Laboratoire International Associé

CNRS International Research Project

FRANCE - BRASIL

« Vulnerability of tropical littoral Ecosystems to eutrophication »

2020-2024

Gwenaël Abril

Biologie des organismes et des écosystèmes aquatiques CNRS, Muséum National d'Histoire Naturelle, Paris, France

Bastiaan A. Knoppers

Programa pós-graduação em Geoquímica, Universidade Federal Fluminense, Niterói, Brasil

Aguinaldo Marques Jr

Programa de Biologia Marinha e Ambientes Costeiros, Universidade Federal Fluminense, Niterói, Brasil

Historique du partenariat

2007-2013 : Projet CARBAMA: Cycle du CARBone et échanges atmosphériques dans le Fleuve AMAzone et ses plaines d'inondation. (G. Abril, T. Meziane, C. Hubas)

2013-2016 : Projet CO2CO: Cycle du carbone et flux de CO2 dans les écosystèmes côtiers brésiliens. Bourse G. Abril « science sans frontière » du CNPq

2016-2018 : Accueil de G. Abril à l'IRD affecté à l'UFF dans le cadre du volet « impacts sur le littoral » du LMI-IRD PALEOTRACES.

2016-2020 : Projet Mangrove FAPERJ et CNPq; Projet lagune hypersaline FAPERJ

2014-... : G. Abril professeur associé à l'UFF, programme de Géochimie depuis 2014 et programme de Biologie Marine depuis 2018 (60 heures/an)

2019-2020 : Chaire du consulat général de France à Rio de Janeiro à l'UERJ

6 thèses co-encadrées soutenues (5 BR – 1 FR), 4 en cours (BR)
3 masters co-encadrés (2 BR – 1 FR)

17 publications co-signées (4 chercheurs FR et 7 chercheurs BR)

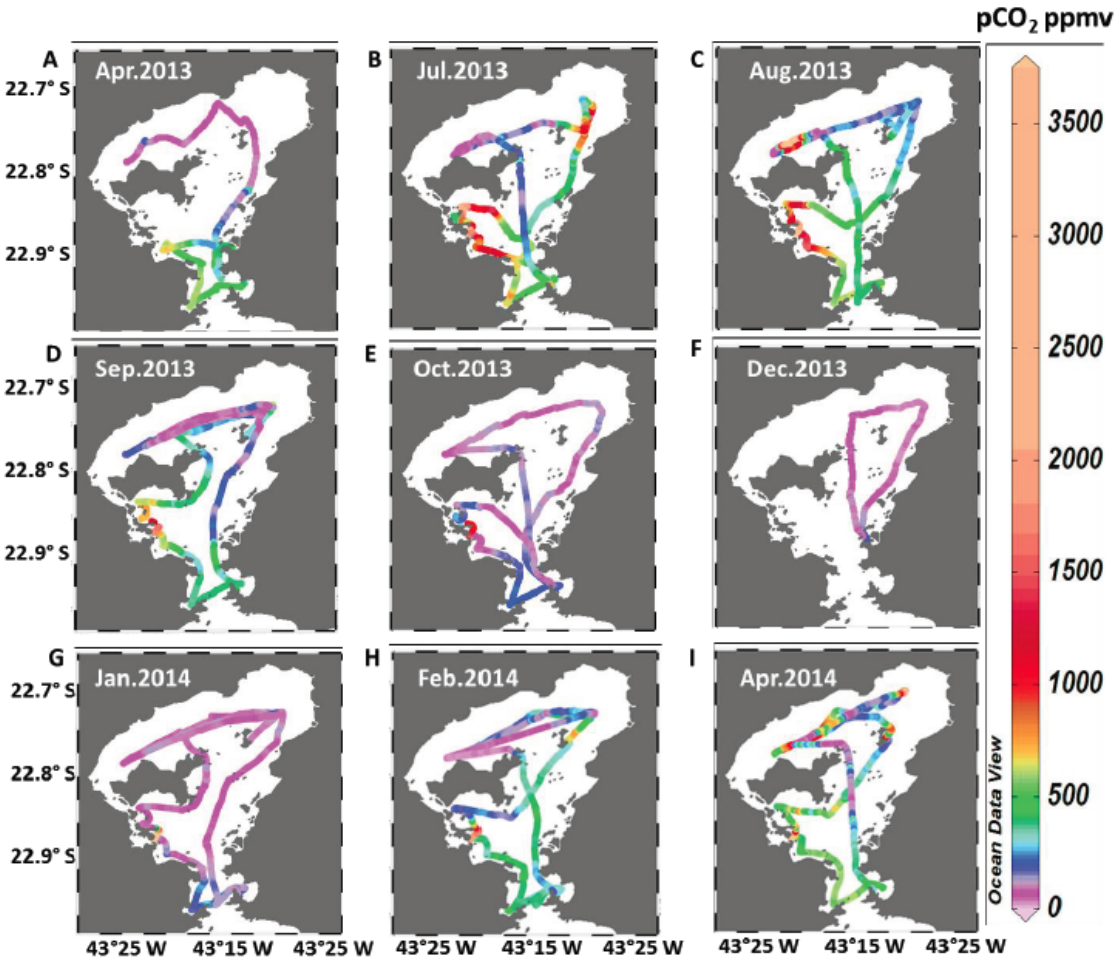
Co-organisation de sessions thématiques : AGU 2010 Foz do Iguaçu, Brésil; ORE HYBAM 2011, Lima, Pérou; Colloque franco-brésilien sur les Sciences de la mer 2013, Buzios, Brésil; ASLO 2015, Grenade, Espagne.

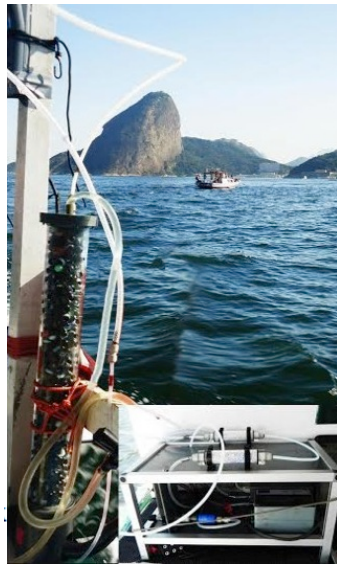
Biogeosciences, 12, 6125–6146, 2015
www.biogeosciences.net/12/6125/2015/
doi:10.5194/bg-12-6125-2015

Biogeosciences Open Access EGU

A strong CO_2 sink enhanced by eutrophication in a tropical coastal embayment (Guanabara Bay, Rio de Janeiro, Brazil)

L. C. Cotovicz Jr.[1,2], B. A. Knoppers[1], N. Brandini[1], S. J. Costa Santos[1], and G. Abril[1,2]

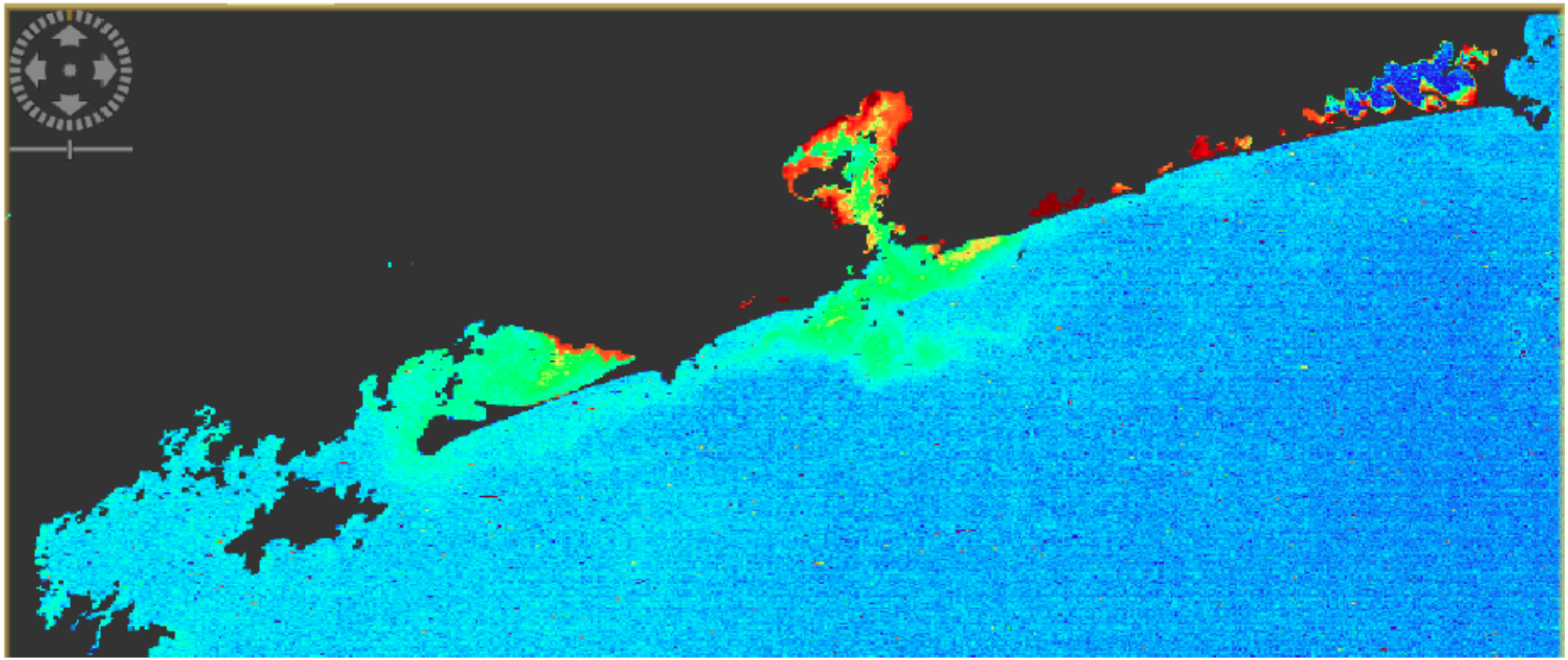




The Coastal zone in the tropics

A mosaic of ecosystems:

Mangroves
Shallow coastal lagoons (sometimes hypersaline)
Embayments (generally densely populated)
Large rivers plumes on the continental shelf (impacted by damming)
Continental shelf with coral reefs and other calcifying communities coralline algae



The multiples impacts on the Brazilian littoral

- Global change
  - Global temperature increase
  - Ocean acidification
  - Sea level rise
  - Increasing droughts
- Land and water use
  - Hydroelectric reservoirs
  - Mangrove deforestation
  - Aquaculture
  - Urban concentration

Salinization
Reduced sediments loads
Loss of fertility

Eutrophication

Synergic impacts

« **VELITROP** »

Vulnerability of littoral tropical Ecosystems to eutrophication

2020-2024

Theme 1: Propagation of eutrophication at the land-sea interface

Theme 2: Vulnerability of mangrove blue carbon to eutrophication

Theme 3: Microbiology, carbonate chemistry and bio-calcification in hyper-saline lagoons

Social and educative actions and participative sciences

The state of Rio de Janeiro (16 Mhab) is used as a representative site in order to study the key mechanisms of eutrophication at different spatial and temporal scales

+ Comparison with macrotidal sites in Nordeste (Ceará)

Modifications of biological communities and biogeochemical fluxes from the upstream limit of the tide to the shelf break at decadal to century scales.

LIA CNRS INEE (INSU)

VELITROP

Vulnerability of littoral tropical Ecosystems to eutrophication

BOREA Museum National d'Histoire Naturelle
FRE CNRS 2030
Gwenaël Abril, DR CNRS
Tarik Meziane, Pr MNHN
Cédric Hubas, MC MNHN
Dominique Lamy, MC SU
Frédéric Olivier, PR MNHN
Claire Lazareth, CR IRD
Eric Goberville, MC SU

LPG-BIAF Université d'Angers
UMR CNRS 6112
Emmanuelle Geslin, PR U. Angers
Edouard Metzger, MC U. Angers
Aurelia Mouret, MC U. Angers

LOG Université du Littoral Côte d'Opale – Université de Lille – UMR CNRS 8187
Vincent Vantrepotte, CR CNRS

Universidade Federal Fluminense
Programa de pós-graduação em Geoquímica
Prof. Bastiaan Knoppers *CNPq 1D*
Profa. Catia Barbosa
Prof. Marcelo Bernardes *CNPq 2*
Prof. Wilson Machado *CNPq 2*
Prof Humberto Marotta *CNPq 2*
Profa. Kita Macario *CNPq 1D*

Programa de pós-graduação em Biologia Marinha
Prof. Aguinaldo Marques Jr
Prof. Fernando Lamego

Universidade Do Estado do Rio de Janeiro
Faculdade de Oceanografia
Prof. Eduardo Negri
Prof. Alexandre Macedo Fernandes
Profa. Gleyci A.O. Moser

Universidade Federal do Ceará
Instituto de Ciências do Mar – Labomar
Prof. Visitante Luiz Carlos Cotovicz Jr
Profa. Rozane Marins CNPq 1D
Prof. Luis Drude Lacerda CNPq 1A

Pesquisa em parceria....

LIA CNRS INEE (INSU)

VELITROP

Vulnerability of littoral tropical Ecosystems to eutrophication

Gwenaël Abril – Carbon Cycle, ecosystem metabolism, carbonate chemistry, greenhouse gas emissions, stable isotopes, coupled biogeochemical models.

Tarik Meziane – Sources and transformations of organic matter, trophic fluxes, fatty acids, stable isotopes, mangroves.

Cédric Hubas – Microbial Ecology of biofilms, exo-enzymatic activity, exudation products, 13C spiking, hypersaline microbial ecosystems**.**

Dominique Lamy – Prokaryotes, organic matter degradation, enzymatic activity, priming effect.

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VELITROP

Vulnerability of littoral tropical Ecosystems to eutrophication

Eric Goberville – Plankton Ecology, zooplankton, bio-indicators, global databases analysis

Claire Lazareth – Environmental changes, biocarbonate archives, geochemistry, sclerochronology.

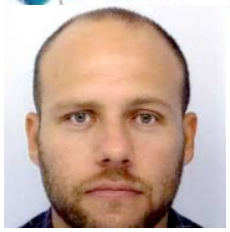
Frédéric Olivier – Marine benthic ecology, trophic ecology, sclerochronology, Functioning of benthic ecosystems, anthropogenic pressures.

Doctorant X – Vulnerability of mangrove blue carbon to coastal eutrophication. Bourse Fondation Total. 100% LIA.

LIA CNRS INEE (INSU)

VELITROP

Vulnerability of littoral tropical Ecosystems to eutrophication



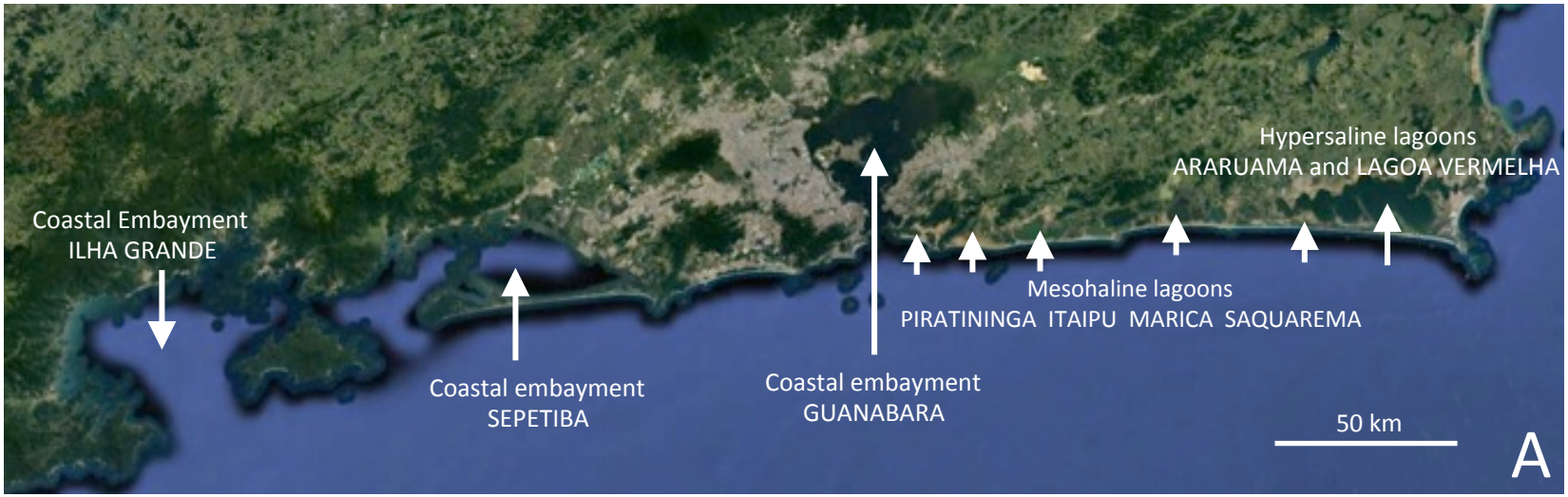
Edouard Metzger – Benthic Geochemistry, High resolution diagenetic profiles, modelling, mangrove, coastal lagoons.

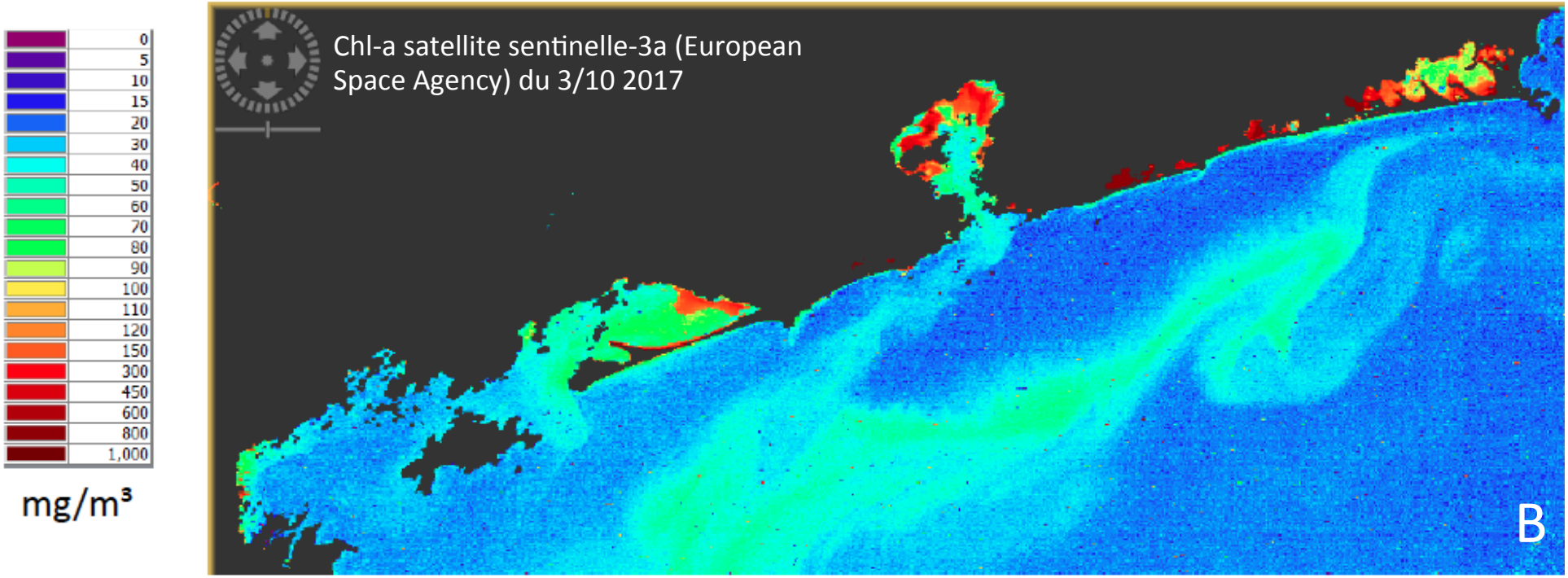
Emmanuelle Geslin – Ecology of benthic foraminifera.

Aurelia Mouret – Benthic Geochemistry, Phosphorus speciation, diagenesis, mangrove

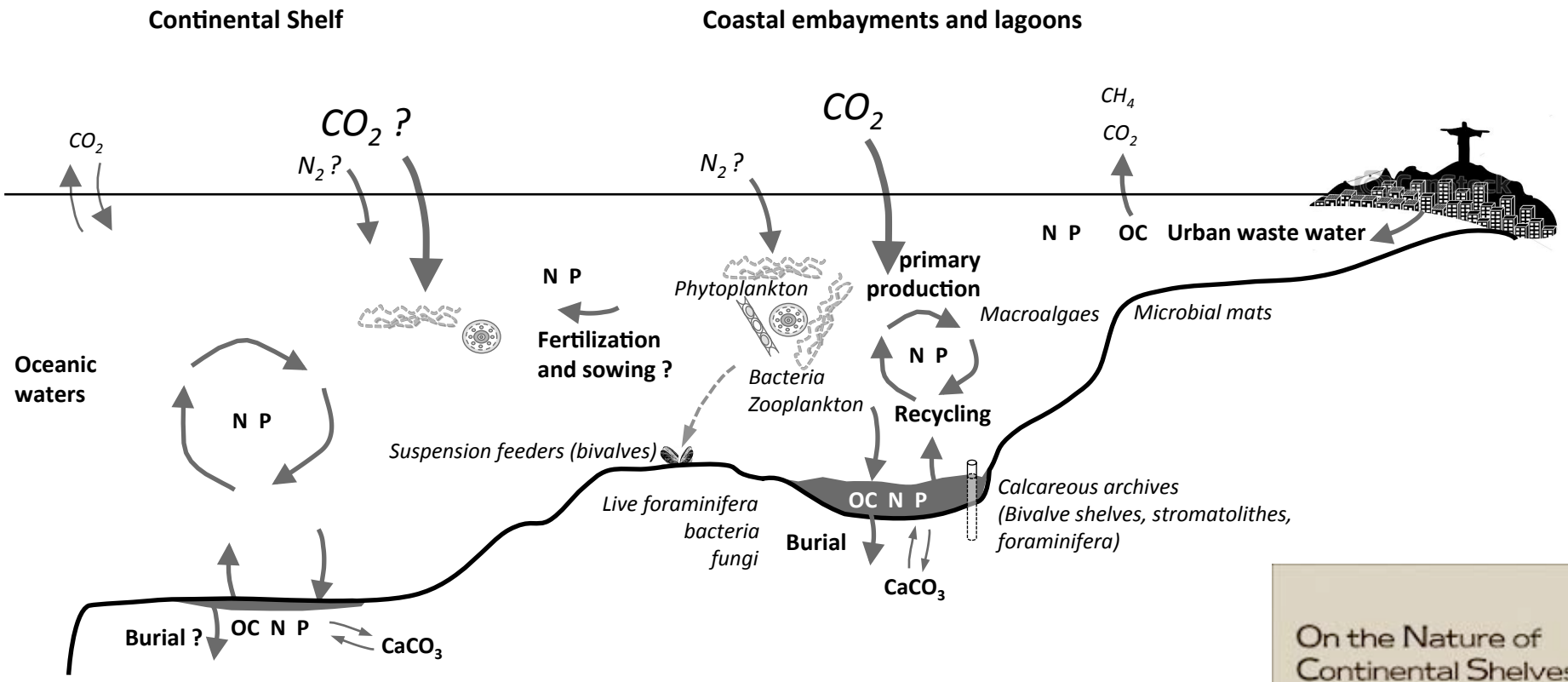
Vincent Vantrepotte – Marine optics, coloured dissolved organic matter, remote sensing, tropical coastal zone.

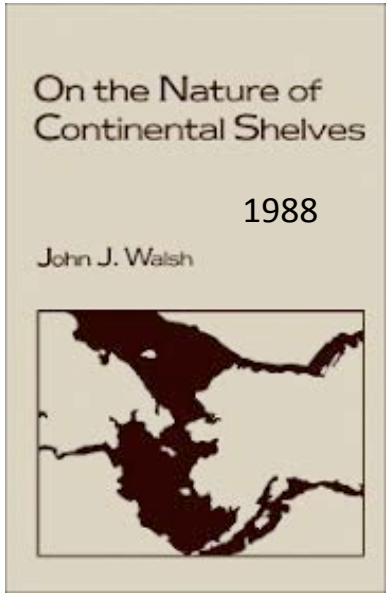
Theme 1: Propagation of eutrophication at the land-sea interface



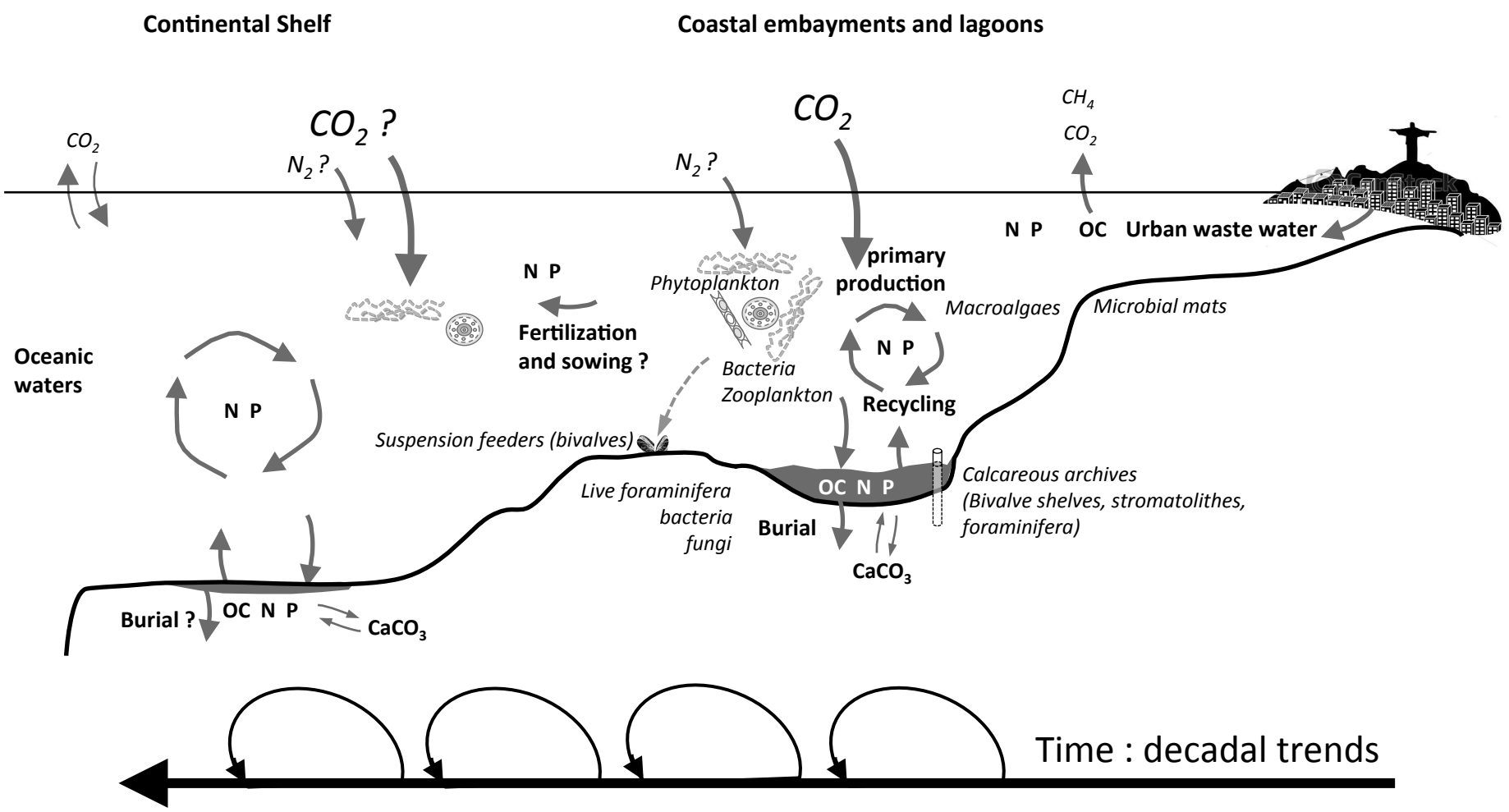


Theme 1: Propagation of eutrophication at the land-sea interface





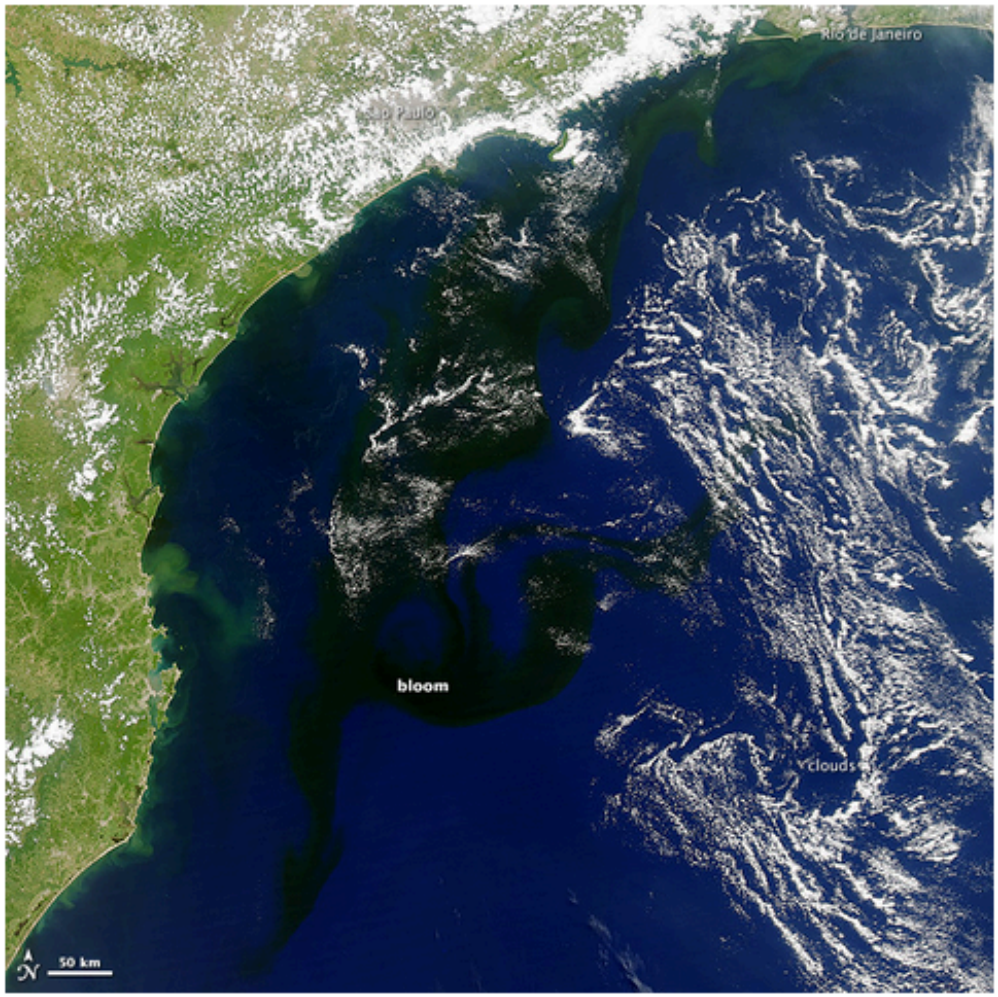
Theme 1: Propagation of eutrophication at the land-sea interface



Global Maps Articles Blogs

NASA earth observatory

A Dark Bloom in the South Atlantic



January 19, 2014 JPEG

Myrionecta rubra

Eucaryote kleptoplaste

Theme 1: Propagation of eutrophication at the land-sea interface

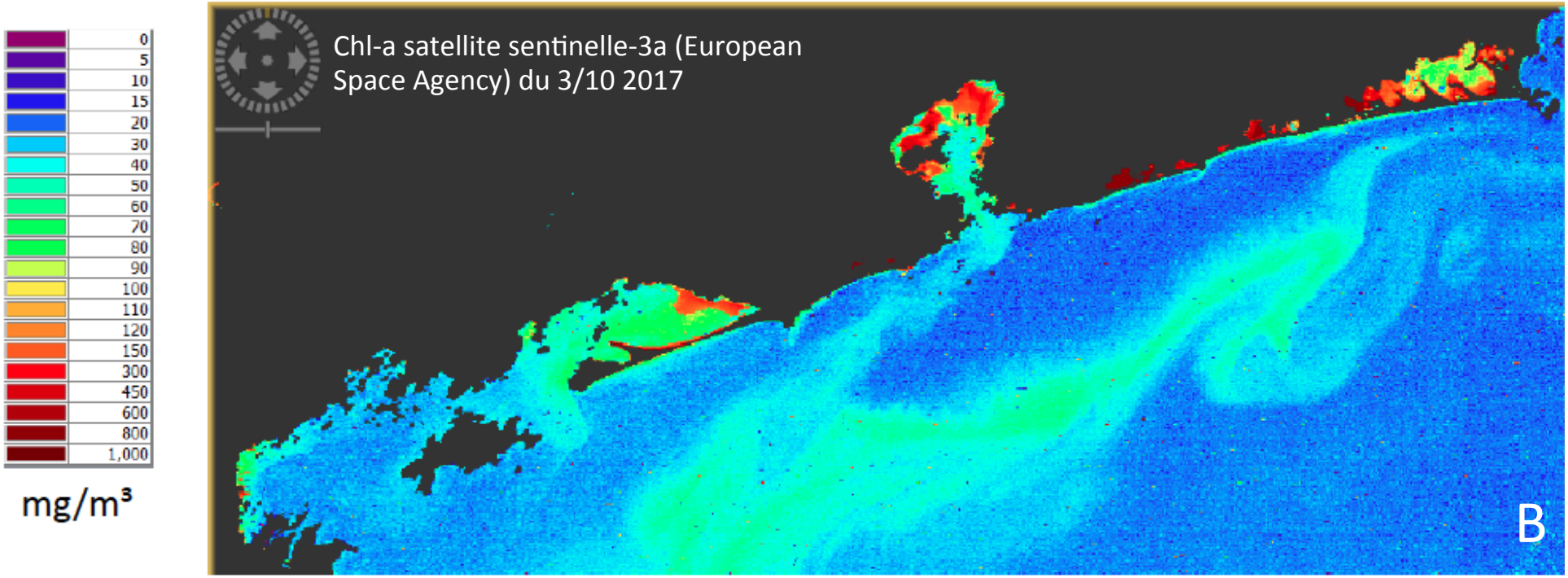
Bio-monitoring of eutrophication using bivalves

Cheap and easy sampling

Soft tissues:
Response to food resource
Fatty acids, ^{13}C et ^{15}N

Shells:
Response to water physico-chemistry: salinity, temperature, carbonate system, pH...?
Ca, Mg, ^{13}C , ^{18}O, D, Ba...

Theme 2: Vulnerability of mangrove blue carbon to eutrophication

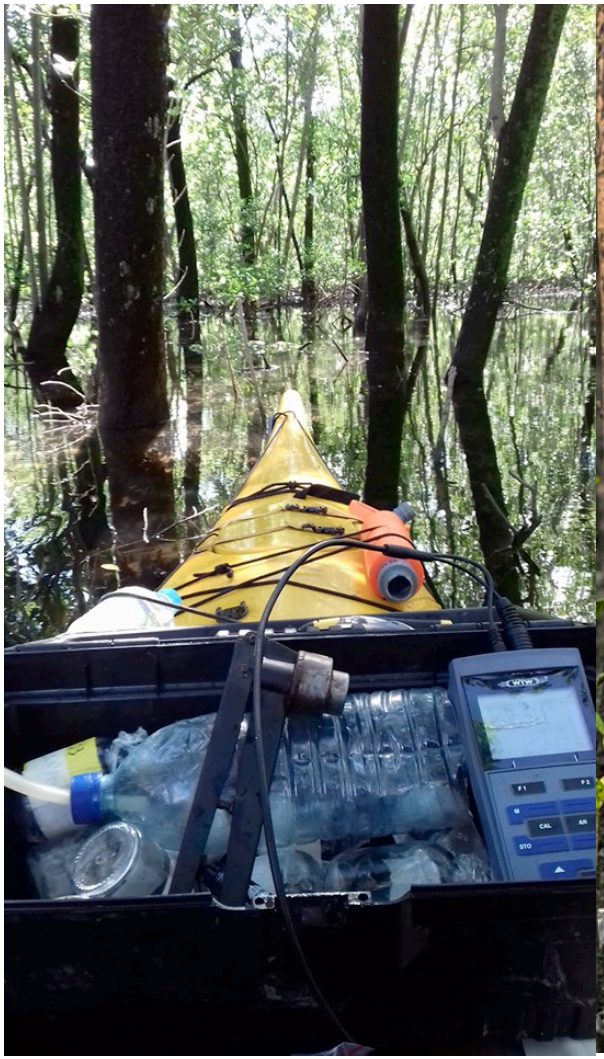


Theme 2: Vulnerability of mangrove blue carbon to eutrophication

Carbon Stock in Mangroves at the global scale = about 8-10 PgC

Brazil = second country for Mangrove extension

What happens when phytoplankton material is deposited on mangrove soils?

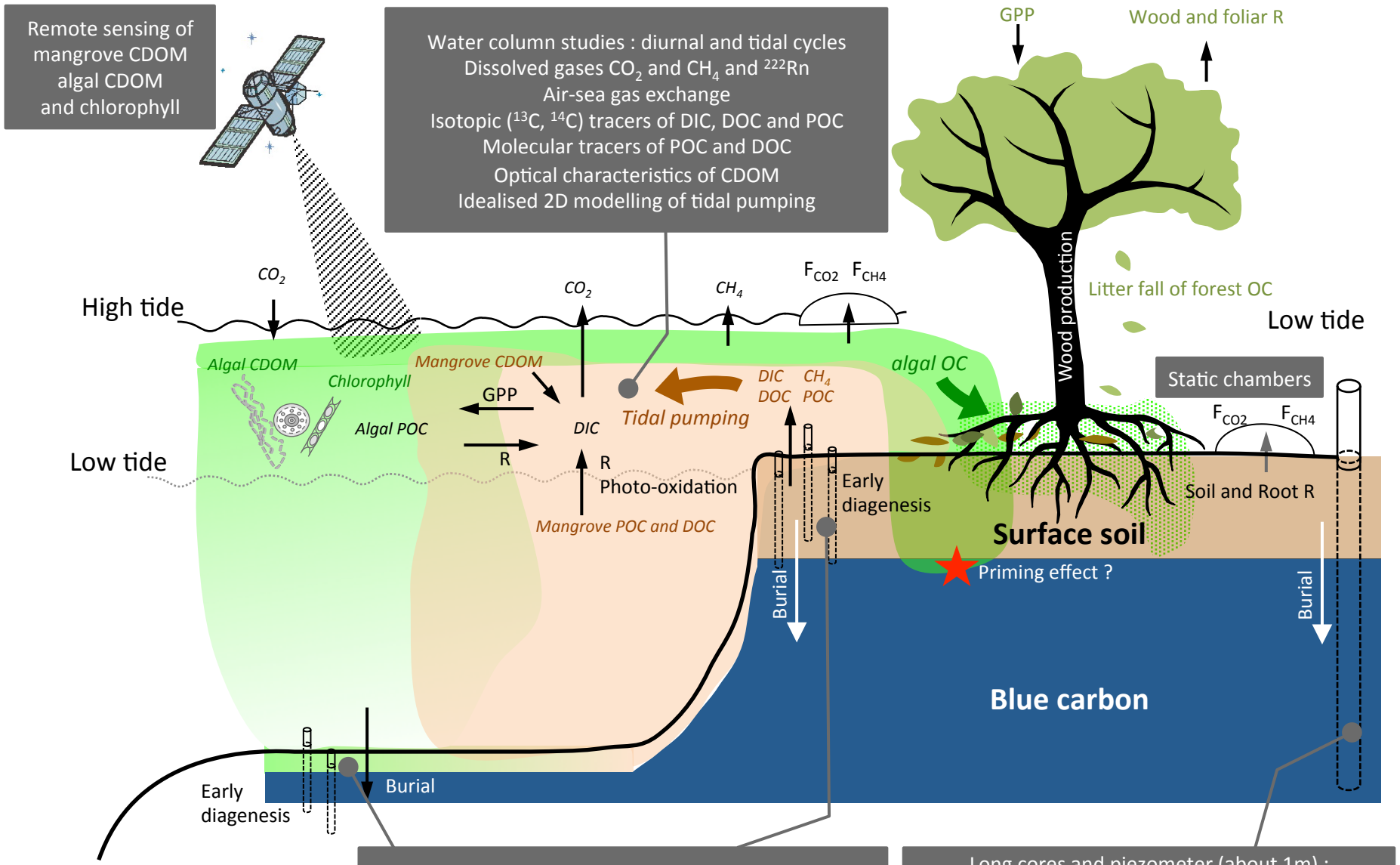


Field work in Saco de Mamangua

Avicennia and Rizophora spp.

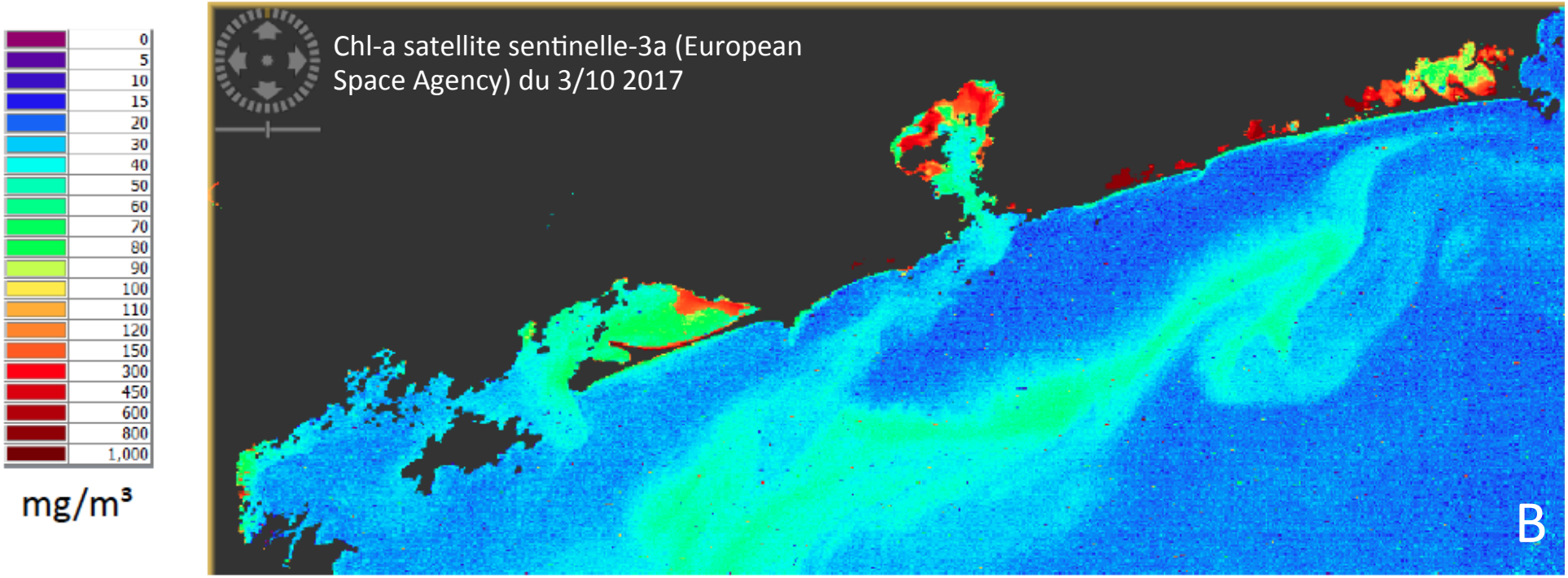
Continental Shelf - Coastal Bays - Tidal Creeks

Mangroves



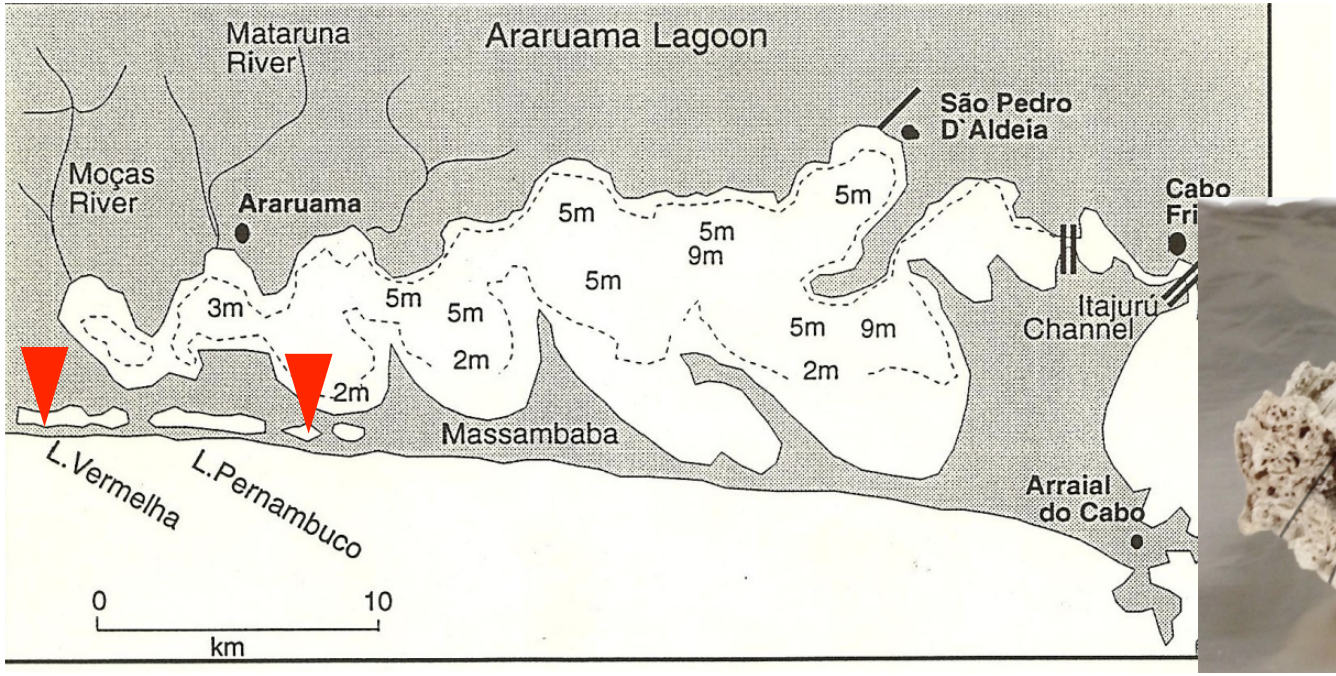
Projet VuBleu
LEFE-INSU 2019-2020

Theme 3: Microbiology, carbonate chemistry and bio-calcification in hypersaline lagoons

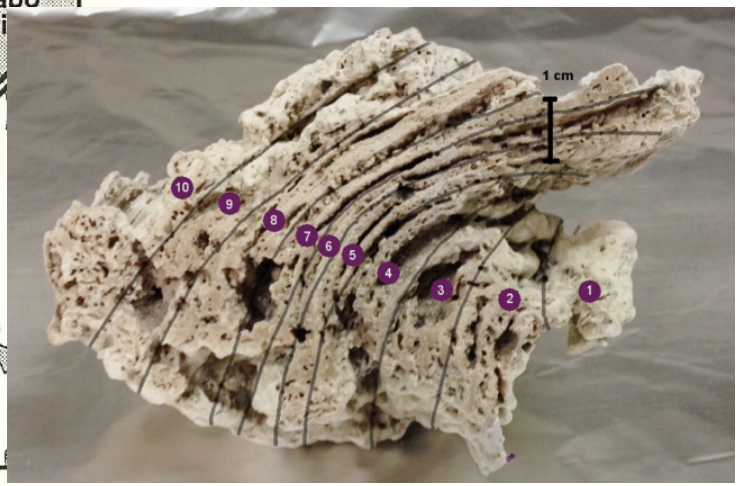


Theme 3: Microbiology, carbonate chemistry and bio-calcification in hypersaline lagoons

Conditions environnementales proches des conditions passées de l'océan (jusqu'au précambrien)
Nombreux travaux par des géologues sur les stromatolithes (structures calcaires produites par des tapis de cyanobactéries)
On sait peut de choses sur les mécanismes actuels (chimie des carbonates, substances extracellulaires polymériques, conditions de précipitation de calcite et dolomite, etc...)



Carvalho et al. 2017



Theme 3: Microbiology, carbonate chemistry and bio-calcification in hypersaline lagoons

Précipitation de dolomite

NATURE · VOL 377 · 21 SEPTEMBER 1995

Microbial mediation as a possible mechanism for natural dolomite formation at low temperatures

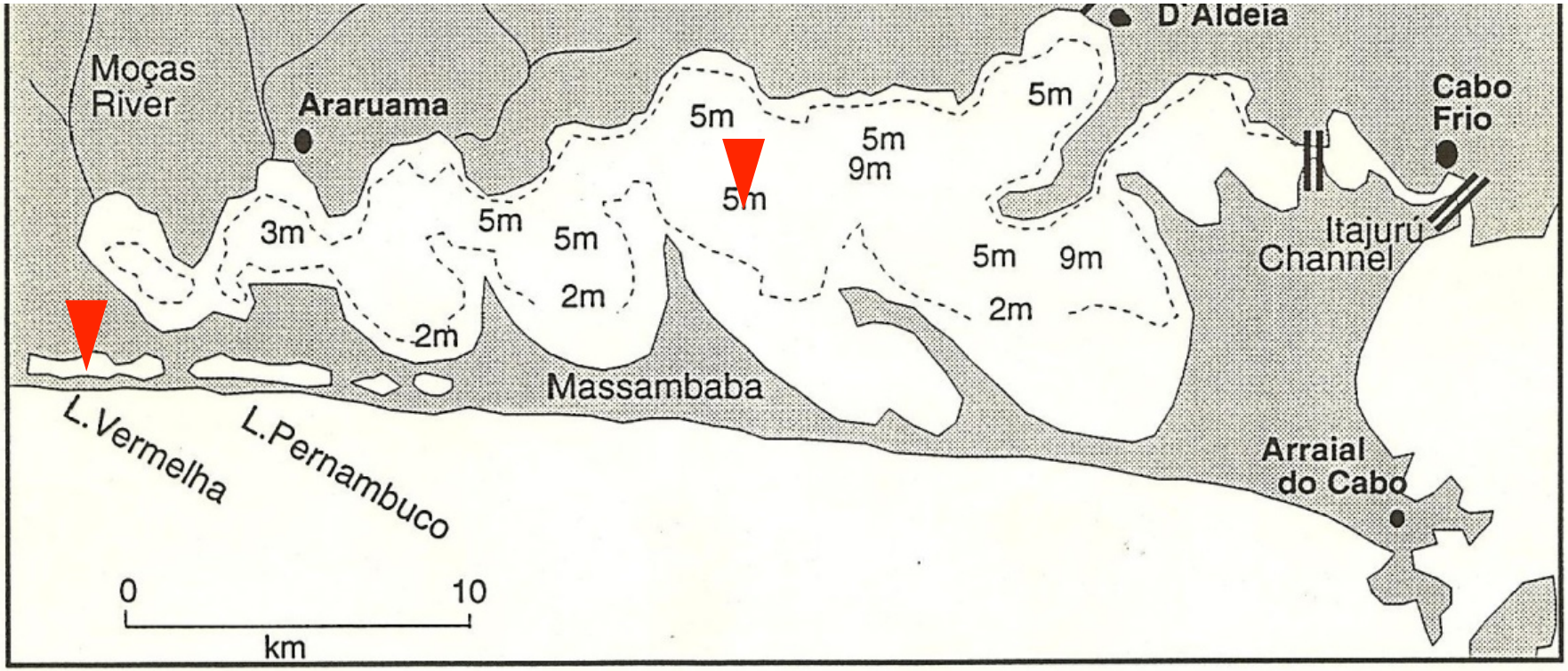
Crisogono Vasconcelos*†, Judith A. McKenzie*‡, Stefano Bernasconi*, Djordje Grujic* & Albert J. Tien§

* Geological Institute, ETH-Zentrum, 8092 Zürich, Switzerland
† CNPq-LAGEMAR, Universidade Federal Fluminense, Niteroi, Rio de Janeiro, Brazil
§ Microbiology Department, EAWAG, 8600 Dübendorf, Switzerland

DOLOMITE ($CaMg(CO_3)_2$) is a common carbonate mineral which is found in much greater abundance in ancient rocks than in modern carbonate environments. Why this is so remains a mystery. Over the past 30 years, dolomite formation has been observed in several modern environments, and various thermodynamic, kinetic and hydrological factors have been proposed to explain its formation[1,2]. But attempts to precipitate dolomite at low temperatures in the laboratory have been unsuccessful[3,4], and the 'dolomite problem' remains a source of controversy in sedimentary geology[5–7]. Here we describe experiments in which a ferroan dolomite with a fairly high degree of cation order was precipitated in the presence of sulphate-reducing bacteria from the *Desulfovibrio* group. We propose that the direct mediation of these anaerobes can overcome the kinetic barrier to dolomite nucleation, and that they may play an active role in the formation of this mineral in natural environments.

Theme 3: Microbiology, carbonate chemistry and bio-calcification in hypersaline lagoons

	Araruama	Lagoa Vermelha
Température (°C)	24-28	37
Salinité	40-60	85
pH	8.1-8.6	8.9
pCO_2 (ppmv)	110-240	20
Alcalinité Totale (mmol kg^{-1})	2.6-3.1	2.6
DIC (mmol kg^{-1})	1.9-2.2	0.9
δ13C-DIC (‰ PDB)	1.1-3.5	-12.5
POC (mg L^{-1})	5-8	0.2
DOC (mg L^{-1})	10-15	62



Social and educative actions and participative sciences

Research Institutes

Sampling
Monitoring

Nautical clubs

Social projects

Initiation training

Conferences

Field trips

Sampling
Monitoring

Suburban communities
Fishermen
Itaipu lagoon, Saco do Mamangua
Guapi-Mirim

Urban communities
15-25 Years old

Conservation institutes
Environmental protection areas

ÁREA DE PROTEÇÃO AMBIENTAL DE
GUAPI-MIRIM
ICMBio-MMA

Skills and equipements – France – Brasil – France and Brésil

Air-sea CO_2 et CH_4 exchange, equilibrator, chambers, IRGA, GC-FID, CDS...

Elemental Analyse C, N, P particulate, dissolved, organic, inorganic

Stratigraphy, sedimentation, burial, ^{210}Pb, ^{14}C datation (Alpha et Gamma spectrometers, AMS)

Stable isotopes (^{13}C, ^{15}N) in organic matter, carbonates and dissolved inorganic carbon

Radiocarbon ^{14}C in organic matter, carbonates and dissolved inorganic carbon (AMS)

Biomarqueurs dans la matière organique et biota:
Fatty acids, lignin, n-alcanes, sterols, photosyntetic pigments (GC-FID, GC-MS, HPLC)
Molecular tracers : ARN et ADN 16S, 18S, monosaccarhides

Primary Production, respiration and calcification (O_2 , CO_2, Δalca, diurnal cycles), exo-enzymatic activity

Incubations in microcosms et mesocosms; 13C spiking ; NanoSims

Sclérochemistry et sclérochronology on shells (ICP-MS)

Optical properties of waters and remote sensing : suspended matter, CDOM, chlorophyll (radiométry, fluorescence probres)

Microscope observations (Phytoplancton, zooplancton, foraminifères benthiques)

Travaux d'étudiants sur les thématiques du LIA

BRESIL

Programa de Geoquimica UFF, Niteroi, Rio de Janeiro

- **2016 – 2020 : DOCTORAT Glenda Camila Barroso** – Impactos da eutrofização sobre processos de mineralização da matéria orgânica e produção potencial de CO_2 e CH_4 no sedimento de manguezais. Encadrement Marotta (Dir. Brasil) – Abril (Codir. France) à l'UFF.
- **2017 – 2020 : DOCTORAT Suzan Juliana da Costa Santos** – Fluxos de carbono transportado pelos rios da bacia de drenagem do Rio Piabanha (Estado de Rio de Janeiro). Encadrement Abril (Dir. France) – Bernardes (Codir. Brésil) à l'UFF. Bourse CNPq.
- **2018 – 2021 : DOCTORAT Grazielle Nascimento** – Processos diagenéticos em Ecossistemas de Manguezal sob Múltiplos Impactos Antrópicos na Baía de Guanabara/RJ. Co-encadrement Machado (Dir Brésil)/Diaz (Dodir, Brésil) – Metzger (Codir.)/Abril (Codir, France), Bourse CAPES.
- **2019-2022 : DOCTORAT Daniel Tremmel** – Dinâmica do fitoplâncton na bacia de Santos a traves de analises de pigmentos. Co-encadrement Vianna (Dir. Brésil) – Abril (Codir, France) – Manzi (Codir, Brésil), à l'UFF. Bourse PETROBRAS.

Programa de Biologia Marinha e Ambientes Costeiros UFF Niteroi, Rio de Janeiro

- **2019-2020 : MASTER Thais Elbas** – Fluxos de CO2 na Interface Água-Atmosfera no sistema lagunar Piratininga-Itaipu. Co-encadrement Abril (Dir, France) - Marques Jr. (Codir, Brésil), Bolsa FUNBIO.

Programa de Pós-Graduação em Ciências Marinhas Tropicais UFF Fortaleza, Ceara

- **2018-2021 : DOCTORAT Raisa Siqueira** – Dinamica do CO2 e da materia organica no Delta do Rio Parnaiba (Nordeste, Ceara) Co-encadrement Marins (Dir, Brésil), Cotovicz (Codir, Brésil) – Meziane (Codir, France)

FRANCE

Museum National d'Histoire Naturelle

- **Jan. – Juin 2019 : MASTER Sofia Rockomanovic**– Eutrophisation du littoral en région tropicale : impact sur la composition de la matière organique des sols de mangrove. Co-encadrement Meziane (Dir, France) – Abril (Codir, France)
- Oct 2019 – sept. 2022 : **DOCTORAT XXX**– Impact de l'eutrophisation sur le carbone bleu des mangroves Co-encadrement Meziane (Dir, France) – Abril (Codir, France). Bourse Fondation Total.

MERCI POUR VOTRE ATTENTION