



# Energia Ondas

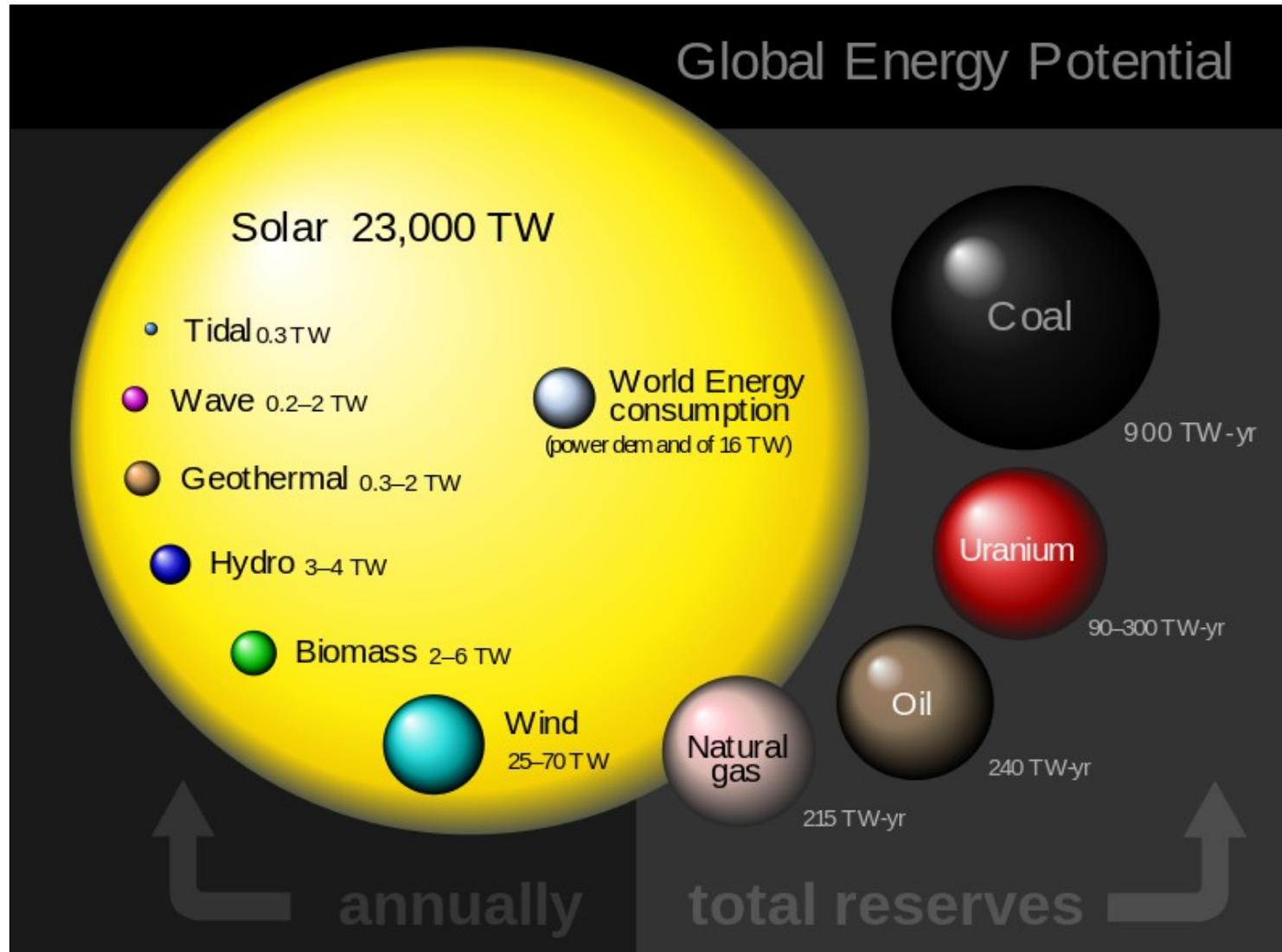
João Flesch Fortes



# Energia Oceânica

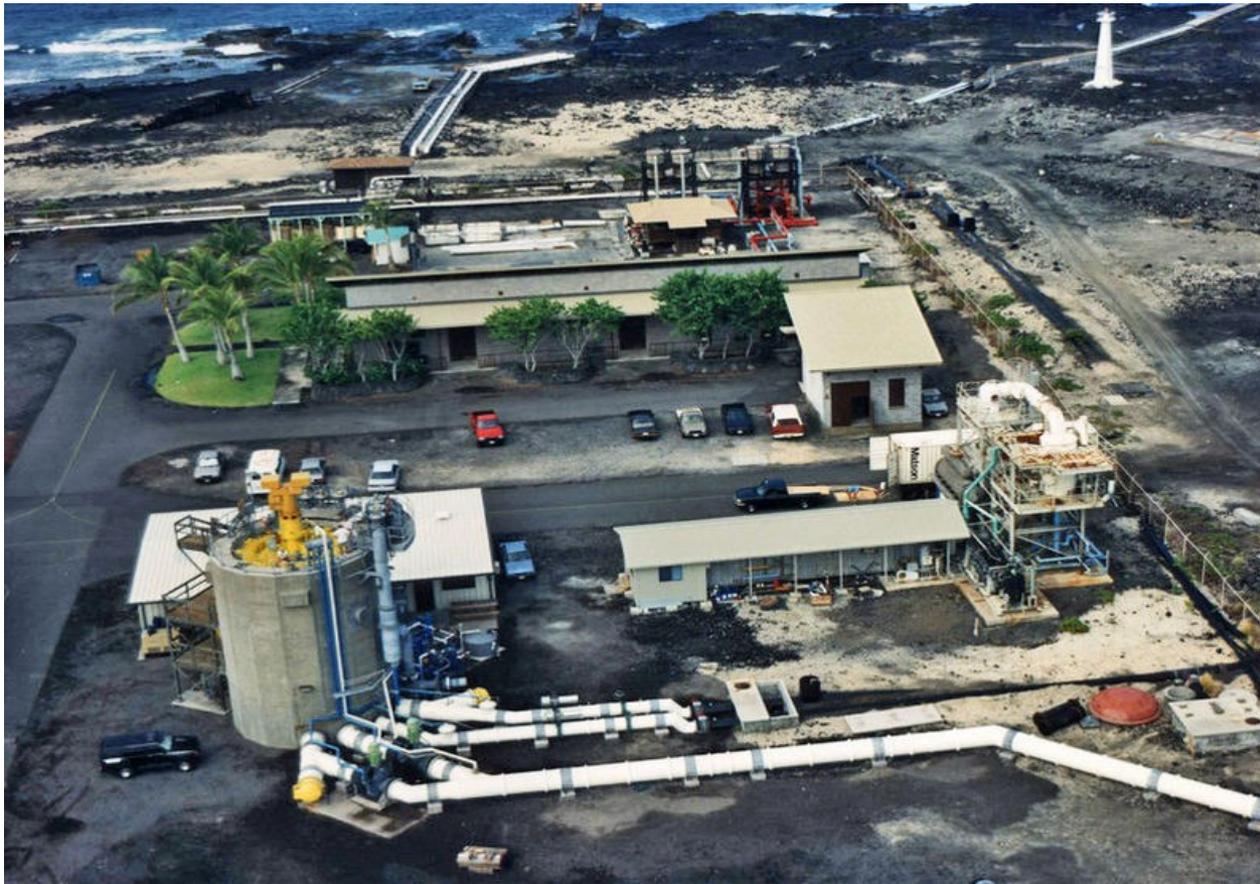
- Ondas
- Correntes
- Maré
- Diferença de Temperatura
- Diferença de Salinidade
- VIV - Vibração induzida por Vortice

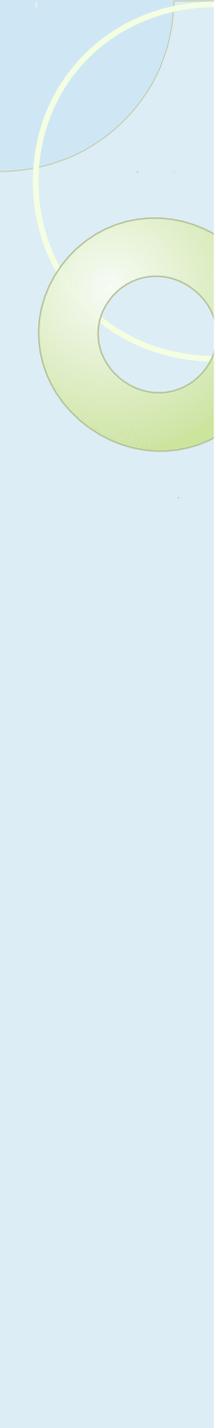
# Panorama Mundial e Nacional



# Energia Oceânica

- Térmica - Havaí

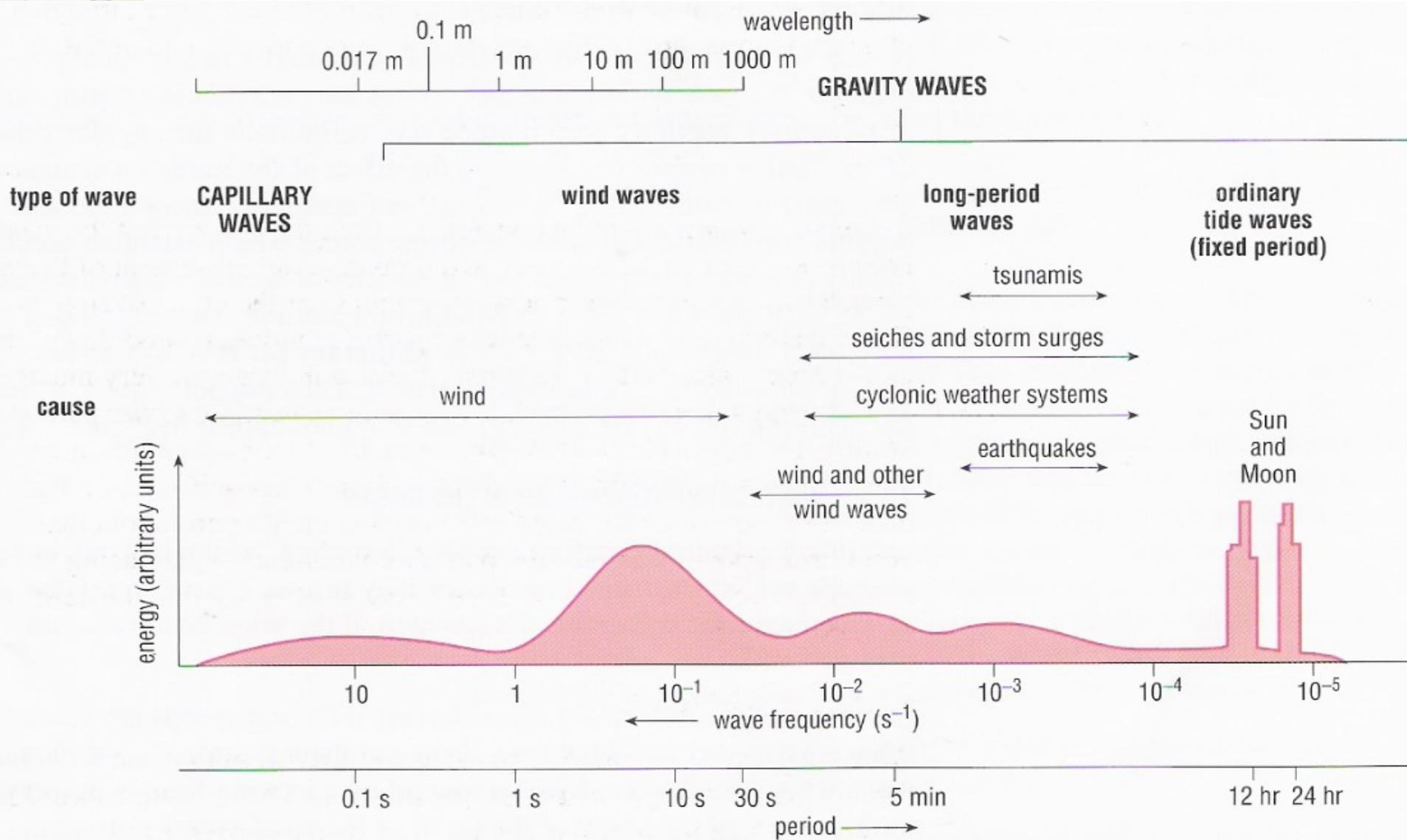




# Energia de Ondas

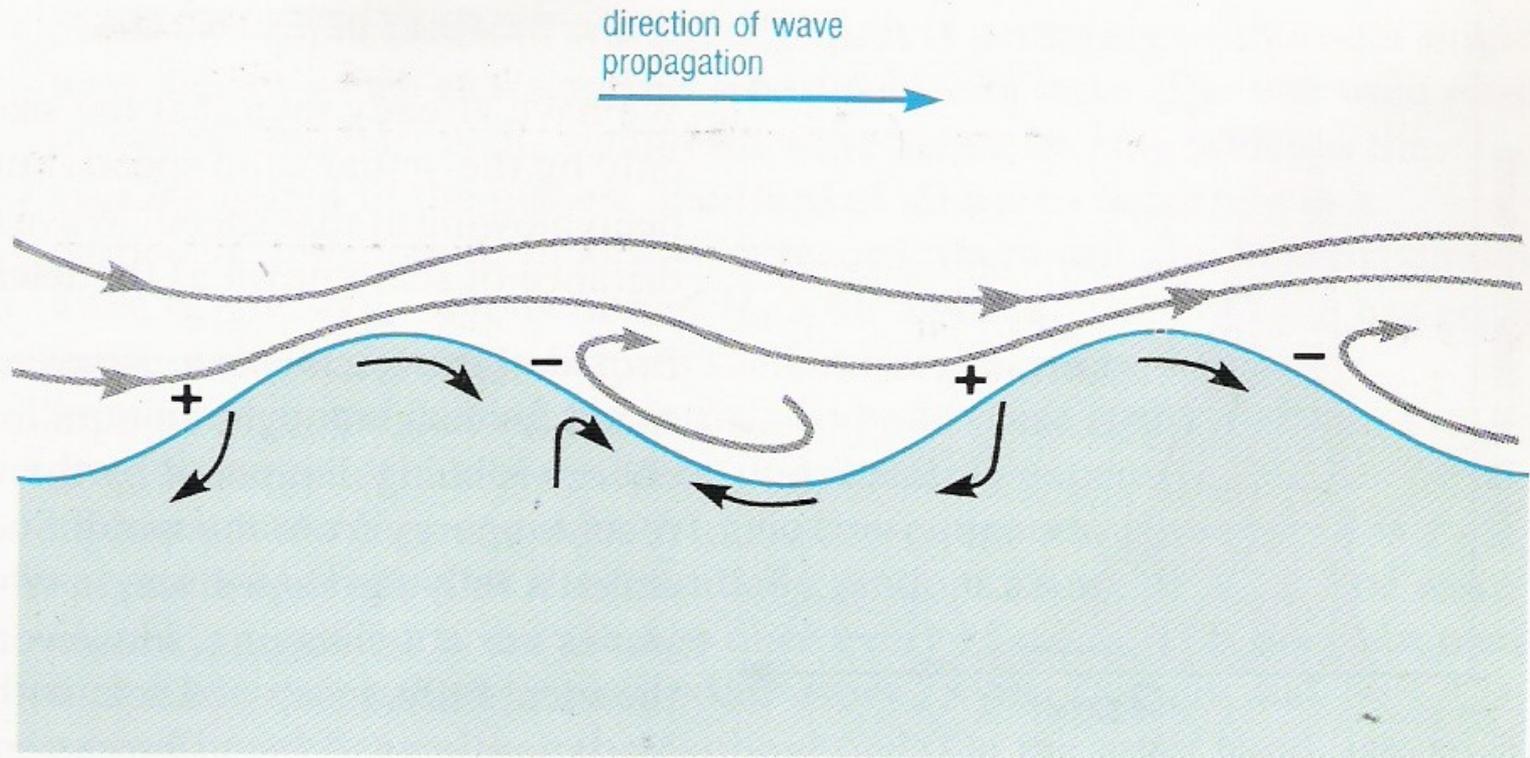
Energia de ondas de gravidade de superfície geradas pelo vento.

# Ondas de Gravidade de Superfície



# Geração de Ondas

11

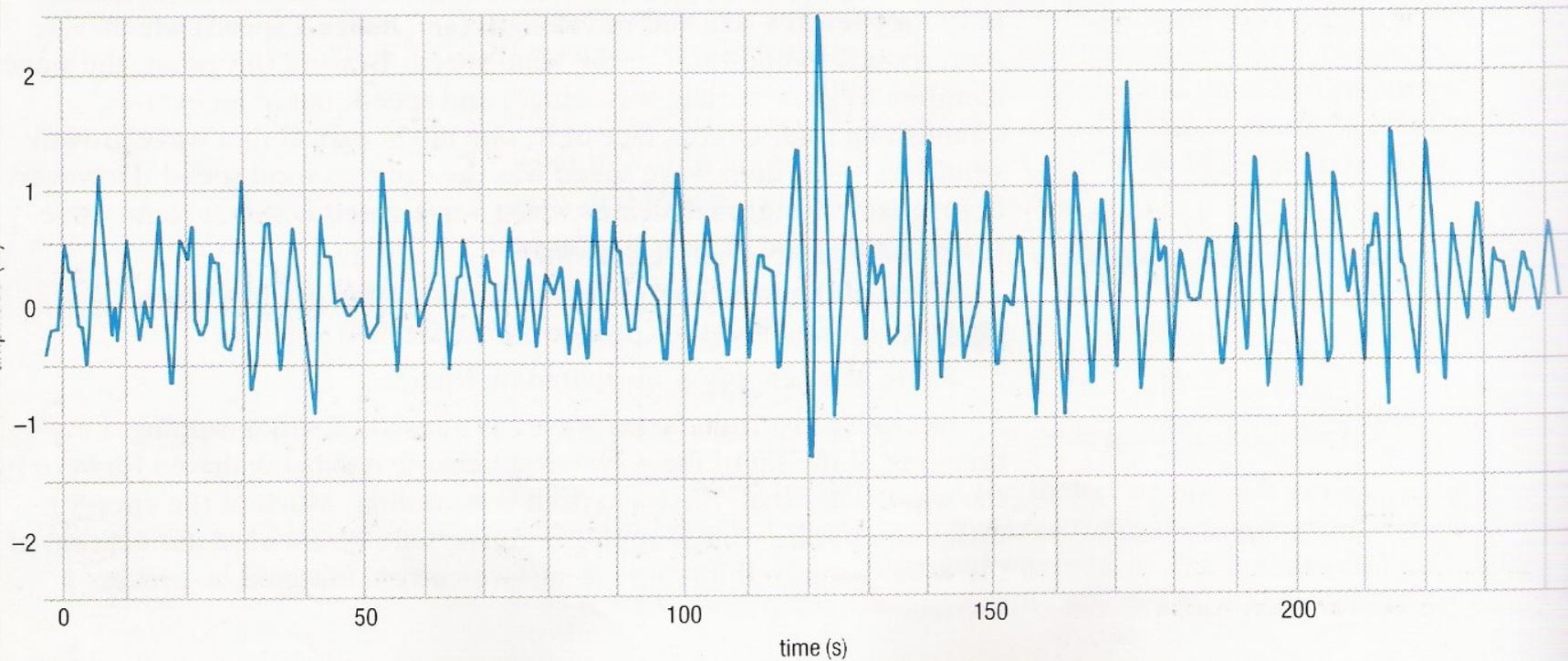




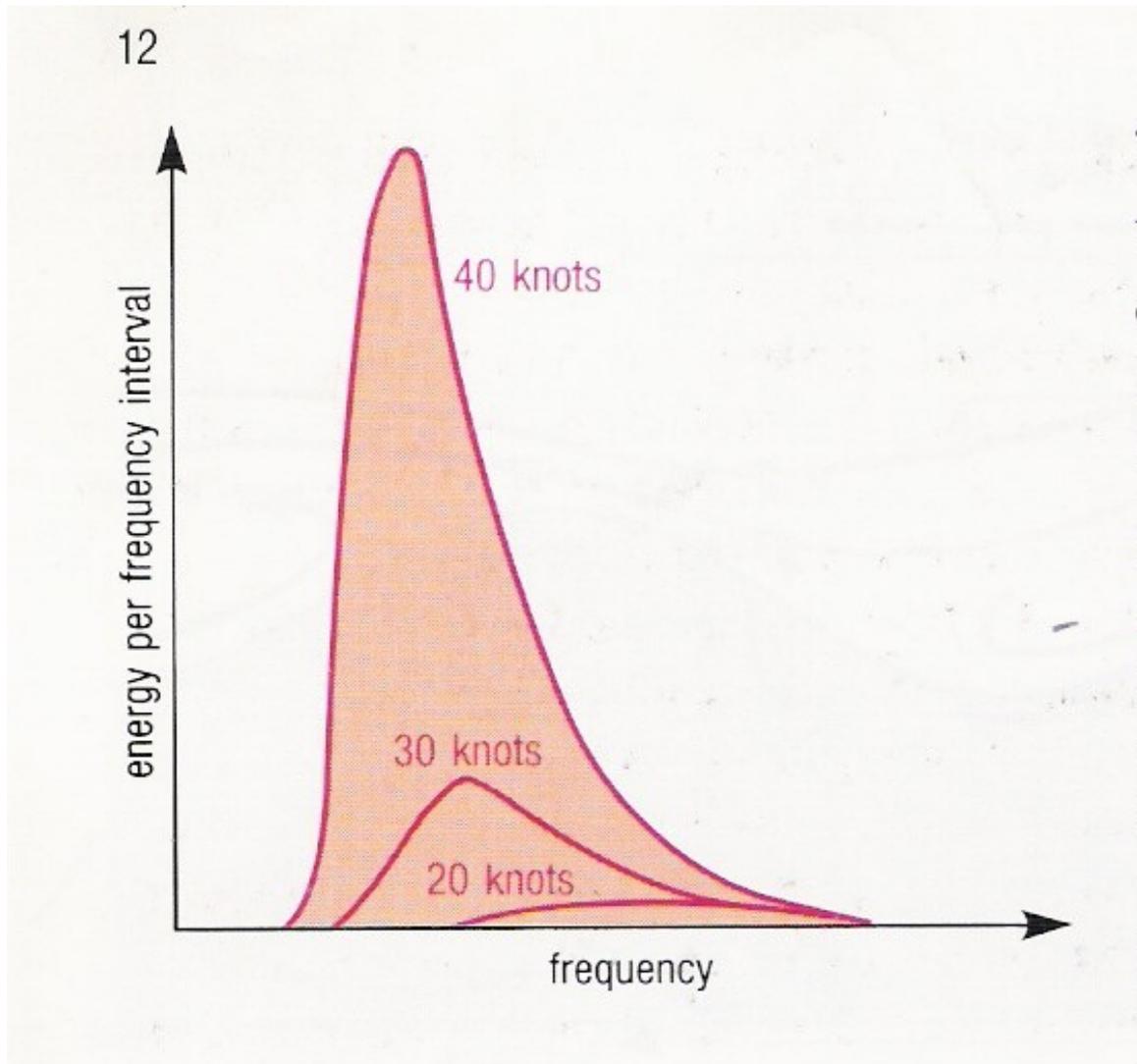
# Geração de Ondas

- Intensidade do vento
- Persistência do vento (duração)
- Pista (área de ação do vento)

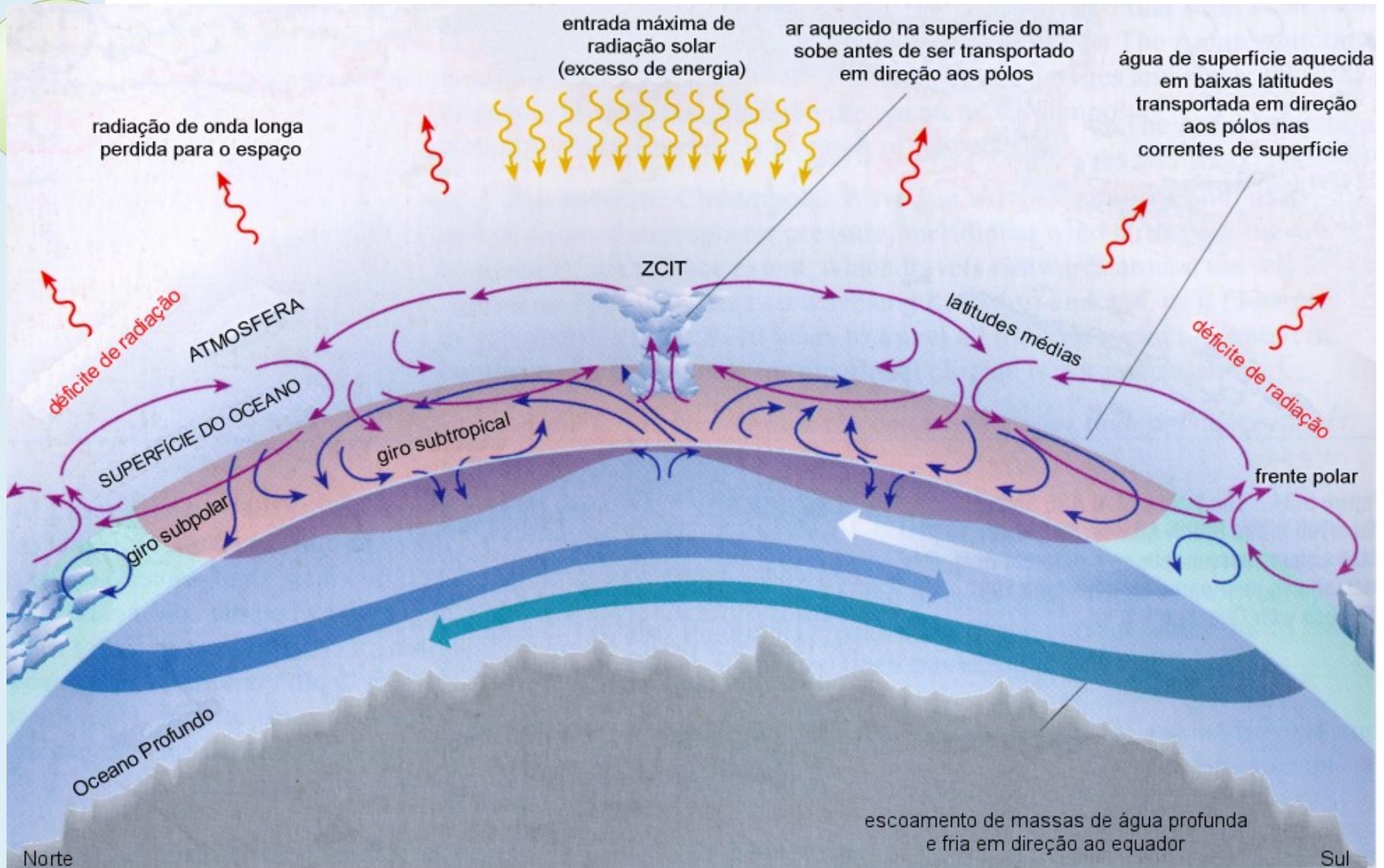
# Geração de Ondas



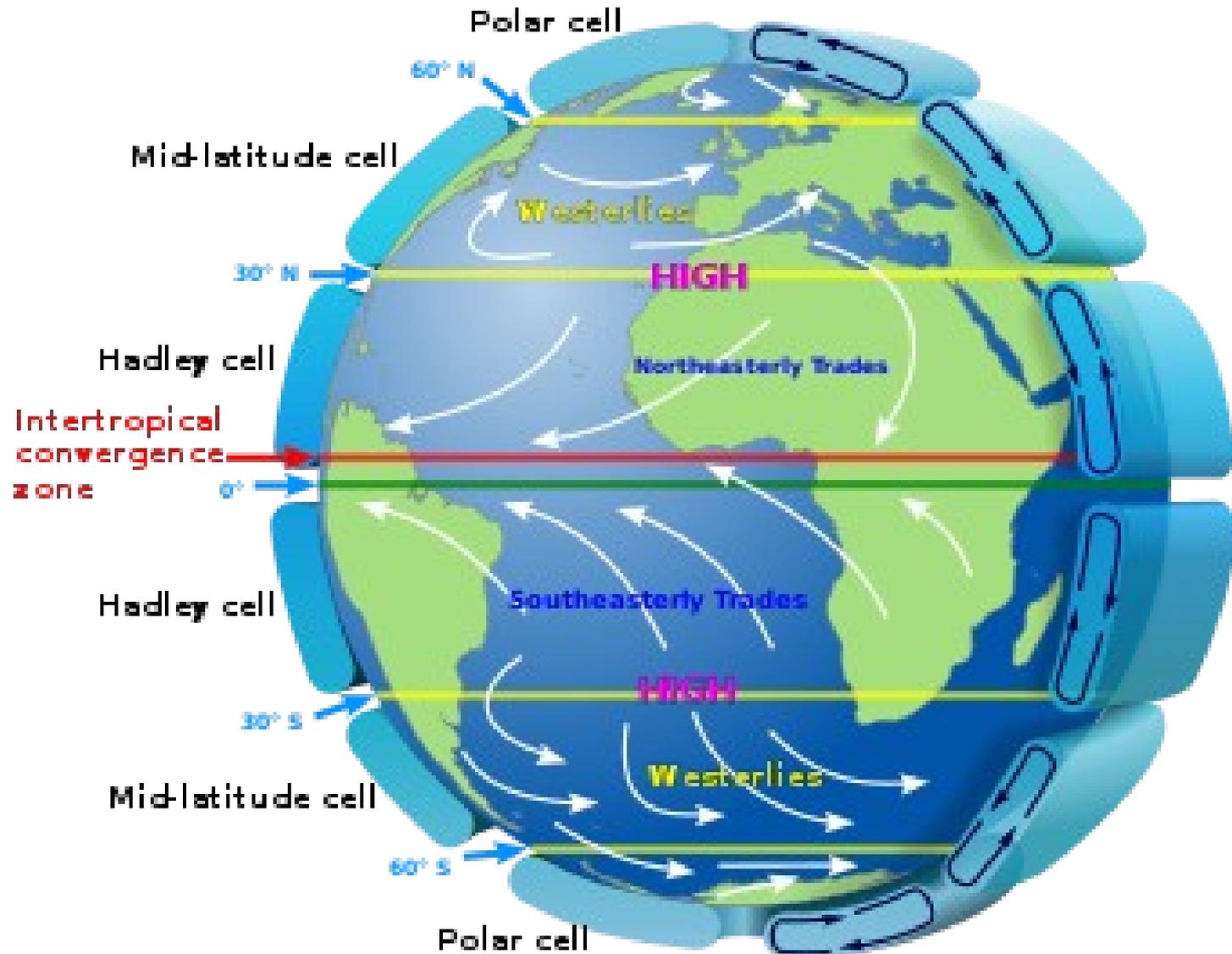
# Geração de Ondas



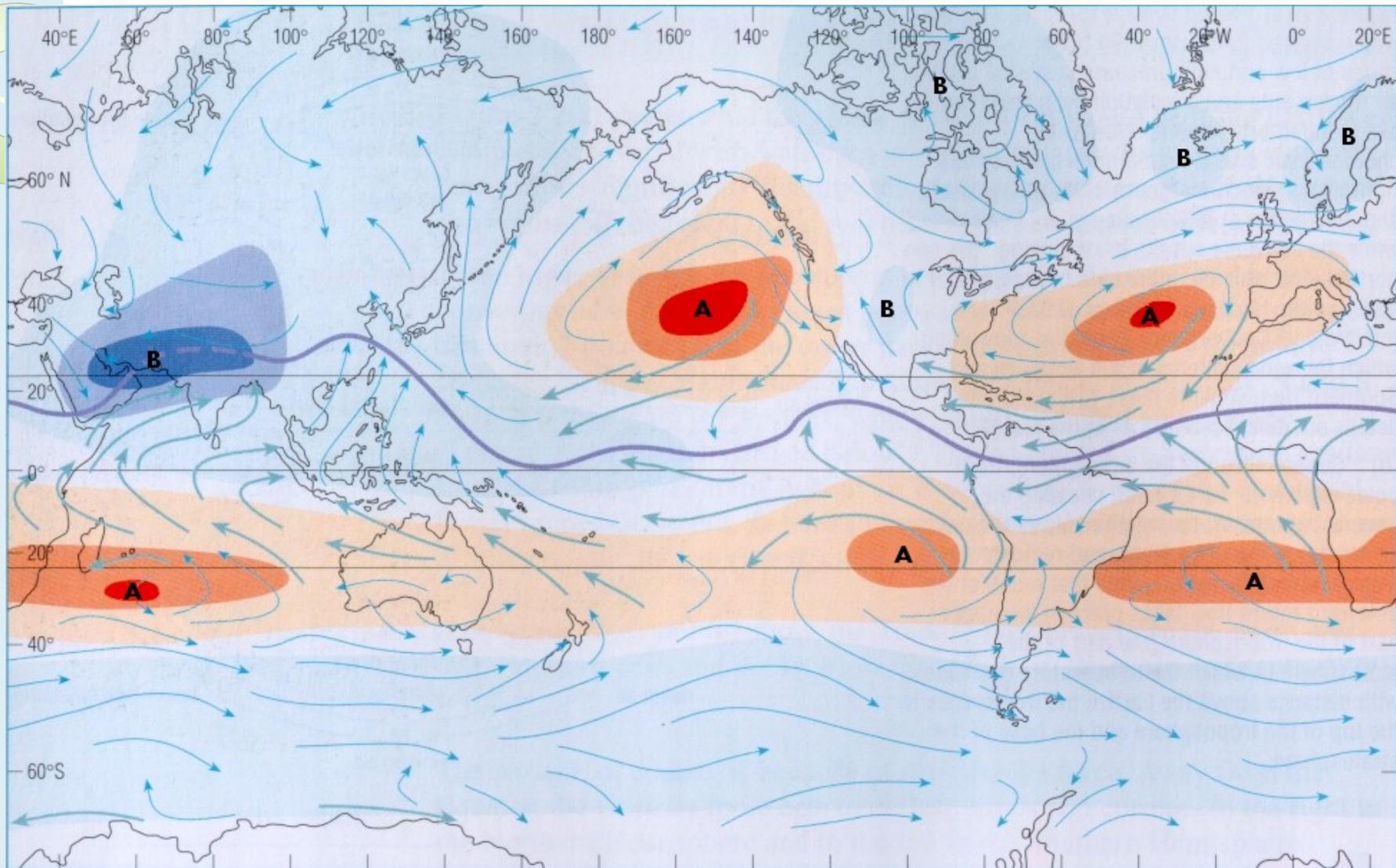
# Vento



# Vento



# Circulação Básica

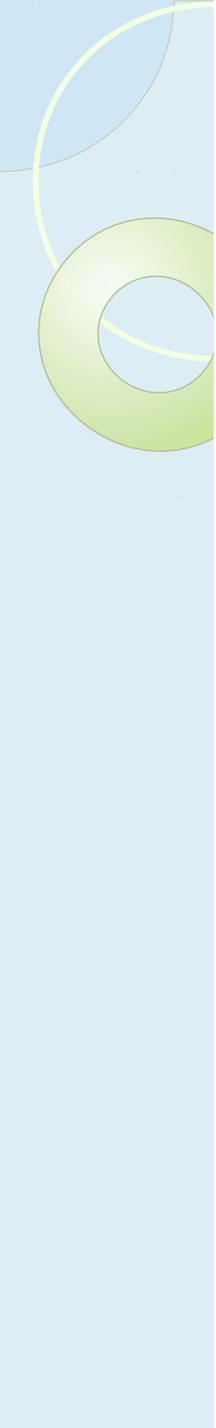


JULHO

— posição média da  
Zona de Convergência Inter-Tropical (ZCIT)

← direção de ventos  
mais frequentes

← direção de ventos prevalentes  
(≥ 50% das observações)



# Visualização

- Earth Null School  
<https://earth.nullschool.net/pt/>

# Fluxo de Energia

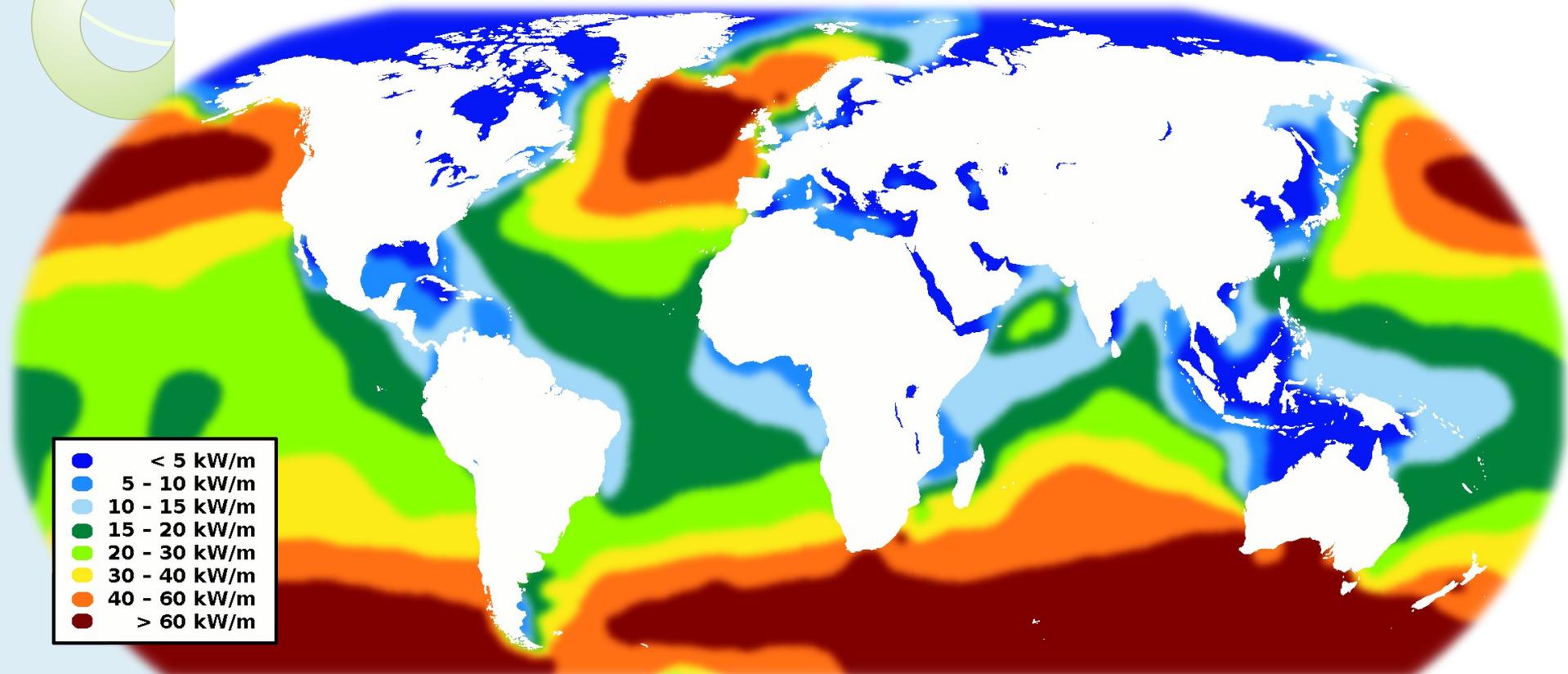
$$FE = \frac{1}{16}g \times \rho \times H_s^2 \times c_g$$

# Fluxo de Energia

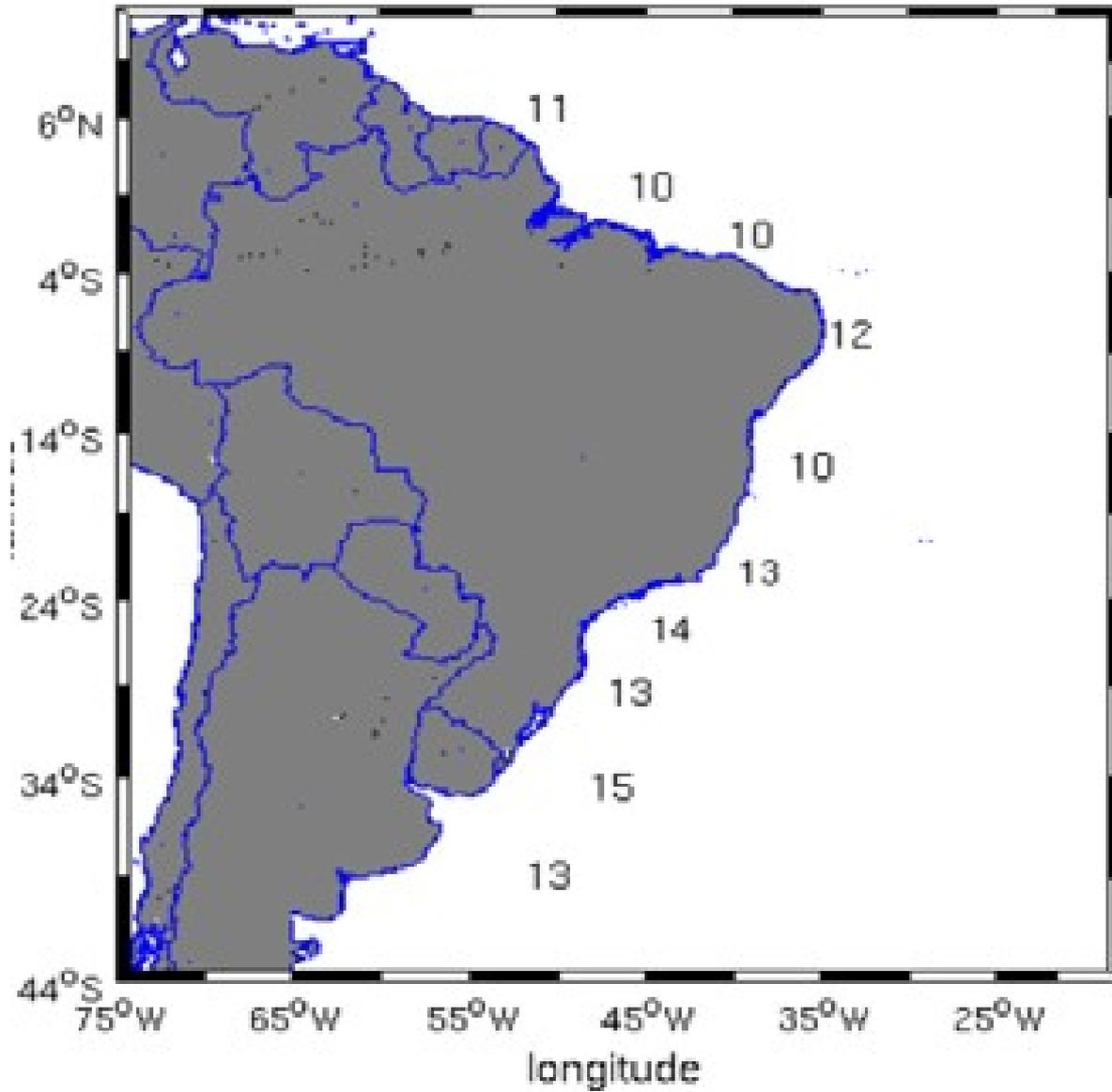
$$FE = k \times H_s^2 \times T$$

$$k = \frac{\rho g^2}{64\pi}$$

# Panorama Mundial



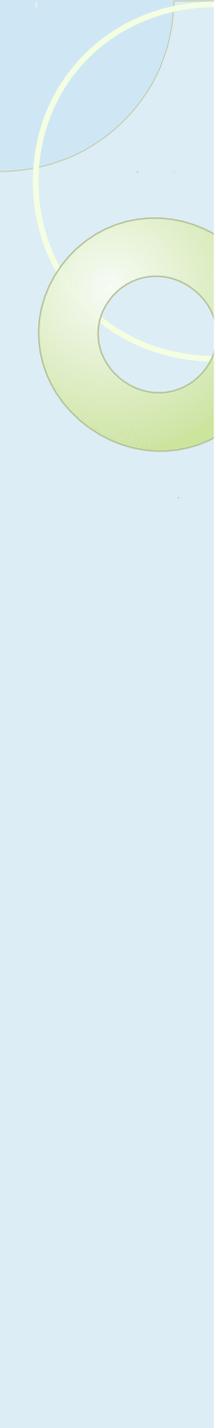
# Panorama Nacional



# Dados Nacionais

- PNBOIA

<https://www.marinha.mil.br/chm/dados-do-goos-brasil/pnboia-mapa>



# Dados Nacionais

- SimCosta  
<http://www.simcosta.furg.br/>



# Dados Nacionais

- Avaliação do potencial de energias marinhas na região de São Sebastião

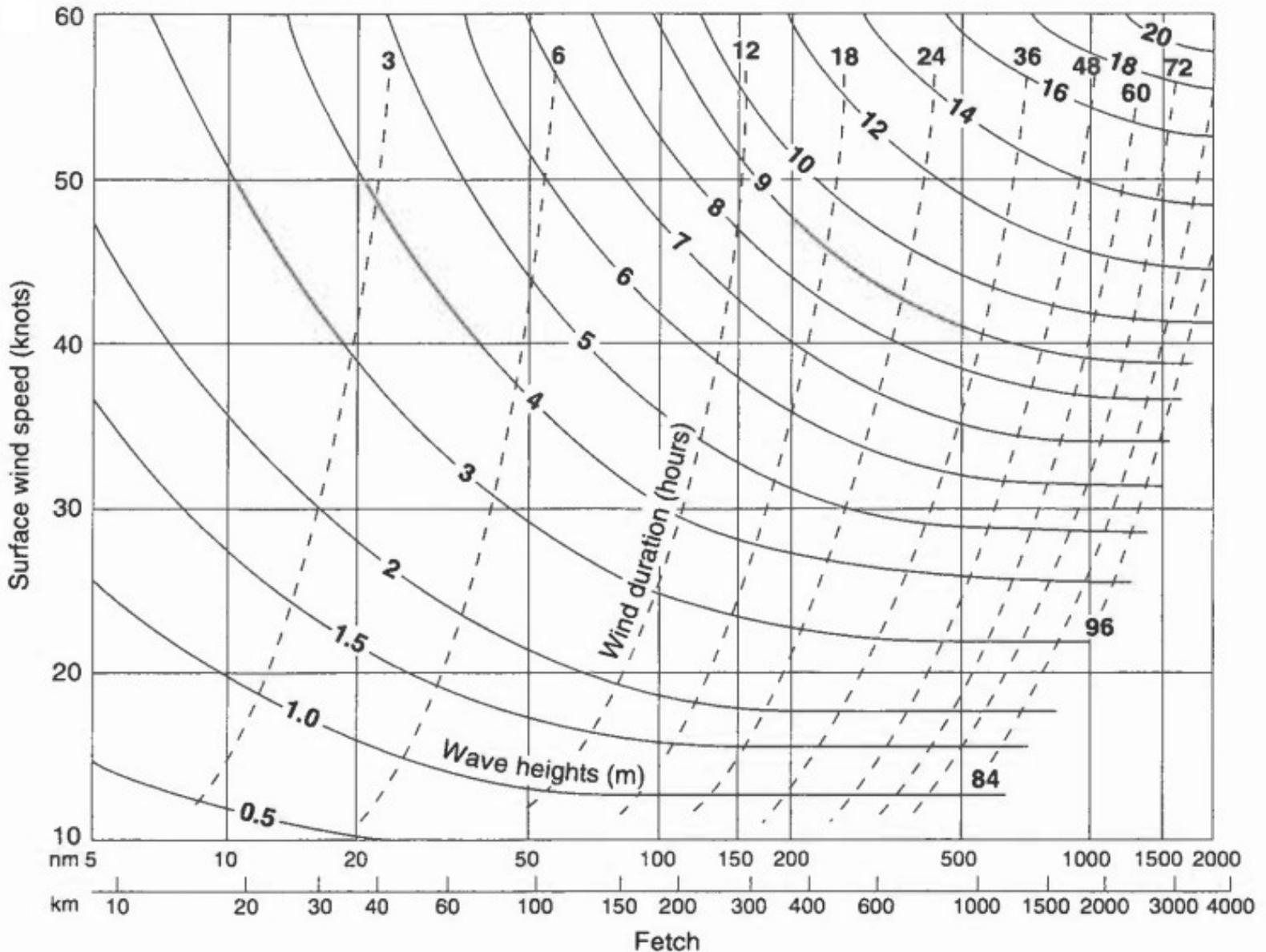


<https://teses.usp.br/teses/disponiveis/21/21135/tde-09012019-135013/pt-br.php>

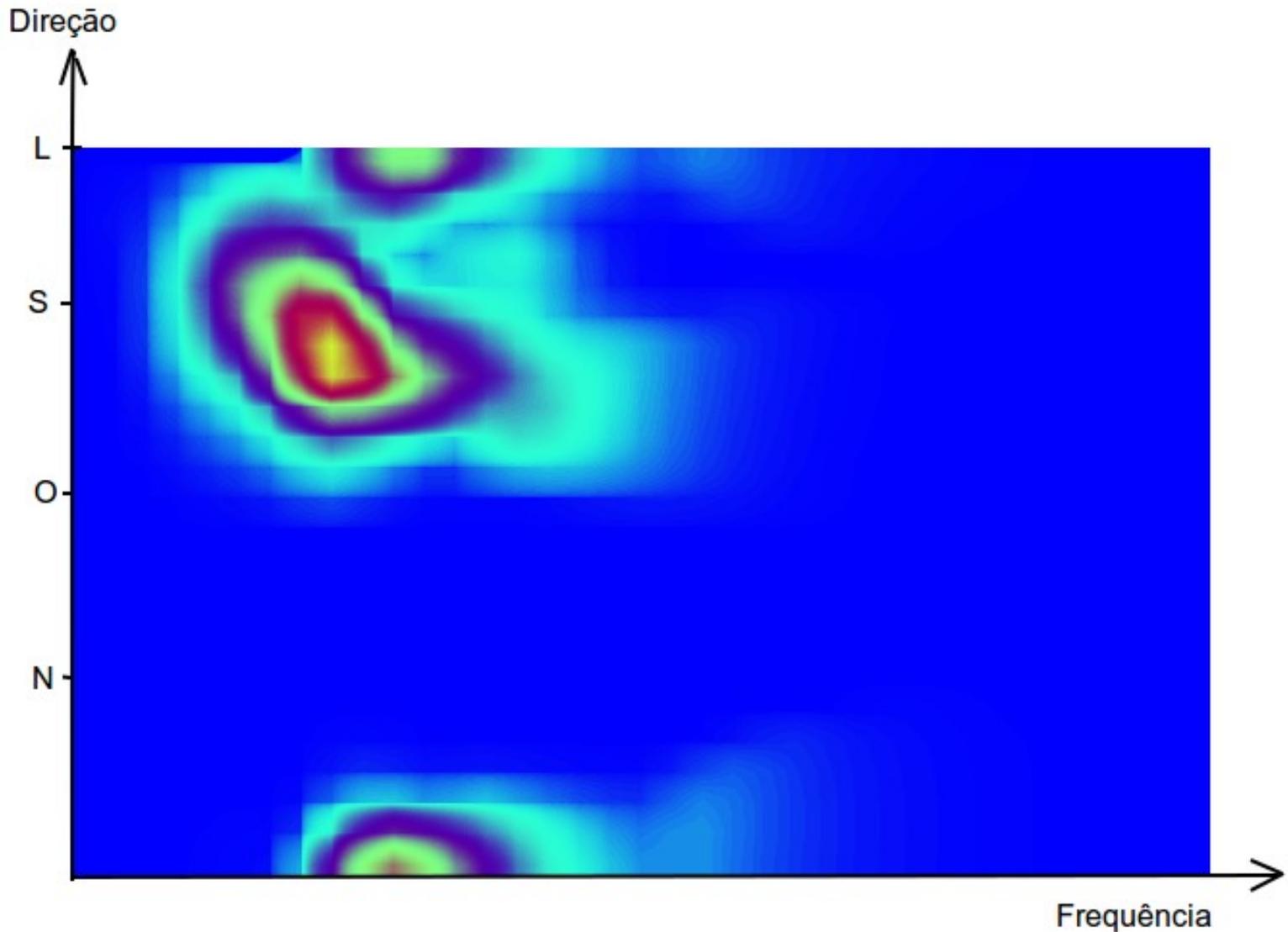
# Modelos

- Wavewatch III (WW3)
- WAM
- SWAM
- UMWM
- ...

# Modelos 1ª geração



# Modelos 3ª geração

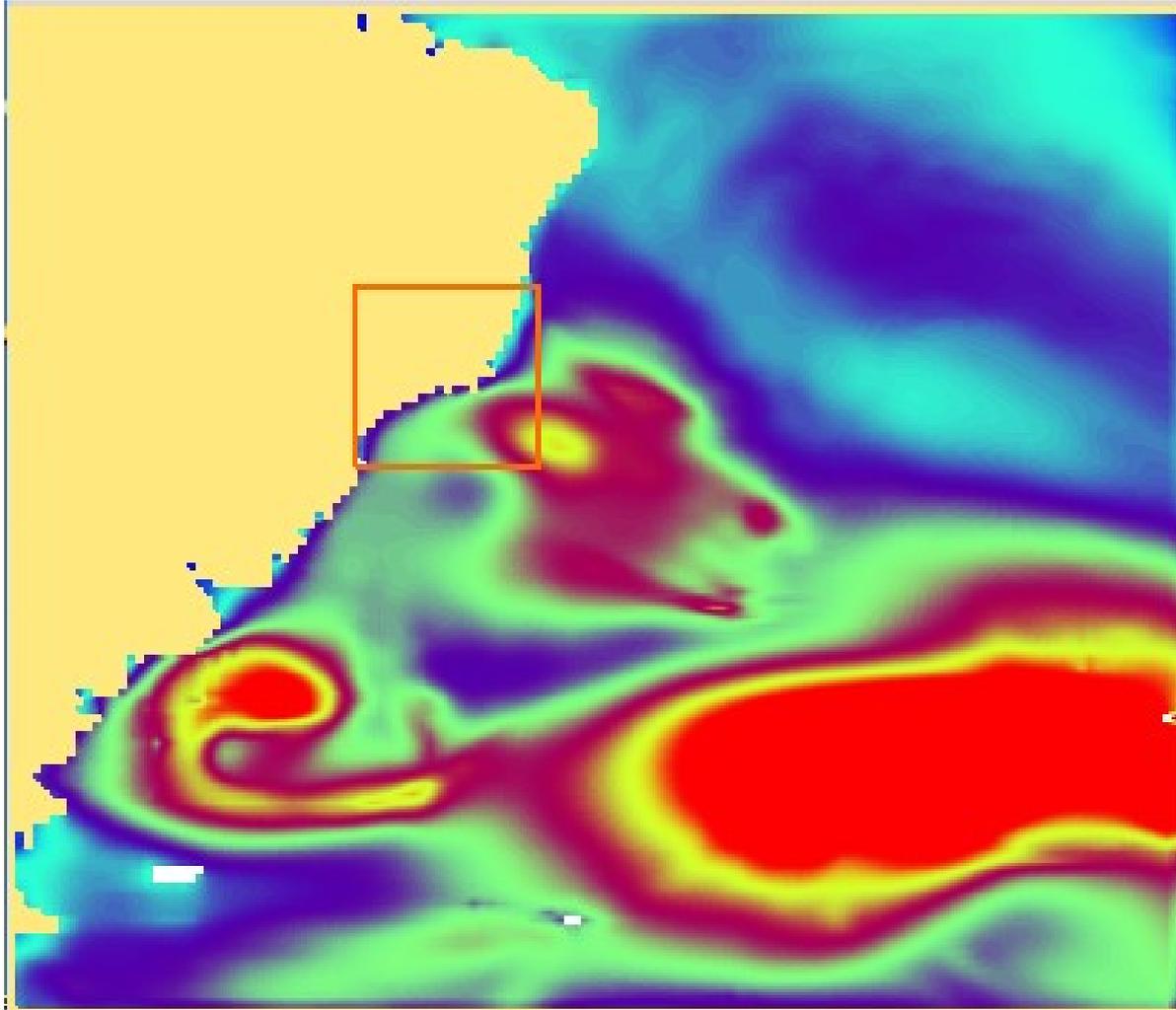




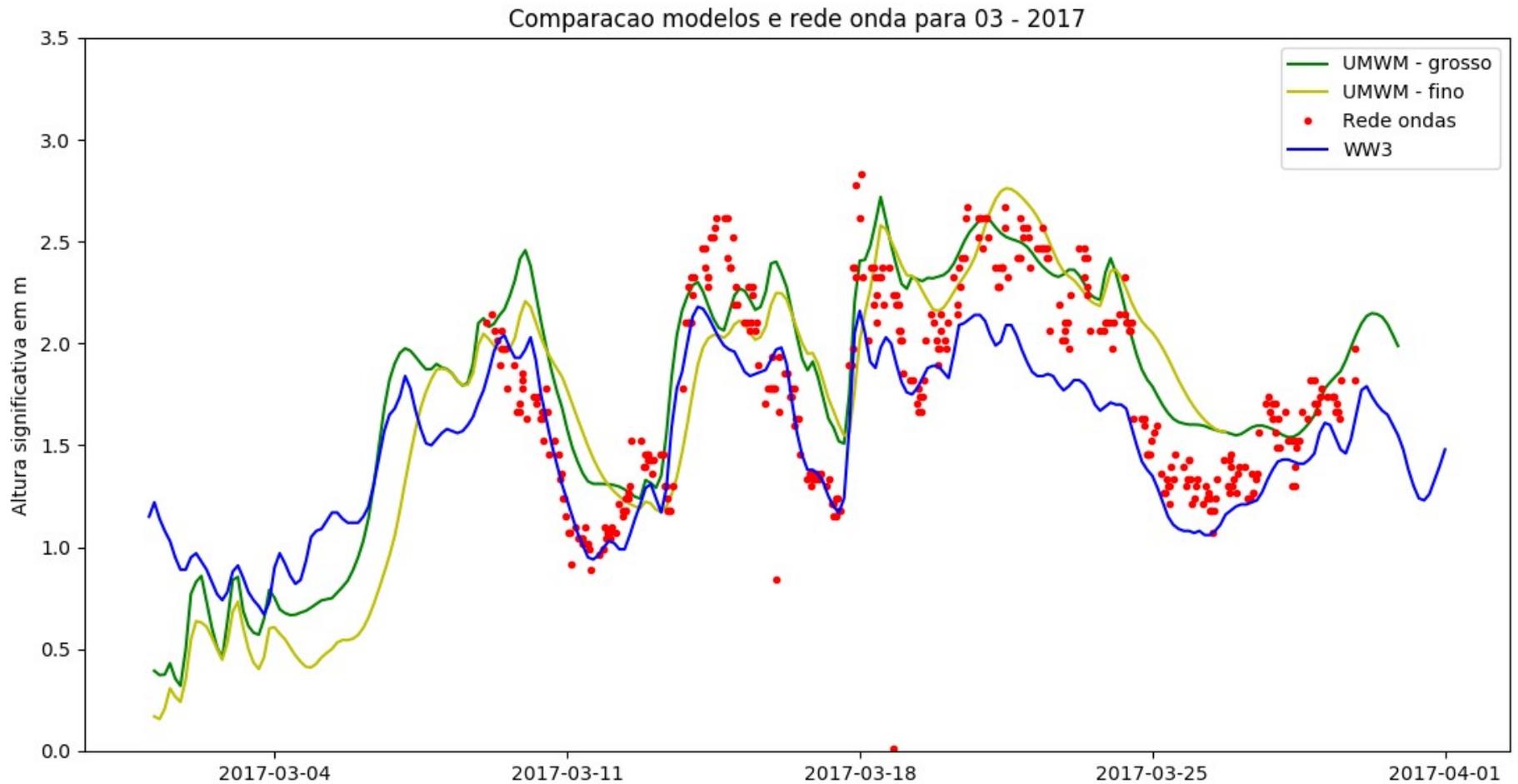
# Resultado de Modelos

- CPTEC (<https://www.cptec.inpe.br>)
- NOAA (<https://polar.ncep.noaa.gov/waves/>)

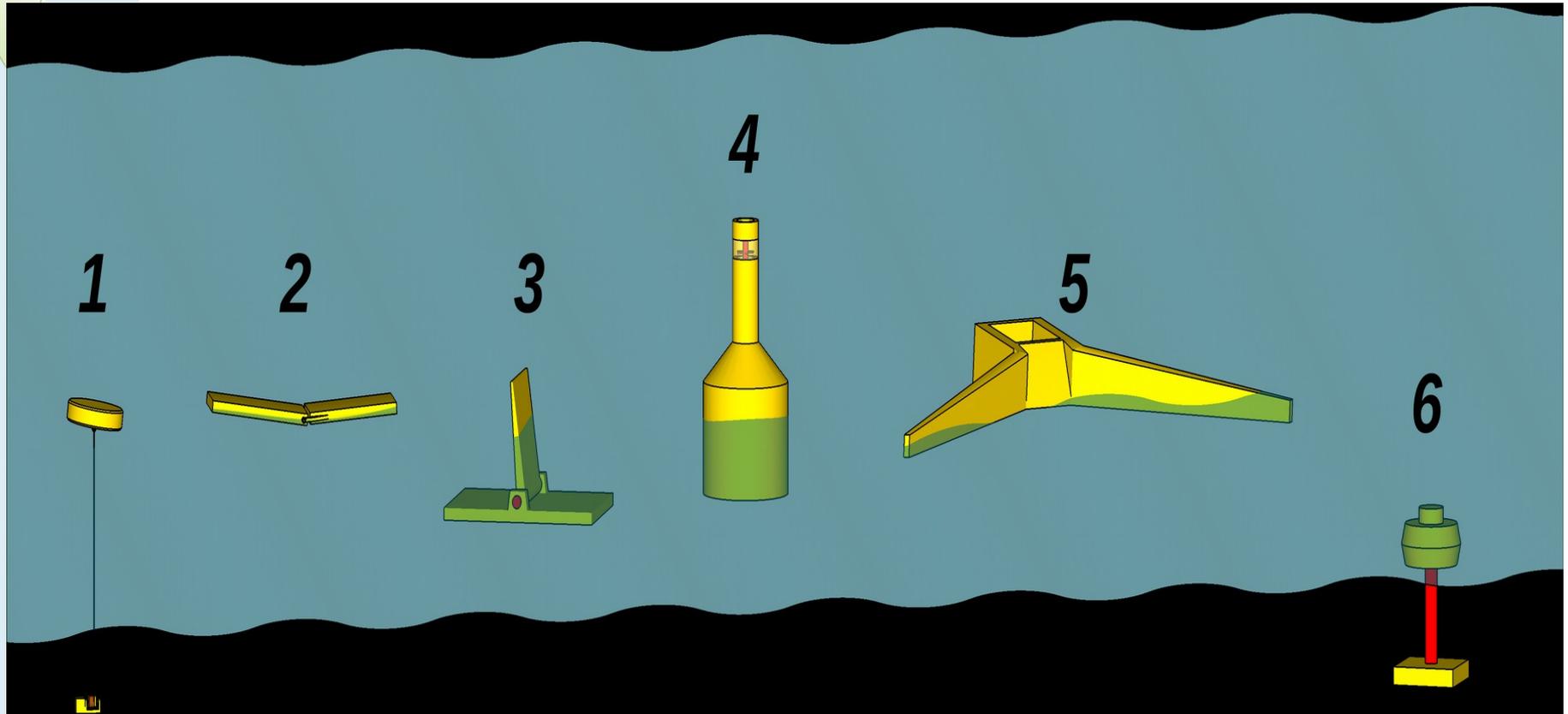
# Potencial em SSB - Ondas



# Potencial em SSB - Ondas

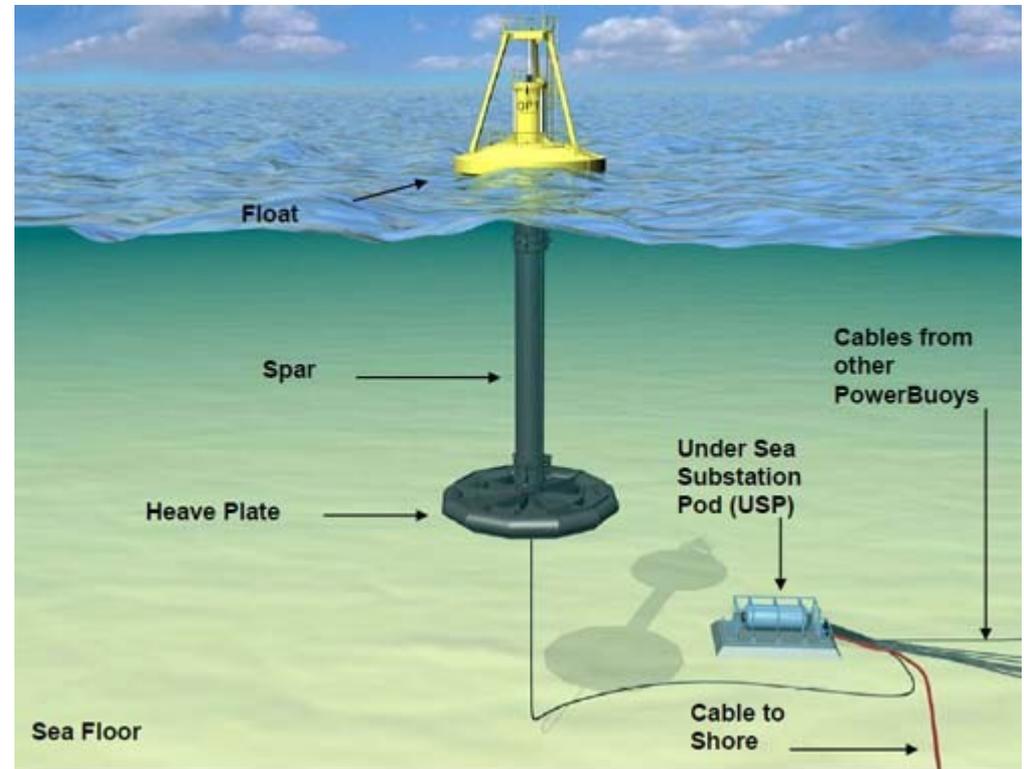
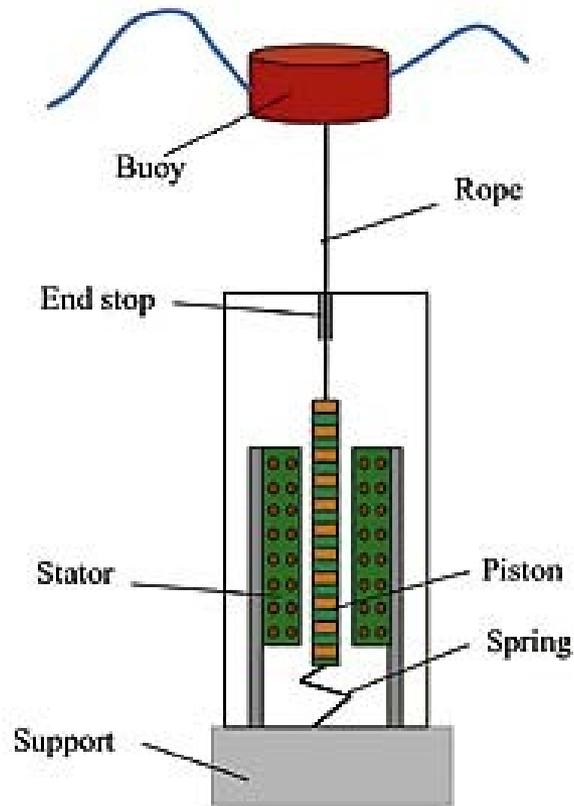


# Conversores Ondas



# Conversores Ondas

## Point Absorber Buoy



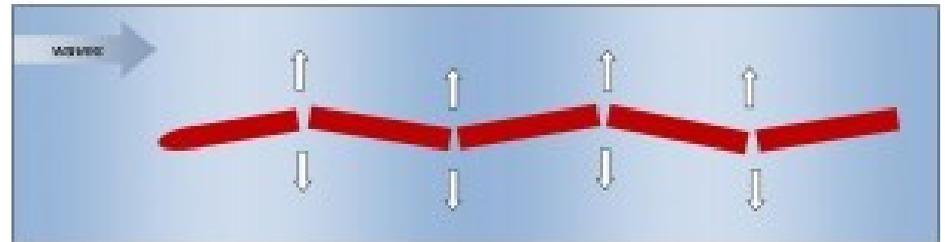
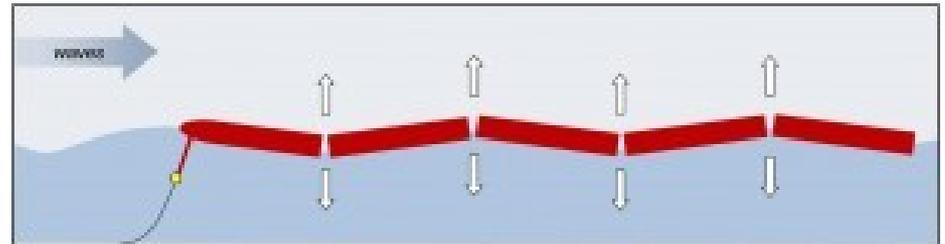


# Conversores Ondas



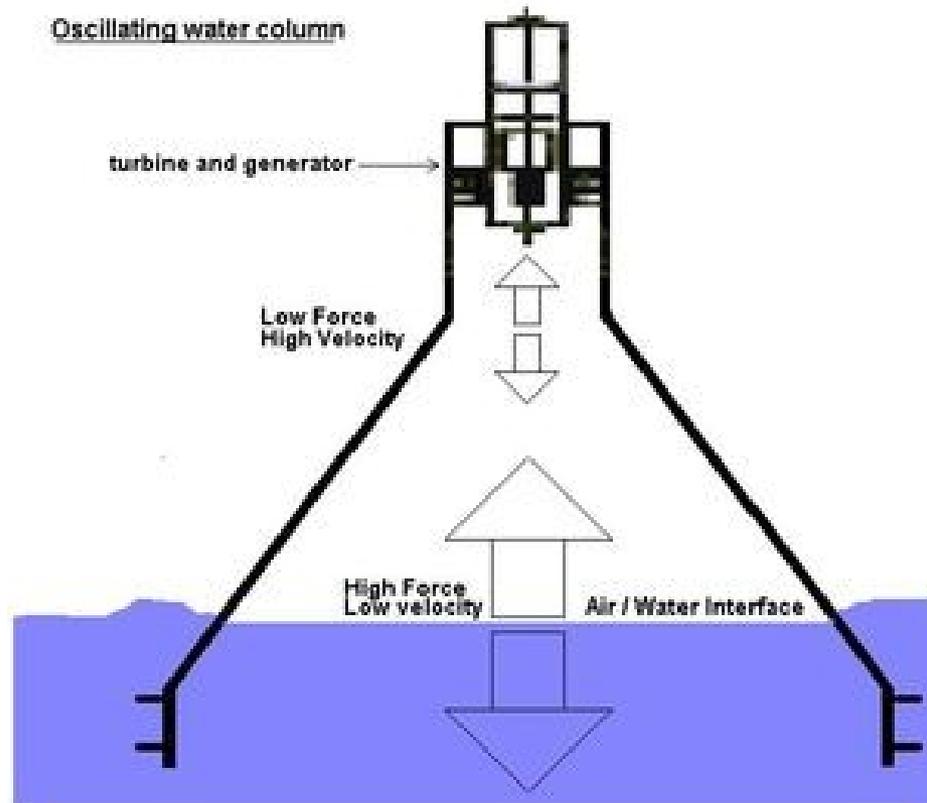
# Conversores Ondas

## □ Pelamis



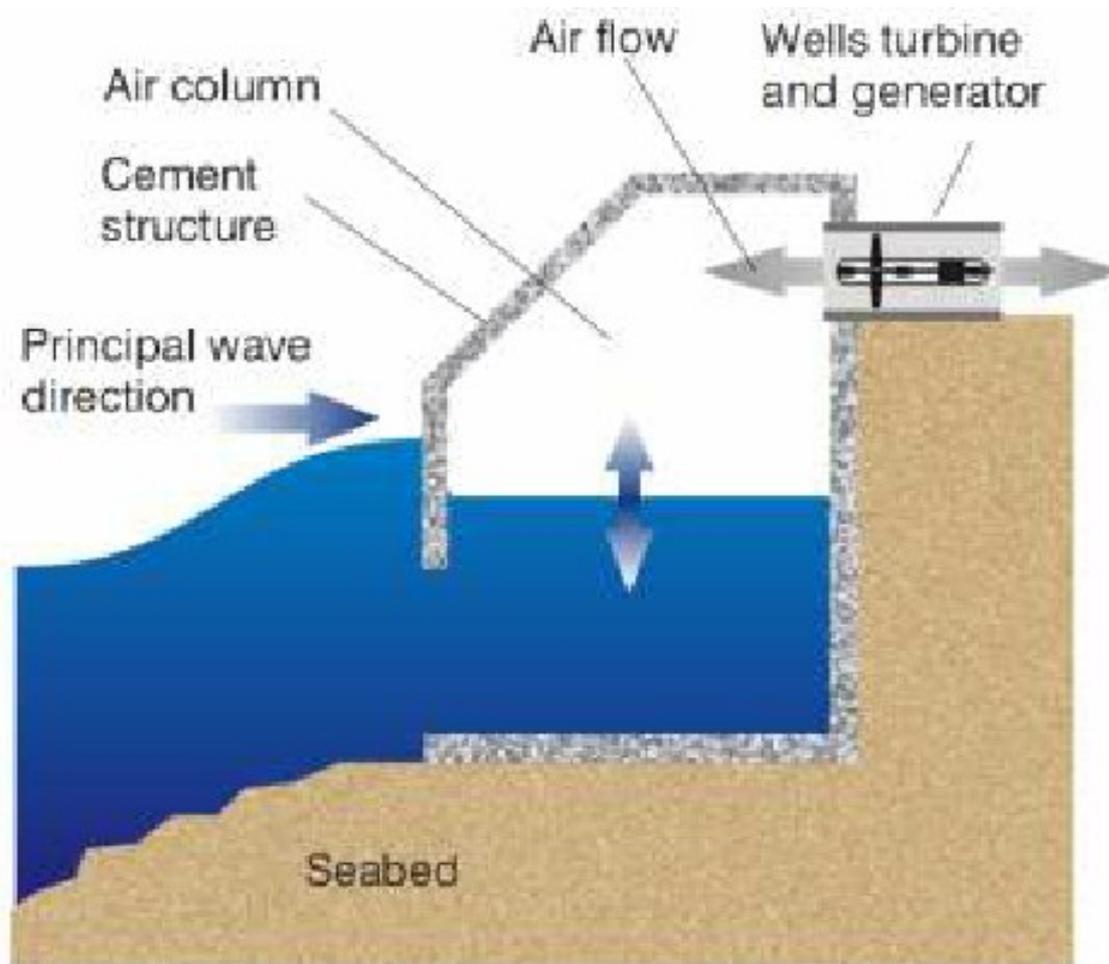
# Conversores Ondas

## □ Oscillating Water Column



# Conversores Ondas

## □ Oscillating Water Column



# Conversores Ondas

□ OWC – Usina de Pico, Açores



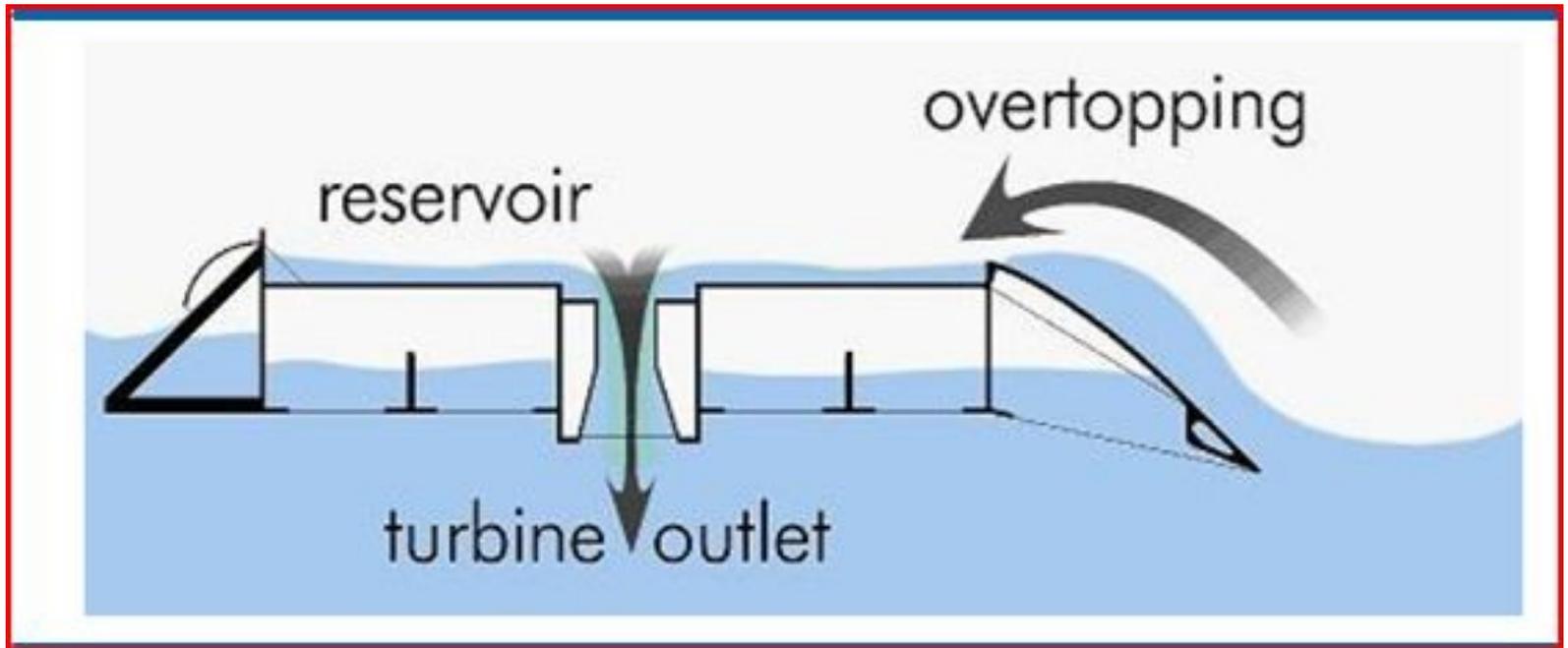
# Conversores Ondas

□ OWC - Oceanlinx



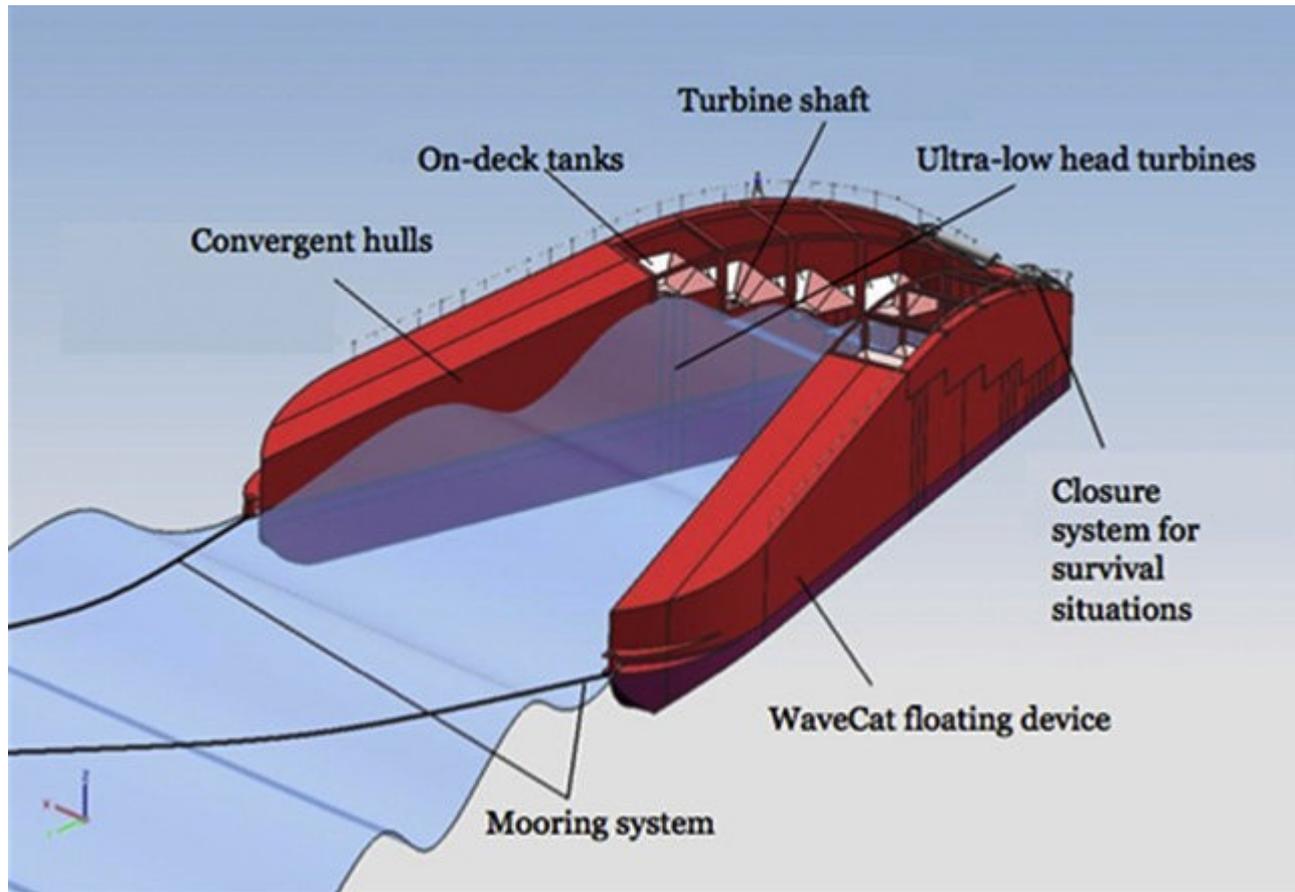
# Conversores Ondas

## □ Overtopping Device



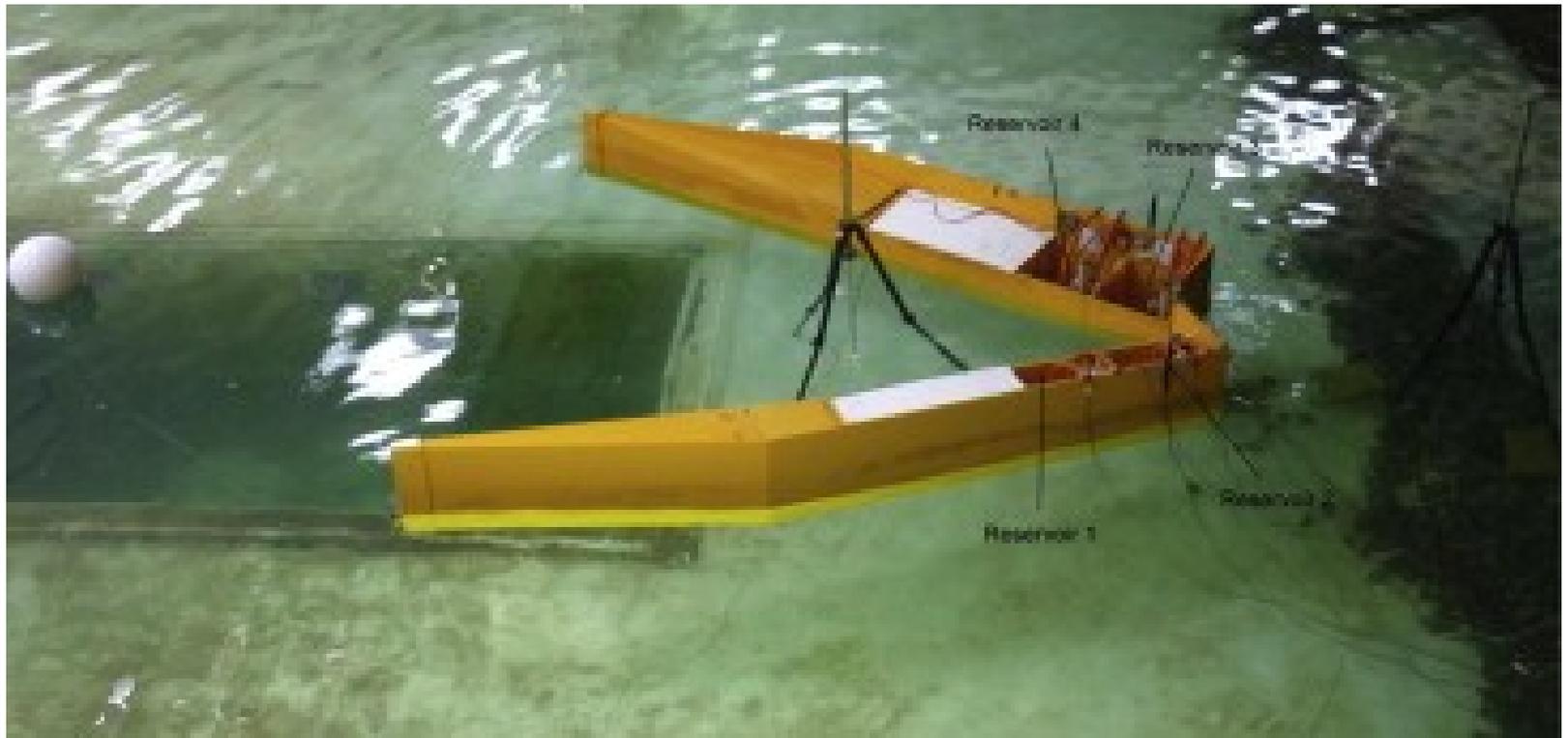
# Conversores Ondas

## □ Overtopping Device – WaveCat



# Conversores Ondas

- Overtopping Device – WaveCat



# Conversores Ondas

## □ Eccentric Mass



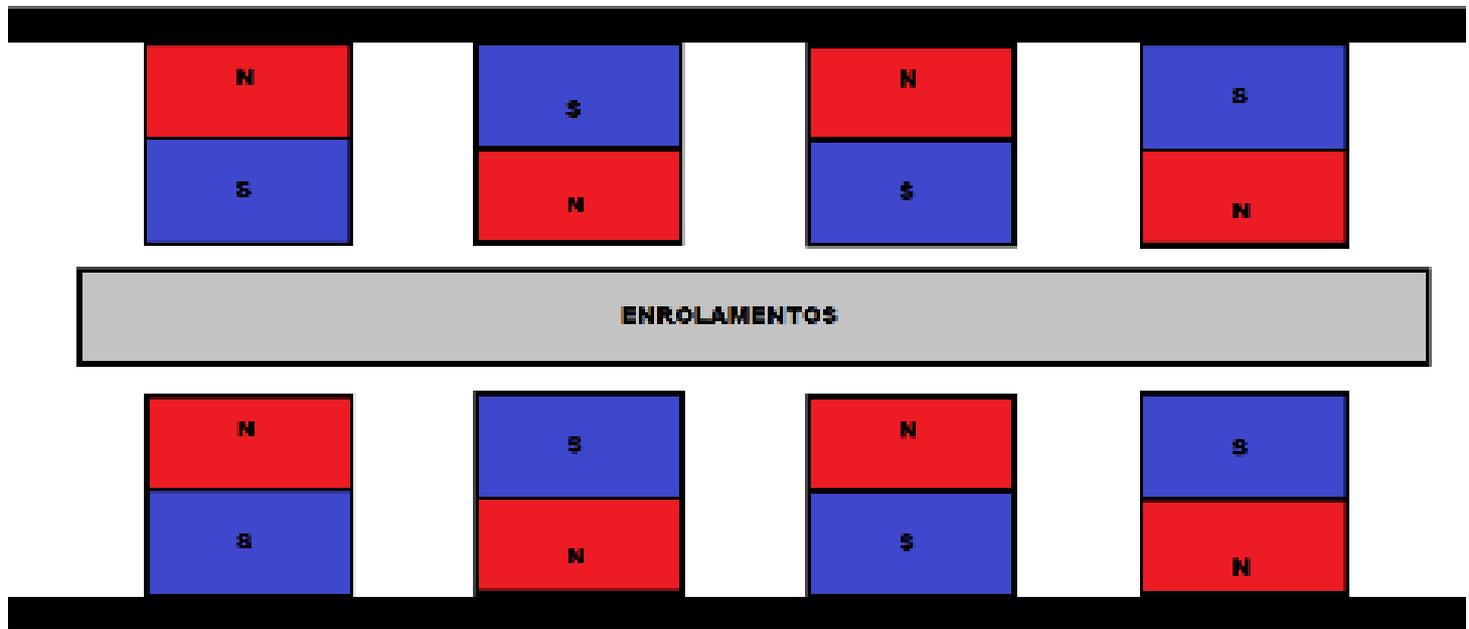
# Conversores Ondas

## □ Eccentric Mass - Wello

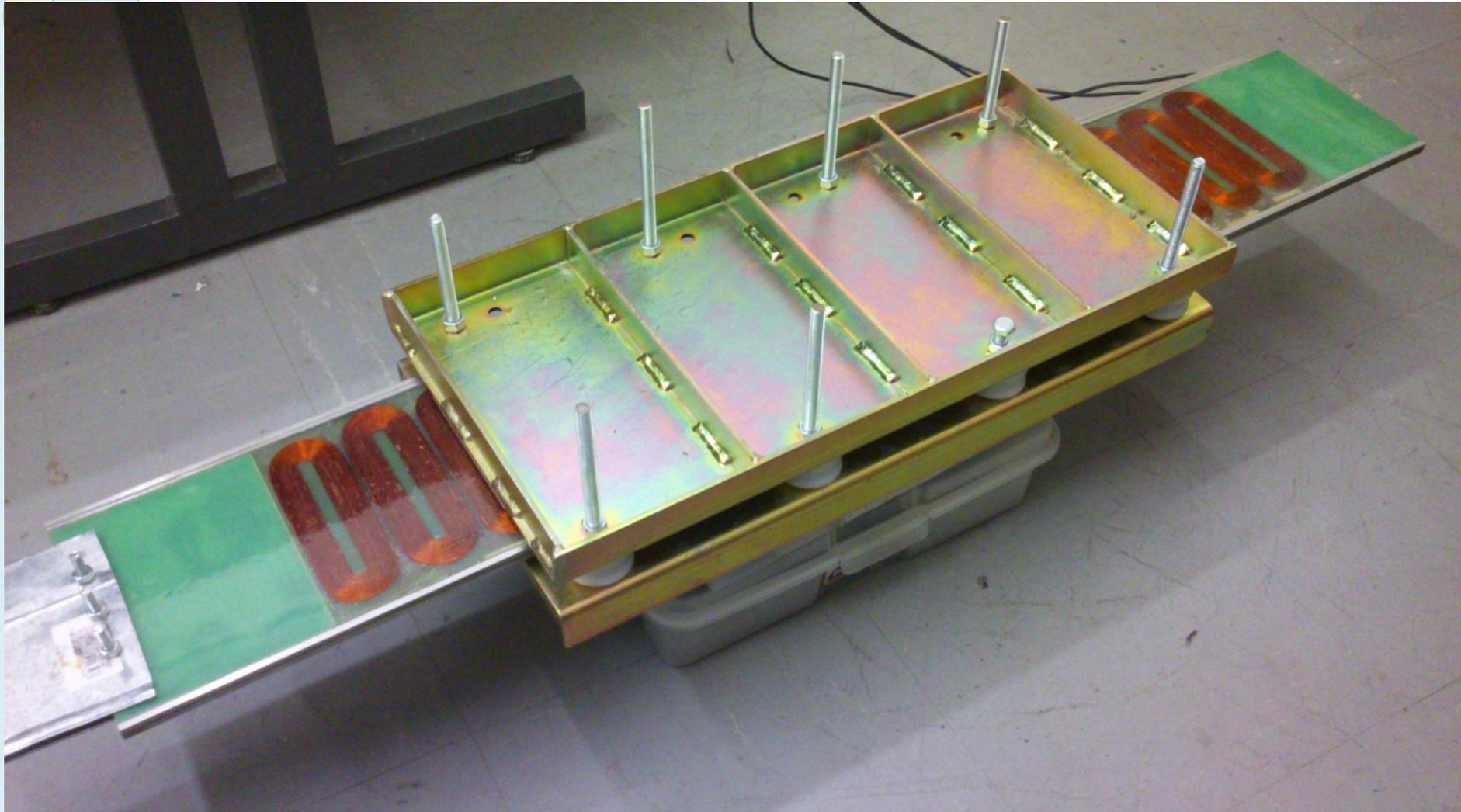


# Geradores Lineares

## □ Movimento linear

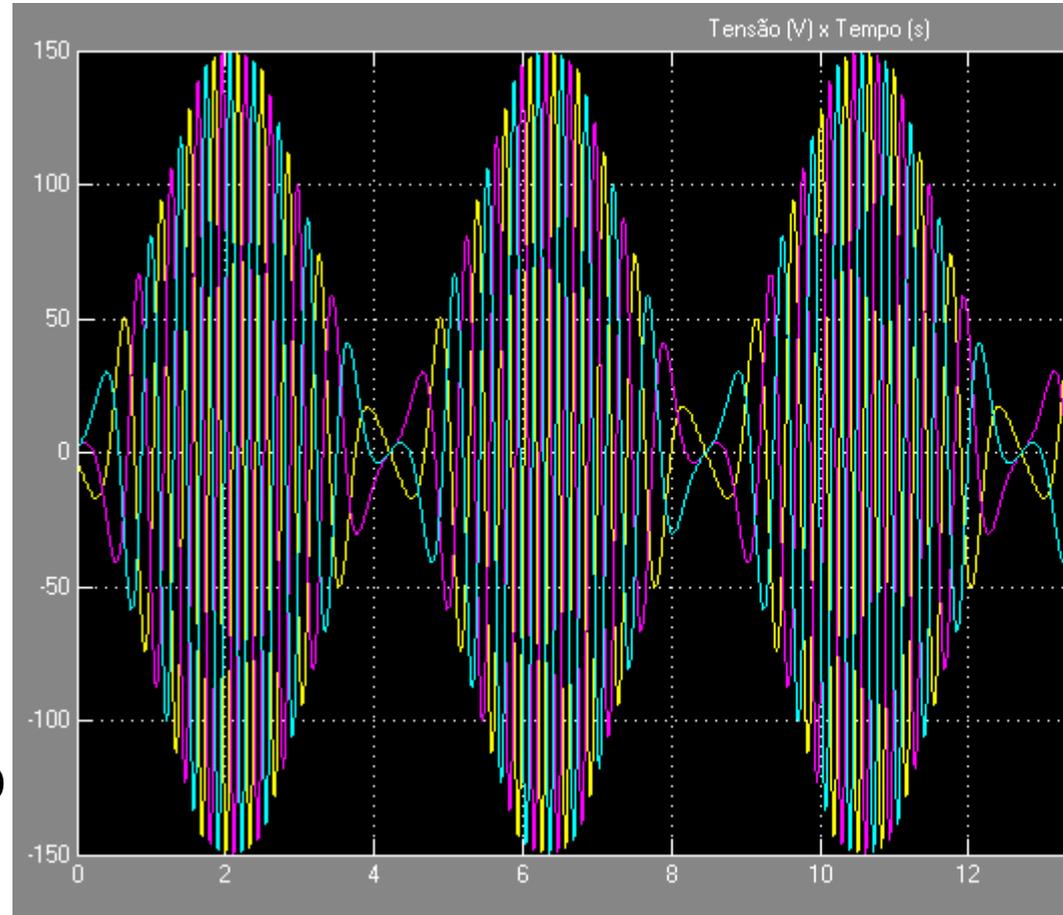


# Geradores Lineares



# Geradores Lineares

- $E = B.l.v$
- Baixa velocidade
- Forma de onda pulsada
- Requer acondicionamento



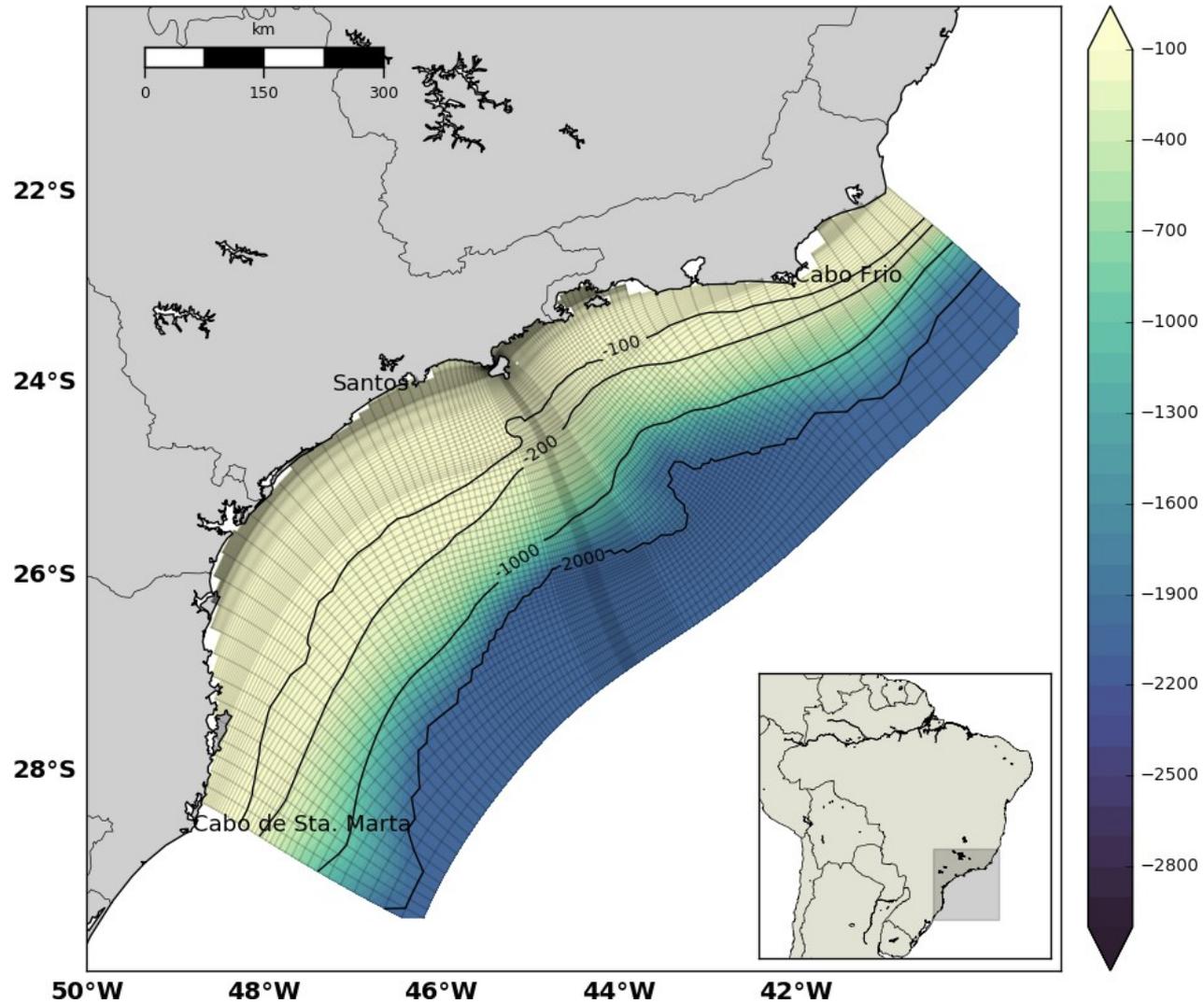


# Energia de Correntes

As correntes podem ser geradas por marés astronômicas, ventos e gradientes de densidade.

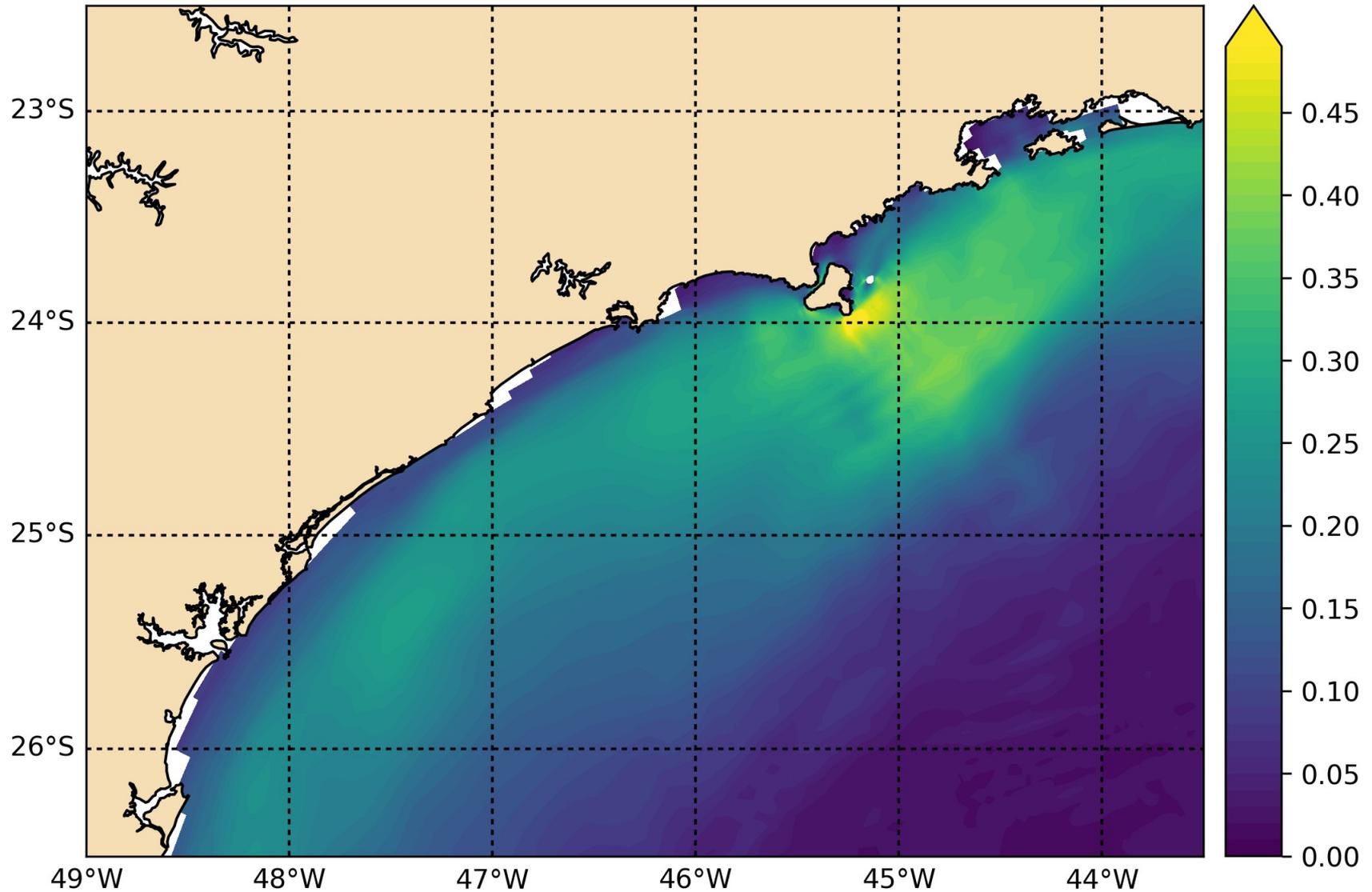
<https://teses.usp.br/teses/disponiveis/21/21135/tde-09012019-135013/pt-br.php>

# Potencial em SSB - Correntes

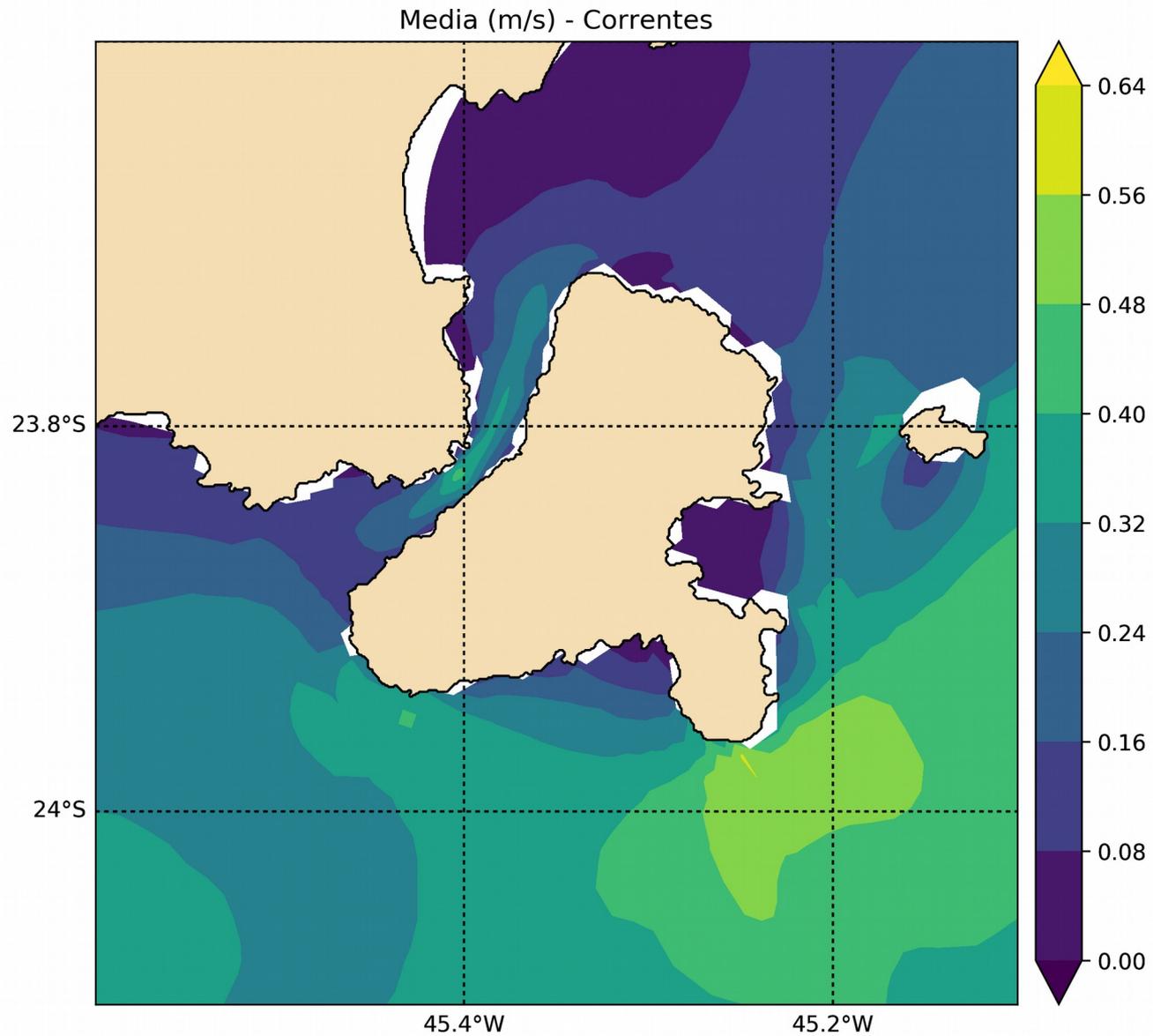


# Potencial em SSB - Correntes

Media (m/s) - Correntes



# Potencial em SSB - Correntes



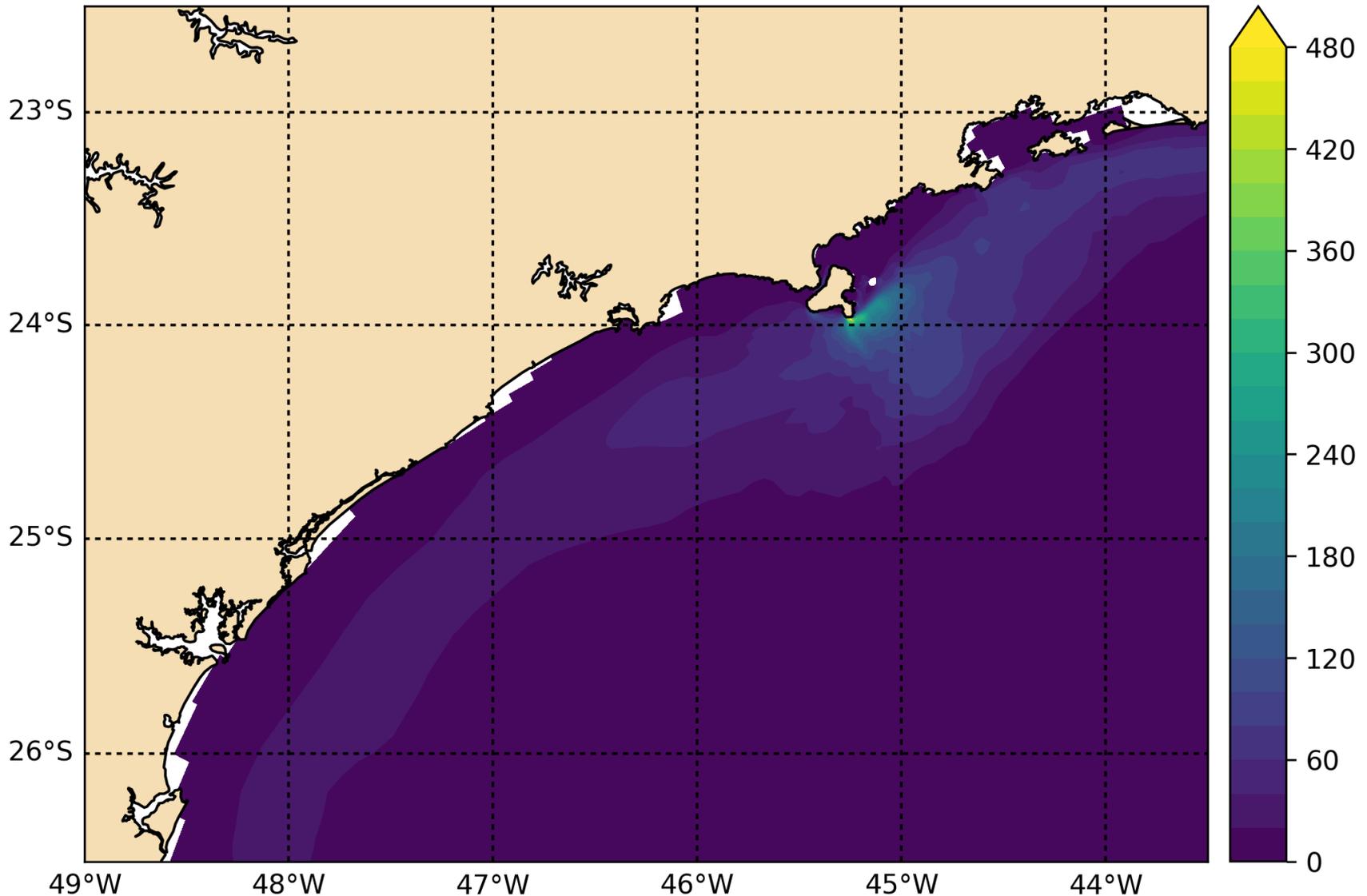
# Potencial em SSB - Correntes

Densidade de potência

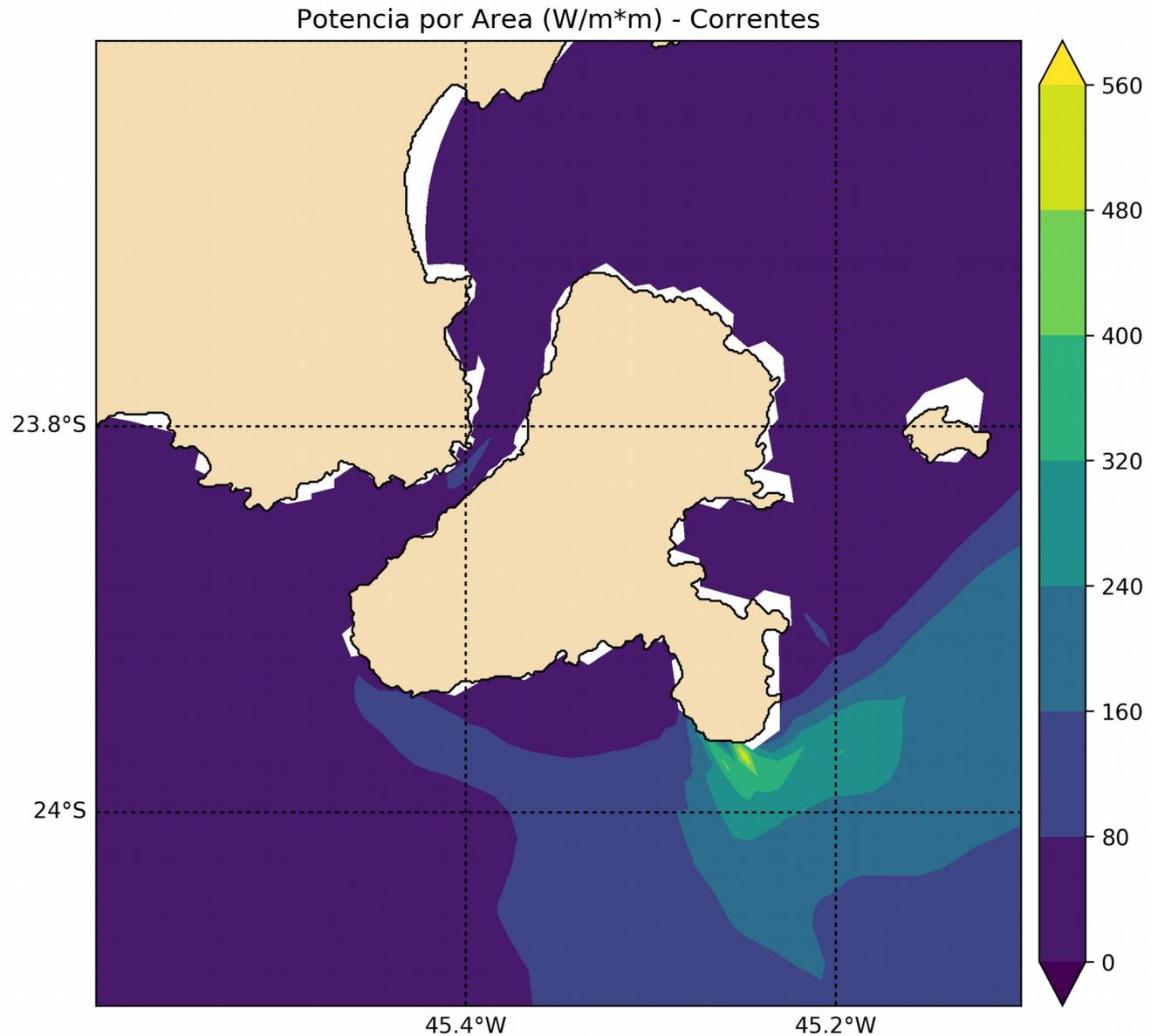
$$\frac{P}{A} = 0,5 \rho v^3$$

# Potencial em SSB - Correntes

Potencia por area (W/m<sup>2</sup>) - Correntes

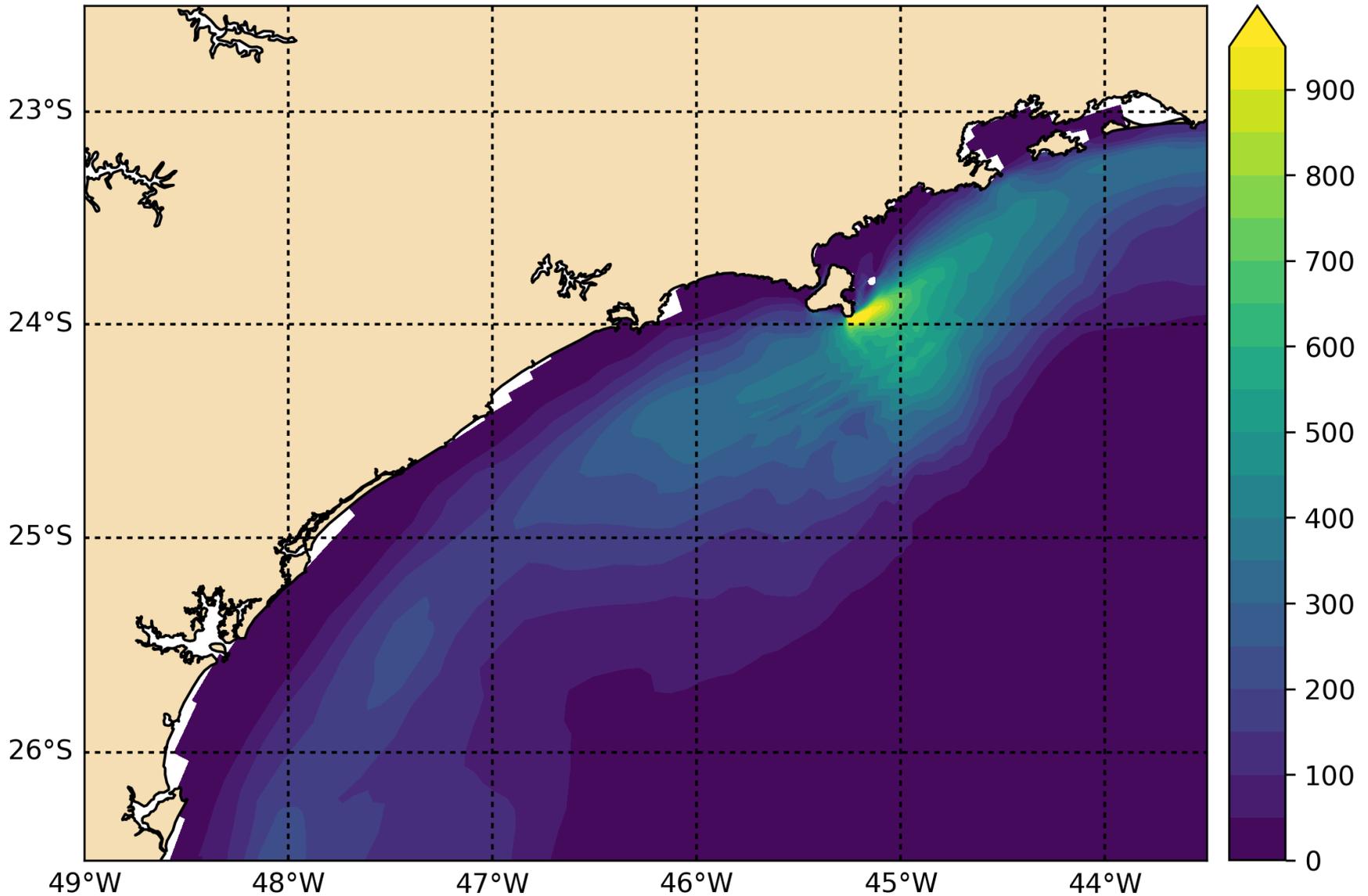


# Potencial em SSB - Correntes



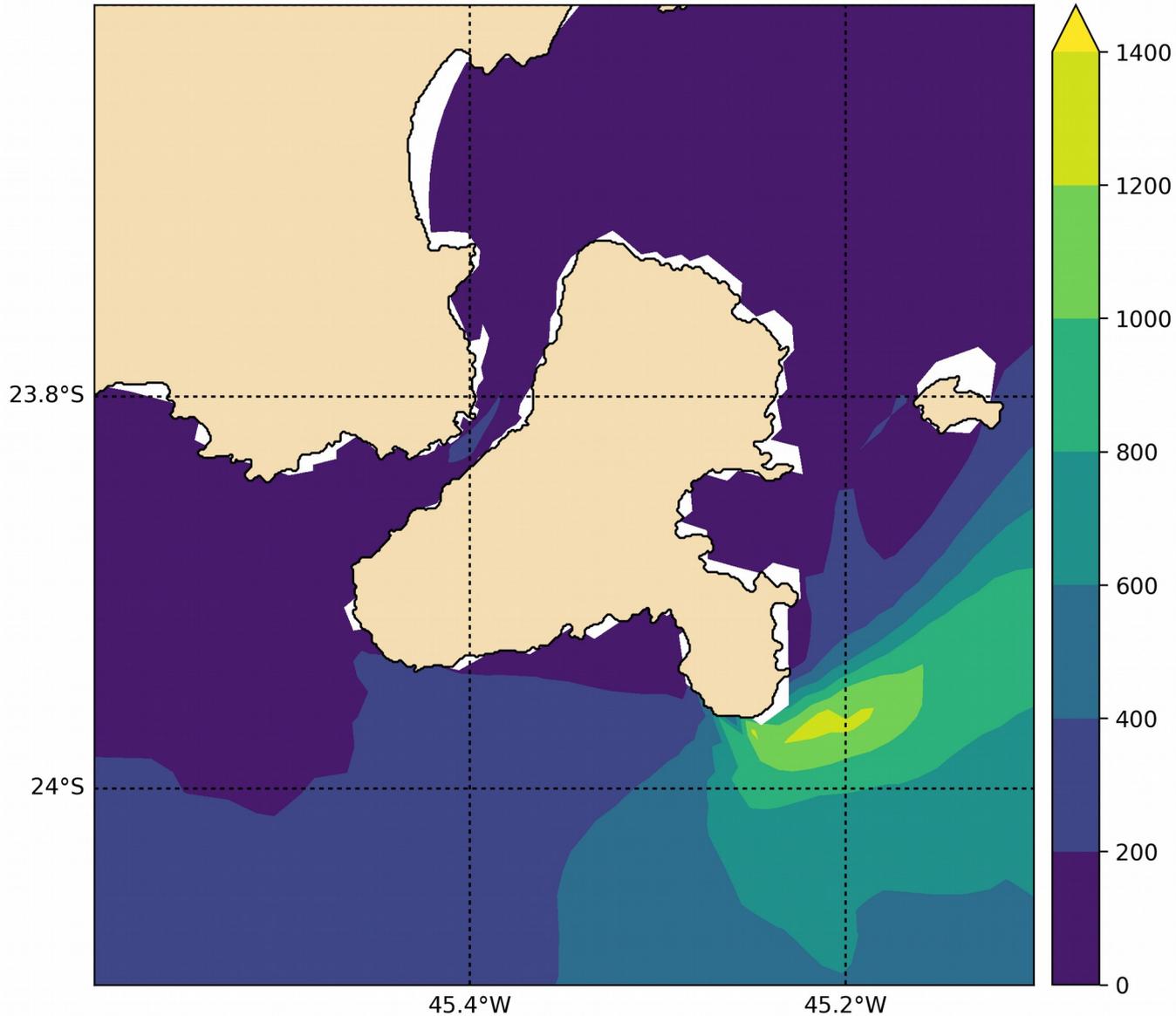
# Potencial em SSB - Correntes

Potencia por area (W/m<sup>2</sup>) - Correntes - Sup



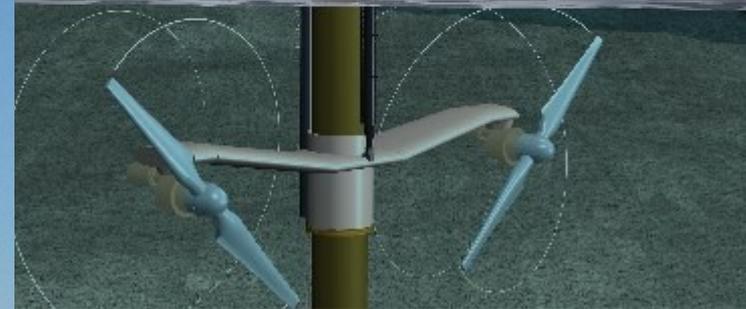
# Potencial em SSB - Correntes

Potencia por area (W/m<sup>2</sup>) - Correntes - Sup



# Energia Oceânica

- Correntes - SeaGen



# Energia Oceânica

- Correntes - Orkney EMEC



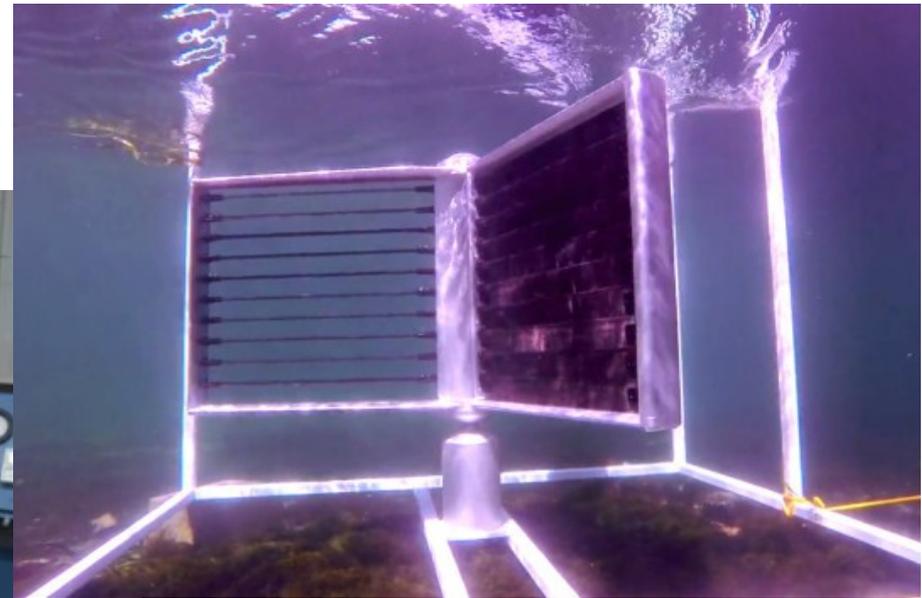
# Energia Oceânica

- Correntes - SABELLA



# Energia Oceânica

- Corrente – Crowd Energy



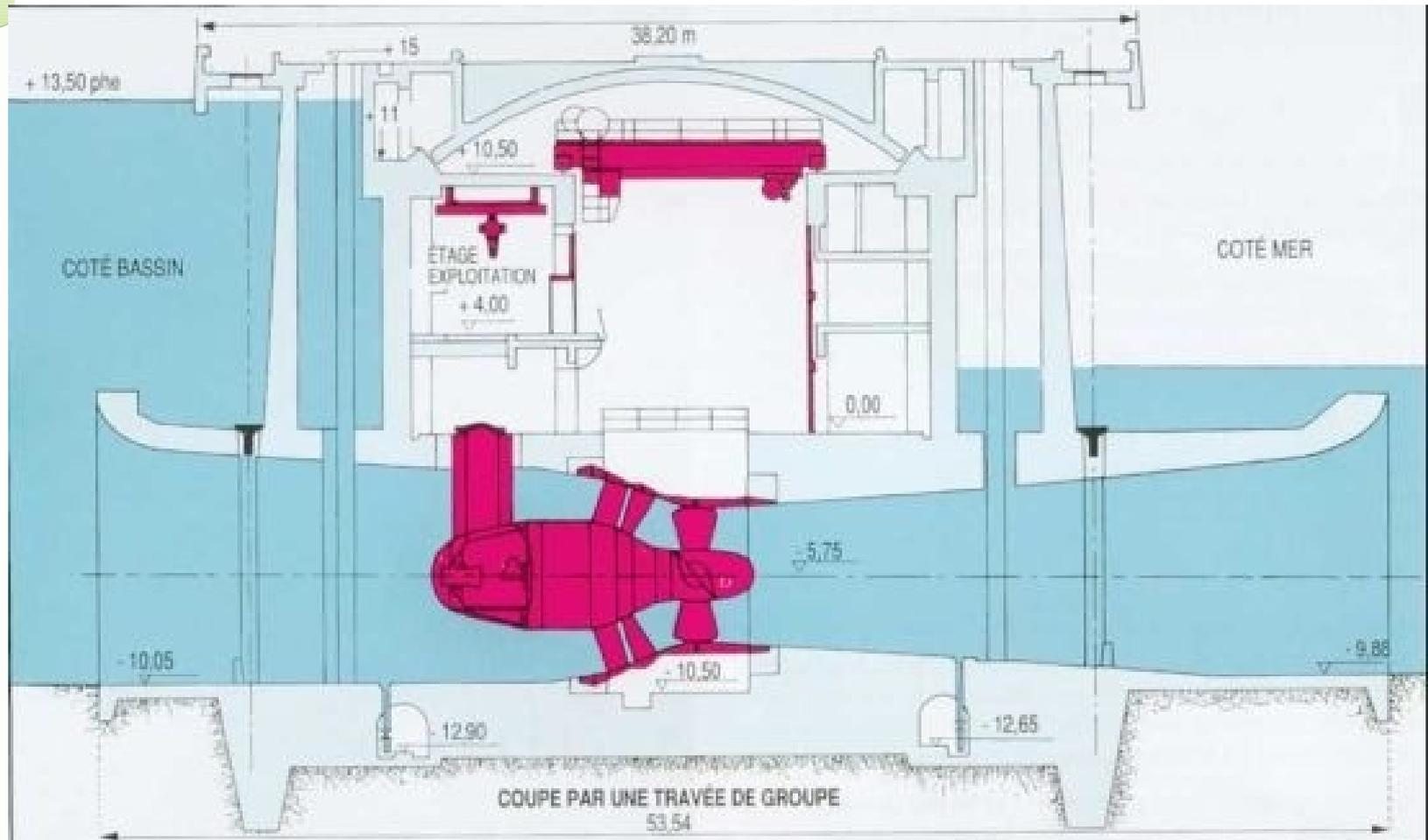
# Energia Oceânica

- Maré com barragem - La Rance  
240MW



# Energia Oceânica

- Maré com barragem - La Rance



# Energia Oceânica

- Maré com barragem - Sihwa-Lake  
254MW



# Energia Oceânica

- Estuário do rio Bacanga - MA

