FINAL REPORT PROGRAM LEFE

Program LEFE/	GLIFI	Years 2022 – 2023
CYBER	GLIder dans un panache au sud de FIji : impact des apports par les fleuves en milieu tropical et modélisation petite échelle	

PI: Dupouy, cecile.dupouy@mio.osupytheas.fr,
Mediterranean Institute of Oceanography,

Participating Laboratories: IRD UAR IMAGO, University of the South Pacific, Scripps Institution of Oceanography, Helmholtz-Zentrum Hereon, ALSEAMAR Cie (Rousset)

Contribution to international programs : SEA EXPLORER Glider Program, MOU between IRD and University of the South Pacific, Fonds Pacifique, NEXOS (CE)

Other funding sources : IRD, CNFC, University of the South Pacific, Scripps Institution of Oceanography, Helmholtz-Zentrum Hereon, IRD UAR IMAGO

Context: The oceanic biogeochemical environments of tropical islands can be influenced by continental forcing as observed in the large Rewa River south of the main island of Viti Levu (Ganachaud et al., OSR6, 2022). The impact of continental plumes on phytoplankton microbial processes, i.e. carbon and nitrogen fluxes, fishery abundance or coral resources of the Southern Fijian archipelago is unknown.
Objectives / scientific questions: To determine the extent and nature of the river plume through acquisition of in situ and satellite optical and biological data in the South Fiji, and to measure the concentration and identify the patterns of dissolved organic and suspended matter due to terrigenous inputs (plume), or phytoplankton biomass through simultaneous satellite observations, in situ measurements of parameters and glider deployments.

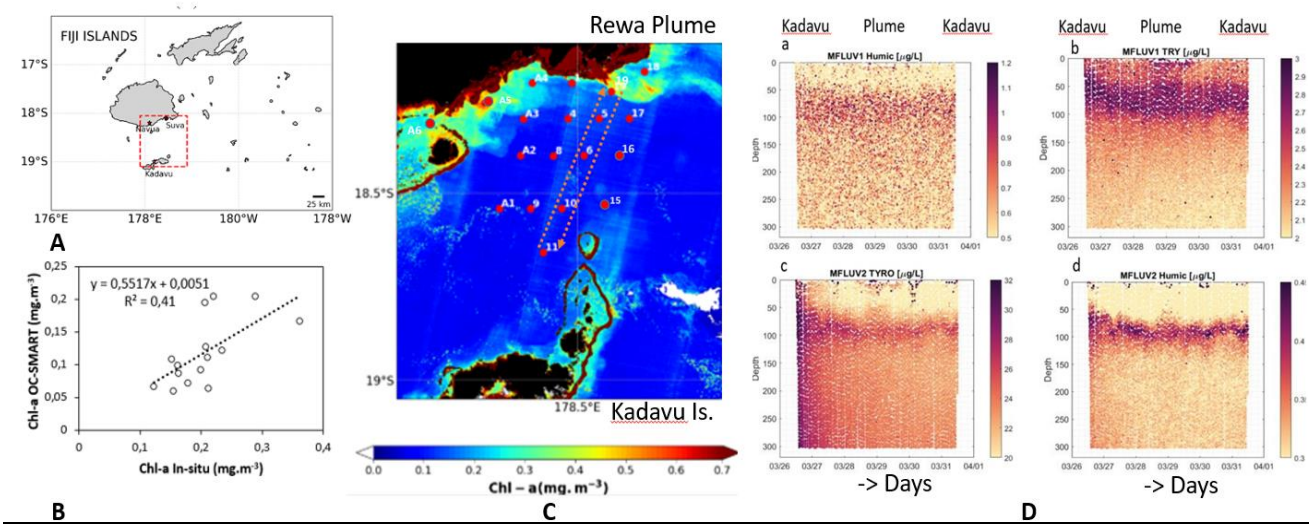

Figure 1ABCD: A) Situation map **B)** Regression between in situ and Sentinel 3 Chl-a concentration (mg.m^{-3}) on 29 March 2023 ; **C)** Clearest image from Sentinel 3 on 3 April 2022 (OC-SMART processing) with stations (red bullets) and cruise transect (yellow dashed lines) **D)** Back and forth sections of fluorophores obtained by the SeaExplorer glider mini-fluo sensors between the surface and 300 m isobath with the two main from the Mini-Fluo indicating inputs from the coastal plume in the centre of the section graph (March, Tuesday 29).

Main results: The SOKOWASA cruise south of the main island of Fiji (Figure 1A) allowed to sample coastal Chla-enrichments with a reduced plume issued from Laucala Bay (no rain in 2022). CTD/rosettes validated the satellite Chla data (Figure 1B, PhD Whiteside et al., 2023) south of Fiji, at stations indicated on the Sentinel 3 image (Figure 1B) at the northernmost station reached by the glider. Glider Wetlab Puck differentiates distributions of living particles (fluo), detritus (bb700) and CDOM. Minifluos (4 Ex/Em couples) discriminate different sources of DOM : humics (autochthonous), tyrosine (corals), and tryptophan (microbial). Marine humics (Fig. 1D a, d) show a significant signal at 100m depth in the DCM, indicating a strong autochthonous production. Tryptophan (Fig 1D b) shows similar pattern to chla: microbiological activity around the DCM and

the photic layer. Tyrosine (Fig.1D c) marks the area near Kadavu (Tyrosine-like is often related to the presence of coral reefs). The optical and biogeochemical measurements (DOC/DON, POC/PON, nutrients, HPLC pigments, flow cytometry, optics, carbon and nitrogen fluxes) as well as zooplankton biomass exhibits the typical tropical vertical structure of oligotrophic waters, and the reduced extension of the coastal plume formed by phytoplankton, as a consequence of the low rainfall during this period.
The GLIFI project demonstrates the feasibility of using the SEA003 Mini-Fluos and suggests that high-frequency deployments of sensor-equipped gliders would be a useful tool for better understanding the environment of lagoons and islands in the South Pacific (Fiji). Together, the sensors provide a fluorescence matrix that is characteristic of the DOM and allows the variability of DOM sources to be captured. Interestingly, the coupling of real-time satellite and glider observations allows the understanding of biogeochemical interactions between small and medium scale physical structures and biological functioning in South Fiji.

Future of the project : A second cruise during the rainy season, when a larger plume is expected, will record the change in biogeochemical functioning and compare it with the SOKOWASA cruise in March. Two forcings will be deciphered, i.e. the role of filamentous cyanobacteria or/and the anthropogenic impact on the ocean from Fiji largest city.

Number of publications, communications and theses

- 3 Peer-reviewed articles
- 1 PhD these
- 1 L3 report

Communications

- NC 1ere, Caledonia TV: https://nuage.osupytheas.fr/s/DemTHkX7krbtPP9
- TV Caledonia: Musee Maritime film of the conference (23th April 2022) https://www.youtube.com/watch?v=VIe6qAWwynE
- IRD Noumea web site: https://en.ird.fr/node/11454
- Sokowasa presentation at the UIBergen workshop, Suva, July 2022, https://www.usp.ac.fj/news/uib-usp-climate-workshop-fosters-knowledge-and-information-sharing/
- Sokowasa oceanographic research results presentation organized by the French Embassy at Alliance Française, Suva, November 2023 https://fj.ambafrance.org/Conference-The-Hidden-Face-of-the-Ocean-par-Mme
- 2 oral presentations at the two GIS-RS meetings, November 2022 & 2023, Suva, Fiji
- 1 oral presentation at the National glider meeting, Marseille, January 2024.

1- Ganachaud, A., Von Schuckmann, K., Whiteside, A., Dupouy, C., et al., 2022. CMEMS SST and Chl-a indicators for two Pacific Islands : a co-construction monitoring framework for an integrated, transdisciplinary, multi-scale approach, 2022. Copernicus Ocean State Report, issue 6, Journal of Operational Oceanography, 15:sup1, 1-220, DOI: 10.1080/1755876X.2022.2095169- Chapter 2.3. DOI : 10.3390/rs14040836.

2- Whiteside, A.; Dupouy, C.; Singh, A.; Frouin, R.; Menkes, C.; Lefèvre, J. Automatic Detection of Optical Signatures within and around Floating Tonga-Fiji Pumice Rafts Using MODIS, VIIRS, and OLCI Satellite Sensors. Remote Sens. 2021, 13, 501. https://doi.org/10.3390/rs13030501.

3- Dupouy, C.; Whiteside, A.; Tan, J.; Wattelez, G.; Murakami, H.; Andréoli, R.; Lefèvre, J.; Röttgers, R.; Singh, A.; Frouin, R. A Review of Ocean Color Algorithms to Detect *Trichodesmium* Oceanic Blooms and Quantify Chlorophyll Concentration in Shallow Coral Lagoons of South Pacific Archipelagos. *Remote Sens*. 2023, 15, 5194.https://doi.org/10.3390/rs15215194

PhD : Whiteside, A., 2023. Remote Sensing of Ocean Color in the Fiji-Tonga region: Analyzing optical signatures of coastal runoff and volcanic eruptions and their influence on chlorophyll concentration (phytoplankton), Aix-Marseille University, ED251, 7 November 2023, Suva (University of the South Pacific (Fiji), 145 p.

L3 : Boussaye, E. J., 2023. Distribution des abondances de Zooplancton aux Îles Fidji lors de la campagne SOKOWASA (mars 2022), 3ème année de Licence SVT parcours Mer, A.M.U.

Data availability

- SeaExplorer data sea003m352 GDAC CORIOLIS including MiniFluos data
- In situ Data archiving in the SISMER database (in progress).