TELQUEL project : Atmosphere and sunglint correction of Landsat-8 and Sentinel-2 data for water quality monitoring of lakes Bioindicators View project New tools to improve knowledge of nutrients fluxes entering and outgoing lakes View project

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Atmosphere and sunglint correction of Landsat-8 and Sentinel-2 data for water quality monitoring of lakes

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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.

However, the near-nadir viewing geometries of those satellites make them very vulnerable to sunglint contamination (i.e., sunlight reflected on the air-water interface).

In the framework of the TELQUEL project, an original method was developed to correct for the sunglint the decameter scale imageries of Landsat and Sentinel-2 based on exploitation of the SWIR bands (e.g. 1.6 and 2.2 µm).

Deglinting Algorithm

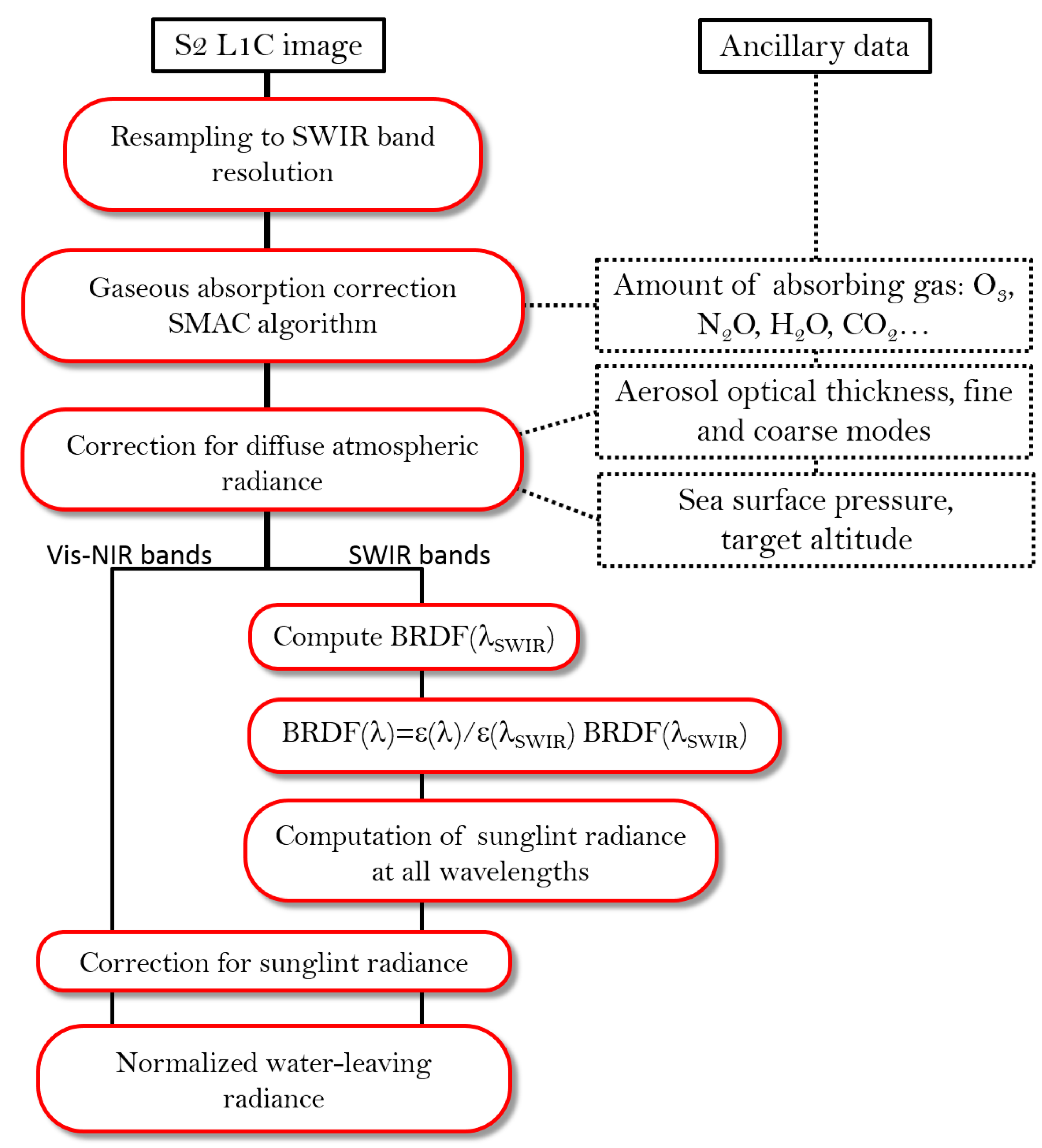
Atmospheric correction (AC) is based on precise radiative transfer computations (OSOAA, *Chami et al., Opt. Express, 2015*).

Ancillary data on aerosol optical thicknesses from the AERONET network.

Sunglint correction is achieved simultaneously to the AC step.

For a given pixel, the sunglint contribution is estimated from the shortwave-infrared (SWIR) part of the spectrum.

Then, the sunglint signal is extrapolated toward the near-infrared and visible bands.



A few principles…

Top-of-atmosphere radiance (satellite measurements):

$$L_t^{TOA}(\lambda) = T_g(\lambda)\left[L_{atm}^{TOA}(\lambda) + L_{dir}^{TOA}(\lambda) + t_u(\lambda) L_w^{BOA}(\lambda)\right]$$

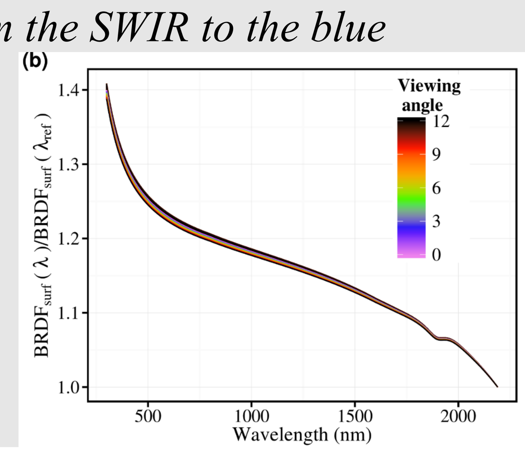
In SWIR (λ>1.2µm): L_{atm}^{TOA}: *Very small*; L_w^{BOA}: *Virtually null*

Sunglint signal:

$$L_{dir}^{TOA}(\lambda,\theta_s,\theta_v,\Delta\varphi) = T_u(\lambda,\theta_v)\, BRDF_{surf}(\lambda,\theta_s,\theta_v,\Delta\varphi)\, T_d(\lambda,\theta_s)\, L_{sun}^{\downarrow}(\lambda,\theta_s)$$

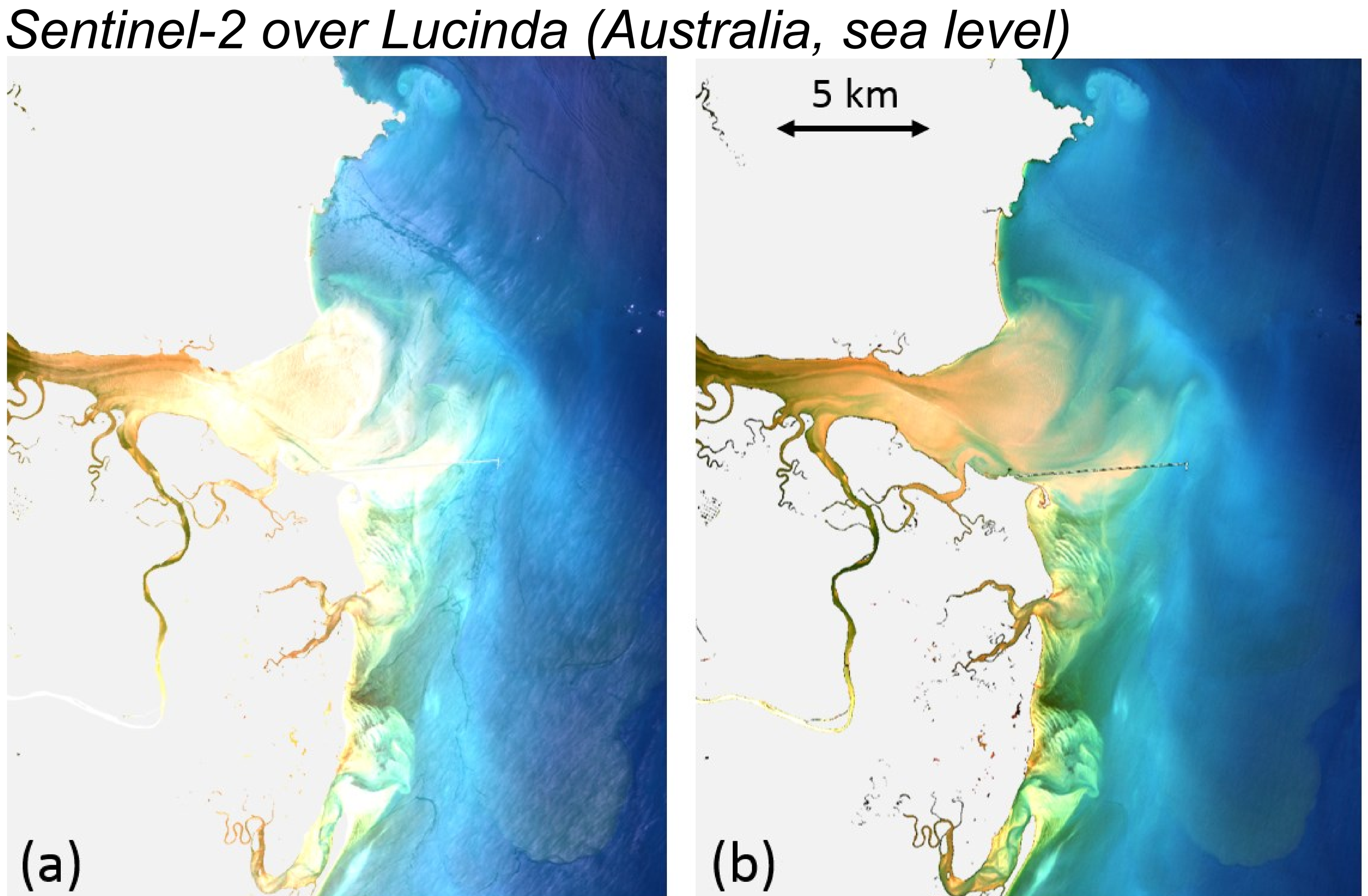
$BRDF_{surf}$: *Unknown to retrieve… but we need to know its spectral variation*

The spectral variation of the bidirectional reflectance distribution function (BRDF) related to the sunglint is around 30-40% from the SWIR to the blue

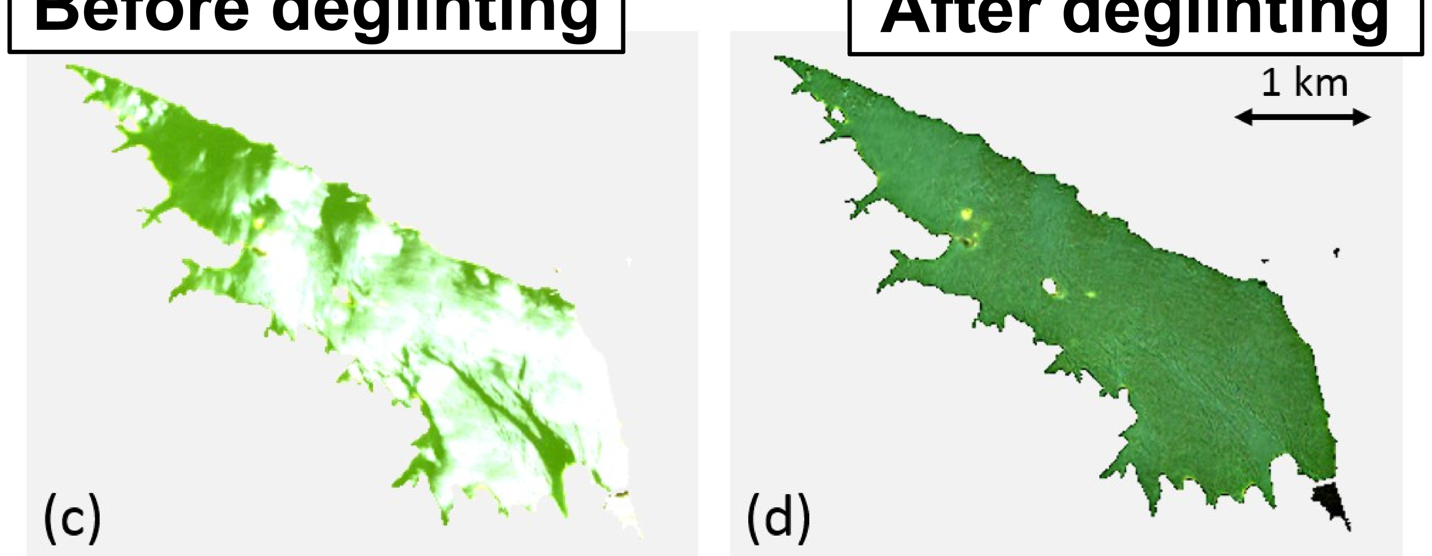


Validation and performances

Sentinel-2 over Lucinda (Australia, sea level)



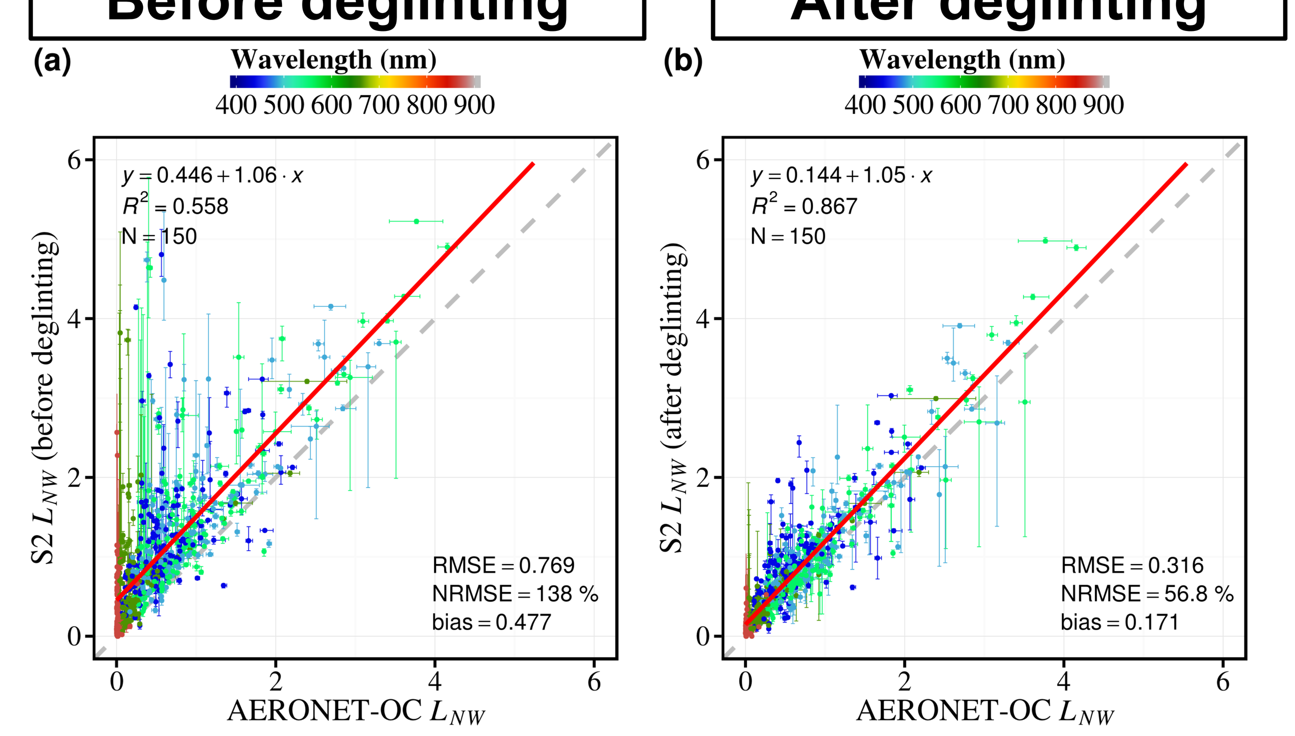
Before deglinting **After deglinting**



Sentinel-2 over Naussac (France, alt=941m)

Application of the TELQUEL chain on hundreds of Sentinel-2 images demonstrates that sunglint patterns are satisfactorily removed over the entire images whatever the altitude of the observed target.

Before deglinting **After deglinting**



Comparison with ground-based data (AERONET-OC) showed strong correlation between satellite and in situ data (R2~0.9).

Perspectives

(i) Provide corrected images for **bio-optical algorithms** to retrieve water transparency and water constituent concentrations (Chl-a, CDOM and TSM), (*see first results in Tormos et al. poster*).

(ii) Couple the algorithm with aerosol retrievals and/or exogenous aerosol data such as that of the ECMWF reanalysis (MACC database).

(iii) Exploit the sunglint signal for water roughness and surface wind speed evaluation from decameter-scale satellite imagery

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