EGU24-20537, updated on 19 May 2024
https://doi.org/10.5194/egusphere-egu24-20537
EGU General Assembly 2024


# Water clarity derived from multispectral imagery by semi-analytical algorithm in association with optical water types to classify inland waters into ecological classes: sensitivity study case in France.

**Guillaume Morin**[1,3], Nathalie Reynaud[2,3], Tristan Harmel[1], Arthur Coqué[2,3], and Thierry Tormos[4]
[1]Magellium, Earth observation, Toulouse, France (guillaume.morin@magellium.fr)
[2]INRAE, Aix Marseille Université, Aix-en-Provence, France
[3]Pôle R&D ECLA, Aix-en-Provence, France
[4]Office français de la Biodiversité, Service ECOAQUA DRAS, Aix-en-Provence, France

Water clarity is a widely used indicator to monitor water quality and ecological status of lakes. It has been routinely assessed through *in situ* measurements of the Secchi disk depth ($Z_{SD}$). Remote sensing (RS) of this parameter could beneficially complement the sparse *in situ* data set but still remains dependent on the availability of ground-truth data to be validated.

Here, high-spatial resolution satellite missions were compared with *in situ* $Z_{SD}$ in various water bodies in France . Our objective is to evaluate the contribution of remote sensing for densifying transparency monitoring in the framework of the WFD. First, Sentinel-2 MSI images were processed for atmospheric-correction (AC) and sunglint removal. Then, we applied a pixel-classification by Optical Water Types to infer bio-optical properties of waters, enabling to characterise optically-active compounds in waters to decipher the applicability, and ultimately tune standard $Z_{SD}$ retrieval algorithms. Based on our *in situ* database, 577 matchups over 76 lakes and reservoirs were successfully established between in situ and satellite data.

Overall performances of the retrievals are satisfactory with RMSE: 1.91 m (40%), MAPE: 46 %, bias: -0.5% and $r^2$: 0.52. This study shows that performances are highly variable with respect to the identified optical water types. Best performances are achieved in clear waters ($Z_{SD}$ > 5m) with RMSE: 1.85 m (35%), MAPE: 37% bias : 8%. On the contrary, turbid waters exhibit larger discrepancies. In case of sediment-laden waters, performances fall to RMSE: 2.8 m (57%), MAPE: 71 %, bias = -34% and $r^2$ = 0.40 while it is even worth in case of hyper-eutrophic waters, due to massive phytoplankton bloom with RMSE: 0.9 m (75%), MAPE: 49 %, bias = -57% and $r^2$ = 0.06.

Nevertheless, those performances make it possible to critically map ecological classes between “high” and “bad”, and to monitor long term tendencies. Optical classification allows criticising the applicability and accuracy of generic RS retrieval algorithms to a country-scale area. It also brings a qualitative interpretation on the factors of degradation of the water quality related to the decrease of transparency, either by increasing sediment content, dissolved carbon inputs or during phytoplanktonic blooms events. Therefore, it provides a additional and valuable information for

many users interested in evaluating the ecological status of inland water bodies from RS data such as academics, authorities and stakeholders.