# The Fate of Man-made Radionuclides in a Semi-Enclosed Basin

Silva, Danilo A.[1] & Dottori, Marcelo[2]
Instituto Oceanográfico da Universidade de São Paulo (IOUSP)
[1]danilo2.silva@usp.br; [2]mdottori@usp.br

## Introduction

In a global scale, water reservoirs are used to dump material from power plants and industries, where the biggest impact occur in areas with low circulation and water exchange with open ocean. In the context of nuclear power plants, 96% are installed closest to water bodies, using this waters in the cooling system. In Brazil, there is two nuclear power plants in operation, located in the Almirante Alvaro Alberto Central Nuclear (AAACN), that captures and discharge water in the Ilha Grande Bay (Figure 1), region with great touristic and social ambiental importance.

Understand the circulation patterns in this region is important to avaliate how the nuclear material will disperse supporting the stakeholders, in the case of a nuclear leakage, such as occurred in Fukushima, in 2011.

This study aims to investigate how wind and tide force the dispersion of these radioactive material in the estuary system and where they will affect with greater impact.

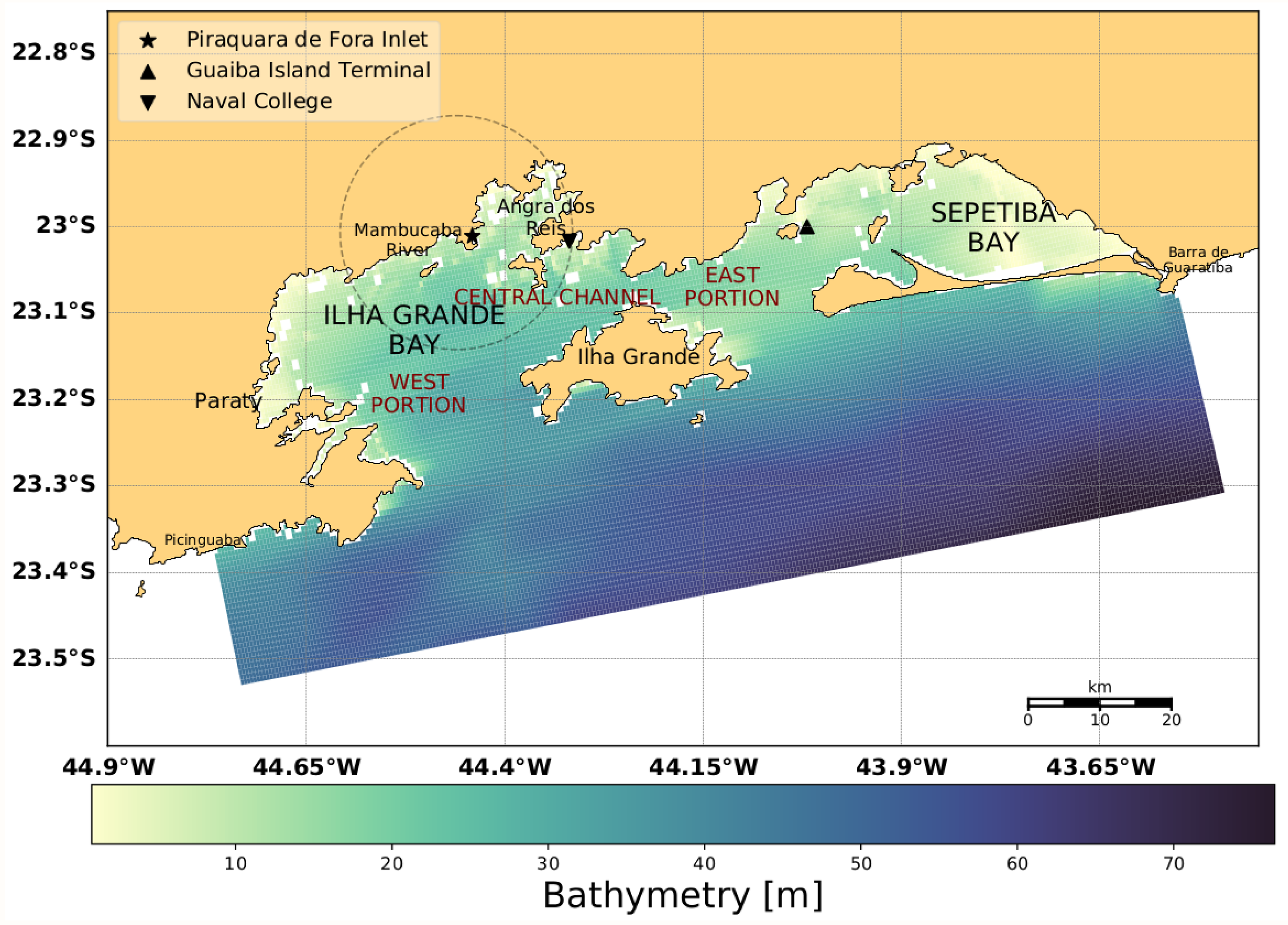


**Figura 1 :** The Ilha Grande and Sepetiba Bay domain used for ECOM model runs, showing bathymetry in meters. Several sites that are discussed in the paper are shown.

## Methods

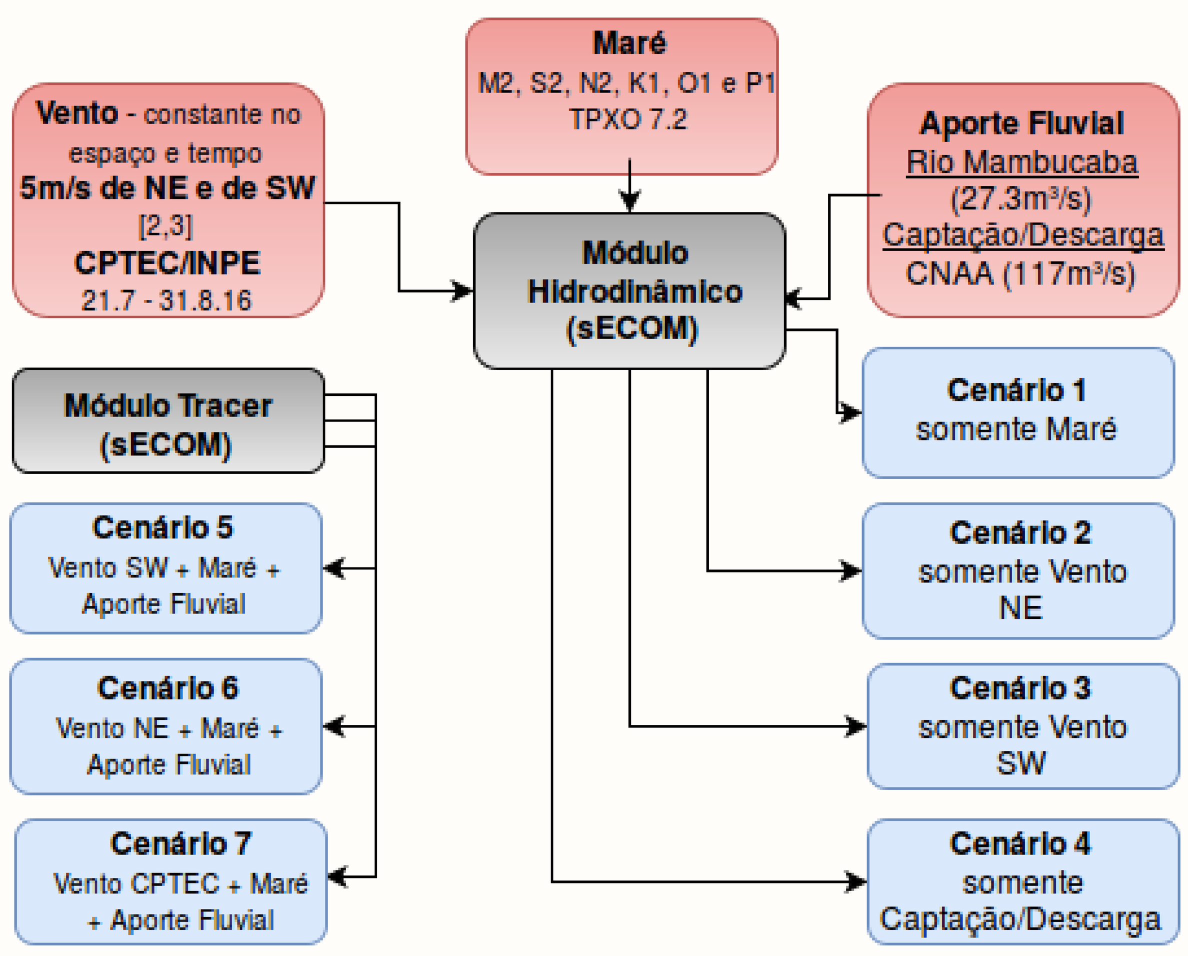


**Figura 2 :** Scheme of the method applied in this work, where the read boxes represent input data, black boxes the modules from ECOM and the blue boxes represent the experiments performed in this work.

## Results and Discussions

### *Wind v. Tide: Surface Circulation*

Was observed an intense eastward current in central channel in the Experiment I, reaching velocities closest to 0.25 $\mathrm{m.s^{-1}}$, while in the Experiment II such current reach a maximum of 0.23 $\mathrm{m.s^{-1}}$, with a westward direction. The difference between those two experiments, considering the same wind's intensity, may be cause by the open area available for southwesterly wind. Finally, in the Experimet III, only with tides from TPXO 7.2, present the highest velocities, concentrated in the eastern region of modelled domain, with maximum of 0.6 $\mathrm{m.s^{-1}}$ during flood spring tide.

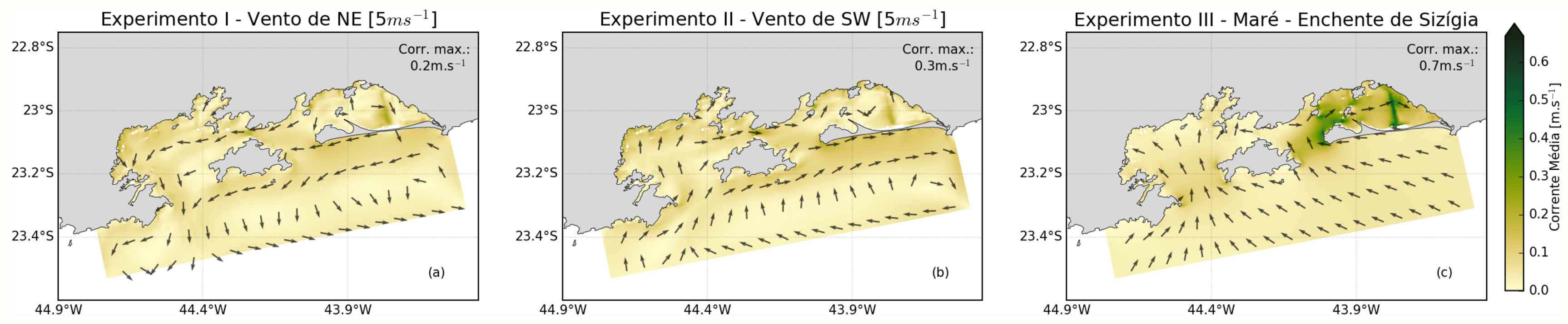


**Figura 3 :** Corrente média nos cenários 1,2 e 3. Os painéis (a) e (b) representam o último instante modelado e (c), o instante da segunda maré enchente de sizígia do período modelado.

Com todas as forçantes disponíveis, foram realizados os experimentos V, com vento constante de nordeste, e VI, com vento constante de sudoeste. Os resultados obtidos (Figura X) mostraram que a somatória positiva das forçantes geram corrente superficiais mais intensas com ventos de sudoeste. Desta forma, a direção do vento determinará a direção de dispersão e a maré irá atuar na

. vento -> domina a direção de dispersão . maré -> domina a mistura do material por advecção

However, the wind's direction still dominate the current's direction and, consequently, the surface dispersion.

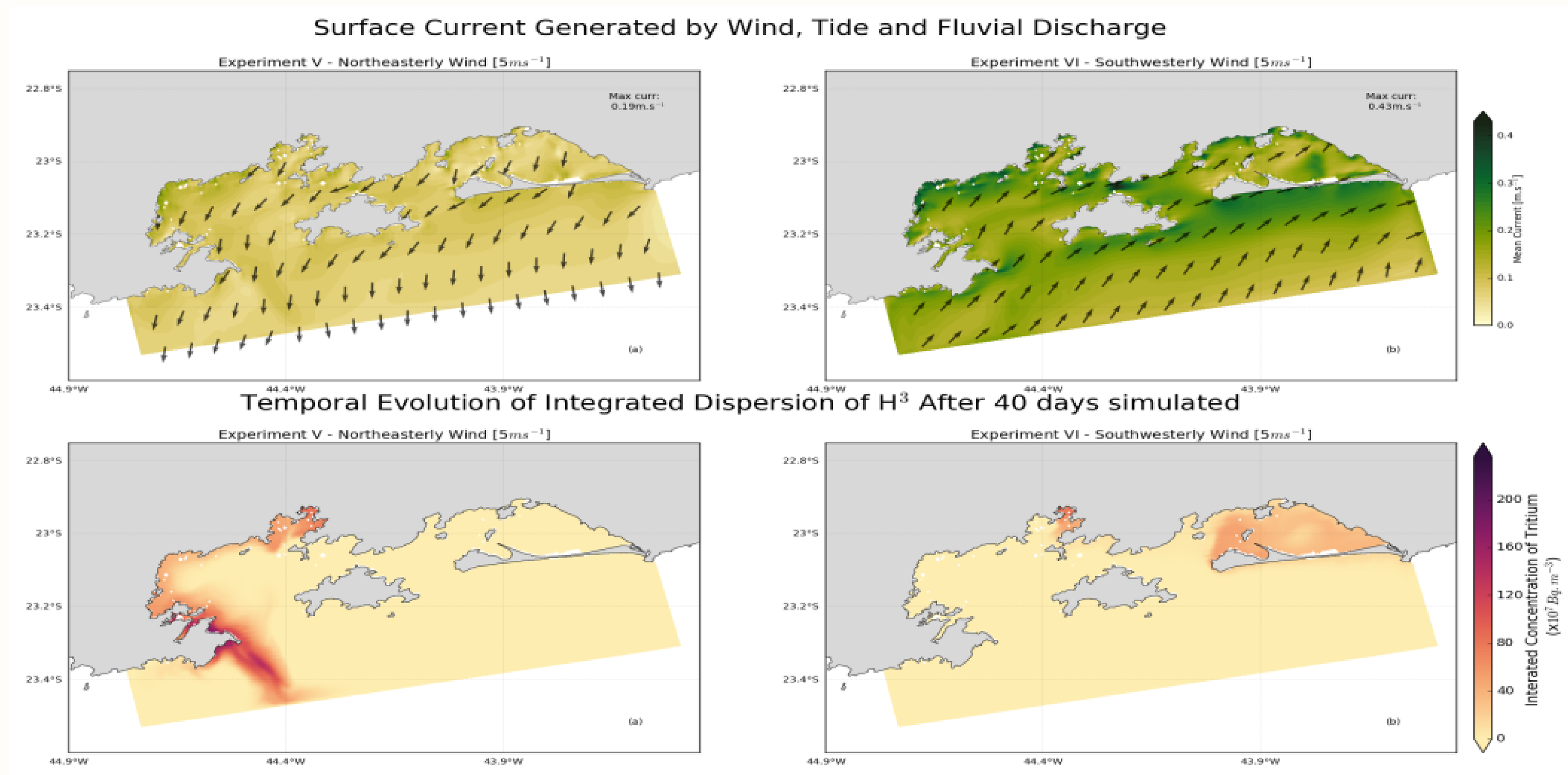


**Figura 4 :** Comparação entre os cenários 5 e 6, respectivamente, no instante correspondente a 40 dias de simulação, sendo a concentração total na coluna.

### *Dispersion in a Scenario Under Nearest to Real Conditions*

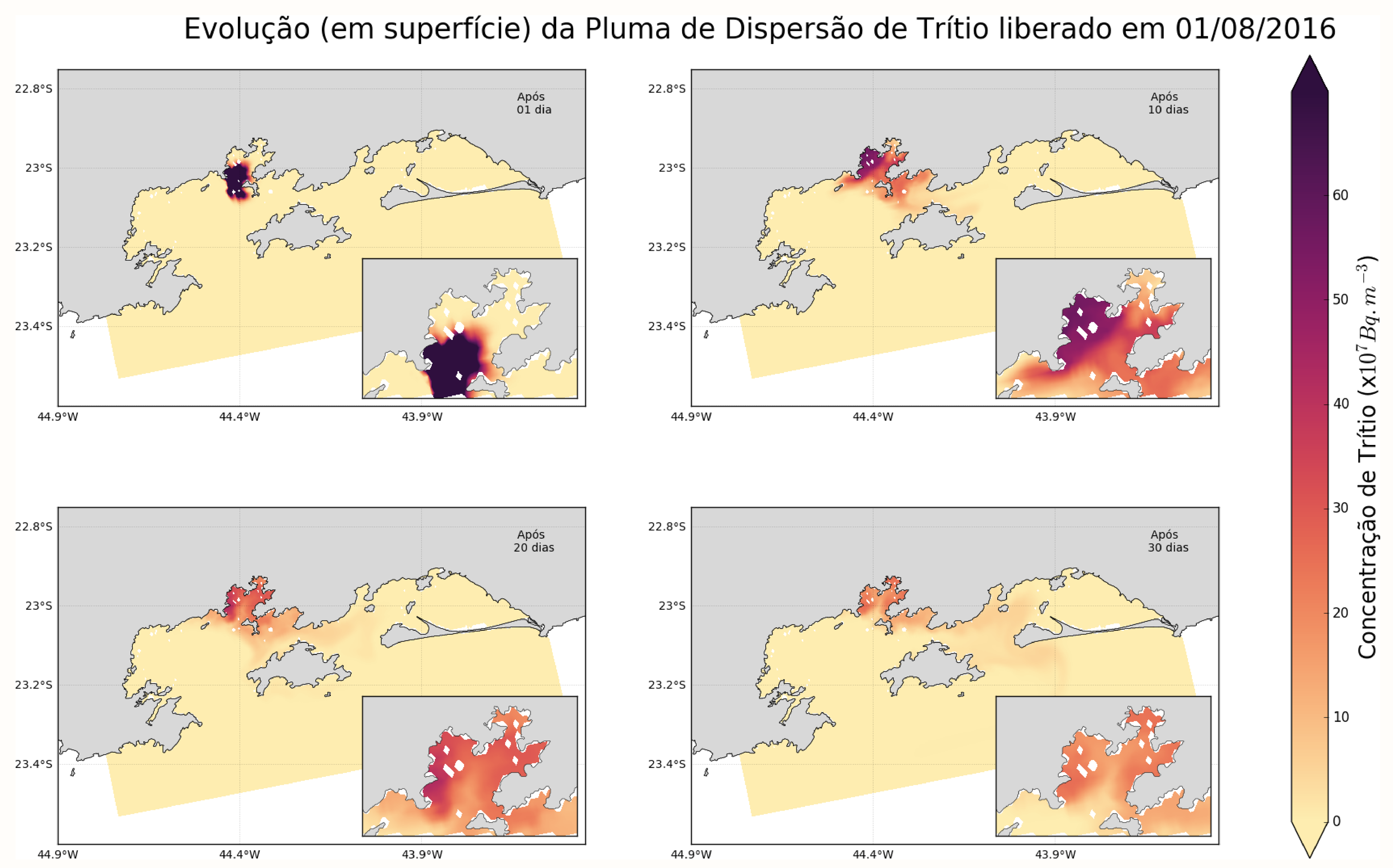


**Figura 5 :** Dispersão da pluma de material radioativo no cenário 6, os painéis representam, na ordem, os instantes de 6 horas, 10 dias, 20 e 30 dias após o vazamento.

Quote Rubens work, about concentration of radionuclides in surface sediment in Angra dos Reis.

## Conclusions

Conclui-se que, em caso de vazamento nuclear na CNAAA, a presença do material radioativo nas águas da região de estudo seria de, no mínimo, 60 dias, até uma redução a níveis de concentração inferiores ao previsto na resolução no283 do CONAMA. Além disso, as regiões de maior impacto seriam: Baía da Ribeira, ponto de descarte da água e, dependendo do regime de ventos no instante do vazamento, a pluma poderá alcançar regiões a oeste, como Paraty e Mambucaba, ou a leste, como Angra dos Reis, Baía de Sepetiba e Marambaia. Destaca-se que a pluma será melhor diluída ao atingir regiões a leste do domínio estudado, onde a maré gera correntes mais intensas.

## Referências

[1] Signorini, S. R. 1980a. 'A Study of the circulation in Bay of Ilha Grande and Bay of Sepetuba: part I: a survey of the circulation based on experimental field data."Boletim do Instituto Oceanográfico 29(1): 41-55.

[2] Signorini, S. R. 1980b. "A Study of the circulation in Bay of Ilha Grande and Bay of Sepetuba: part II: an assessment to the tidally and wind-driven circulation using a finite element numerical model." Boletim do Instituto Oceanográfico 29(1): 57-68

[3] Simões Filho, F. F. L., A.S. Aguiar, A.D. Soares e C.M.F. Lapa. 2013. "Modelling the transport of radionuclides released in the Ilha Grande bay (Brazil) after a LBLOCA in the primary system of a PWR." *Instituto de Engenharia Nuclear: Progress Report, no. 1:103.*