Deep Intraseasonal Variability in the Central Equatorial Atlantic

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Equatorial Atlantic Variability

mean wind-driven circulation

tropical instability waves

deep intra-seasonal variability

interannual surface variability

equatorial deep jets

climate predictability

by courtesy of Martin Claus
Meridional velocity observations

[Graph showing meridional velocity observations with depth and time.]

- Upward phase propagation
- Downward energy propagation

<table>
<thead>
<tr>
<th>Energy source(s)?</th>
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<td>Propagation mechanism?</td>
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Data distribution – Kinetic energy

- Almost 15 years of velocity data from an equatorial mooring at 23°W
- Gaps in the data coverage introduce uncertainty
- High kinetic energy close to the surface $\rightarrow$ downward propagation
Seasonal cycle of TIWs

- Consistent annual maximum in boreal summer (August)
- Remarkable year-to-year variations of the annual intensification
- Weaker maximum in boreal winter (January)
DEIV in the central Atlantic Ocean

Frequency [cycles per year]

Depth ranges:
- 20-50m
- 50-800m

Depth levels:
- 0m
- 1000m
- 2000m
- 3000m

[m²s⁻²]

- >10⁰
- 10⁻¹
- 10⁻²
- 10⁻³
- <10⁻⁴

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DEIV in the central Atlantic Ocean

Deep Equatorial Intraseasonal Variability | PREFACE ’18 | Franz Philip Tuchen
DEIV in the central Atlantic Ocean

Frequency [cycles per year]
DEIV in the central Atlantic Ocean

[Graph showing frequency vs. depth for different depth ranges: 20-50m, 20-3530m, 50-800m, 1000-2000m, 2000-3530m]
Equatorial waves

Yanai waves
Rossby waves
Kelvin waves
Guiavarc’h et al. (2008)

Frequency $\omega$ (s$^{-1}$)
Wavenumber $k$ (m$^{-1}$)

$1^{st}$ mode
$2^{nd}$ mode
$3^{rd}$ mode
Modal decomposition of \( u \) and \( v \)

\( \text{Baroclinic Mode} \)

\( \text{Baroclinic Mode} \)

\( \text{Frequency [cycles per year]} \)

\( \text{Variance \left[ m^2 s^{-2} \right]} \)

\( \text{Zonal} \)  \( \text{Meridional} \)

a) only Kelvin waves

b) only Yanai waves

c) Gravity waves

Rossby waves

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Yanai beams – energy pathways

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Conclusions

- At the equator: intraseasonal variability is observed down to 2000 m

- A modal decomposition shows that mainly Yanai waves are responsible for the observed variability

- Intraseasonal wave energy is propagated east- and downward along Yanai beams