TELQUEL project : Calibrating bio-optical models for retrieving ecological parameters of lakes from SENTINEL-2 and LANDSAT 8

Thierry Tormos, Tristan Harmel, Malik Chami, Pierre-Alain Danis

TELQUEL project : Bio-optical models for retrieving ecological parameters of lakes from SENTINEL-2

First results for retrieving transparency

[1]Thierry Tormos,[2,3]Tristan Harmel, [4]Chami Malik, [2]Reynaud Nathalie, [1]Pierre-Alain Danis

International Ocean Colour Science Meeting 2017

Advancing Global Ocean Colour Observations

TELQUEL OBJECTIVES

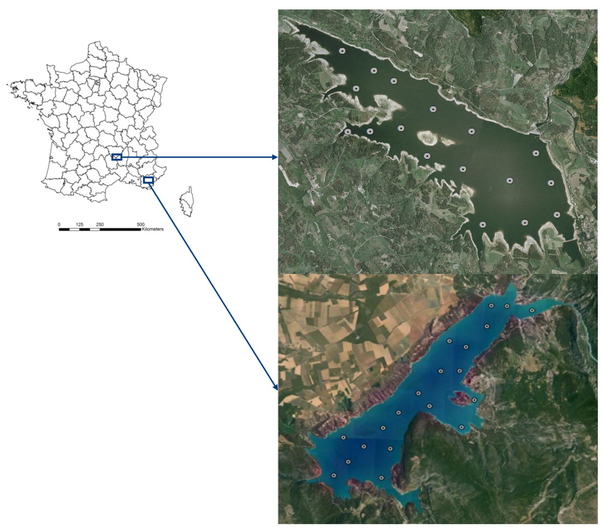
The main objective of the TELQUEL (TELédétection de la Qualité Ecologique des Lacs) **project is to provide quantitative remotely sensed observations to monitor the ecological state of the French lakes.** In this direction, MSI/Sentinel-2 and OLI/Landsat 8 data are exploited to :

(i) identify/develop a **specific atmospheric correction and deginting algorithm** over lake areas (**see Poster from Harmel, T. et al. in this conference**);

(ii) provide **bio-optical algorithms** to retrieve water transparency and water constituent concentrations (Chl-a, CDOM and TSM), **first results are shown in this poster.**

(iii) use the retrieved bio-optical properties and matter concentrations for enhancing the lake water quality evaluation and biogeochemical models.

STUDY SITES & FIELD DATA

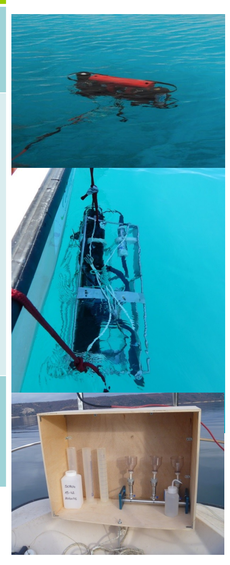


Naussac
(1050 ha)

Ste-Croix
(2200 ha)
(only for winter campaigns)

- 8 field campaigns have been planned for collecting **apparent and inherent optical properties** (AOP, IOP), **transparency and biogeochemical concentrations** (see table below for details).
- 1 campaign per season over 2 years.
- 7 campaigns have already been done.
- a comprehensive database has been generated for an easy access to the collected data.

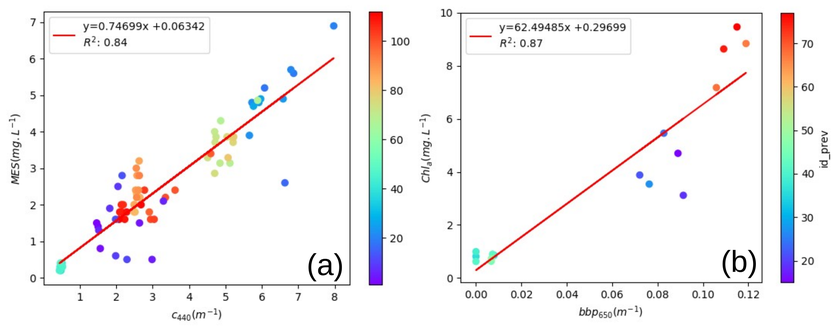
Data Type	Measures	Materials
AOPs	**L_u** : upwelling radiance **E_d** : downwelling irradiance **E_0** : solar irradiance	C-OPS (Wetlabs Ins.)
IOPs	**c** : attenuation coefficient **a** : absorption coefficient **acdom** : cdom absorption coefficient **bbp** : back-scattering coefficient	AC-S & ECO BB3 (Wetlabs Ins.)
	aphyto : phytoplancton aborption coefficient	Sprectrometer with integrating sphere (in the laboratory)
Biochemical parameters	TSS : Total Suspended Solids SOM : Suspended Organic Matter Chl-A : Chlorophylle-a concentrations SD: Transparency from Secchi Disk	Filtration rampers Concentrations measurements in the laboratory. Secchi Disk



METHODS & RESULTS

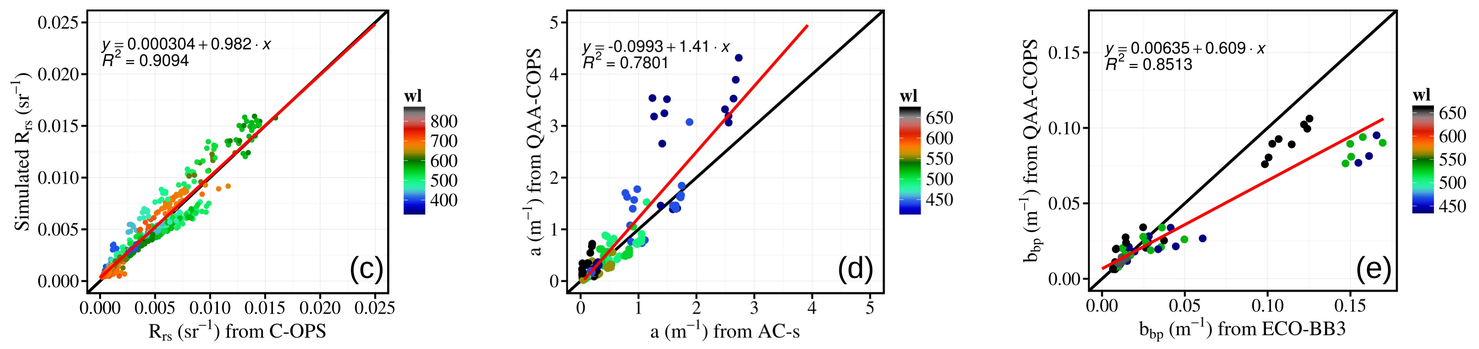
Bio-optical relationships

Strong correlations (R^2>0,7) are observed between water constituent concentrations and IOPs attesting the interest to use watercolour tools for monitoring ecological parameters of lakes. See on the right, for illustration, in (a) c at 440 nm and TSS concentrations; and in (b) bbp at 660 nm and chl-A concentrations.



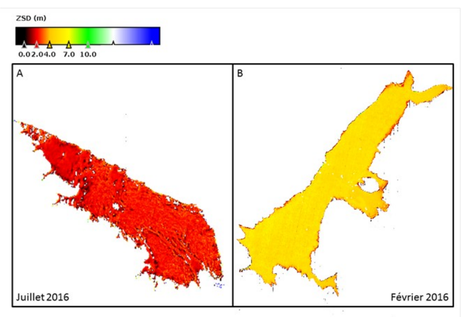
Radiometric Inversion (QAA model)

Good result (R^2=0,90 and regression slope near 1, see Figure c) obtained from optical closure exercise using Gordon model (Gordon et al., 1988) justifies the use of inversion models for lakes. QAA inversion model from Lee et al. 2002 was implemented for C-OPS and Sentinel-2 data. Results show clearly **the need of a specific calibration of QAA for estimating lake IOPs**. The estimation of a (see Figure d) is satisfactory except for high value (>2 m^{-1}) and despite of a better correlation, bbp are under-estimated (about a factor of two, see Figure e).



First product using Sentinel-2 (transparency, SD)

SD was retrieved from Kd following Lee et al. 2015. Kd was derived from Sentinel-2 reflectances following Lee et al. 2005 & 2013 parametrization. Reflectances were obtained from TELQUEL level 2 algorithm (atmospheric and sunglint correction, see poster Harmel T. in this conference). a and bb require for deriving Kd were estimated using standard QAA model (see above) and modified QAA model for . Sentinel-2 time series were computed over the two study sites. SD values obtained were quite uniform. Results are coherent regarding in situ measures. XXX



IN THE FUTURE

1- Enriching the library of optical data representative of lakes and reservoirs color variability.

2- Building specific bio-optical algorithms for OLI and MSI sensors based on Lee et al. 2002 algorithm calibrated and ajusted from our field data.

3- Testing the biogeochemical products retrieved from Landsat 8 and Sentinel-2 for evaluation and modeling of lake ecological state.

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[1] AFB, DREC Pôle hydro-écologie des plans d'eau, **Aix-en-Provence, France**
[2] IRSTEA, UR RECOVER, **Aix-en-Provence, France**
[3] UMPC, UMR CNRS 7093, **Villefranche-sur-Mer, France**
[4] UPMC, UMR CNRS 8190 LATMOS, **Paris, France**

Contacts :
Thierry Tormos; thierry.tormos@afbioidiversite.fr
Tristan Harmel; tristan.harmel@irtsea.fr
Malik Chami; malik.chami@upmc.fr
Nathalie Reynaud; nathalie.reynaud@irstea.fr
Pierre-Alain Danis; pierre-alain.danis@afbioidiversite.fr

Acknowledgements:

We would like to thank the TOSCA CNES program and the French National Agency for Biodiversity (AFB) for funding TELQUEL Project.

Third International Ocean Colour Science Meeting, Lisbon, Portugal, 15-18 May 2017