





SWOT in the Tropics High-resolution regional modeling effort around New Caledonia

CalVal site for eddy-internal tide interactions Supervision by Lionel Gourdeau & Sophie Cravatte





What makes New Caledonia an ideal study site for eddy-internal tide interactions?



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(Ray and Zaron, 2016) due to complex

bathymetry such as ridges and seamounts



What makes New Caledonia an ideal study site for eddy-internal tide interactions?



Today's talk objective Introduction to **regional** modeling effort Insight into internal tide field B characteristics SWOT Science Team Meeting June 2022 Perspectives on eddy-internal tide interactions



S

set

Model

High-resolution modeling effort

CALEDO60 multi-year regional simulation (1/60°, 125 vertical levels)

Barotropic tide forcing

at the lateral boundaries of **TROPICO12** allowing for free wave propagation into regional domain

AGRIF 2-way nesting

framework allowing for interaction between mother domain and nest











Two simulations to study eddy-internal tide interactions







Two simulations to study eddy-internal tide interactions





dŋ set **Model**

How does the model compare to climatology and observations?

Overall, good agreement between observations and model (tidal run) in terms of mesoscale, submesoscale, tidal, and inertial energy levels.





tide

nterna.

The main **formation sites** are located near **ridges** and **seamounts** at the northern and southern tip of New Caledonia, with predominant **tidal beams**

Formation sites





Dissipation





Excitement of high baroclinic modes

High baroclinic modes are being excited at the main formation sites south of New Caledonia with **mode-1** being most dominant





tide

Interna

≈ Complex SSH signature

Internal tide induced SSH field with contribution of many high baroclinic modes





≈ Tidal incoherence

tide nterna **Internal tide temporal variability** (monthly tidal analysis) suggests **tidal incoherence**, i.e. in areas of high meso-/submesoscale activity





Eddy-internal tide interactions

Summer: Tidal simulation more energetic than simulation without tides
Winter: No evident differences between the two simulations except at the Mesoscale



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🗞 🏁 Eddy-internal tide interactions

Tidal forcing shifts **transition scale** between forward and inverse energy cascade to larger scales in **winter** months

Tidal forcing appears to enhance both **forward and inverse energy cascade**, i.e. during **summer** months

$$\Pi_{\rm sp}(K) = -\rho_0 \int_K^\infty \hat{\mathbf{u}}_h^* \cdot (\widehat{\mathbf{u}_h \nabla_h \mathbf{u}_h}) \, dK,$$

 \rightarrow unit =[W m⁻² km⁻¹]
 \rightarrow K - isotropic wavenumber horizontal advection term





Summar

New Caledonia is a region of strong eddy-internal tide interactions High-resolution modeling effort with and without barotropic tidal forcing

Internal tide excitement of highbaroclinic modes, complex SSH, and tidal incoherence Internal tides may impact both the forward and inverse energy cascade







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2-way nesting framework allowing for free wave propagation between mother domain and nest



c n set <u>Mode</u>

AGRIF Adaptive Grid Refinement In Fortran





evaluation **Model**

How does the model SSH compare to the barotropic tide model FES2014?

 \rightarrow Assuming that SSH signal is dominated by barotropic tide

180°W

20°N

10°N

10°9

20°S 30°S

40°S

TROPICO12

FES2014





140°W

100°W



Ide [cm]

How does the model SSH compare to the barotropic tide model FES2014?

 \rightarrow Assuming that SSH signal is dominated by barotropic tide

TROPICO12 and CALEDO60 correspond with each other suggesting the **proper propagation of tides into the regional domain**.



How does the model compare with internal tide observations?

(Semidiurnal) internal tide **amplitude** and **phase** derived from isopycnal displacements suggest a **good agreement** between **glider observations** and **model**.



First insight into eddy-internal tide interaction analysis

- Mesoscale EKE (5-day averaged, horizontally binned velocities to 1/4° resolution, and high-pass filtered with a cutoff period of 180 days representative of the mesoscale time scale) appears more energetic in the tidal run, i.e. in areas of increased eddy activity.
- How do internal tides modulate the forward and inverse energy cascade?
 - \rightarrow energy spectra & spectral fluxes

