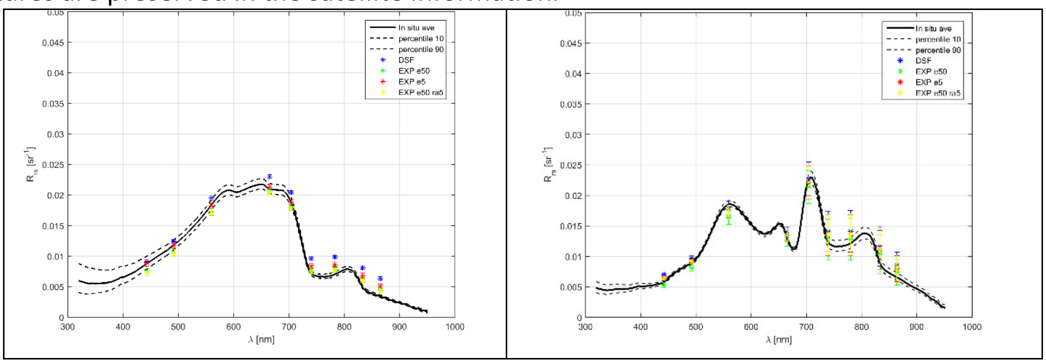
Evaluation of satellite spectral signatures to retrieve water quality parameters using different atmospheric corrections in the Rio de la Plata turbid waters

Fernanda Maciel[1] and Francisco Pedocchi[1]

Remote sensing of coastal turbid waters is challenging due to its optically complex waters in comparison with the open ocean. This work focuses in the northern coast of the estuary Rio de la Plata, located in South America between Argentina and Uruguay. The study period includes the southern hemisphere Spring-Summer 2018-2019. The data available are: 1) remote sensing information from Landsat-8 and Sentinel 2 (A and B); 2) above water reflectance obtained using Ramses-Trios hyperspectral radiometers, matching the time of satellite images (+/- 2 hours); 3) in situ data of turbidity and fluorescence of chlorophyll-a and phycocyanin. Firstly, data from 1) and 2) are compared to evaluate the performance of different atmospheric correction (AC) methods. The software Acolite (version 20181210.0) is used, and the recently available Dark Spectrum Fit (DSF, Vanhellemont & Ruddick 2018) is compared to the aerosol exponential model using SWIR bands (Vanhellemont & Ruddick 2015). For the latter, fixed 50th and 5th percentile ε are evaluated, as well as fixed 5th percentile aerosol reflectance (with 50th percentile ε). Two examples of in situ and satellite reflectance spectra are shown below (left: moderate turbidity and low phytoplankton concentration, right: low turbidity and cyanobacterial bloom). Considering the available data so far (more data will be available by the end of Summer.), the best fit is obtained using exponential SWIR AC with fixed ε, with relative error around 30%, and RMSE of 2.4×10^{-3} and 3.7×10^{-3} sr^{-1} for the 5th and 50th percentile ε respectively. The RMSE is similar for the fixed aerosol reflectance AC, but the relative error increases to 50%, while for the DSF method the relative error is over 80%. Except for the 50th percentile ε, all the methods present a global positive bias. When results are considered independently for each wavelength band, DSF presents a good performance for the visible bands, but highly overestimate the NIR region. A similar behavior is observed for the fixed ε and fixed aerosol reflectance method, while the fixed ε methods present a good to moderate performance for all the bands. It is important to highlight that all the methods give very similar spectrum shapes. Furthermore, data from 3) will be used to identify spectrum features for different water quality conditions, including the presence of blooms, and whether these features are preserved in the satellite information.



In figures satellite data is referred to each band center-wavelength. For AC evaluation in situ spectra is averaged for each bandwidth.

Vanhellemont, Q., and K. Ruddick (2018). Atmospheric correction of meter-scale optical satellite data for inland and coastal water applications. Remote Sens. Environ. Vol. 216, pp. 586-597.

Vanhellemont, Q., and K. Ruddick (2015). Advantages of high quality SWIR bands for ocean color processing: examples from Landsat-8. Remote Sens. Environ. Vol. 161, pp. 89-106.

1 Instituto de Mecánica de los Fluidos e Ingeniería Ambiental, Facultad de Ingeniería, Universidad de la República, Uruguay. fmaciel@fing.edu.uy and kiko@fing.edu.uy