



# SWOT-Tropics

SWOT Science Meeting – Toulouse  
19 - 22 September 2023

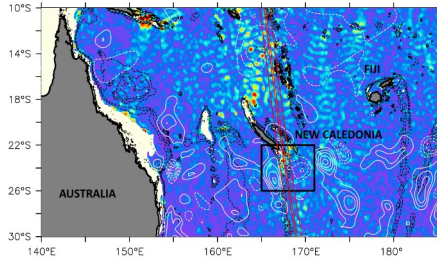
## Internal tides and mesoscale interactions in a tropical area: Insights from model, in situ data, and SWOT

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1. LEGOS, 2. LOPS, 3. MIO, 4. LIENSS

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### 1. Motivation

M2 stationary tide amplitude (shading, Ray and Zaron, 2016) superimposed on a snapshot of mesoscale eddies from AVISO (white contours). In red, the swath SWOT crossing the southern Caledonia area during the Fast Sampling Phase.



#### • Why focusing on New Caledonia region?

- New Caledonia Island, in the Southwest Tropical Pacific Ocean, is characterized by:
  - Intense meso/submesoscale features (Keppeler et al., 2018)
  - Hot spots of internal tide generation (Ray and Zaron, 2016, Bendinger et al., 2023)
  - A SWOT swath during the Fast Sampling Phase

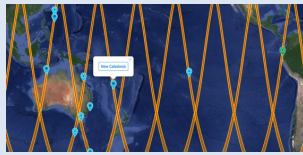
#### • What are the objectives of the project?

- The projet focuses on the life cycle on internal tides south of New Caledonia, and on their interactions with mesoscale eddies. Dedicated to SWOT observability, it aims to quantify and understand the SSH signatures of balanced and unbalanced motions, and their time variability. The project includes:
  - a modeling framework (see Bendinger et al. poster)
  - In-situ cruises (SWOTALIS, March-April 2023, part of ADAC consortium), presented below.

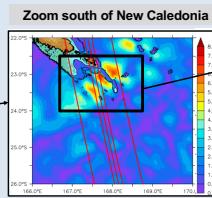
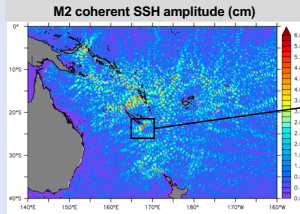
### 2. The SWOTALIS cruises, part of the ADAC (ADopt-A-Crossover) consortium



The R/V Antea, leaving from Nouméa, New Calédonie. J.M. Boré, IRD



SWOTALIS are part of the ADAC consortium, and collected in situ data under a 1-day repeat Fast Sampling Phase SWOT swaths



#### The SWOTALIS cruises

took place on board the R/V l'Antea, south of New Caledonia, in an area of seamounts and ridges, in a hot spot of internal tides generation. Model simulation and observations show that the M2 coherent SSH signal there is around 5-8 cm (Bendinger et al., 2023). A combination of in-situ platforms (moorings, bottom pressure sensors, profilers, CTD, GPS blanket) were deployed under the SWOT swath to infer the variability of internal tides, their SSH signature and their interactions with meso-submesoscale structures

### Mooring deployments on the internal tides main generation sites (13-22 march 2023)

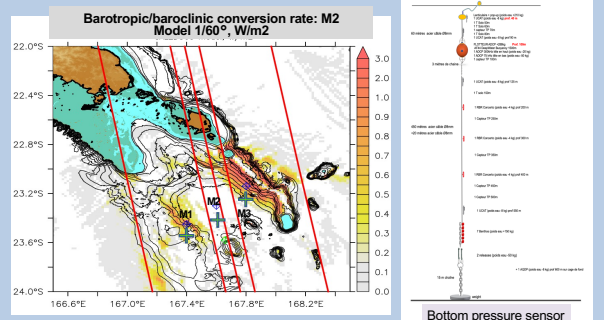


Moorings instruments onboard l'Antea before the deployments © D. Vignon

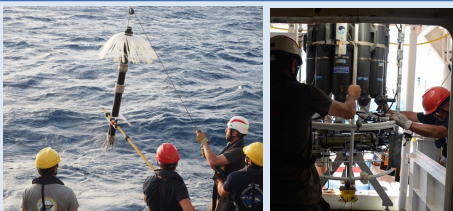
#### 3 fully-instrumented moorings

- were deployed successfully on the main tidal generation sites (at 600m, 1200m and 600m depth) to document:
  - the vertical structures of the internal tides
  - their variability/incoherence
  - their SSH signature

They will be recover on November, 22. GPS buoys couldn't be deployed.



### Fixed stations to document the internal tides associated mixing and impacts on biogeochemistry (24 march-10 april 2023)

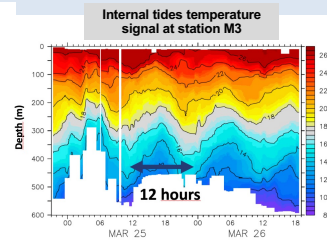
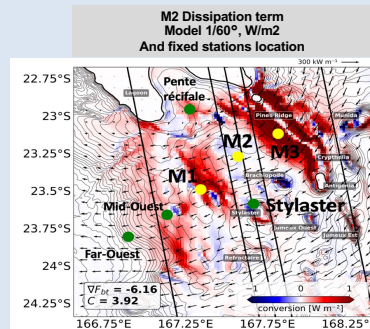


VMP (Vertical Microstructure Profiler) and CTD deployments onboard l'Antea © L. Gourdeau, S. Cravatte

#### 7 fixed stations of ~48 hours

- alternating CTD every 3 hours and VMP to document:
  - the spatial variability of the internal tides dissipation and associated mixing
  - their impact on nutrients availability, phytoplankton and diazotrophs
  - with a gradient from the open-ocean to the reef/lagoon

304 CTD profiles, 225 VMP profiles were acquired



### Repeated Transects along the energy beam and under the SWOT swath (12 avril-1 may 2023)

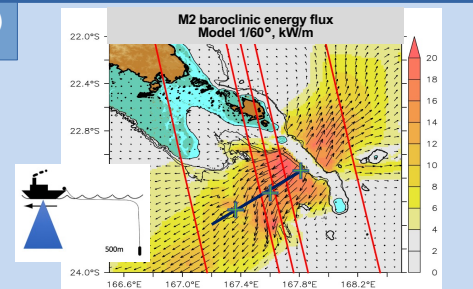


RapidCast (left) for CTD profiles in rough sea conditions and GPS blanket (right) to measure SSH onboard l'Antea © E. Kestenare

#### Repeated transects during 15 days,

the vessel towing a CTD profiler and a GPS blanket to infer:

- the vertical structures of the internal tides along the propagation beam
- their SSH signature
- the vertical structure of the submesoscale structures



### 3. Perspectives

Under the auspices of the new ST SWOT, our motivation is first to investigate the SWOTALIS dataset, second to pursue model analysis especially on the role of internal tides in the energetic of the system, and third to explore the new SWOT data. These different tasks were initially planned but they were not completed due to the delay of SWOT launch.

The project will benefit of the CNES post doctoral position at LOPS of Arne Bendinger to work on data from the moorings and the fixed stations and of a new phd student at LIENSS, Nushrat Yeasmin, to work on the repeated sections with GNSS data under the swath SWOT.

#### References:

- Bendinger, A., S. Cravatte, L. Gourdeau, L. Brodeau, A. Albert, M. Tchilibou, F. Lyard, and C. Vic. Regional modeling of internal tide dynamics around New Caledonia. Part I: Coherent internal tide characteristics and sea surface height signature. *EGU sphere*, <https://doi.org/10.5194/egusphere-2023-361>, 2023
- Keppeler, L., Cravatte, S., Chaigneau, A., Pegliasco, C., Gourdeau, L., and Singh, A.. Observed characteristics and vertical structure of mesoscale eddies in the southwest tropical Pacific. *J. Geophys. Res.-Oceans*, 123, 2731–2756. <https://doi.org/10.1002/2017JC013712>, 2018.
- Ray, R.D. and Zaron, E.D.. M2 internal tides and their observed wavenumber spectra from satellite altimetry. *J. Phys. Oceanogr.*, 46, 3–22. <https://doi.org/10.1175/JPO-D-15-0065.1>, 2016.

