



**HAL**  
open science

## Validation of inferred high resolution ocean pCO<sub>2</sub> and air-sea fluxes with in-situ and remote sensing data

Ismael Hernandez-Carrasco, J Sudre, Veronique Garcon, Hussein Yahia, Boris Dewitte, Christoph Garbe, Serena Illig, Ivonne Montès, A. Paulmier, I. Dadou, et al.

### ► To cite this version:

Ismael Hernandez-Carrasco, J Sudre, Veronique Garcon, Hussein Yahia, Boris Dewitte, et al.. Validation of inferred high resolution ocean pCO<sub>2</sub> and air-sea fluxes with in-situ and remote sensing data. Earth Observation for Ocean-Atmosphere Interactions Science 2014, ESA-ESRIN, Oct 2014, Frascati, Italy. hal-01078314

**HAL Id: hal-01078314**

**<https://inria.hal.science/hal-01078314>**

Submitted on 31 Oct 2014

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Copyright

Titre: Validation of inferred super-resolution ocean pCO<sub>2</sub> and air-sea CO<sub>2</sub> fluxes with in-situ and remote sensing data

#### a) Introduction

Submesoscale 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 CO<sub>2</sub> 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), chlorophyll concentration and low resolution CO<sub>2</sub> 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 pCO<sub>2</sub> field,
- to get more intersections for a wider validation for in-situ pCO<sub>2</sub>.

We have also made comparison of inferred pCO<sub>2</sub> 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 pCO<sub>2</sub> are closer to in-situ pCO<sub>2</sub> when we use merged ocean color (closer with GSM globcolour). Analysis of the PDFs of pCO<sub>2</sub> values show good agreement between inferred pCO<sub>2</sub> 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 excellent 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 evaluation of GHGs fluxes between the ocean and the atmosphere.

#### Bibliography

[1] I. Hernandez-Carrasco, J. Sudre, V. Garçon, H. Yahia, B. Dewitte, C. Garbe, S. Illig, I. Montès, I. Dadou, A. Paulmier, A. Butz

**Inference of super-resolution ocean pCO<sub>2</sub> and air-sea CO<sub>2</sub> fluxes from non-linear and multiscale processing methods**

Geophysical Research Abstracts, Vol. 16, EGU2014-15142, EGU General Assembly 2014  
2014.

[2] S. K. Maji, H. Yahia  
**Edges, Transitions and Criticality**  
Pattern Recognition 47(6) 2104-2115, Elsevier, June 2014

[3] A. Turiel, H. Yahia, C. Pérez-Vicente  
**Microcanonical multifractal formalism—a geometrical approach to multifractal systems:  
Part I. Singularity analysis**  
Journal of Physics A: Mathematical and Theoretical, 2008.

[4] H. Yahia, J. Sudre, C. Pottier, V. Garçon  
**Motion analysis in oceanographic satellite images using multiscale methods and the  
energy cascade**  
Pattern Recognition, 2010