

FINAL REPORT PROGRAM LEFE

Two pages to be written in English

Program LEFE/ GMMC/IMAGO/CYBER	Project Title AMAZOMIX	Years 2019 – 2020
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<p><i>Context</i></p> <p>Internal tides are strongly generated off the AMAZON shelf break and propagate toward the open ocean mainly along the A path. Both at generation sites and along their propagations, internal tides can affect the primary production and thus the whole ecosystems. Such waves have been observed by altimetry and SAR images. But their precise dissipation rate, effect on the primary production, and interactions with the currents have never been looked at in this region. The AMAZOMIX project proposes to focus on these questions using models, satellite data and a dedicated cruise of the same name.</p> <p><i>Objectives / scientific questions</i></p> <p>The aims of the project are to better characterize internal tides at the generation site and along the propagation path in terms of baroclinic currents and dissipation, and to quantify the impact of such waves on the whole ecosystem from the algae until big fishes. The AMAZOMIX cruise will, for the first time, provide multidisciplinary in-situ measurements of the internal tides, its dissipation (VMP), and its impact on the algae production.</p> <p><i>Main results</i></p> <p>This project relies mainly on the AMAZOMIX cruise that has been postponed from February 2019 to Sept 2020 (due to ANTEA agenda) and is now planned for Sep 2021 (due to the pandemic). Meanwhile, model efforts have been conducted as well as satellite data analysis. Michel Tchilibou, as a post-doc (CMEMS), have been working on better characterizing internal tides energy and their interaction with the mesoscale activity from a model simulation. He has used a simulation run by J. Jouanno at 1/36° resolution including tidal forcing. He quantified that the generation occurs on the shelf break between 100 and 700 m depth (figure 1). The baroclinic flux is dominant for the A site (46°W, 1°N), whereas other points show less propagative energy. Dissipation occurs at the generation site with a ratio of 30% from the total baroclinic energy. Along the A path, dissipation occurs at about ~100km beam, according to a dominant mode 1 (figure 1 and 2). In contrasted season with low EKE (vs High EKE) the stratification is shallower (vs deeper) and the baroclinic flux from A is deflected by the intense currents from the retroflexion and mesoscale activity (figure 2).</p> <p>Also, SAR images have been analyzed (figure 3) showing mode 1 (light blue points) and mode 2 waves (dark blue points). A good agreement is found with the occurrence of Internal solitary waves and the presence of intensified dissipation as predicted by the model (figure 3 right).</p> <p>A Phd recently started on the impact on internal tides on the chlorophyll (Fernand Assene, oct 2020, IRD/Mercator). He first looked at the impact of internal tides on surface properties and shown that the spring/neap tidal cycle of dissipation of the tides induces a cooling at the same frequency.</p> <p>During this two years when the cruise have been postponed, the multidisciplinary and multitask on board of the cruise have tremendously grown up: we have now planned to have primary production, continuous phytoplankton/chlorophyll (Felipe Artigas), Phytoplankton and zooplankton characterization, abundance, size (C. Carre, M. Picheral, K. Reiner, R. Schwamborn), Microplastic characterization from water sample and stomach from fishes analysis (F. Luciana, M. Mauro). Finally, we are under discussion to add continuous CO2 measurements (F. Artigas, D. Ruiz Pino).</p>		

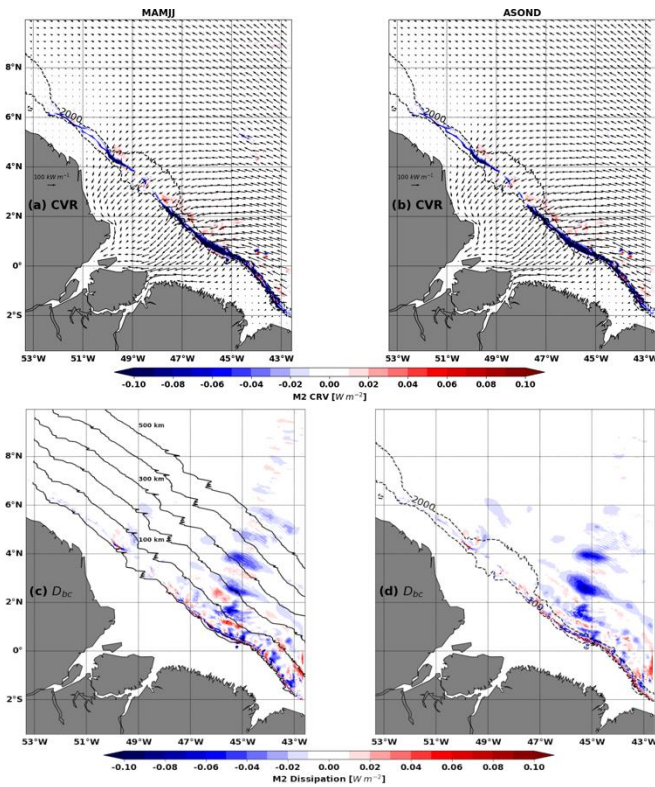


Figure 1 : (top) generation and (bottom) dissipation (W/m) of internal tides in the model, in contrasted season : (right) ASOND and (left) MAMJJ.

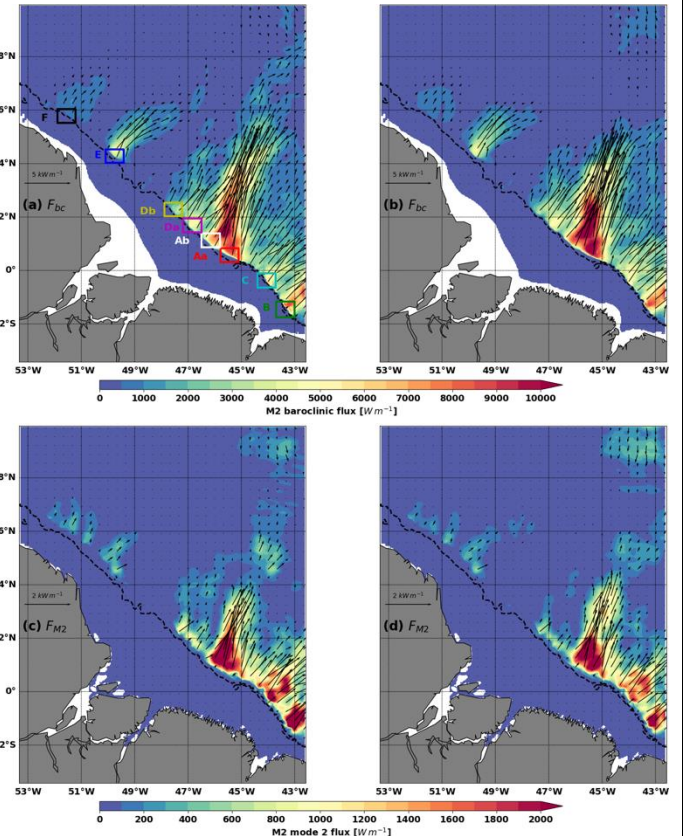


Figure 2 : baroclinic flux of internal tides, (top) total, (bottom) mode 1, in (right) ASOND and (left) MAMJJ.

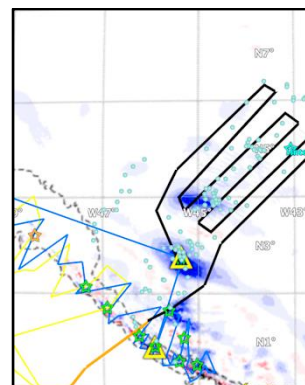
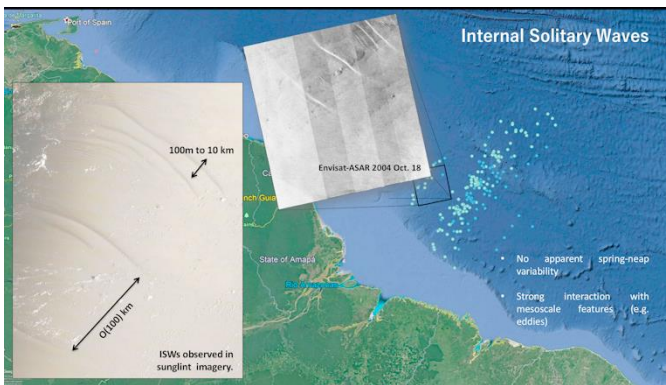


Figure 3 : (left) Internal solitary waves as observed by about 200 SAR images in autumn, (right) mode 1 ISW identified by SAR in good agreement with model dissipation occurrence. Courtesy of J. Magalhaes

Future of the project :

The project has been delayed but also has grown up. All the tasks related to the cruise will mainly start next fall. Indeed, the AMAZOMIX cruise is planned for sept 2021 on board of ANTEA. In this cruise additional measurements (continuous surface CO₂, Primary production, continuous surface Chlorophyll, UVP video of zooplankton, microplastic, bacteria) in comparison to what has been planned earlier will make the AMAZOMIX cruise as one of the first complete multidisciplinary cruise from the bubble to the bacteria and up to the fish. A new regional model configuration has been developed in the framework of the PhD of Fernand Assene. It is similar to the previous one with an extension toward the East (until 35°W), in order to better resolve the interaction with the mesoscale and also resolve others sites of generation such as B (43°W, 2°S). Finally, a Post-doc is about to start to analyze the SAR data in close comparison to the ocean color data (Carina Macedo, April 2021, CNES, 2 years).

*Nombre de publications, de communications et de thèses
(citer au maximum 5 publications en lien direct avec le projet)*

Tchilibou, M., Koch-Larrouy, A., F. Lyard, S. Barbot, D. Allain, R. Morrow, Y. Morel, Internal tide in the Amazon shelf during two contrasted EKE seasons: Interaction with currents and SSH imprints, to be submitted.