Validation of inferred high resolution ocean pCO2 and air-sea fluxes with in-situ and remote sensing data

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Titre: Validation of inferred super-resolution ocean pCO2 and air-sea CO2 fluxes with in-situ and remote sensing data

a) Introduction

Submesocale activity is being recognized as of primary importance in global ocean processes such as for instance the precise determination of GHGs exchanges between the ocean and the atmosphere. The scarcity of oceanographic cruises and the lack of available satellite products for GHG concentrations at high resolution prevent from obtaining a global assessment of their spatial variability at small scales. In this ESA Oceanflux project, the teams are making use of non-linear signal processing methods for inferring super-resolution maps (pixels resolution: 4kms) of CO2 fluxes by setting up a novel methodology based on the determination of an optimal multiresolution analysis computed from singularity exponents associated to Sea Surface Temperature (SST), chlorophyl concentration and low resolution CO2 fluxes. The multiresolution analysis makes use of (MERIS, MODIS AVW-MERGED and GSM-MERGED products. We present validation experiments using in-situ boat campaigns data colocalized with the generated high resolution products. Validation has been performed in Benguela OMZ region.

b) Method

SIngularity exponents are important non-linear and multiscale characteristics of turbulent data [1, 2, 3]. They can be used to set up optimal inference across the scales of complex signals [4]. In this work, seasonal regression coefficients are computed from ROMS simulation outputs. We have been using globcolour merged products (AVW and GSM) for ocean colour to:

increase the number of points in the ocean pCO2 field,
to get more intersections for a wider validation for in-situ pCO2.

We have also made comparison of inferred pCO2 from Globcolour with those from MERIS. In AVW CHL_a values are weighted by the relative error for each sensor on the simple averaging. In GSM we use fully normalized water leaving radiances.

c) Results

The validation analysis shows that values of superresolution pCO2 are closer to insitu pCO2 when we use merged ocean color (closer with GSM globcolour) . Analysis of the PDFs of pCO2 values show good agreement between inferred pCO2 and CarbonTracker (better for merged products). From singularity spectra analysis we obtain that the merged products improve the representation of the transition fronts (binomial cascade behaviour at small values of the singularity exponents).

d) Discussion & Conclusion

The methodology introduced in the ESA Oceanflux proposal is able to derive super resolution maps of GHGs fluxes validated by in-situ boat campaigns with excellents results which in particular are outperforming the outputs of simulation models such as CarbonTracker: not only the resolution, but the data itself is closer to in-situ data. As a consequence, the methodology presented in the ESA Oceanflux will serve as a tool for better quantitative evazluation of GHGs fluxes betwwen the ocean and the atmosphere.

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