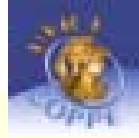




laboratório de dinâmica  
de sedimentos coesivos



## **Problemas de navegação na Barra Norte do rio Amazonas**

### **Navigation Issues on the Amazon North Channel**

**Susana Vinzon, Marcos Gallo, Rodrigo  
Fernandes, Carla Vilela**

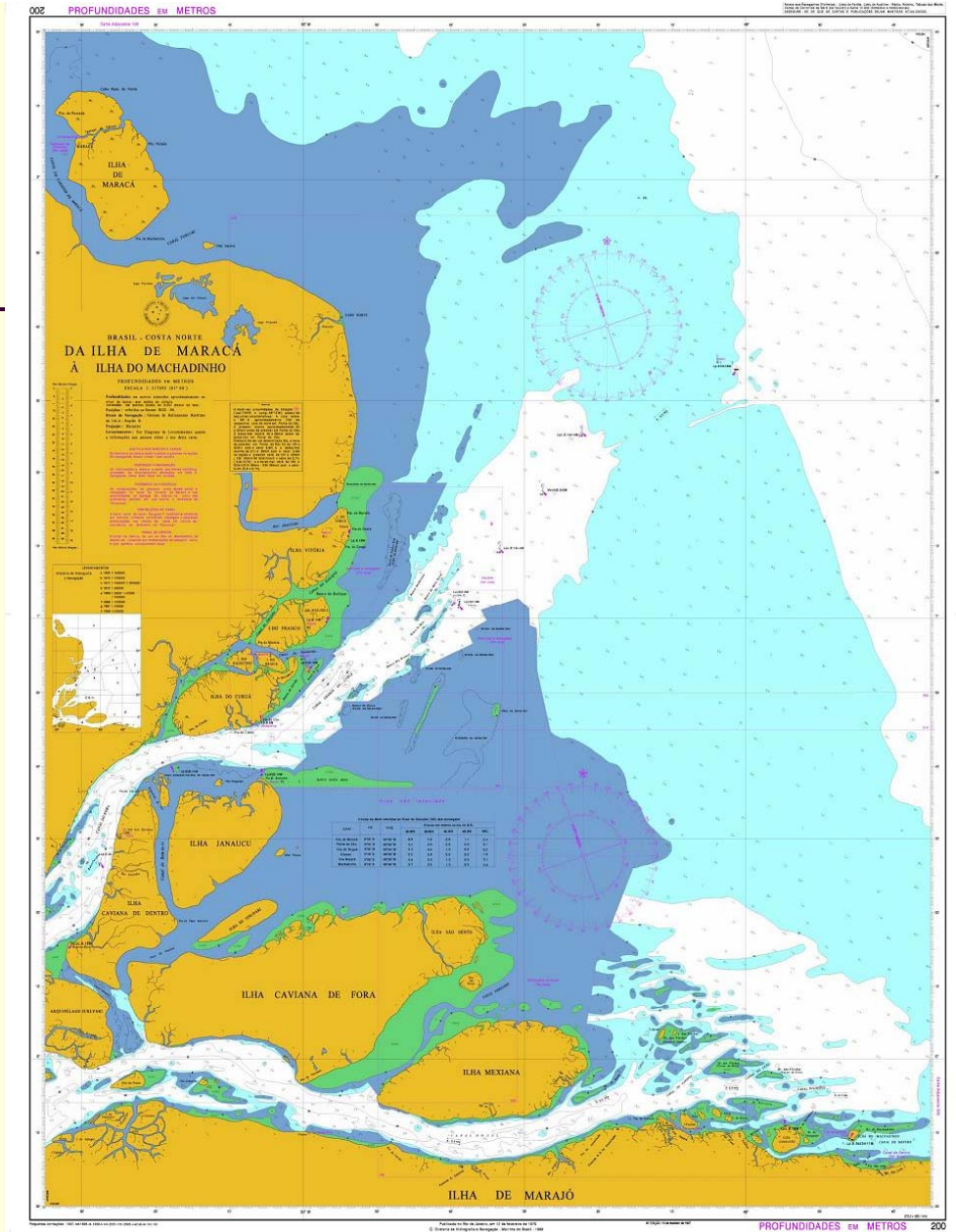
Coastal and Oceanographic Engineering Area,  
COPPE, UFRJ

**Cte Augusto Silva, Cte Alberto Costa Neves,  
Cte Maria Fernanda Rezende**

Centro de Hidrografia da Marinha (CHM),  
Brazilian Navy

**Marcio Sousa Silva**

Instituto Estadual de Pesquisas do Amapá (IEPA)

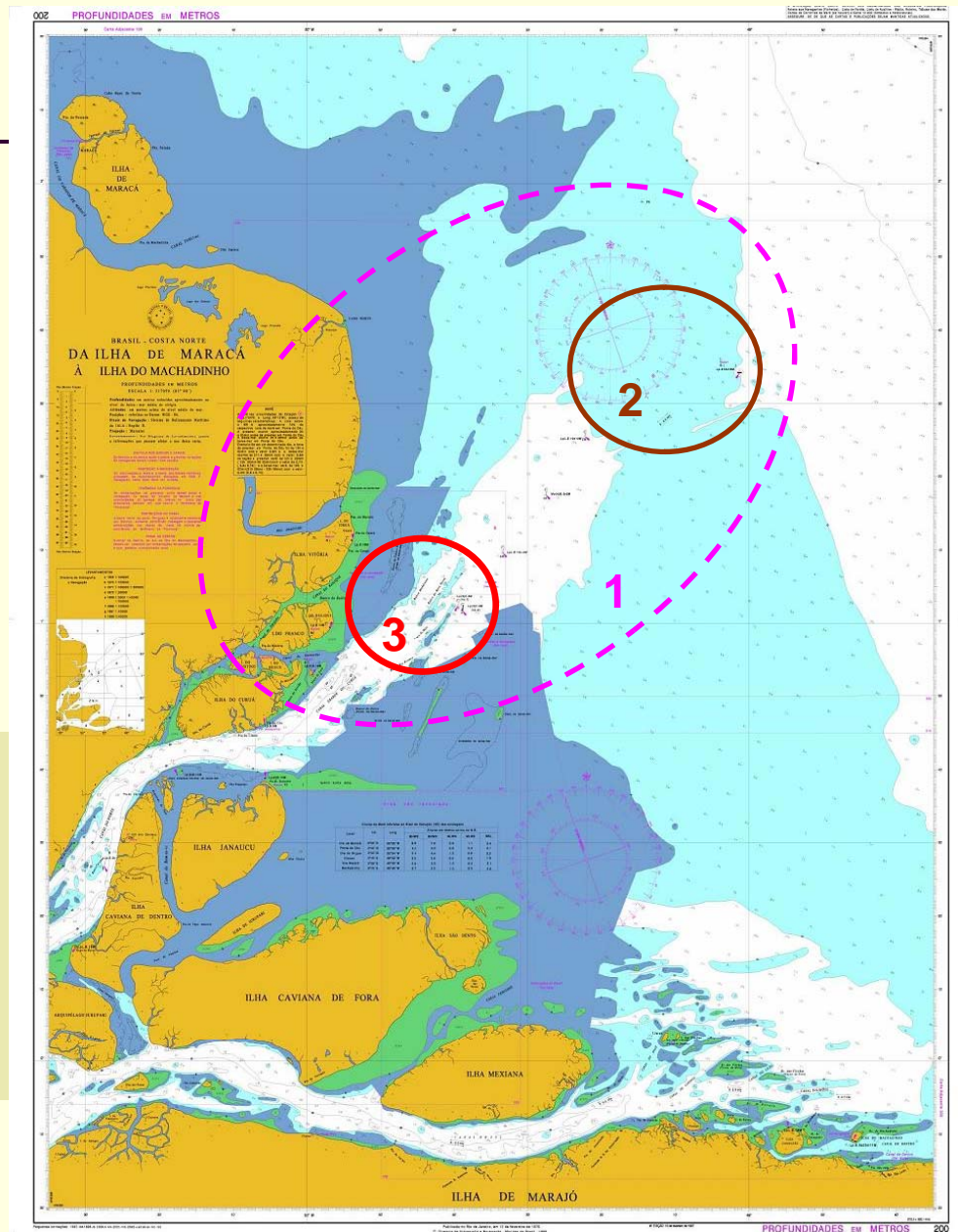


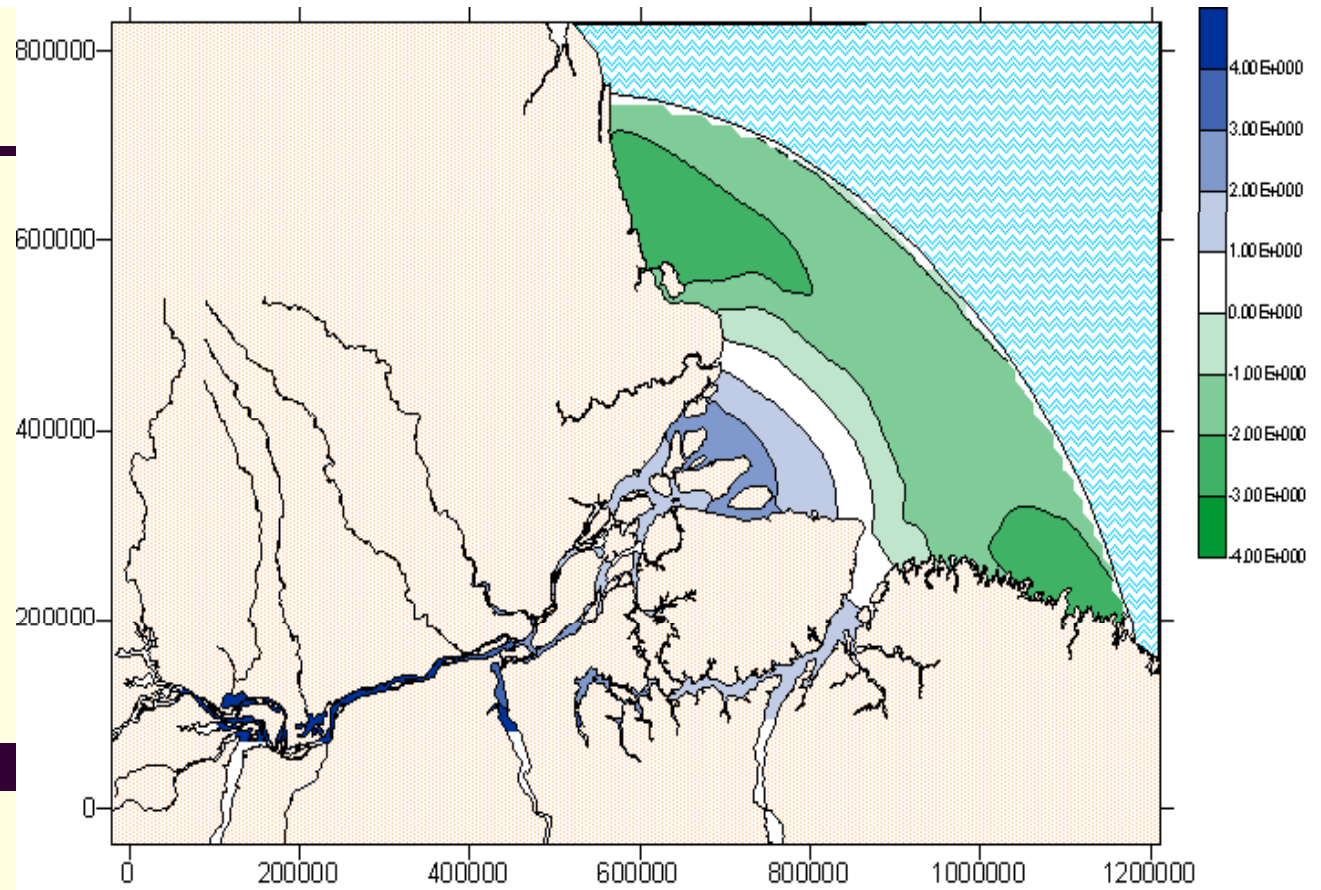
## ***Problemas de navegação na Barra Norte do rio Amazonas***

- 1. Extensão e variabilidade da maré (redução de sondagens e previsão de maré)**
- 2. Mínimas profundidades com fundo lamoso**
- 3. Migração de bancos de areia**

## ***Navigation Issues on the Amazon North Channel***

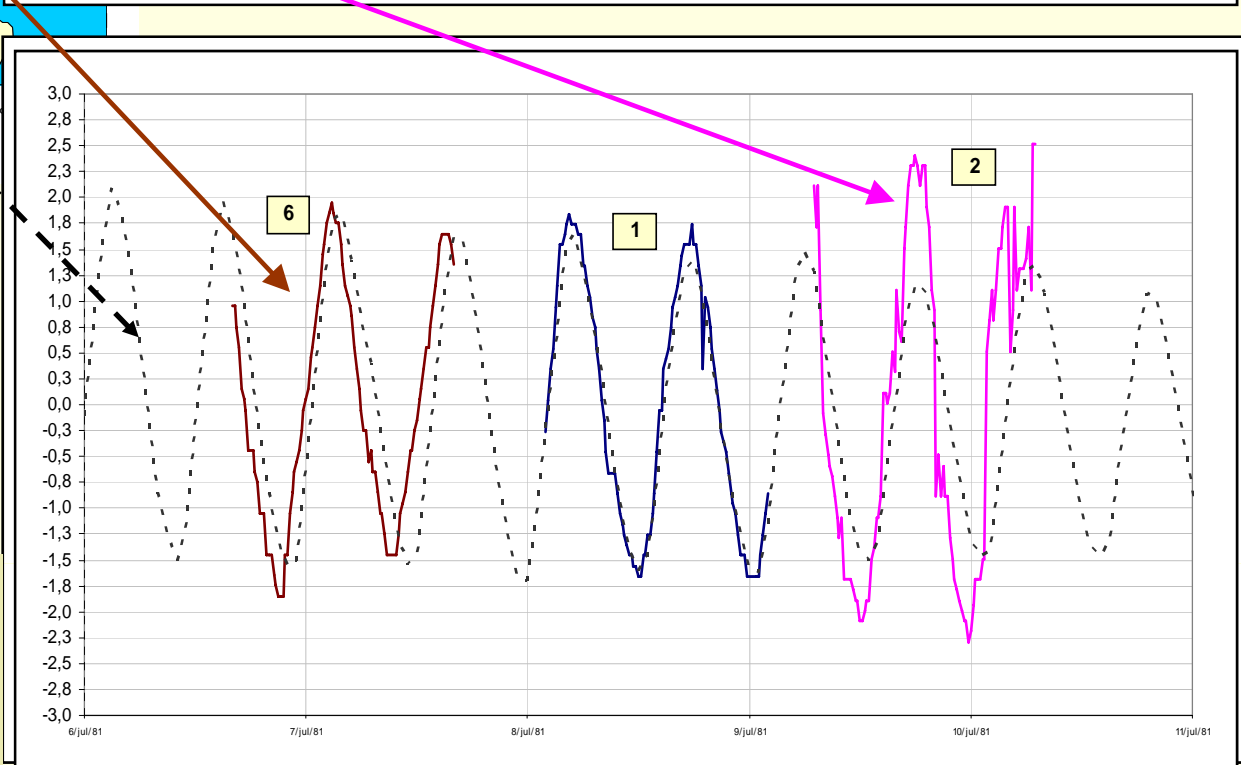
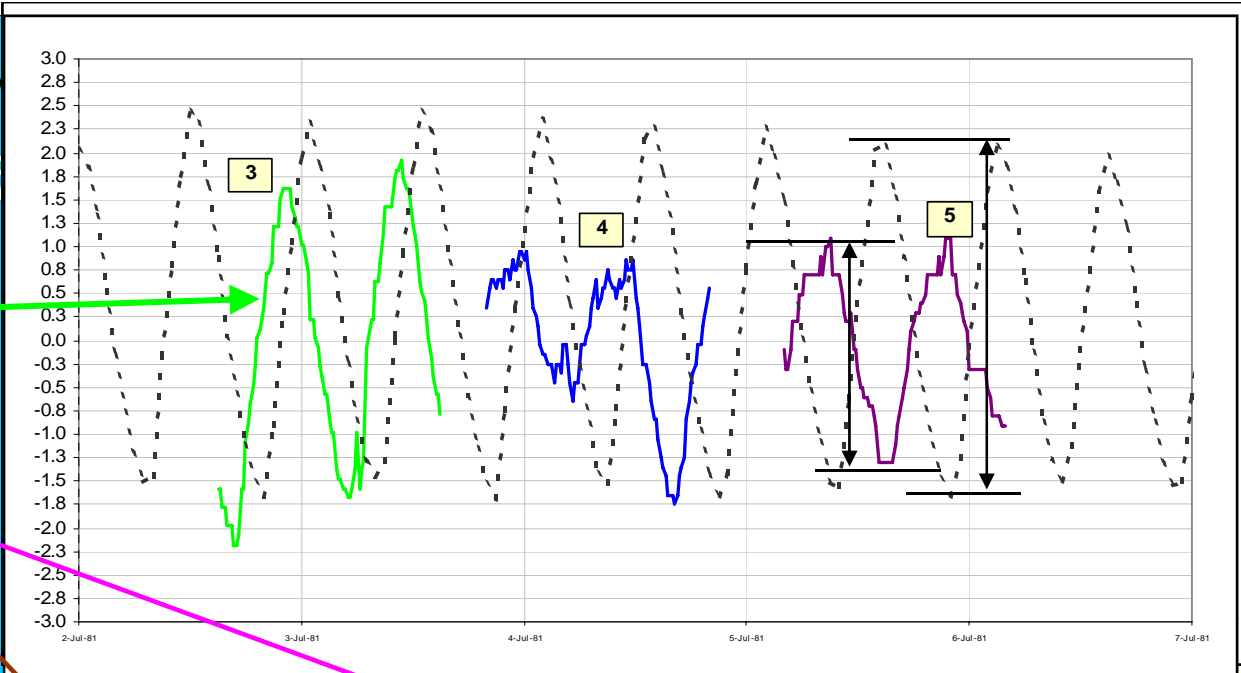
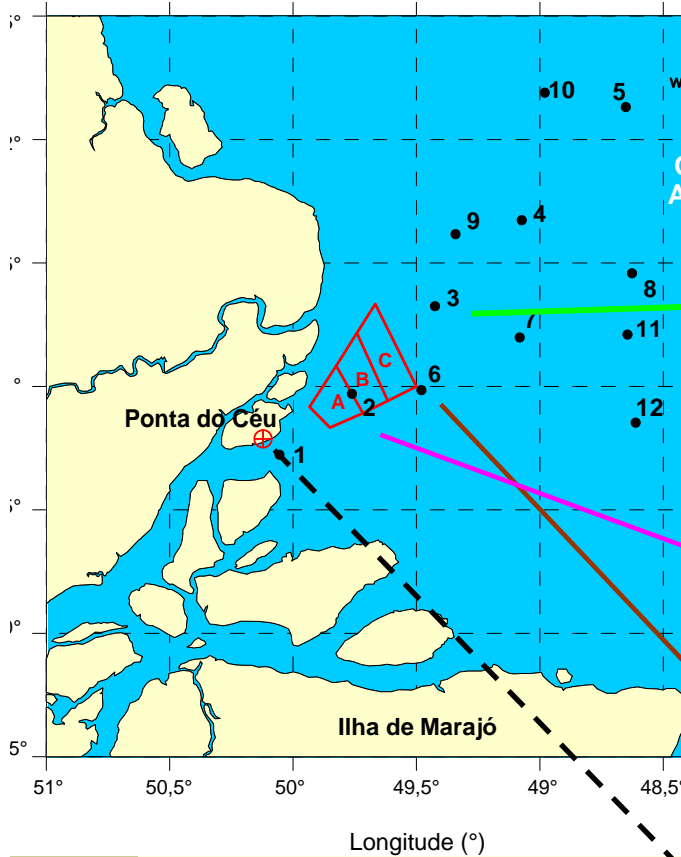
- 1. Large area & tidal variability (sounding reduction & tidal prediction)**
- 2. Minimum depth with fluid mud**
- 3. Sand bank migration**





## ***Problema 1: Variabilidade da Maré***

### ***Issue 1: Tidal Variability***



**Níveis d'água medidos:**

- Estação de referência (linha tracejada)
- Ao longo do canal (linha cheia)

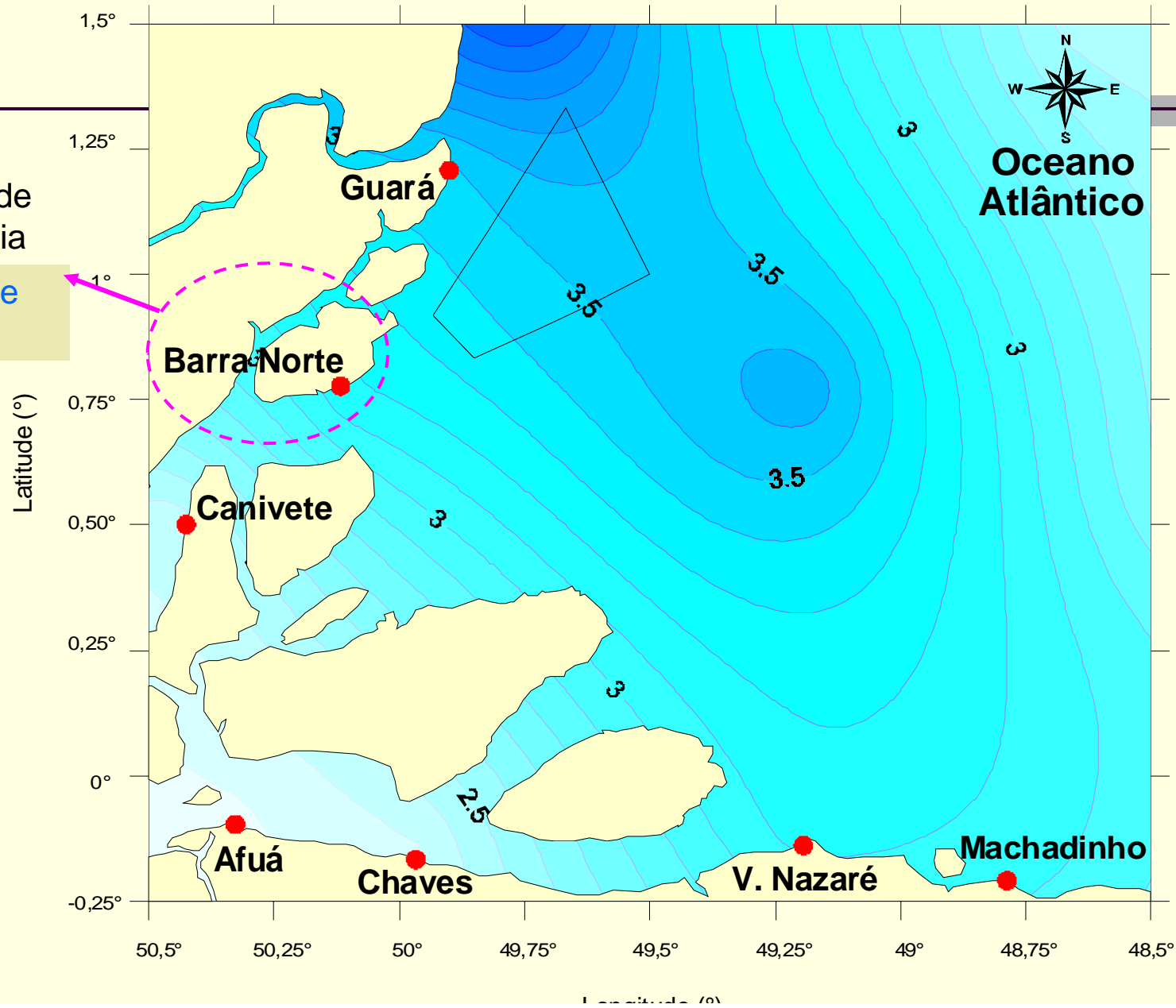
**Measured water level at:**

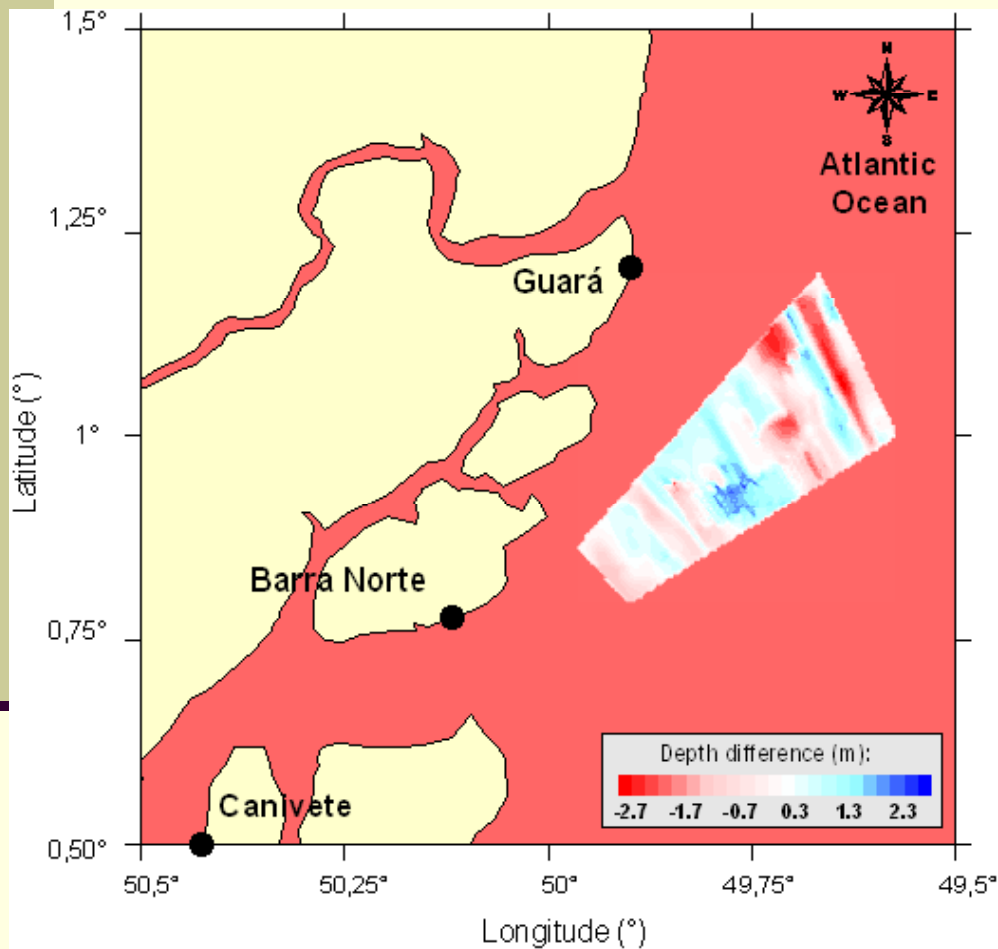
- Reference station (dot line)
- Along the navigation channel (solid lines)

# Amplitude da maré (componente $M_2$ )

Tidal amplitude ( $M_2$  compound)

Estação de Referência  
Reference Station





**Conseqüência na redução de sondagens:** Diferenças nas profundidades decorrentes do Método de Zoneamento Discreto

**Consequence in the sounding reduction:** Depth differences due to Discrete Zoning Method

**Positive differences (red) indicate lower depth than indicated in the navigation charts.**

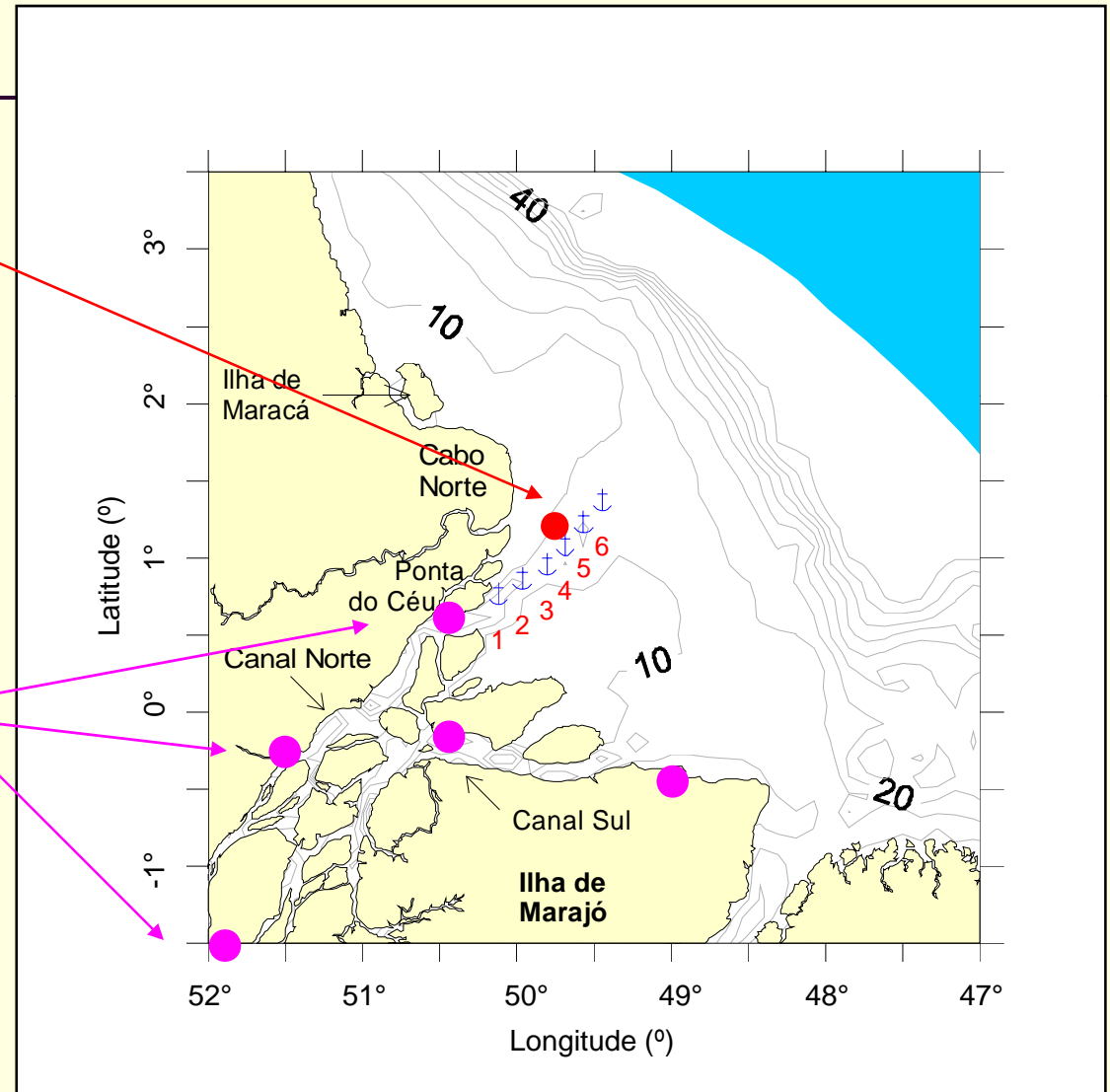
# PROJETO BARRA NORTE

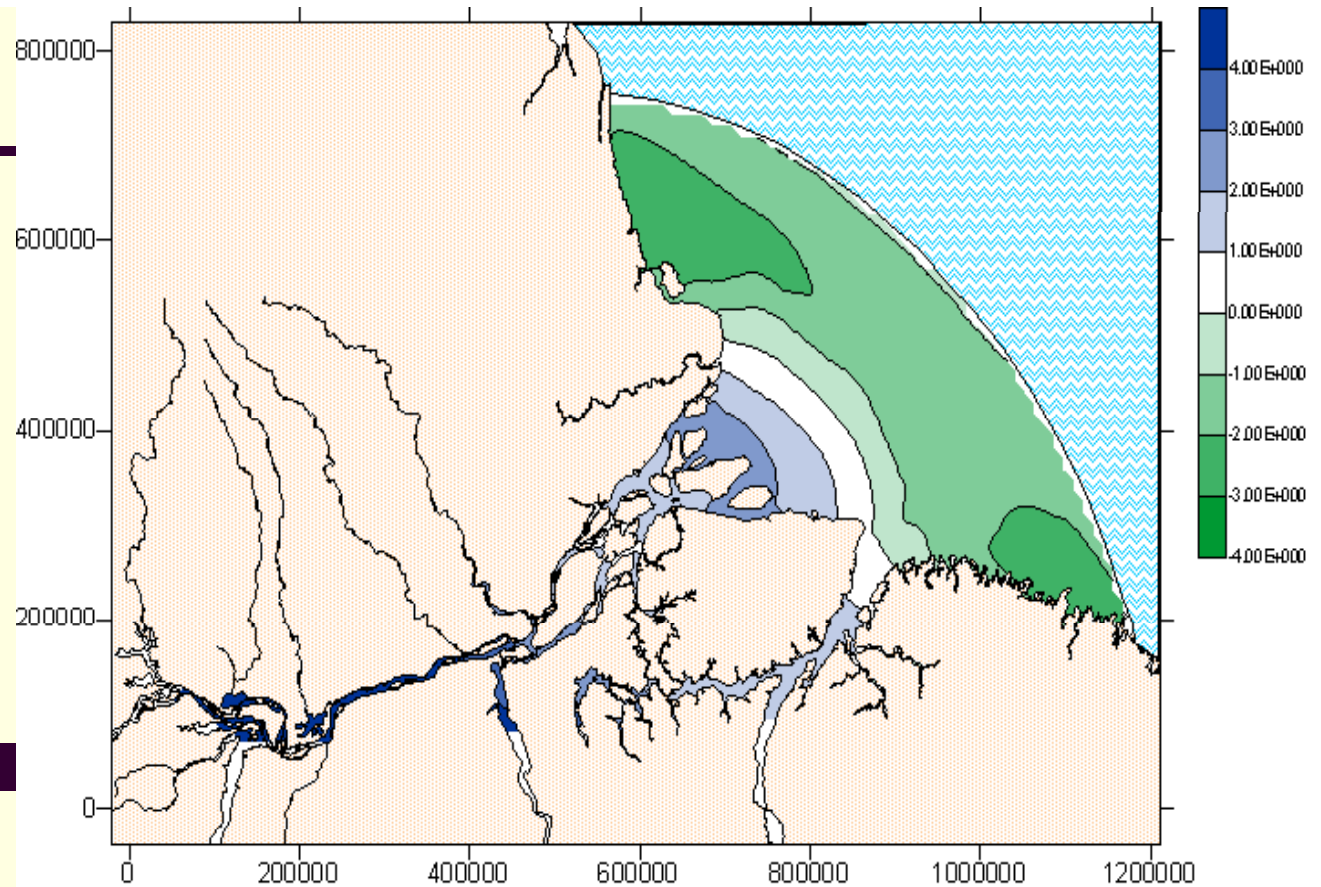
Estação ao largo  
(estaca)

Offshore  
Station  
(pole)

Estações costeiras  
(longo termo)

Coastal  
Stations

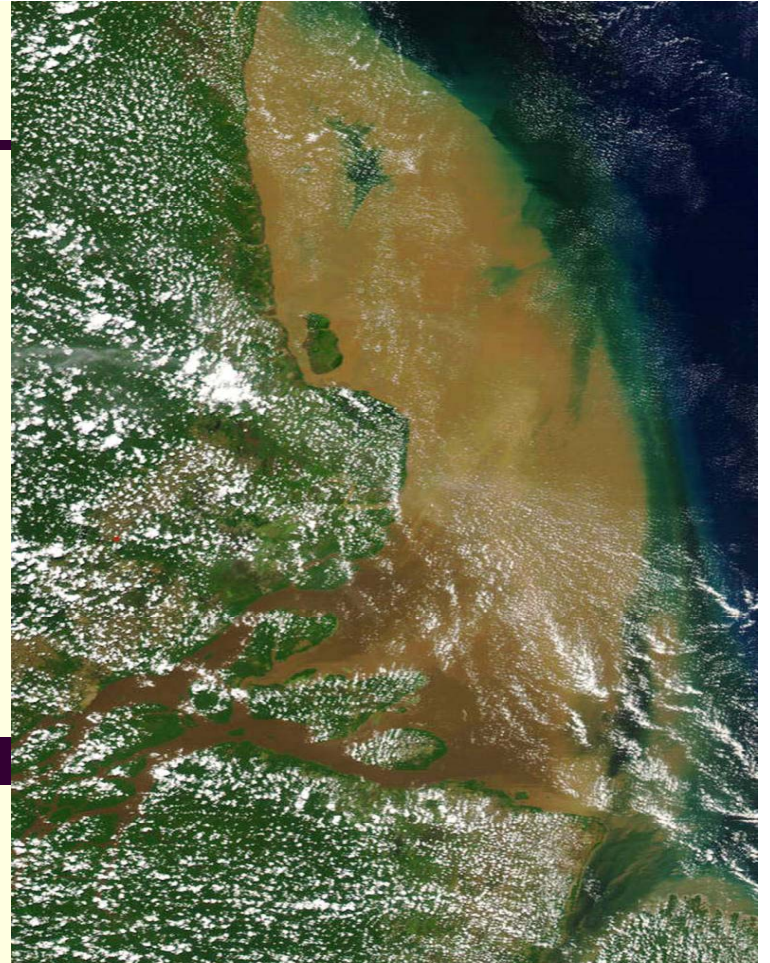




***Solução proposta: Operacionalizar modelo hidrodinâmico /  
Medição contínua numa estaca instrumentada***

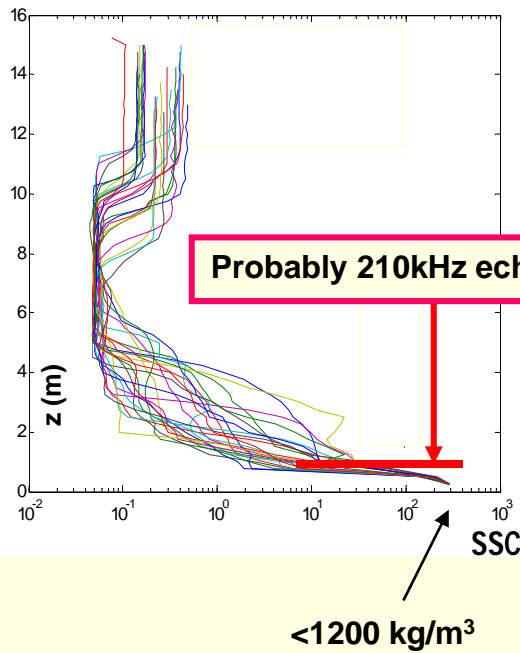
***Proposed solution: Hydrodynamic modeling / Permanent gauge  
station in an instrumented pole***





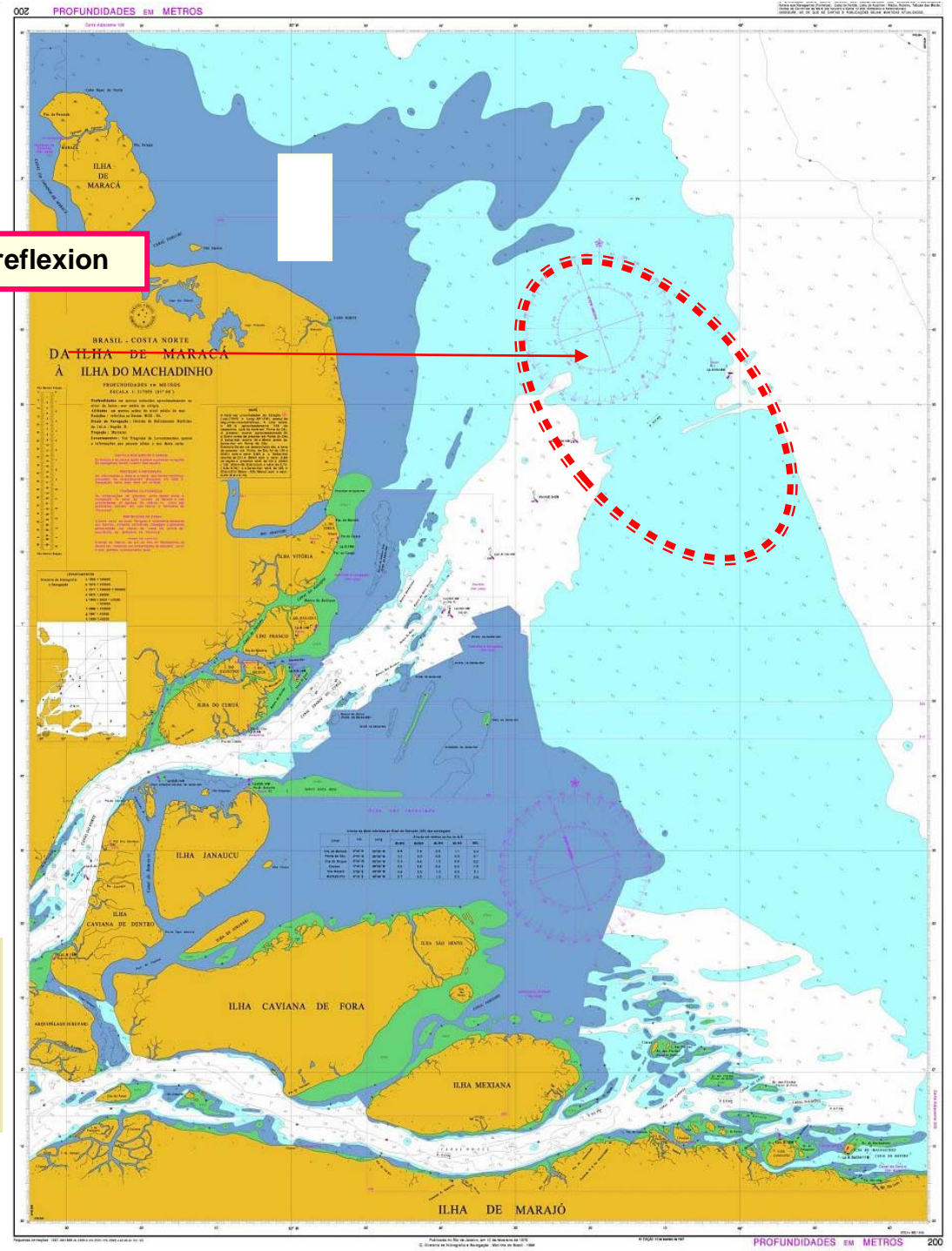
***Problema 2: Baixas profundidades em região de lama fluida***

***Issue 2: Low depths in fluid mud bottom area***



Probably 210kHz echo reflexion

<1200 kg/m<sup>3</sup>

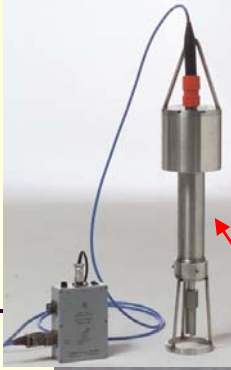


**Questões:** Qual é a dinâmica destas camadas de lama fluida ? Qué tão confiável seria determinar a profundidade navegável a partir, por exemplo, do ecobatímetro de 33kHz ?

**Questions:** How is the dynamic of the fluid mud layers ? How safe is to use, i.e., the 33 kHz echo for determining the navigation depth ?

# PROJETO BARRA NORTE

Perfis de DENSIDADE e  
VISCOSIDADE da  
LAMA



Perfis de  
correntes  
(ADCP)



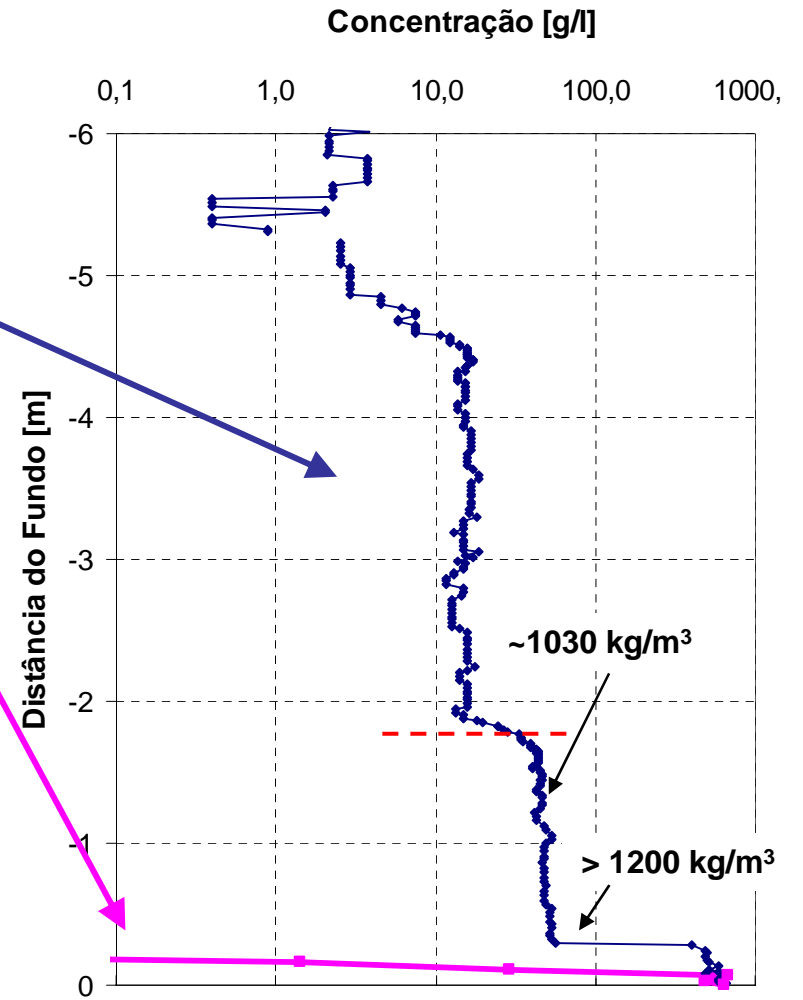
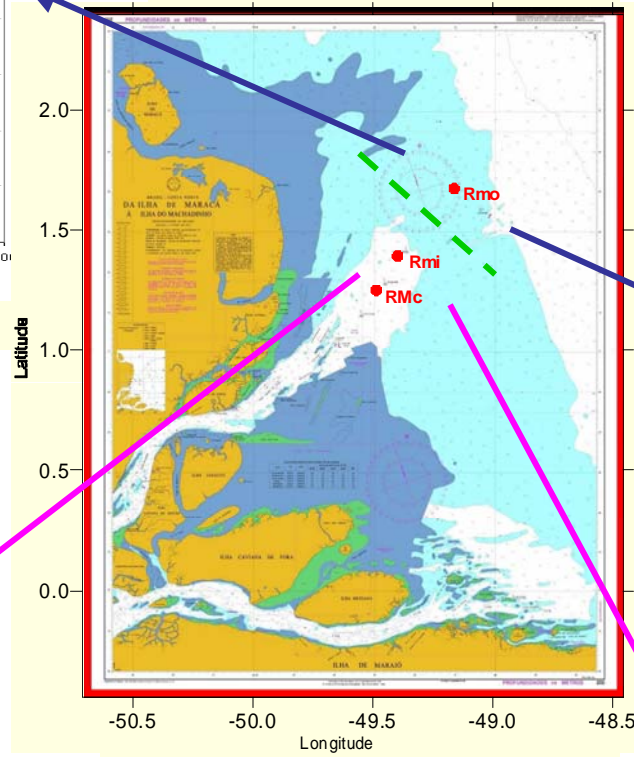
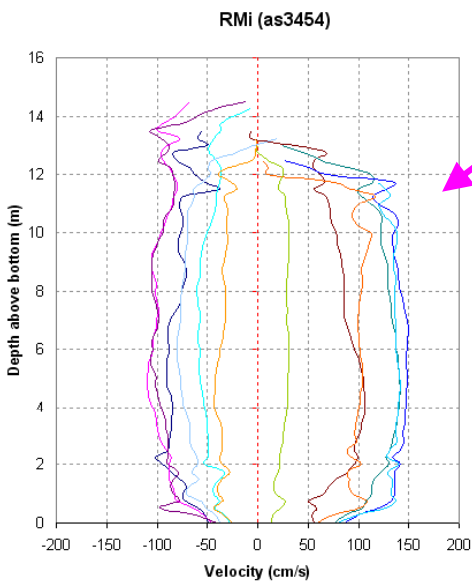
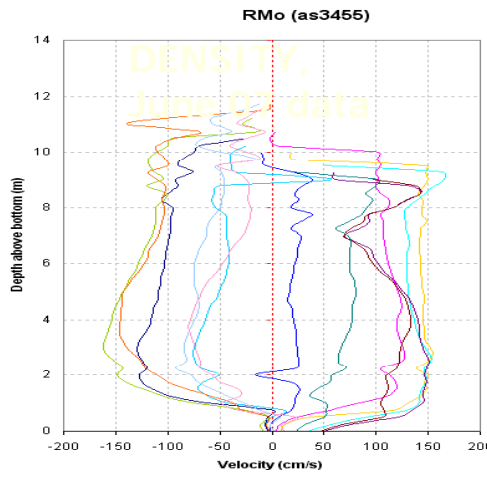
Radiometria



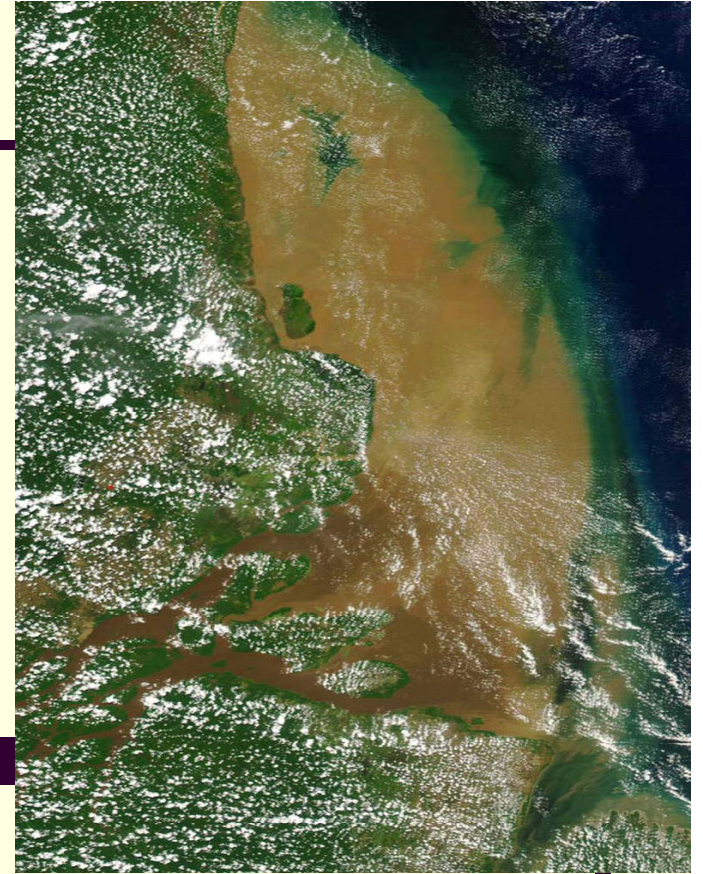
Identificação  
extensão das  
planícies de  
maré

Perfis de CSS,  
tamanho de flocos,  
turbulência,  
salinidade,  
temperatura



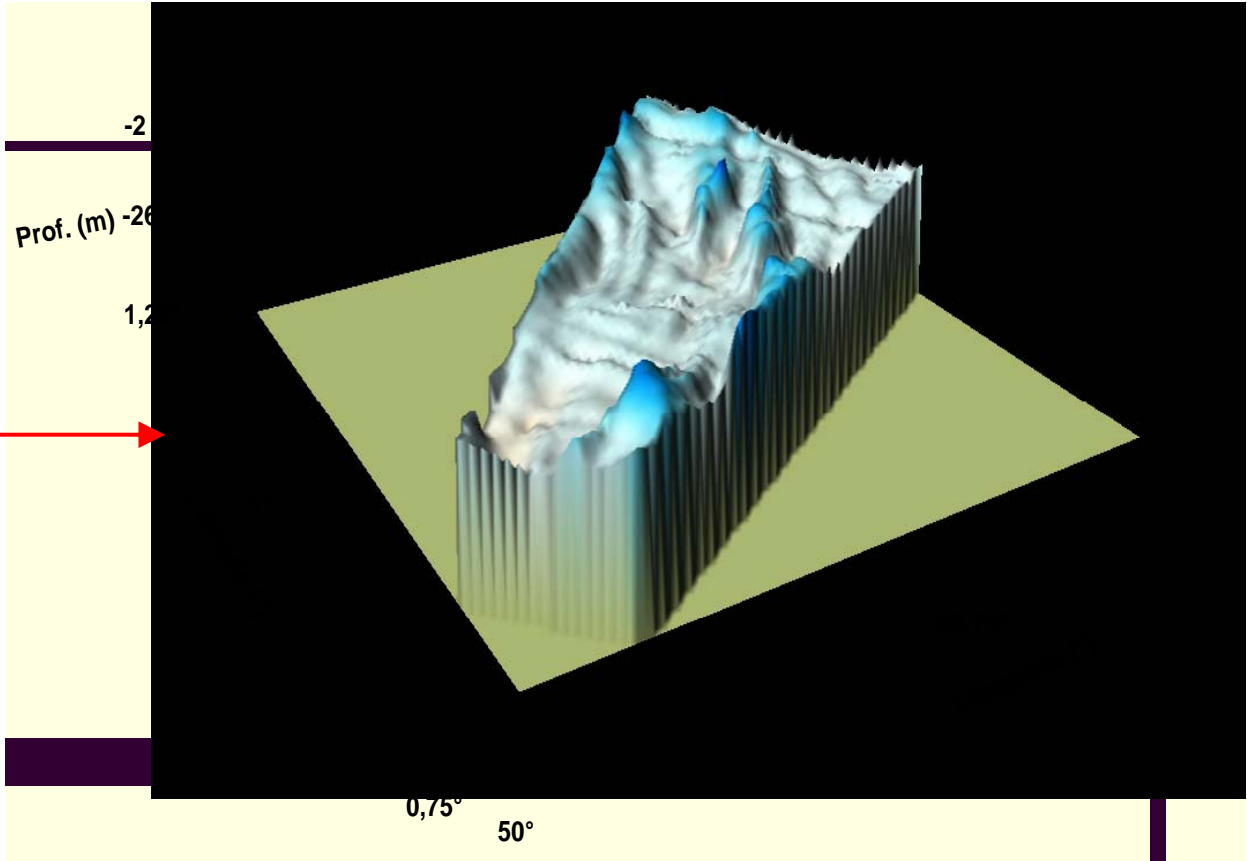


From density data, Barra Norte project



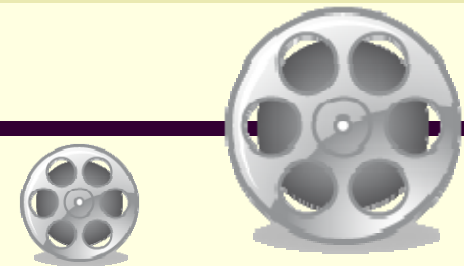
***Solução proposta: Realização de medições para aferir a mobilidade e propriedades da lama fluida (densidade e viscosidade)***

***Proposed solution: In situ measurements to establish the mobility of the fluid mud layers and its properties (density and viscosity)***



**Problema 3: Migração de bancos de areia na foz**

**Issue 3: Sand bank migration at the mouth**



***Solução proposta: Análise do histórico de dados batimétricos (1953 – 2007), medições no curto prazo para estabelecer taxas de transporte, e verificar a viabilidade técnica/econômica da dragagem.***

***Proposed solution: Analysis of bathymetry records (1953 – 2007), short term measurements in order to establish the transport rates... to dredge or not to dredge... ?***



Obrigada pela atenção !

*Thanks for your attention !*



**Acknowledgments:**

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**CAPES & CNPq**

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**CENPES/Petrobras**