



**HAL**  
open science

**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**

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

► **To cite this version:**

Tristan Harmel, Malik Chami, Thierry Tormos, Pierre-Alain Danis. 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. Third International Ocean Colour Science (IOCS) meeting, May 2017, Lisbon, Portugal. 2017, 10.13140/RG.2.2.13244.95369 . hal-02993024

**HAL Id: hal-02993024**

**<https://hal.inrae.fr/hal-02993024v1>**

Submitted on 6 Nov 2020

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/319395890>

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

Poster · May 2017

DOI: 10.13140/RG.2.2.13244.95369

CITATIONS

0

READS

800

5 authors, including:



**Tristan Harmel**

French National Centre for Scientific Research

54 PUBLICATIONS 522 CITATIONS

[SEE PROFILE](#)



**T. Tormos**

AFB (National Agency for the Biodiversity, France)

34 PUBLICATIONS 285 CITATIONS

[SEE PROFILE](#)



**Pierre-Alain Danis**

French Biodiversity Agency & National Research Institute of Science and Technolo...

56 PUBLICATIONS 636 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Bioindicators [View project](#)



New tools to improve knowledge of nutrients fluxes entering and outgoing lakes [View project](#)

# TELQUEL project :

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

<sup>1,2</sup>Tristan Harmel, <sup>3</sup>Malik Chami, <sup>4</sup>Thierry Tormos, <sup>1</sup>Nathalie Reynaud, <sup>4</sup>Pierre-Alain Danis

### 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  $\mu\text{m}$ ).

#### A few principles...

Top-of-atmosphere radiance (satellite measurements):

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

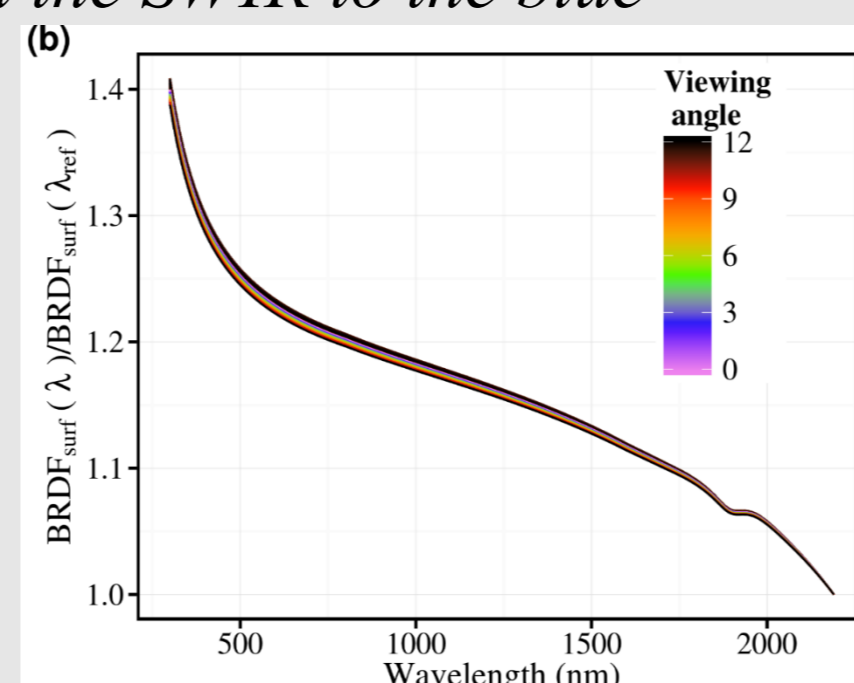
In SWIR ( $\lambda > 1.2 \mu\text{m}$ ): *Very small* *Virtually null*

Sunglint signal:

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

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



### Deglinting Algorithm

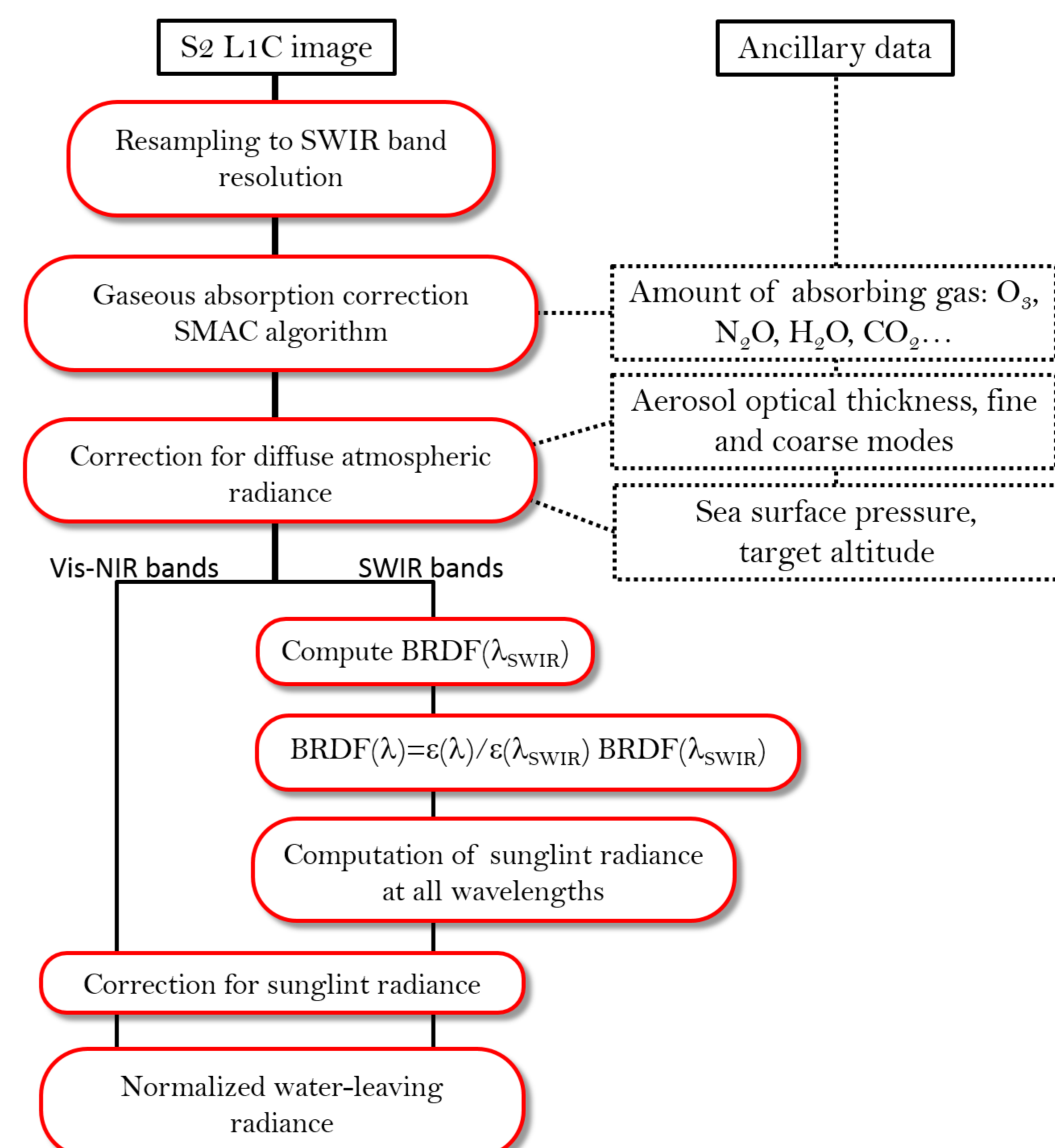
Atmospheric correction (AC) is based on precise radiative transfer computations (OSOAA, Chami et al., Opt. Express, 2015).

Ancillary data on aerosol optical thicknesses from the AERONET network.

Sunglint correction is achieved simultaneously to the AC step.

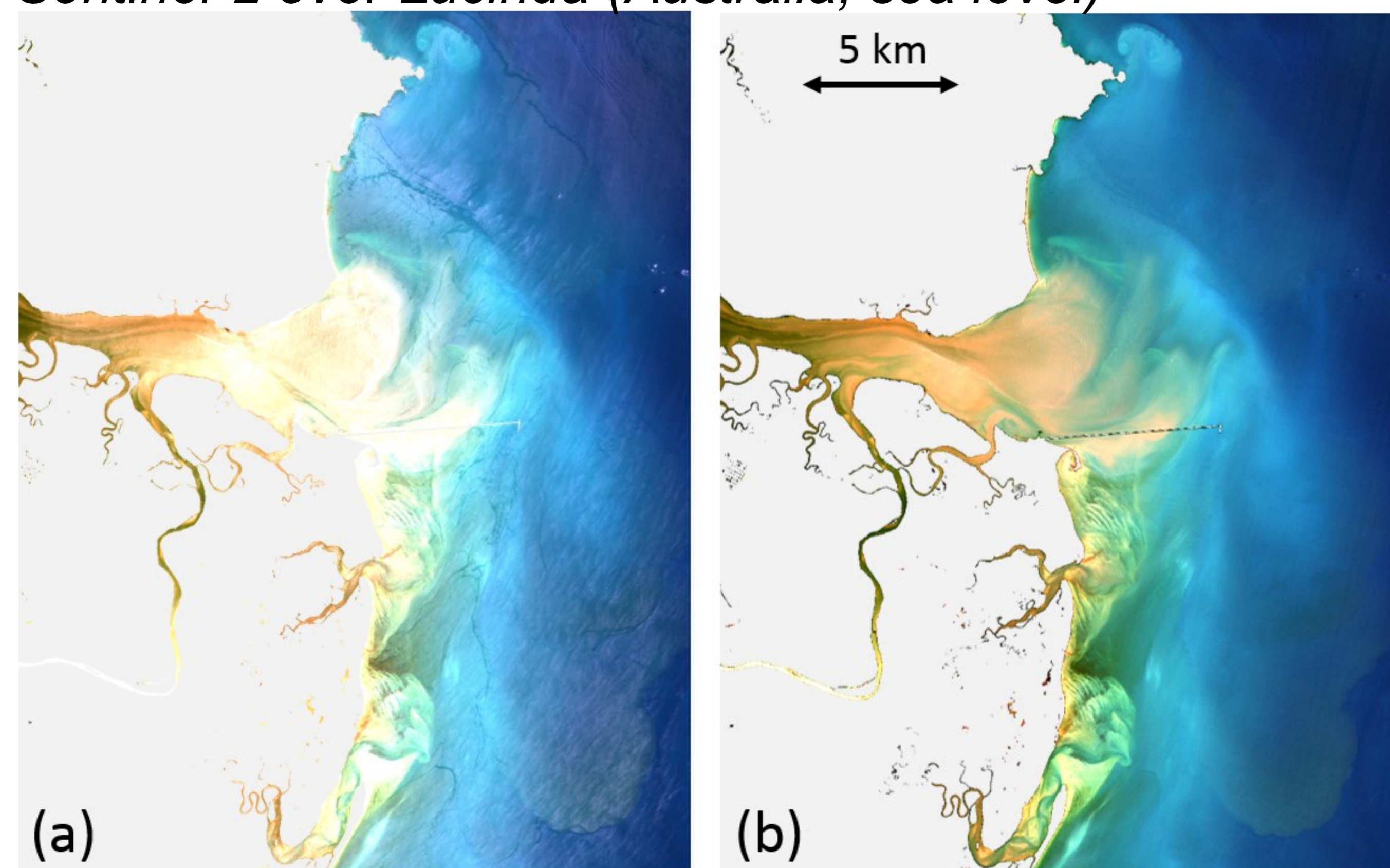
For a given pixel, the sunglint contribution is estimated from the shortwave-infrared (SWIR) part of the spectrum.

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

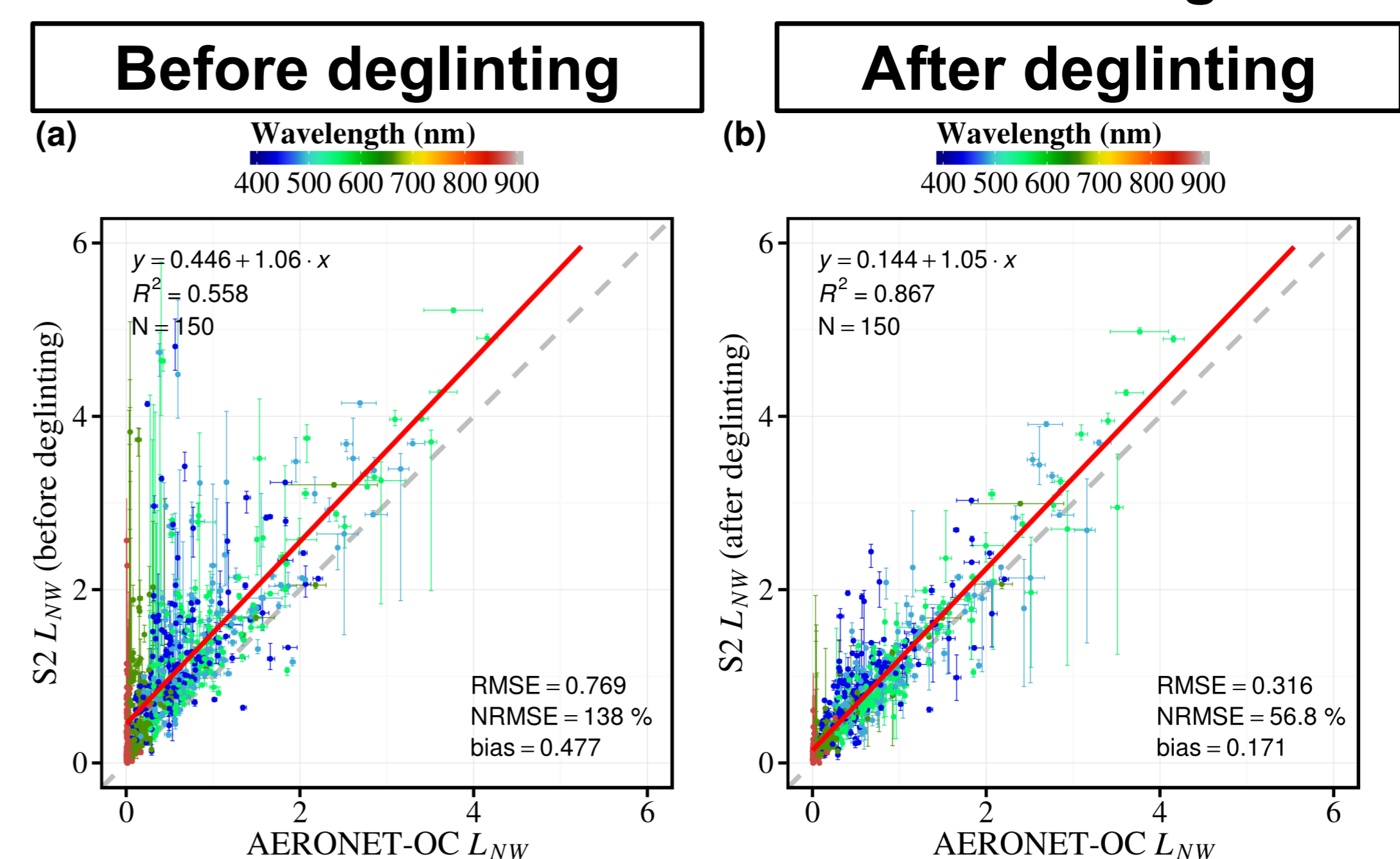


### Validation and performances

Sentinel-2 over Lucinda (Australia, sea level)



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.



Comparison with ground-based data (AERONET-OC) showed strong correlation between satellite and in situ data ( $R^2 \sim 0.9$ ).

### Perspectives

- 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).
- Couple the algorithm with aerosol retrievals and/or exogenous aerosol data such as that of the ECMWF reanalysis (MACC database).
- Exploit the sunglint signal for water roughness and surface wind speed evaluation from decameter-scale satellite imagery

#### Contacts :

Tristan Harmel; [harmel@obs-vlfr.fr](mailto:harmel@obs-vlfr.fr)  
Malik Chami; [malik.chami@upmc.fr](mailto:malik.chami@upmc.fr)  
Thierry Tormos; [thierry.tormos@afbioiversite.fr](mailto:thierry.tormos@afbioiversite.fr)  
Nathalie Reynaud; [nathalie.reynaud@irstea.fr](mailto:nathalie.reynaud@irstea.fr)  
Pierre-Alain Danis; [pierre-alain.danis@afbioiversite.fr](mailto:pierre-alain.danis@afbioiversite.fr)

#### Acknowledgements:

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