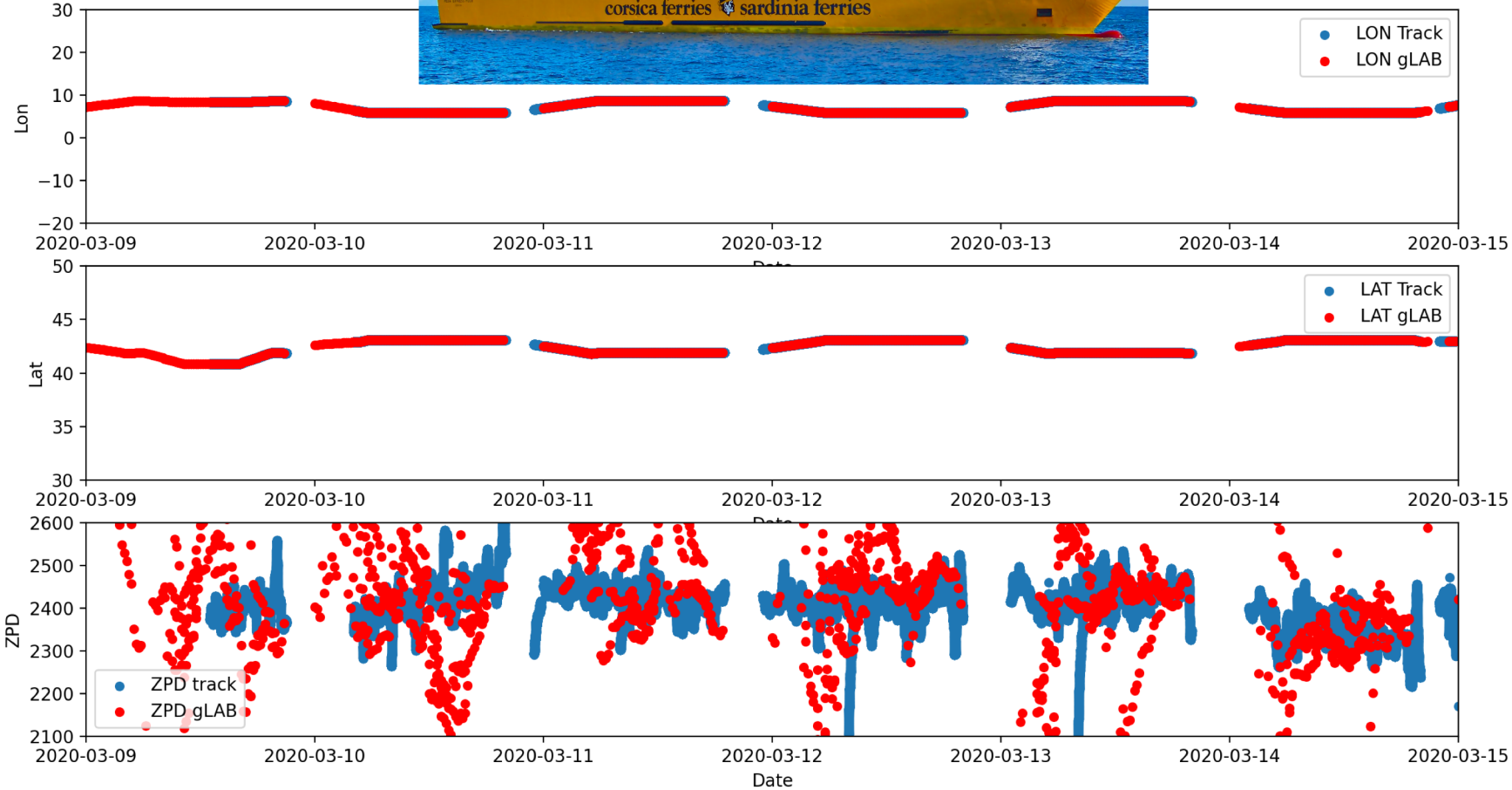
ZPD FROM MEGA EXPRESS FOUR



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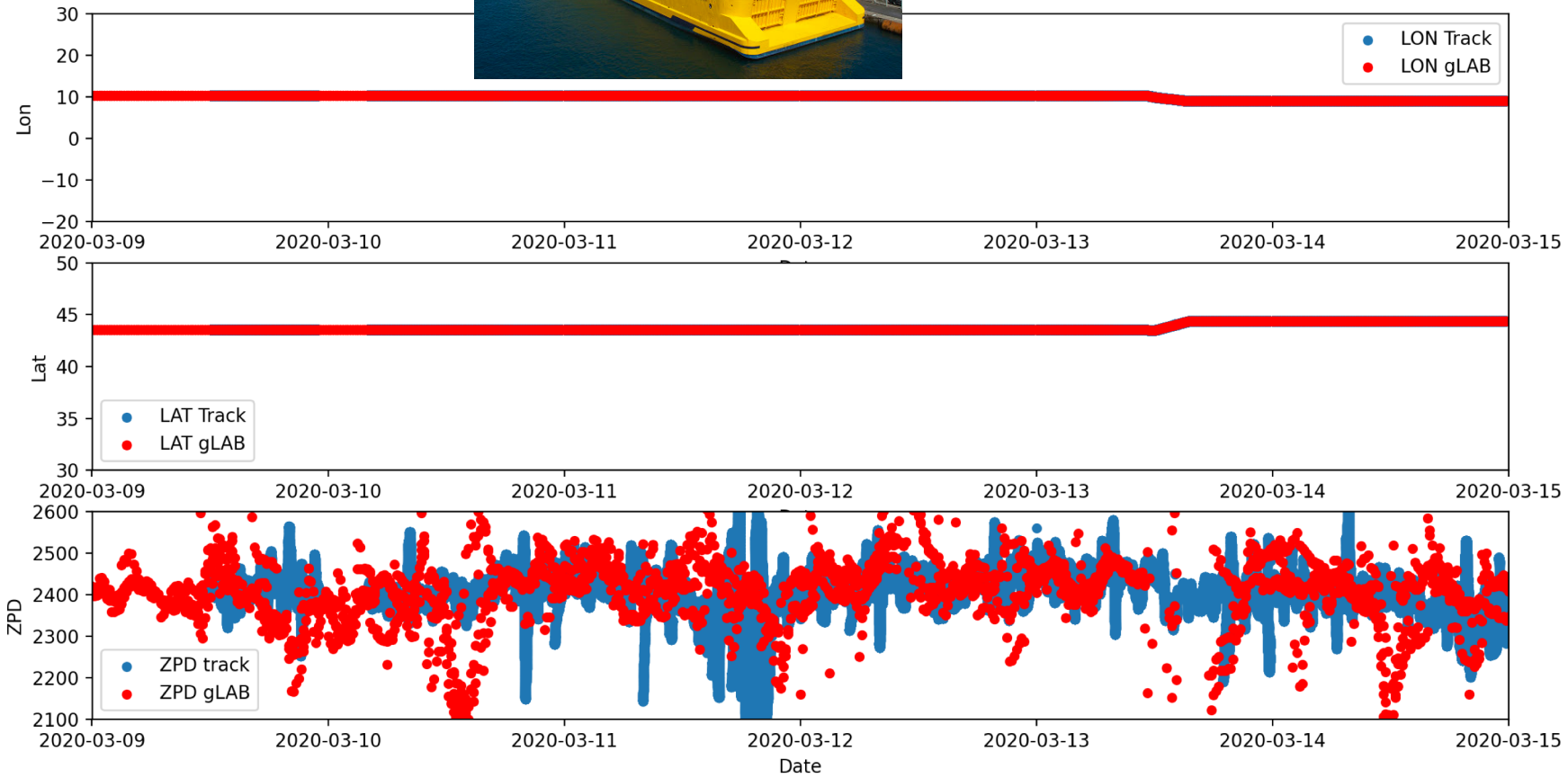
ZPD FROM MEGA SMERALDA



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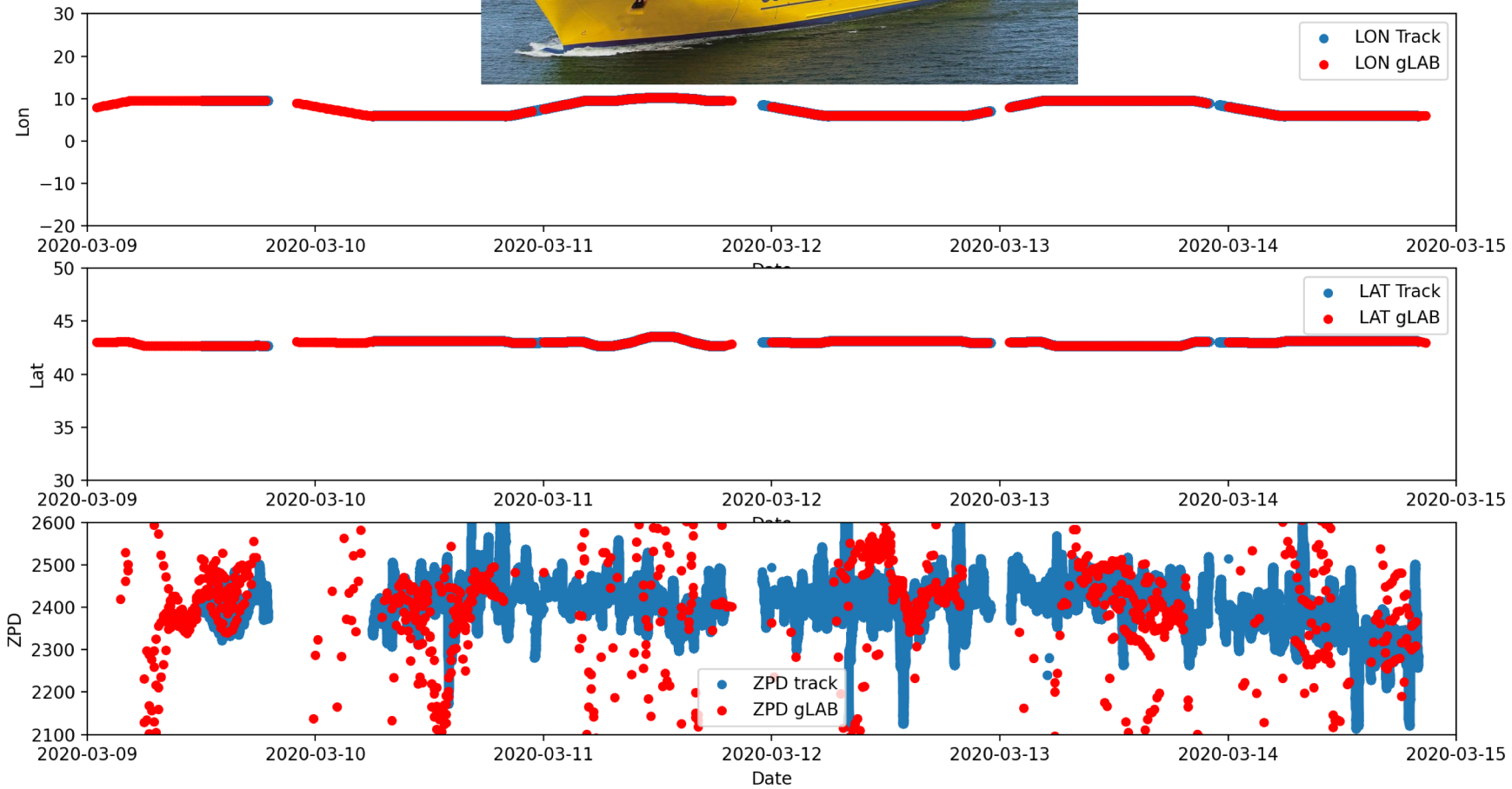
ZPD FROM PASCAL LOTA



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CONCLUSIONS

- **Real time** application with ultra-rapid ephemeris (CODE)
- In **static conditions** there is **good accordance of the ZPD** values
- In **kinematic conditions** the **TRACK** software **is more «stable»**, with respect to **gLAB** that **shows big oscillations** (values from 2000 to 3000 mm)
- Current version of **TRACK** software **is not able to process Galileo** (not yet implemented modules) **and GLONASS** (some unstable clock behaviours) data.
- 6 hourly data are processed in **a few seconds by gLAB** and in **more than two hours by TRACK software**. Some problems exist for real time applications