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Inferred IOP and particulate matter from MERIS and MODIS multi-spectral satellite images

Marjorie SCHMELTZ[1], Jean-Marie FROIDEFOND[1], Peter GEGE[2], Frédéric JOURDIN[3]

[1] EPOC, UMR 5805, Université Bordeaux 1, Av. Facultés, F-33405 Talence, France
[2] DLR Remote Sensing Technology Institute, Oberpfaffenhofen, D-82234 Wessling, Germany
[3] Service Hydrographique et Océanographique de la Marine, CS 92803, 29228 Brest Cedex 2, France

Email : m.schmeltz@epoc.u-bordeaux1.fr

Introduction

How to accurately determine and quantify particulate and dissolved matters at the water surface in coastal areas (case 2 waters) using passive ocean colour remote sensing is still a topical issue. The best actual models, like the OC5 algorithm from Gohin et al., 2002, are empirical, and usually restricted to a limited area; hence the need to gather numerous oceanographic data is strong.

To improve our understanding of in-water radiation law, we tested a numerical bio-optical model with several components including bottom reflectance. The software called WASI (Water Colour Simulator) was developed by Peter Gege (Gege, 2004) and integrates forward and inverse modelling for eight common types of optical in-situ measurements in aquatic environments (in particular remote sensing reflectance, absorption or attenuation), using well-established analytical models. In forward mode, it simulates reflectance spectra using the IOP or the particulate and dissolved matters. In inverse mode, an input hyperspectral reflectance spectra measured with a spectro-radiometer is analyzed by fitting iteratively possible reflectance curves under constraints on some bio-optical parameters (simplex method) so as to provide the IOP and the particle concentrations.

We used in-situ data acquired during the oceanographic mission OPTIC-CONGO (Gulf of Guinea) to evaluate the accuracy of the model results. The substance concentrations derived by the WASI model were compared with the in-situ measurements and the results are encouraging (Schmeltz et al., 2009).

To apply this inversion to satellite data from MODIS (NASA) or ENVISAT/MERIS (ESA), we developed a multiple regression program adapted from Wernand (1997) to reconstruct hyperspectral reflectances from the multi-spectral satellite channels (10 bands for MODIS and 15 bands for MERIS). These reconstructed spectra are inverted in WASI to obtain the IOP and substances concentrations.

Data

We focus on data acquired during the BATEL-1 mission in the Bay of Biscay that took place between June 4th 2007 and June 13th 2007. Rrs as well as suspended matter concentrations and fluorescences were measured at different stations. During the mission, the MERIS instrument on the ENVISAT satellite made remote sensing reflectance measurement over the same area on June 5th.

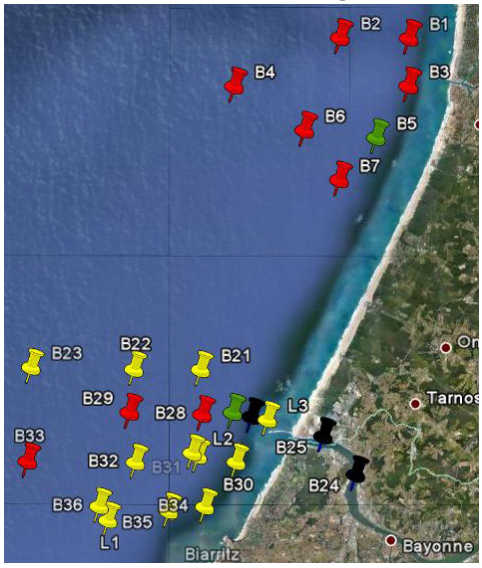

Figure 1. Location of the BATEL-1 stations (2009©IGN France & Google Earth)

Figure 1 shows the location of the BATEL-1 stations surveyed on June 4th, 5th and 6th 2007. The black pins correspond to the stations surveyed on June 4th 2007 (the day before the MERIS pass), the red and green pins correspond to the stations surveyed on June 5th (the day of the pass) and the yellow pins correspond to the stations surveyed on June 6th (the day after the MERIS pass). B5 and B27 correspond to the stations that are the closest in time to the satellite pass and are in green. Stations B24 and B25 (black pins) are located in the Adour river, where there is no data from MERIS.

Preliminary comparisons and results

We first compare the two datasets, the one from BATEL-1 in-situ measurement and the other from the MERIS data processing outputs, in particular at the BATEL-1 stations that were surveyed the closest to the satellite pass (stations B5 and B27).

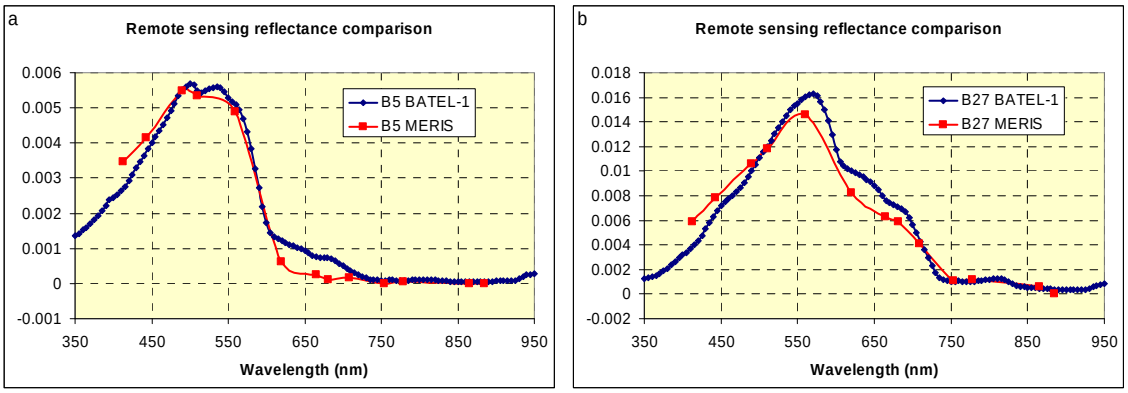

Figure 2. Remote sensing reflectance comparison.

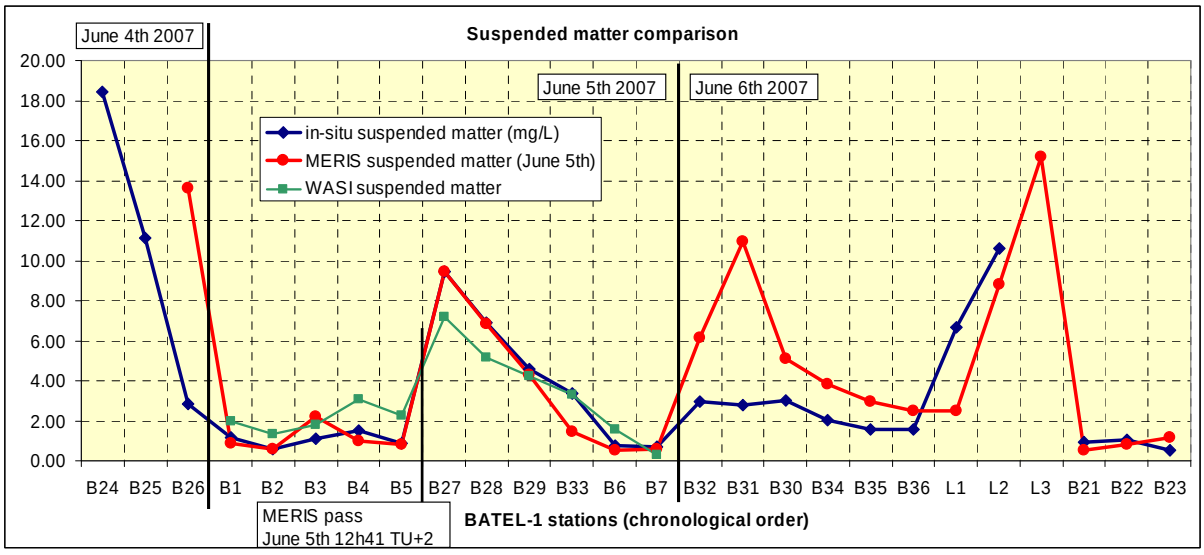

Figure 3. Suspended matter concentrations comparison

Figure 2 shows the comparison between the remote sensing reflectance measured with the spectroradiometer and the reflectance from MERIS at station B5 (2a) and at station B27 (2b).

The suspended matter concentrations derived by the algorithm programmed in the MERIS data processing are similar to the ones measured during the BATEL-1 mission on June 5th (see figure 3). The values derived by WASI compare reasonably well with the satellite and in-situ observations.

References

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