

Water quality monitoring in Térraba Sièrpe Wetland (Costa Rica) using multi- and hyperspectral EO data

N. Pinnel¹, P. Gege¹, C. Miller², I. A. Pérez², S. Plattner¹, R. de los Reyes¹, T. Schwarzmaier¹

¹German Aerospace Center (DLR), Earth Observation Center (EOC), 82234 Wessling, Germany

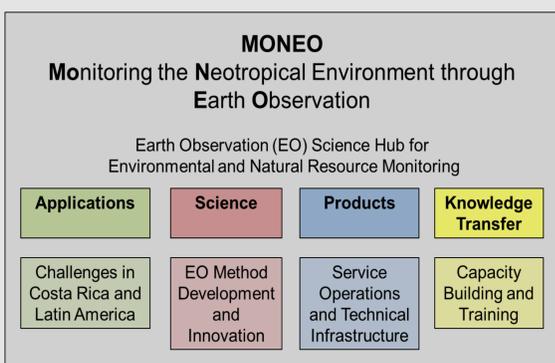
²Centro Nacional de Alta Tecnología Laboratorio CENAT -PRIAS, San José, Costa Rica



Térraba Sièrpe National Wetland, Costa Rica.

ABSTRACT

The project 'Application of multispectral and hyperspectral Earth Observation data to investigate water quality in relation to agricultural activities within the Térraba Sièrpe Wetland in Costa Rica - MONEO-WET' corresponds to an initiative focused on investigating the applicability of remote sensing data in tropical systems.

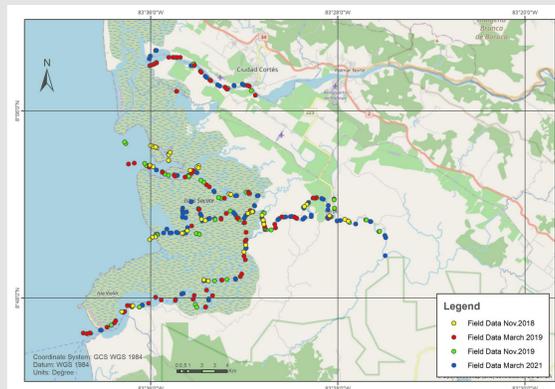


MONEO – Earth Observation Science Hub for Environmental and Natural Resource Monitoring.

The main topic of this project is the use of EO data to assess water quality on the sensitive RAMSAR wetland ecosystem Térraba Sièrpe at the mouth of the Térraba and Sièrpe rivers. The network and the first products created in the MONEO-WET project are used to advance the continuity of the further development of MONEO (MONitoring of NEOtropical Environment through Earth Observation), a science and service hub, for monitoring ecosystems in Latin America.

Field Spectral Measurements

Field campaigns were carried out during wet season (November 2018 and November 2019) and dry season (March 2019 and March 2021) The sampling sites for in-situ measurements were taken an Ocean Optics Sensor System (OOSS).



Field Campaigns in Terraba-Sièrpe Wetland during Nov. 2018, March and Nov. 2019 and March 2021.

Water Sample Analysis

- Chlorophyll-a concentration
- TSM (total suspended matter) concentration
- TSM extinction coefficient (350 – 900 nm)
- CDOM (colored dissolved organic matter) absorption coefficient (200 – 900 nm)

Bio-optical modelling

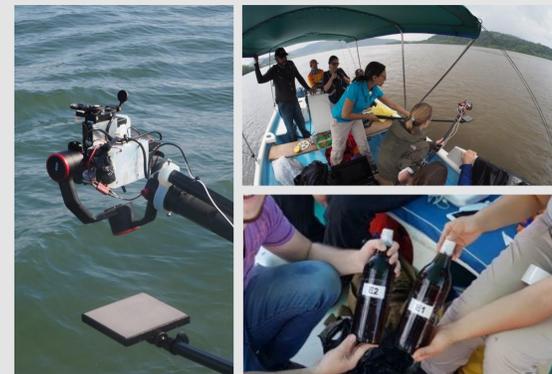
The WASI-2D software (Gege, 2014) retrieves optically active water quality variables using physically based algorithms. It was parameterized with site-specific inherent optical properties (SIOPs) to determine chlorophyll, total suspended matter (TSM) and colored dissolved organic matter (CDOM). It was applied in the Terraba-Sièrpe area to obtain time series of L2A Sentinel-2, Landsat 8 and DESIS images.

References

Gege P. (2014): WASI-2D: A software tool for regionally optimized analysis of imaging spectrometer data from deep and shallow waters. Computers & Geosciences 62, 208-215. <http://dx.doi.org/10.1016/j.cageo.2013.07.022>.

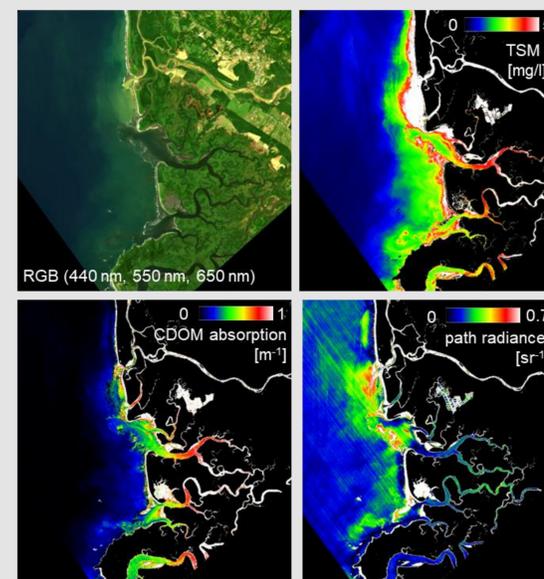
Earth Observation Data

The multispectral (Sentinel 2, Landsat 8) and hyperspectral EO (DESIS) data were atmospherically corrected to Bottom-of-atmosphere (BOA) reflectance using Sen2cor (ESA) and PACO (Python-based Atmospheric Correction, DLR), respectively.



Field spectral measurements using Ocean Optics sensor System and water samples collected during field campaigns.

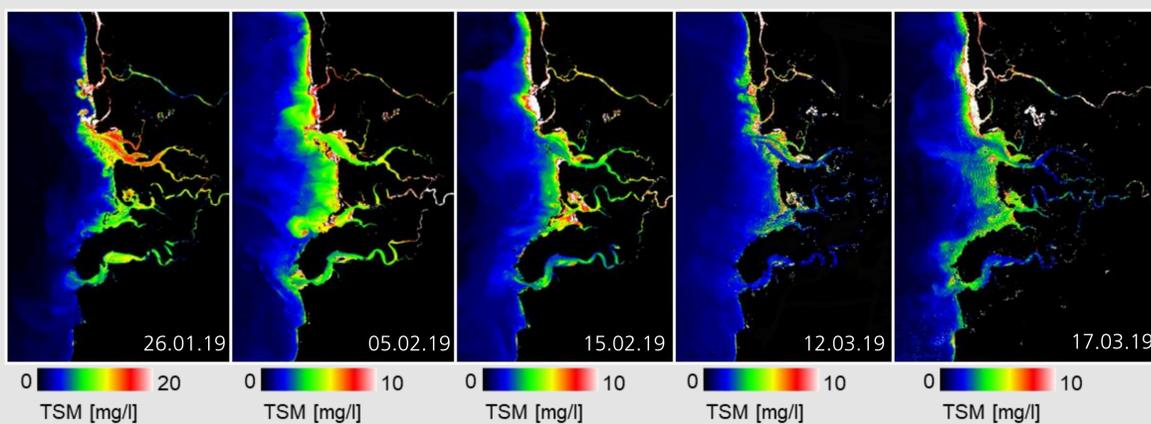
The results indicate that under favorable observational and environmental conditions, the applied atmospheric correction and the used retrieval algorithm are suitable to use DESIS, Sentinel 2 and Landsat 8 data for mapping TSM and CDOM in tropical environments, while chlorophyll is challenging.



The thematic maps of DESIS imagery from 24.04.19 show the concentrations of suspended matter (TSM) and colored dissolved organic matter (CDOM absorption) as well as the path radiance (cirrus clouds) and glint.

SUMMARY

- The methodology is mature to set up a long term monitoring system, which might provide deeper insight into processes of entire wetland ecosystems
- The long-term goal is a sustainable land use management, which is exemplary for many other tropical wetlands in Latin America



Evaluations of time series of Sentinel-2 data show the dynamics in the test area, here exemplified by suspended sediment concentrations on 26.01.19, 05.02.19, 15.02.19, 12.03.19 and 17.03.19.