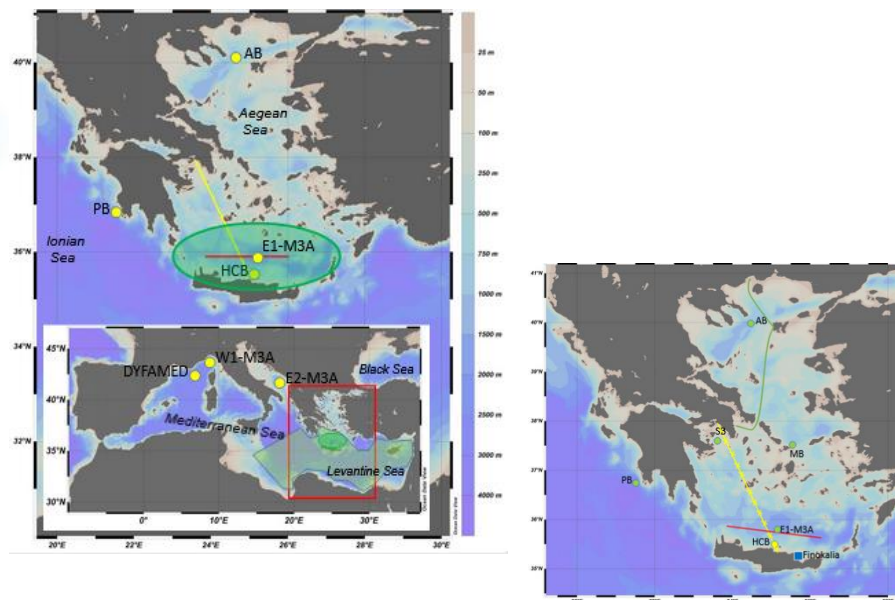
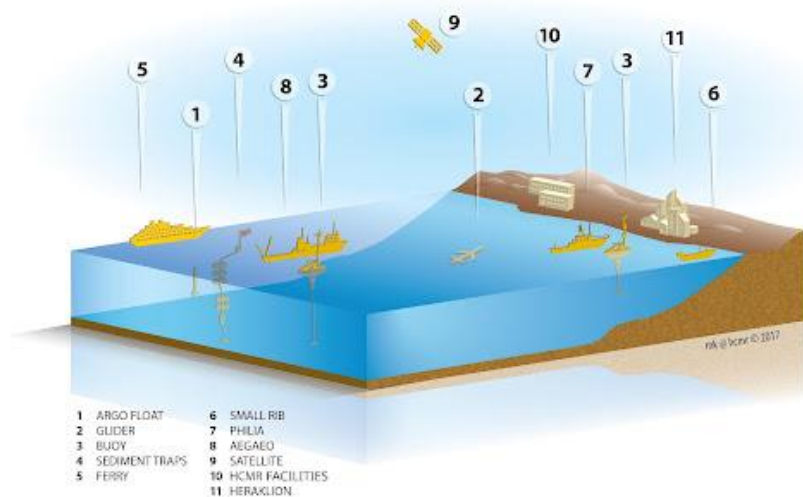


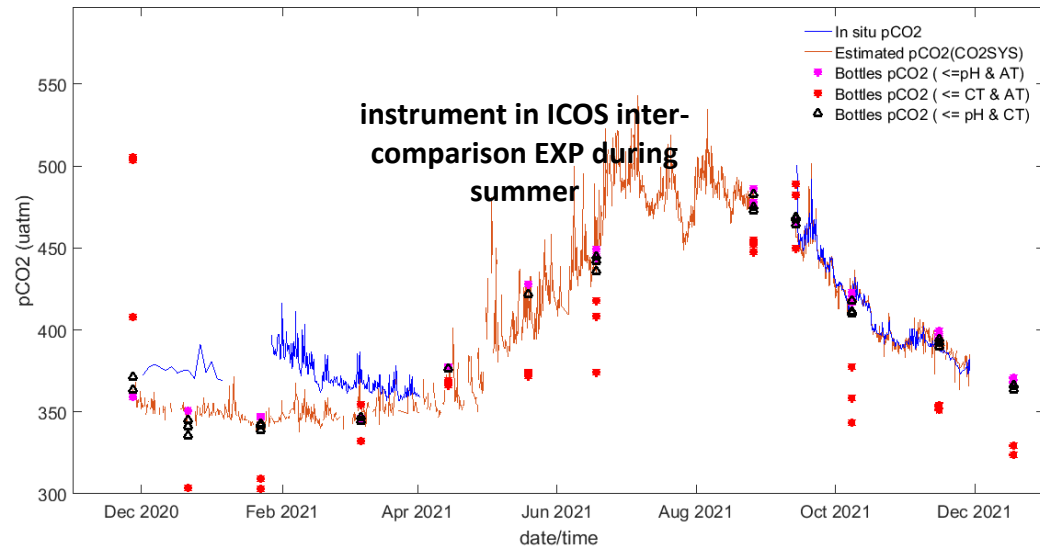
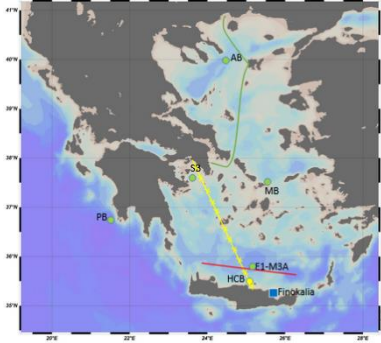
# In situ monitoring of Carbonate System Variables in the Eastern Mediterranean to validate Regional Algorithms, Remote Sensing and Model Products.

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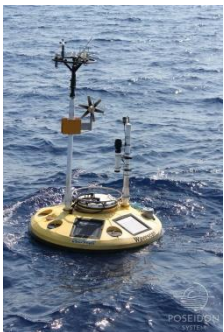
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# CO<sub>2</sub> data from in situ sensor and estimated from in situ (pH, SSS) data against bottles reference data



**Water pCO<sub>2</sub> at HCB: Sensor (blue line) + estimated\* from pH sensor & AT (<=SSS) (orange line).** 1st high frequency (3-6 hours) **Quality Controlled (QC)** Water pCO<sub>2</sub> time series in the Eastern Mediterranean Sea (E Med).

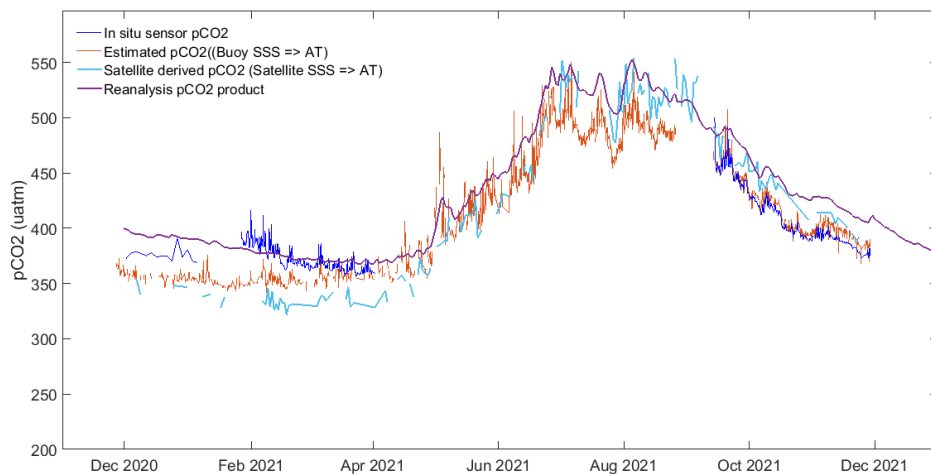
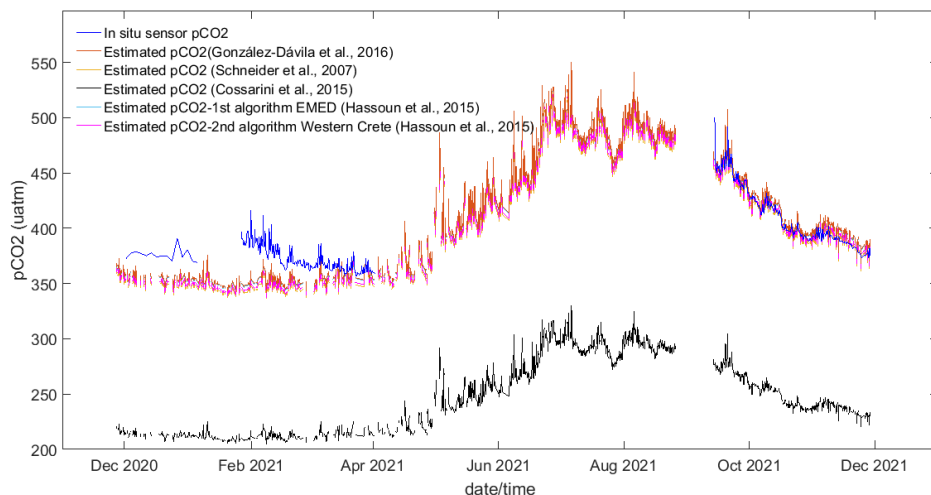
\*González-Dávila et al. 2016



for pCO<sub>2</sub> estimation from samples analyzed in the laboratory **pH & AT** was best pairwise combination of pH, total alkalinity (AT) and dissolved inorganic carbon (CT).



# In situ CO<sub>2</sub> data from sensor and estimated from in situ data (pH, SSS) against Satellite derived and model Reanalysis products

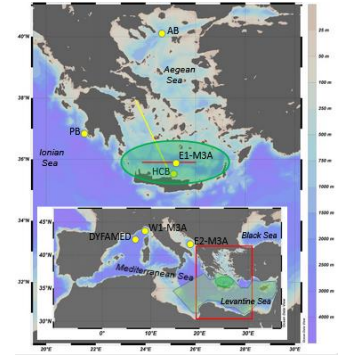
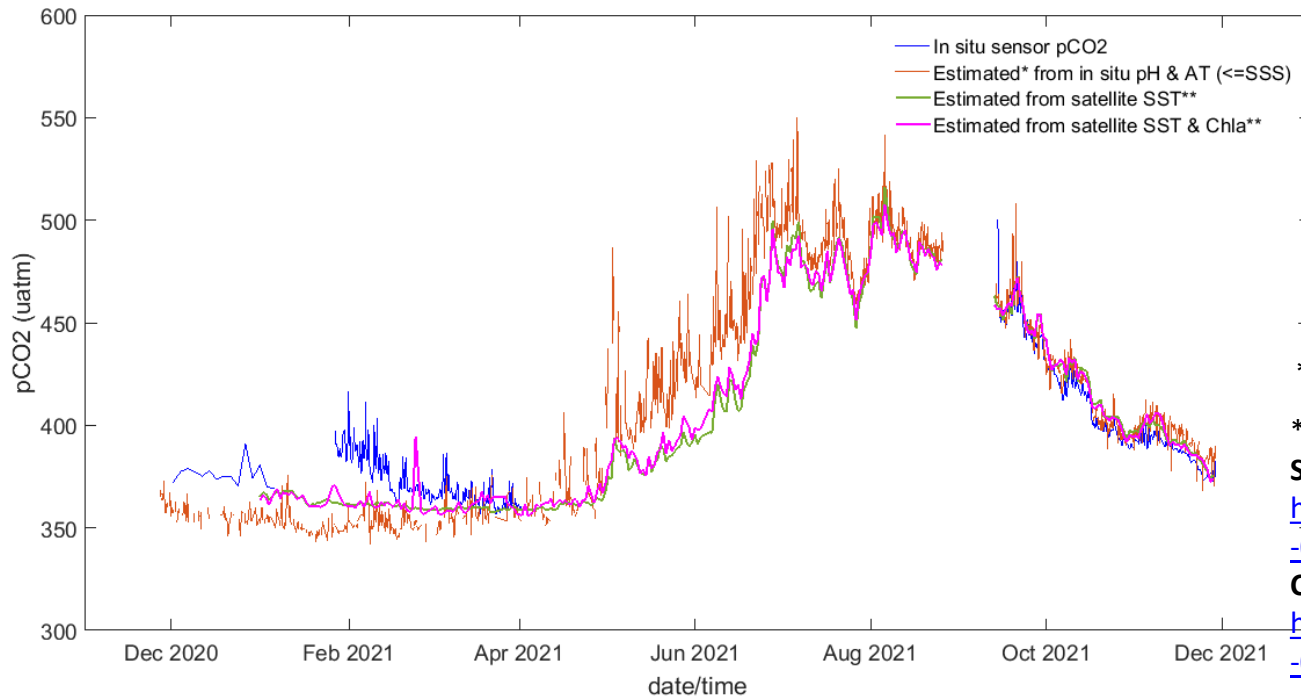


- Best **algorithm** used for estimated **AT** from **SSS** adopted from González-Dávila et al. 2016.
- **SST** appears as the main controlling factor of the diel to seasonal pCO<sub>2</sub> variability .
- Estimated pCO<sub>2</sub> based on **pH & AT** as a potential “gap filling” **tool**.
- Lack of regional & global **reanalysis products** of water pCO<sub>2</sub> - only available source the regional (Mediterranean Sea) reanalysis product <sup>1</sup>.
- Estimated pCO<sub>2</sub> time series using **Satellite SSS** <sup>2</sup> for AT estimation satisfactorily agrees with the in situ data.

<sup>1</sup>Feudale, L., Bolzon, G., Lazzari, P., Salon, S., Teruzzi, A., Di Biagio, V., Coidessa, G., & Cossarini, G. (2021). Mediterranean Sea Biogeochemical Analysis and Forecast (CMEMS MED-Biogeochemistry, MedBFM3 system) (Version 1) set. Copernicus Monitoring Environment Marine Service (CMEMS). [https://doi.org/10.25423/CMCC/MEDSEA\\_ANALYSISFORECAST\\_BGC\\_006\\_014\\_MEDBFM3](https://doi.org/10.25423/CMCC/MEDSEA_ANALYSISFORECAST_BGC_006_014_MEDBFM3)

<sup>2</sup>Meissner, T., F. J. Wentz, A. Manaster, R. Lindsley, 2019: Remote Sensing Systems SMAP Ocean Surface Salinities [Level 2C, Level 3 Running 8-day, Level 3 Monthly], Version 4.0 validated release. Remote Sensing Systems, Santa Rosa, CA, USA. Available online at [www.remss.com/missions/smap](http://www.remss.com/missions/smap), doi: 10.5067/SMP40-2S0CS

# Development and Validation of new Algorithms for Satellite derived pCO<sub>2</sub> data



\*(González-Dávila et al. 2016)

\*\*Satellite data source:

SST:

<https://doi.org/10.48670/moi-00172>

CHL-a

<https://doi.org/10.48670/moi-00113>

Satellite\*\* derived pCO<sub>2</sub> computed by new developed algorithms using satellite data:

- (1var) based on a single variable (**satellite SST**) and
- (2var) based on two variable (**satellite SST and CHL-a**).

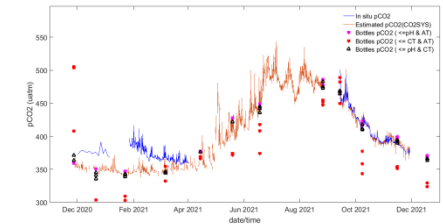
Statistical fit against both pCO<sub>2</sub> from in situ sensor and estimated\* (from in situ pH & AT<=SSS) data shows satisfactory results for both algorithms.

The 2var algorithm shows a slightly better agreement with the estimated values\* (RMS= 16.25uatm) compared to the 1var algorithm (RMS= 17.07uatm), while the comparison with the in situ sensor shows similar result (RMS=11uatm).

# Knowledge gaps and priorities at 1, 5, and 10 year timescales

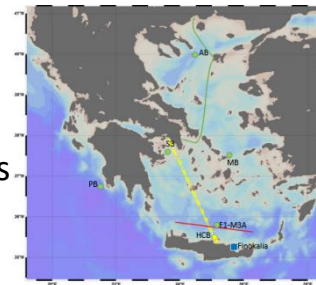
## At 1 year:

- Regional Best practices for carbonate system data processing/management
- Data flow at global data networks (i.e. SOCAT)
- Dissemination of carbonate system variables (i.e.  $p\text{CO}_2$ , pH) activities
- Evaluate algorithms
- Parameterization/Calibration of 3D hydrodynamic/BGC/Carbonate ecosystem model using in situ, satellite data
  - ✓ identify potential biases and necessary modifications



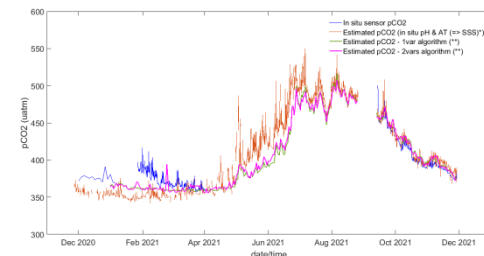
## At 5 years:

- Propose best regional algorithm for water  $p\text{CO}_2$  obtained from satellite images.
- Characterization of Eastern Mediterranean as a “source” or “sink” of  $\text{CO}_2$  based on air-sea  $\text{CO}_2$  fluxes
- Expand  $\text{CO}_2$  observations (air and sea) to other platforms (e.g. Ferrybox)
- Design optimum sampling strategies, evaluate novel technologies.
- Upscale of regional data to a wider area using a 3D hydrodynamic/BGC/Carbonate ecosystem model:
  - ✓ more realistically simulate air-sea  $\text{CO}_2$  fluxes
- Dissemination to workshops/conferences e.t.c.
- HCB to be included as ICOS station.
- Development of Global and Regional model reanalysis products (in addition to CMEMS).



## At 10 years:

- Satellite water  $p\text{CO}_2$  data free accessible for scientific and public community.
- Global Carbon budget: integrated satellite, in situ observations, products and modeling data feed national, regional and global policy frameworks related to Climate Change.



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