

One year survey of CO₂ fluxes from sediments and water column in mangrove ecosystem (New Caledonia)

A. Léopold^{1,2}, C. Marchand², J. Deborde³ & M. Allenbach¹

¹EA 3325, Université de la Nouvelle-Calédonie, Nouméa, New Caledonia. E-mail: audrev.leopold@univ-nc.nc

²Institut de Recherche pour le Développement (IRD), UR 206/UMR 7590 IMPMC, Nouméa, New Caledonia.

³CNRS, EPOC, UMR 5805, Université de Bordeaux, F-33400 Talence, France.

Abstract

Mangrove swamps are a highly productive ecosystem, which may impact global carbon cycling. Mangrove productivity reaches up to $218 \pm 72 \text{ TgC.yr}^{-1}$ but uncertainties remain on its fate (Bouillon et al., 2008). These authors have shown that known and quantified organic carbon sinks, i.e. export, burial and mineralization, only accounted for less than 50% of the estimated net primary production. Some pathways were, thus, suggested to be underestimated. Mineralization may be one of those because of data scarcity. The main purposes of our study are to quantify and to understand the spatio-temporal variability of CO₂ fluxes at both sediment-air and water-air interfaces; CO₂ fluxes being used as a proxy for organic carbon mineralization. To reach our goals, CO₂ fluxes, as well as physico-chemical characteristics of sediments and water, were measured regularly during more than one year, in a mangrove of New-Caledonia that presents a typical zonation of the ecosystem in this country. Concerning fluxes at the sediment-air interface, measurements were done using both transparent and opaque chambers, connected to an InfraRed Gaz Analyzer (IRGA), in four mangrove areas: salt-flat, *Salicornia*, *Avicennia* and *Rhizophora* stands. On the La Foa River, which crosses the studied mangrove, fluxes were determined using a floating chamber, also connected to an IRGA, according to an upstream-downstream transect. Our results suggest that throughout the year, sediments and river are a CO₂ net source for the atmosphere ($57.45 \pm 29.9 \text{ mmolC.m}^{-2}.\text{d}^{-1}$ and $180.7 \pm 186.4 \text{ mmolC.m}^{-2}.\text{d}^{-1}$, respectively). However, a very high variability has been observed at both interfaces. Tides, water quality, and climatic conditions seem to control air-water CO₂ fluxes, while organic carbon and water contents of sediments, as well as, the presence of a biofilm at sediment surface seem to be key parameters. Considering the quantity of parameters that may influence CO₂ fluxes, quantitative studies are still necessary to improve mangrove carbon budget.

Keywords

greenhouse gas, biogeochemistry, climate change