In Situ Thematic Assembly Centre for Copernicus Marine Service 2 - PHASE I (2022-2024)

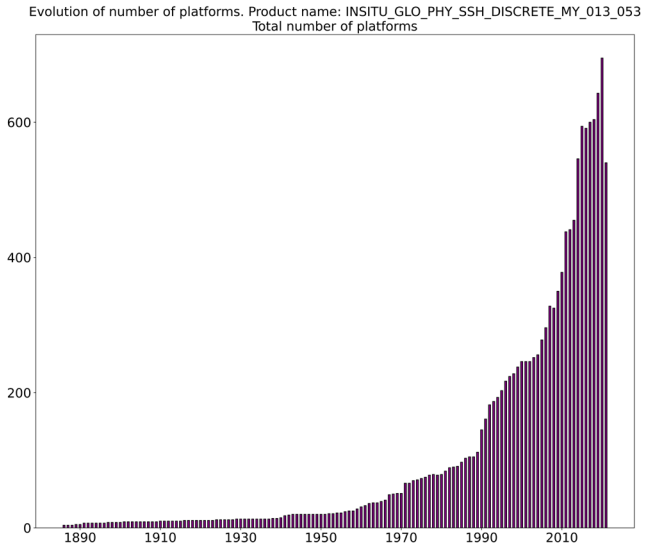
Development of a new global In Situ Sea Level REProcessed product

Begoña Pérez Gómez on behalf
of the Sea Level REP Team

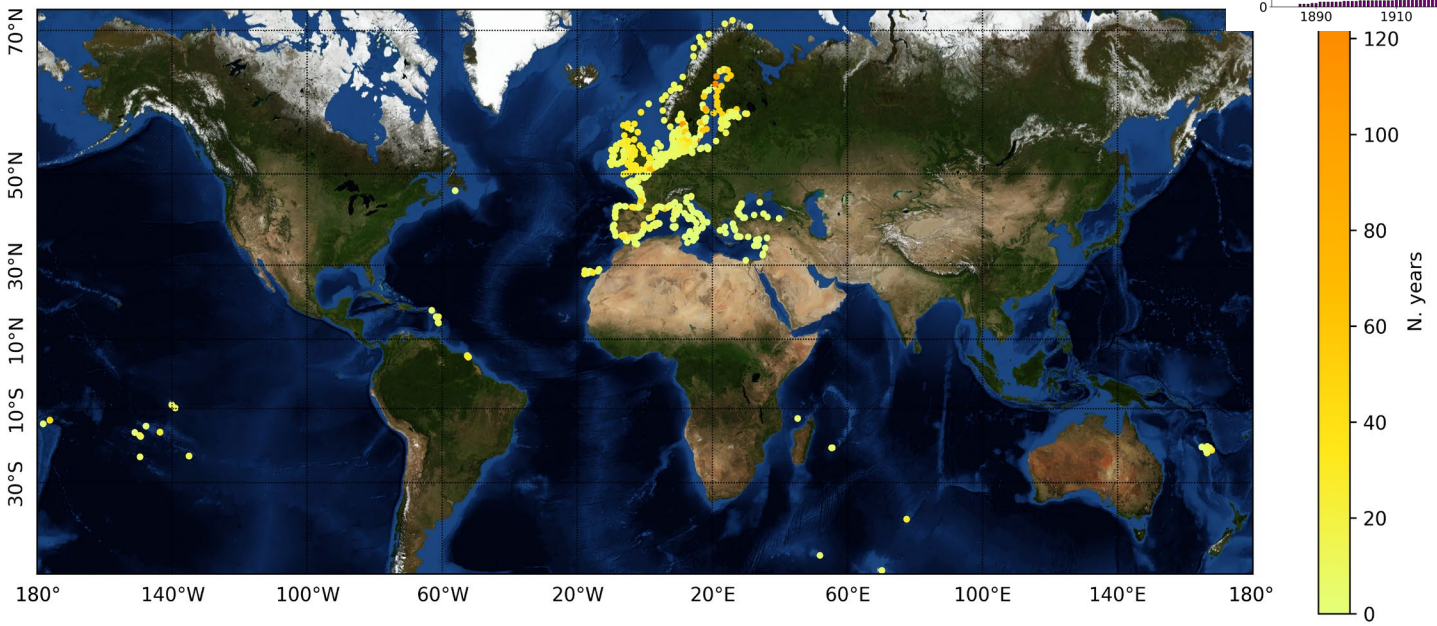
IN-SITU SEA LEVEL STATUS IN COPERNICUS MARINE CATALOGUE

Starting point (2022): INS TAC NRT data

- 639 tide gauges of different technologies (radar, acoustic, floats, pressure sensors), most in European region
- Longest time series in INS TAC in the Baltic (since 1886)
- Global coverage: need to work with GLOSS to include the global network)



Number of years of SLEV data in CMEMS In Situ TAC NRT products (2021)



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NEW SEA LEVEL REP PRODUCT

- **Coastal in-situ sea level data** distributed in delayed mode after homogeneous validation and assessment of historical time series, relevant to models reanalysis validation and climatic studies
- Visual inspection and automatic QC and data processing tools, following **best practices at global and European level (GLOSS, EuroGOOS Datameq WG and Tide Gauge Task Team)**
- Work with the sea level community for agreement on final product definition and **adoption of FAIR principles** (metadata, unique identifiers, interoperability..)

SEA LEVEL REP TEAM: 2 partners + 1 subcontractor (NOC)

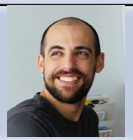
Puertos del Estado

nologin

National Oceanography Centre


Begoña Pérez Gómez


Marta de Alfonso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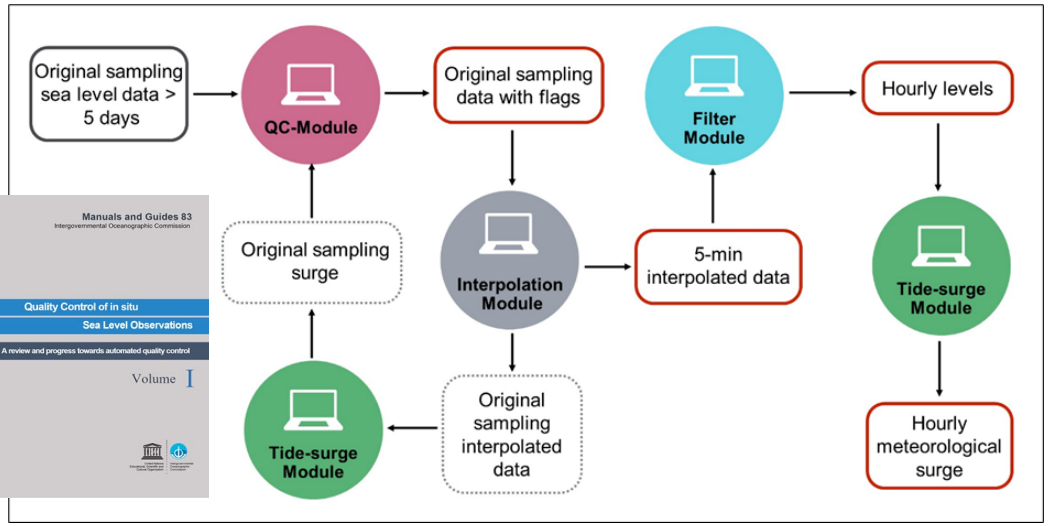
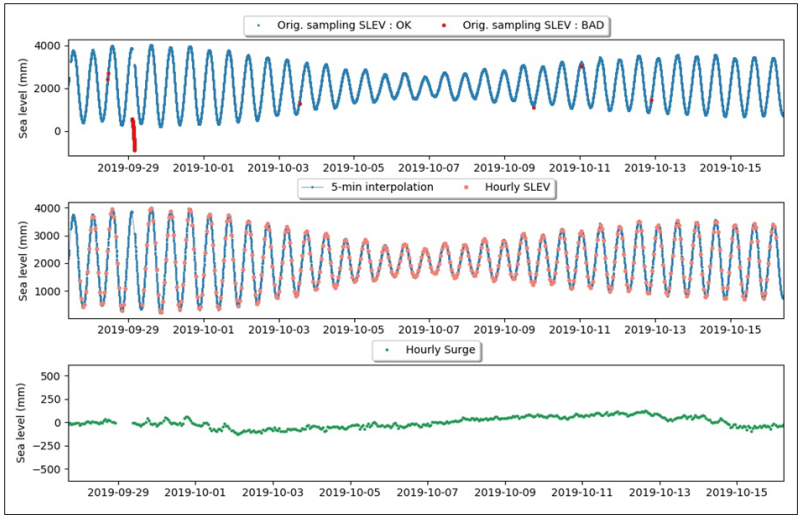
IN-SITU SEA LEVEL STATUS IN COPERNICUS MARINE CATALOGUE. QC/QA

NRT SLEV automatic QC in INSTAC (= NRT or L1 QC according to IOC-UNESCO, 2020):





SELENE software. From IOC-UNESCO, 2020.

- **QC-Module:** Invalid characters, wrong date/time assignment, out of range values, spikes (spline-fit algorithm), constant values. Applied to total sea level and surge, if tidal constants available. Output: original time sampling with flags
- **By-products** (through Interpolation Module and Filter Module) (optional in NRT, not implemented):
  - Timeseries with homogeneous time sampling (resampling and interpolation of flagged data and short gaps)
  - Hourly data (by means of an adequate/standard filter)
  - Non-tidal residuals computation

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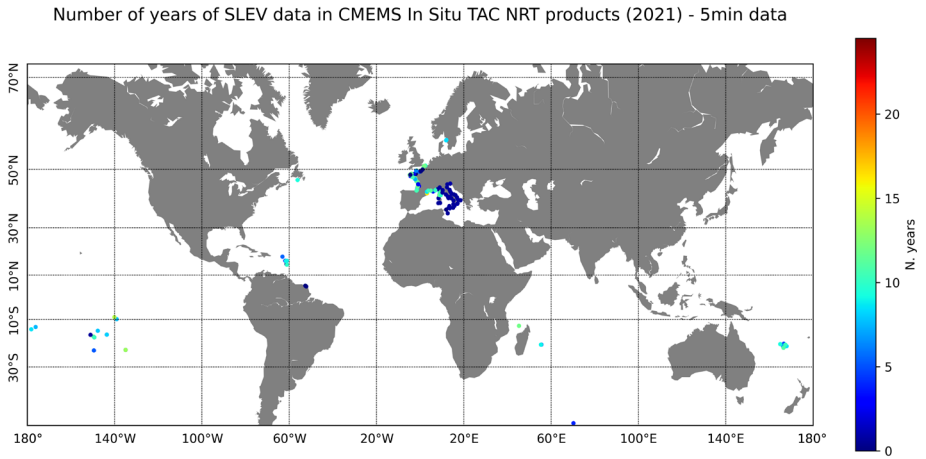
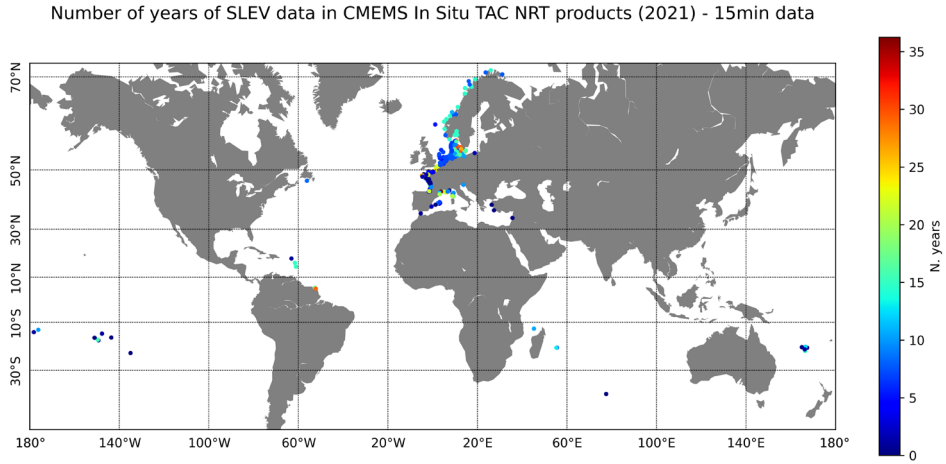
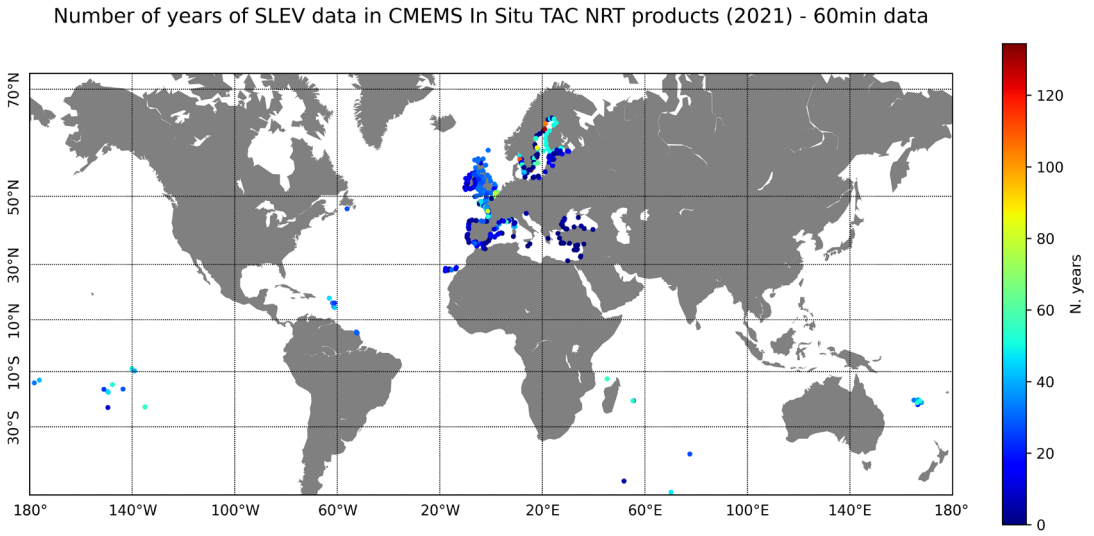
IN-SITU SEA LEVEL STATUS IN COPERNICUS MARINE CATALOGUE. QC/QA





- Different time samplings available in NRT/history data, **mostly hourly values**
- NRT QC routines and data quality dependent on the regions and data providers
- **Survey on QC/QA status in the INSTAC regions launched on January 28**



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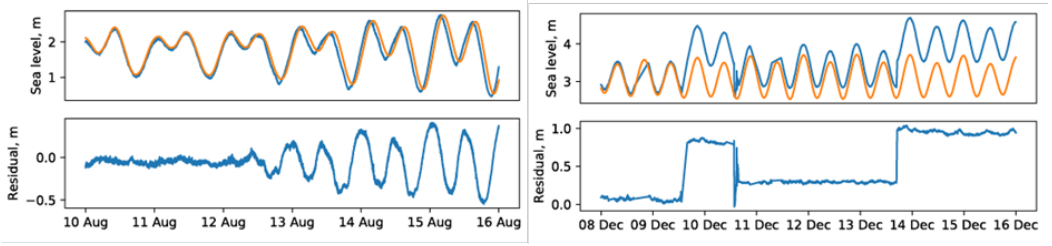
SEA LEVEL REP: NEW QC/QA OF HISTORICAL DATA

Delayed mode QC and data processing (L2, according to IOC-UNESCO, 2020):

- Assessment/validation of historical time series including computation of hourly values (if needed), tide and non-tidal residual
- Detection/correction of additional types of errors in tide gauge data: datum changes, clock malfunction, long-term drifts, etc



New procedures:

1. Visual inspection of historical records (total sea levels and residuals)
2. Neighbour-test or "buddy checking“ applied to non-tidal residuals and monthly means
3. Comparison with altimetry/model data will also be explored

Different statistical techniques will be applied at points 2. and 3. above (e.g.: differences, correlation, Van de Casteele plots, etc).

FAIR principles

Improved sea level metadata from tide gauges following GLOSS and EuroGOOS Tide Gauge Task Team recommendations

EuroSea

Project Information	
Project full title	EuroSea: Improving and Integrating European Ocean Observing and Forecasting Systems for Sustainable use of the Oceans
Project acronym	**EuroSea**
Grant agreement number	862626
Project start date and duration	1 November 2019, 50 months
Project website	https://www.eurosea.eu

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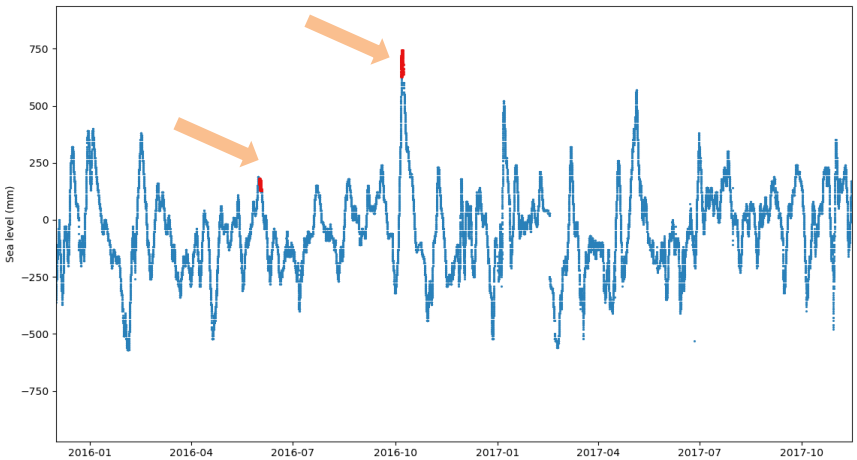
Copernicus

SEA LEVEL REP: NEW QC/QA OF HISTORICAL DATA

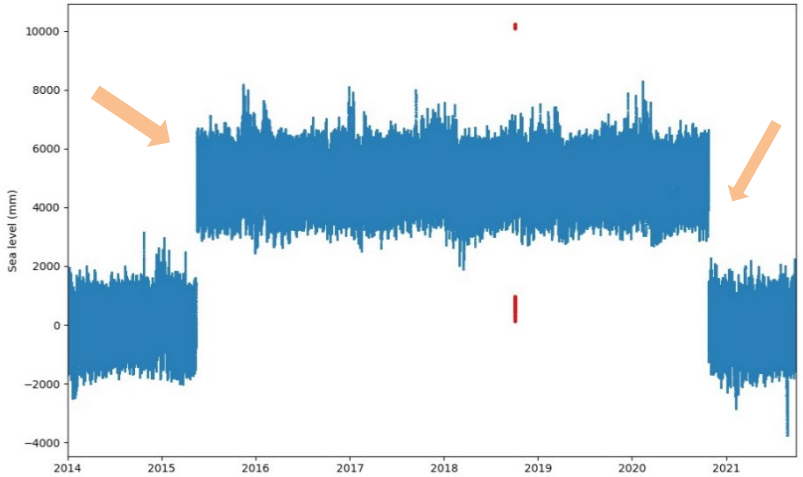
Starting process:

NRT frozen copy → Visualization, flags update and resampling (Original sampling time series) → Homogeneous filtering to hourly values → Visualization (sea level and residuals) (Hourly timeseries) → Validation (including buddy checking)

Examples of problems detected:



- Updated flags will be reported to regions
- New hourly timeseries available for some stations in INSTAC



- Input data needed from data providers (through the regions): availability of reprocessed history files and metadata

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SEA LEVEL REP: PRODUCT EVOLUTIONS 2022-2024

2022:

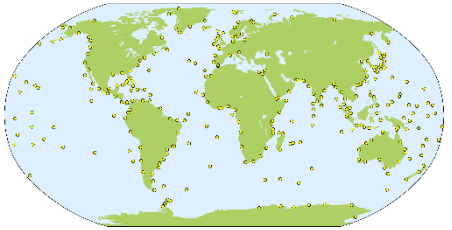
- **Product definition**, including required metadata and final procedures to be implemented
- Review of history files in INSTAC NRT quality status with the regions and data providers
- Upgrade of automatic qc/validation: neighbour test or "buddy" checking in SELENE QC software
- **New Sea Level REP product based on INSTAC NRT time series (Nov. Release): 2 datasets, one for hourly values and one for data in their original sampling**
- Roadmap for inclusion of stations from the global network, through interaction with external providers (GLOSS/EMODnet/SeaDataNet)
- **Feasibility study of a dedicated coastal sea level REP product of tide gauge data (including Global Navigation Satellite System (GNSS) vertical land motion corrections)**

2023:

- Temporal extension
- **Selection of detiding procedure** (in agreement with on-going initiatives in GLOSS/IAPSO and the MFC's)
- New detiding tools in SELENE software
- **Dataset for hourly sea levels including astronomical tide and non-tidal residuals in the IBI region**

2024:

- Temporal extension
- **Increased spatial coverage of the product with hourly dataset including stations from the global network**



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SEA LEVEL REP: Enhancements and Post-2024 plans

Product enhancements 2022-2024:

- First sea level reprocessed product in INSTAC
- Adoption of recommendations from the EuroGOOS TGTT and GLOSS on tide gauge metadata and identifiers
- Work with the global sea level community to include stations from the global network (GLOSS)
- Improving interoperability with existing data portals with tide gauge data
- Integration of historical tide gauge data with the support of the regions
- Homogeneous and centralized data production and dissemination
- Improvements on existing QC tools and data processing including computation of non-tidal residuals

Post-2024 plans, potential additional funding available (Service evolution activities)

- Possible generation of new higher-frequency sea level datasets (e.g. 1-min) to deal with smaller scale processes
- Extend generation of the tide and surge parameters to all regions for better understanding of coastal processes.
- Generation of a sea level REP product with Vertical Land Movement correction
- Analyze the possibility of in-situ sea level measurements from other type of coastal and offshore platforms (e.g. GNSS-IR, ocean bottom pressure sensors, etc)

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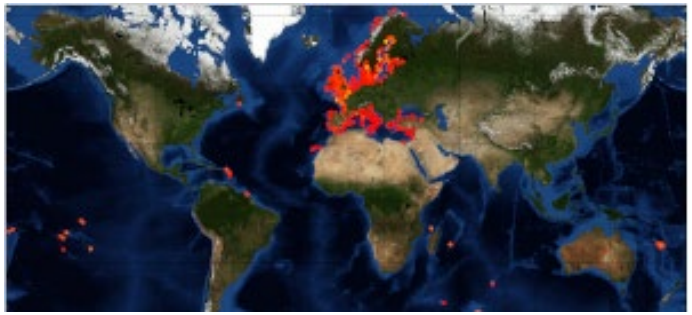
SEA LEVEL REP: Status July 2022

- New QC/data processing modules implemented in SELENE software for delayed mode application
- On-going discussion with In Situ TAC Technical Working Group about NetCDF attributes
- Preparation of the **first release of the product in November 2022**:
  - Product definition (two datasets) and structure defined
  - Creation of infrastructure (data base) and generation of first NetCDF files
  - Documentation preparation: **Product User Manual (PUM)** and draft versions of the Test Report, the **Quality Information Document (QUID) and Synthesis Quality Overview (SQO)**

Product	INSITU_GLO_PHY_SSH_DISCRETE_MY_013_053	
Datasets	cmems_obs-ins_glo_phy-ssh_my_na_irr	cmems_obs-ins_glo_phy-ssh_my_na_PT1H
	Index_history.txt, history	Index_history.txt, history
Data type	TG	TG
NetCDf files	One file/platform original sampling	One file/platform hourly reprocessed data
	E.g.: BO_TS_TG_Forsmark.nc	*E.g.: BO_TS_TG_Forsmark_60minute.nc*



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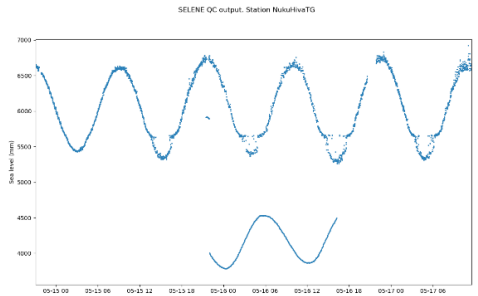
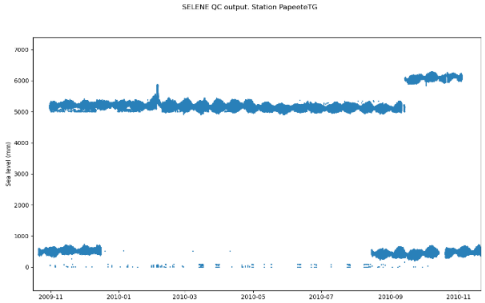
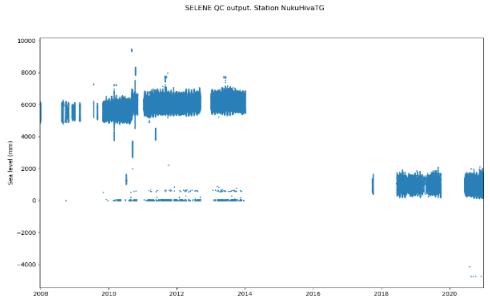
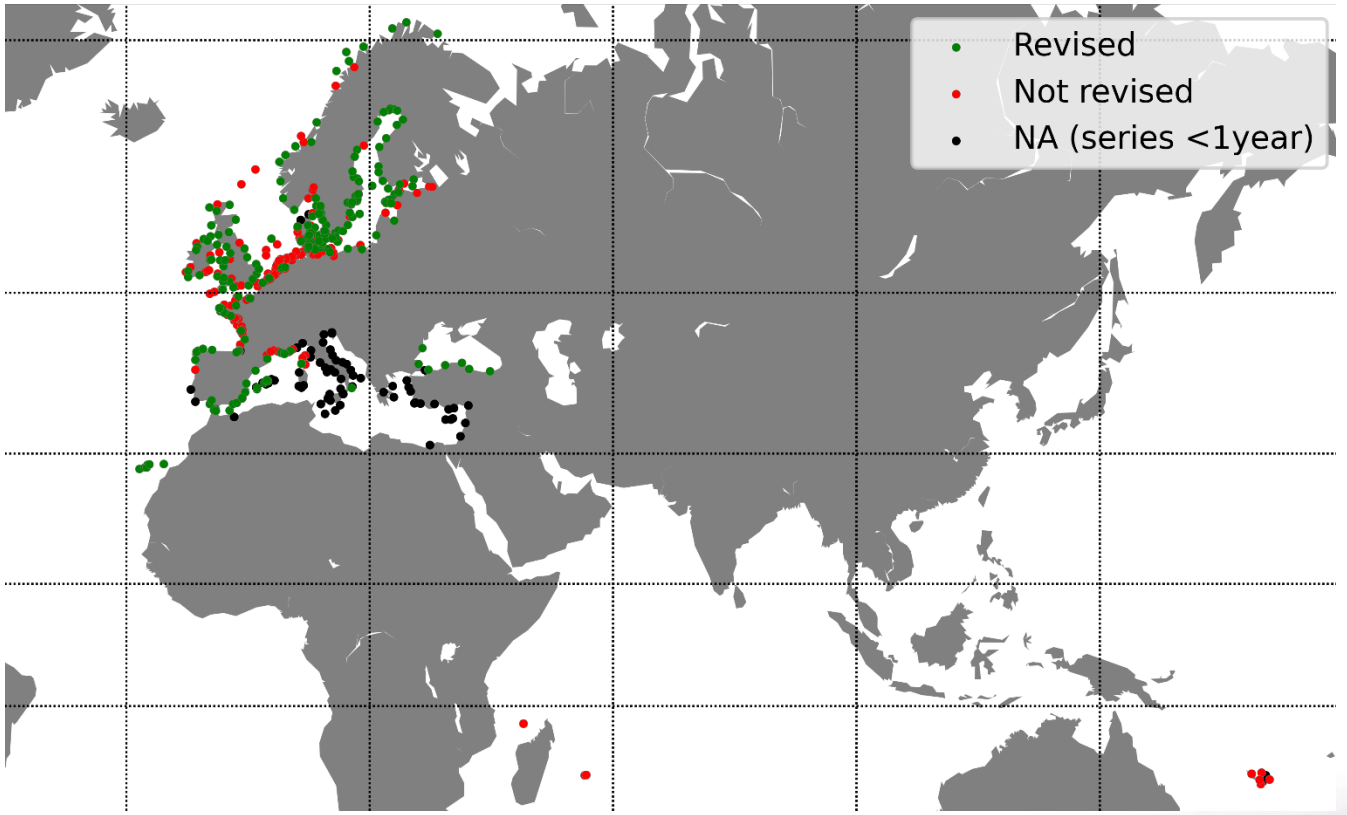
SEA LEVEL REP: Status July 2022







- 48% of stations in the IN SITU TAC NRT dataset already reprocessed
- Detection of first problems and communication to the regions and data providers
- Blacklisting of stations on-going: duplicates for same time sampling, datum changes, etc



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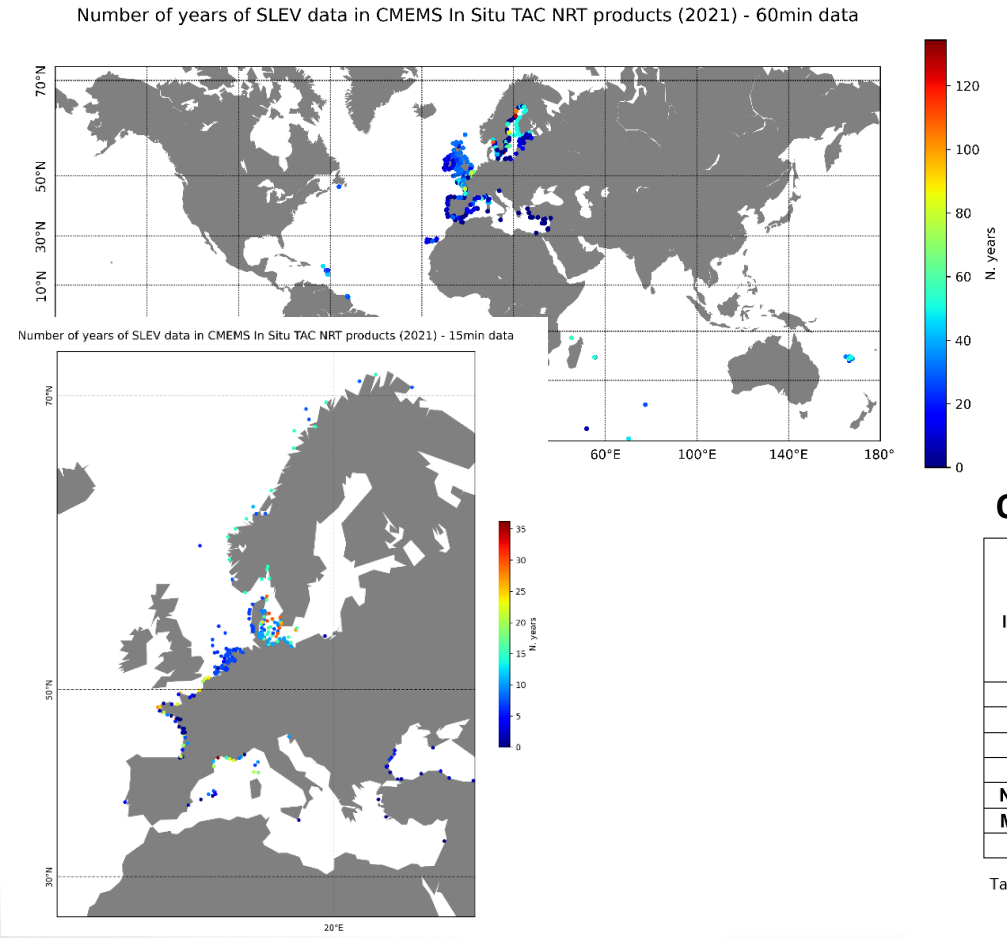
SEA LEVEL REP: Status July 2022

Example of QUID draft content, on-going action:

Spatial and temporal coverage:



Metrics:

Short description	*Applicability of metrics*				
	Raw data	By-products computation:			
	Original time sampling	Interpolation module (Resampled TS) ✓	Tide-Surge Module (Non-tidal residuals) ✓	Filter Module:Hourly data ✓	Monthly means ✓
Strange characters detection	X				
Date and Time	X				
Out of range values	X		X		
Stability/flatline test	X		X	X	
Attenuated signal				X	
Spike detection	X		X		
Buddy-checking	X		X		X
Clock malfunction			X		
Datum change			X		X
Drift					X

Table 3: Metrics used for delayed mode quality control of the Sea Level REP product, according to GLOSS best practices (IOC, 2020).

Overview of data quality:

Sea level	Coverage (Number of platforms and Completeness Index)											
	1850-1969				1970-1992				1993-2021			
	$\overline{N}$	Std	$\overline{C.I.}$	Ny>70	$\overline{N}$	Std	$\overline{C.I.}$	Ny>70	$\overline{N}$	Std	$\overline{C.I.}$	Ny>70
GL												
AR												
BO												
BS												
NWS												
MED												
IBI												

Table 5. Mean number of platforms $\overline{N}$ and Std, mean Completeness Index ($\overline{C.I.}$), and number of years with C.I.>70% for different regions and three periods: 1850-1969, 1970-1992 and 1993-2021.

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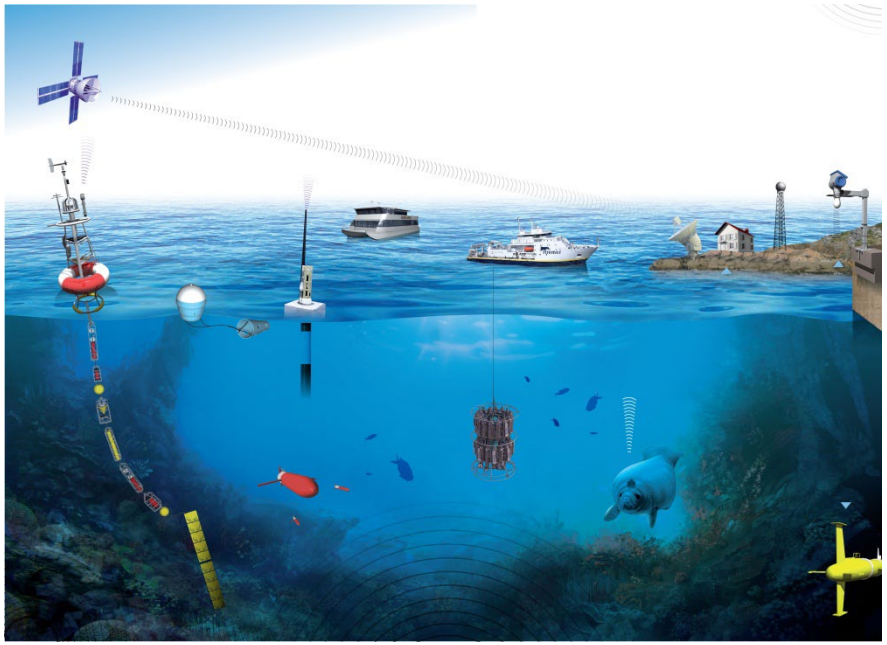

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