Dynamics of colored dissolved organic matter in Pacific Islands: an application of ocean color remote sensing.

Koliyavu, T. [1], Martias, C. [2,*], Singh, A.[1], Lefèvre, J. [3,*], Lal, S. [1], Wattelez, G. [2,*], Douillet, P. [1,*], Tedetti, M. [1], Holland[1], E., Fichez, R.[2], Dupouy, C. [1,*]

[1] PACE-SD, Pacific Centre for Environment and Sustainable Development, The University of the South Pacific, Laucala Campus, Suva, FIJI
[2] Aix-Marseille Univ., Toulon Univ., CNRS, IRD, Mediterranean Institute of Oceanography (MIO), UM 110, 13288, Marseille, Cedex 09, France, cecile.dupouy@ird.fr
[3] LEGOS, 31000, Toulouse, FRANCE
[4] Department of Oceanography, University of Hawaii at Manoa, Hawaii, USA.
*IRD, Centre of Noumea, BP A5, 98848 New Caledonia
Email : koliyavu@yahoo.com

All Pacific countries are vulnerable to climate change, which modify the equilibrium in the biogeochemistry of coastal waters. Health of the coastal waters is a crucial challenge for economies of PICS (coral reef sustainability, fisheries). Ocean color remote sensing is a critical tool for determining coastal health over large spatial domains, which is becoming even more effective when improved by in situ observations and survey cruises (Dupouy et al., 2014). Studies of CDOM are scarce in tropical environments (Tedetti et al., 2011; 2016). The study focuses on the description of CDOM transfers from rivers to reef and onto open ocean, including the spatial distribution; and identifying the sources as anthropogenic or natural just as it was done in New Caledonia (Carstea, 2012; Ferretto et al., 2017; Martias et al., 2017; 2018). The goal is to combine ocean color satellite data and CDOM in situ measurements in a variety of tropical lagoons to establish the usefulness of CDOM (Lefèvre, 2010). In order to establish the credibility of satellite imagery, we will compare high temporal resolution in situ optical data with satellite analyses.

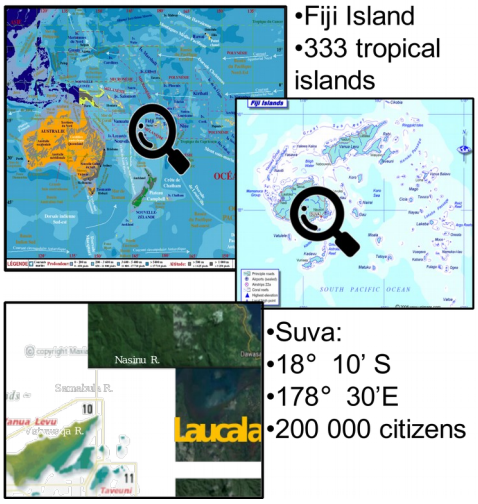

Figure 1. Zone of study in the South Pacific Ocean.

The first CDOM distributions were obtained in Laucala Bay in 2015-2017 complementing MES, nutrients, and Chla distributions which complement the first BULA IRD cruises (2000-2004, Fichez et al., 2005). The optical fingerprints of terrestrial inputs from 2 different river systems (Vatuwaqa River and the Kinoya Sewage Treatment), on the western coast, and from the Rewa river (Dupouy et al., 2017). Impact of terrestrial inputs extending far southward can be documented from MODIS satellite images (Wattelez et al., 2016; 2017).

CDOM and FDOM measurements provided the optical fingerprint and the MODIS images were able to document the spatial impact of terrestrial inputs. The combination made an effective tool to understand the coastal interface in Laucala Bay, Fiji.

The objectives of the study are to characterize and relate Chla, MES, CDOM distributions to nutrients and flow cytometry, TOC, particulate absorption coefficients, reflectance (TRIOS) from surveys in Laucala Bay and Ba Rivers). Spectrofluorescence data will allow to identify pollution sources, by PARAFAC analyses of fluorophores. These data will help in validating modelling of CDOM as a passive tracer in Laucala Bay (YDROLAG, Fonds Pacifique

Funding 2018) with 3D hydrodynamical models. Retrieving CDOM distributions with dedicated algorithms for Sentinel 3 (COMETE, Fonds Pacifique Funding 2018), in the frame of the USP PHD project 'Color plumes around the Islands of Fiji', 2017-2019, will allow the linkage of CDOM distribution with ocean color and spectrofluorescence indications.

Carstea, E.M., Bridgeman, J., Baker, A., Reynolds, D.M.. Fluorescence spectroscopy for wastewater monitoring: a review. *Water Res*. 2016, 95, 205-219

Dupouy, C., Röttgers, R., Tedetti, M., Martias, C., Murakami, H., Doxaran, D., Lantoine, F., Rodier, M., Favareto, L., Kampel, M., Goutx, M., Frouin, R., 2014. Influence of CDOM and Particle Composition on Ocean Color of the Eastern New Caledonia Lagoon during the CALIOPE Cruises, Proc. of SPIE Vol. 9261, 92610M • © 2014 SPIE. Hirose K., Metal-organic matter interaction: ecological roles of ligands in oceanic DOM. *Appl Geochem.* 2007; 22:1636-45

Dupouy, C., Martias, C., Singh, A., Koliyavu, T., Wattelez, G., Lal, S. , Douillet, P., Tedetti, M., Lefèvre, J. , E. Holland, 2017. Dynamics of colored dissolved organic matter in Pacific Islands: an application of ocean color remote sensing. International Ocean Colour Symposium, 15-19 mai, Lisbonne, Portugal.

Ferretto, N., Tedetti, M., Guigue, C., Mounier, S., Raimbault, P., Mounier, S., Goutx, M., 2017. Spatio-temporal variability of fluorescent dissolved organic matter in the Rhône River delta and the Fos-Marseille marine area (NW Mediterranean Sea, France). *Environmental Science and Pollution Research*, 24, 5 4973–4989.

Fichez, R., Adjeroud, M., Bozec, Y.M., Breau, L., Chancerelle, Y., Chevillon, C., Douillet, P., Fernandez, J.M., Frouin, P., Kulbicki, M., Moreton, B., Ouillon, S., Payri, C., Perez, T., Sasal P., Thébault, J., 2005. Selected indicators of particles, nutrients and metals inputs in coral reef lagoon systems. *Aquat Living Resour* 18: 125-147.

Martias, C., Tedetti M., Jamet L., Goutx M., Dupouy, C., 2017. Spatial distribution of chromophoric dissolved organic matter and trace metals in the New Caledonia tropical lagoon (South Pacific Ocean), ASLO meeting, Session 12, Hawaii, Poster February 2017.

Martias, C., Tedetti M., Jamet L., Dupouy, C., 2018. Spatial distribution of chromophoric dissolved organic matter and trace metals in the New Caledonia tropical lagoon (South Pacific Ocean), S*cience of the Total Environment*, 616-617, 438-452.

Murphy, K. R. Distinguishing between terrestrial and autochthonous organic matter sources in marine environments using fluorescence spectroscopy. *Marine Chemistry*, 2008, *108*(1–2), 40–58.

Tedetti et al., 2011. Characterization of dissolved organic matter in a coral reef ecosystem subjected to anthropogenic pressures (La Réunion Island, Indian Ocean) using multi-dimensional fluorescence spectroscopy. *Science of the Total Environment*, 2011, 409(11), 2198–2210.

Tedetti, M., Longhitano, R., Garcia, N., Guigue, C., Ferretto, N., and Goutx, M.: Fluorescence properties of dissolved organic matter in coastal Mediterranean waters influenced by a municipal sewage effluent (Bay of Marseilles, France), *Environ. Chem*., 9, 438–449, 2012.

Tedetti M., Marie L., Röttgers R., Rodier M., Van Wambeke F., Helias S., Caffin M., Cornet-Barthaux V., Dupouy C, 2016. Evolution of dissolved and particulate chromophoric materials during the VAHINE mesocosm experiment in the New Caledonian coral lagoon (south-west Pacific). *Biogeosciences*, 13, p. 3283-3303.

Wattelez, G., Dupouy, C., Mangeas, M., Lefèvre, J., Touraivane, Frouin, R., 2016. A statistical algorithm for estimating chlorophyll concentration in the New Caledonian lagoon, *Remote Sens*. 8(1), 45; doi:10.3390/rs8010045.

Wattelez, G., Dupouy, C., Juillot, F., Fernandez, J.M., Lefèvre, J., Ouillon, S., 2017. Remotely-sensed assessment of turbidity with MODIS in the oligotrophic lagoon of Voh-Koné-Pouembout area, New Caledonia, *Water*, 9, 737.