WORLD OCEAN CIRCULATION
USER CONSULTATION MEETING

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Internal waves, submesoscale eddies, and some of their interactions off the tropical West Atlantic

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Surveyed features include:

- Internal Solitary Waves (multiple modes)
- Transcritical Internal Solitary Waves
- Internal Solitary Waves over the shelf
- Fronts
- Instabilities

150 images:
- Envisat-ASAR
- TerraSAR-X
- Sentinel-1
- Sentinel-2
- Sentinel-3
- MODIS
- MERIS
Interactions with Ocean Circulation

MODIS-Terra 2017 Sep. 7

Aviso DUACS Velocity (m/s)

Interactions with Ocean Circulation
Internal Wave Impacts on Offshore Industry

Internal Waves

$\lambda$

$D$  $C$

$h_1$

$h_2$

$\eta_0$

$c_0$

Orbital velocities classified as currents in metocean

Soliton

$h_1$

$h_2$

$-\eta_0$

$c$

$L$
Quantification of Soliton Velocities

Simple Two Layer Theory

\[ u_1 = \frac{c \eta}{(h_1 + \eta)} \]
Estimating Internal Wave Amplitude

Vertical displacements at the sea surface owing to ISWs

\[ \frac{|\eta|}{h} \approx \frac{g'H^2}{gh} \Rightarrow |\eta| = O(0.1) \text{m} \]

hydrostatic limit, (Stokes, 1847)

\[ Z = \eta(x,t) \]

\[ Z = -H + h(x,t) \]

\[ h \approx -100 \text{m} \]

\[ \approx 10 \text{ km in the South China Sea} \]

Horizontal velocity, \( u \) (m/s)

Internal wave surface displacement (meters)
Sentinel 3 Along Track SAR Altimeter Validated in This Region
Estimating Internal Wave Currents

![Internal Wave Amplitude](image1)

![Internal Wave Surface Currents](image2)
Future Validation Required

Brandt et al. (2002)
Recommendations

• Internal wave crest feature recognition products for various satellite platforms

• Validation and refinement of methods to quantify internal wave amplitude

• Improved simple relationships to estimate the velocity profile

• New atlas of internal wave characteristics with velocity profiles