Identification and assessment of ecological risks from the disperson of plume from ore emerging pollutants tailings from the Fundão DAM (Mariana, Minas Gerais state, Brasil), between the Rio Doce Estuary and the Regência Coast (Espirito Santo state, Brazil), using the MOHID WATER *software*.

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INTRODUCTION

The effects of transport and circulation of emerging pollutants in the form of sediments in estuaries is more sensitive because rivers carry particles from drainage and leaching rain, which can reach coastal strips and bordering maritime environments through hydrodynamic processes influenced by river discharge, currents, tides, winds and waves. Due to their toxicity, the metal iron stand out for being trace metals that, when released irregularly into the environment, contaminate water courses leading to different interactions. and equilibrium states, with the consequent alteration of the processes. Faced with the failure of ore tailings dams that affected the country, it is increasingly necessary to monitor the plumes of sediments carried, and simulations by mathematical models are important tools for identifying transport and dispersion of the same.

OBJECTIVE

The objective of this work was to identify and evaluate the ecological risks of the dispersion of the plume of emerging ore tailings from the rupture of the Fundão dam (Municipality of Mariana, state of Minas Gerais, Brazil) that was carried to the Rio Doce estuary and affected the the coast of the municipality of Regência (state of Espirito Santo, Brazil), using the MOHID Water *software* (Fig.1).

Figure 1 – On the left, Rio doce contaminated with mud from iron ore tailings.; on the right, Regência sea contaminated with mud from iron ore tailings. Source: image bank,Federal University of Espirito Santo.

STUDY AREA

The study was carried out in an area between the coast of Regência and the estuary of the Rio Doce, state of Espírito Santo, country Brazil, coordinates 19°38'30.70"S and 39°49'10.73"W, - 8m elevation (Fig.2).

Figure 2 - Ore tailings slurry loading area and modeling point. Source: Google Earth, acess at december 2022.

The stretch used to carry out the study suffered a transport of ore tailings from the rupture of the Fundão dam, located in the Industrial complex of Germano, municipality of Mariana, state of Minas Gerais, on the banks of the middle Rio Doce, belonging to the mining company Samarco. On November 5, 2015, there was an immediate overflow of approximately 40 million cubic meters of iron ore tailings, of which 16 million continued to flow slowly along the Doce River towards the coast of Regência (ES).

CONCLUSION

The use of numerical models becomes relevant for this and future studies on monitoring environmental impacts in the region.

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METHODS

The MOHID program consists of a three-dimensional numerical modeling system. Known as a hydrodynamic model, it is a software for modeling the dynamics of water masses in marine systems, through the MOHID WATER module, and which has been widely used to simulate oil dispersion, evolution of water quality and transport of sediments in coastal areas, but there is still no work aimed at modeling sediments from ore tailings, nor in marine environments (MARETEC, 2012). To simulate the dispersion of the tailings plume, the Hydrodynamic Module and the Lagrangian Module were used. The forcings considered for the simulation were the water level rise in the oceanic contours and the flow of the Rio Doce in the open contours, collected from the fluviometric station of Colatina - ES (56994500), with averages of 715 m3/s/month (Fig.3).

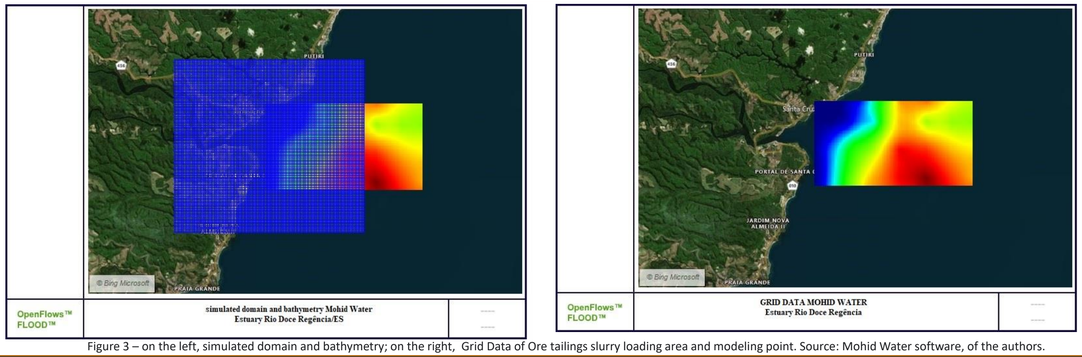

Figure 3 – on the left, simulated domain and bathymetry; on the right, Grid Data of Ore tailings slurry loading area and modeling point. Source: Mohid Water software, of the authors.

Modeling by the Langragian Module of MOHID Water allows evaluating the dynamics of water masses in marine systems, the evolution of water quality and sediment transport in coastal zones, but there are still no works aimed at modeling ore tailings sediments (Fig.4).

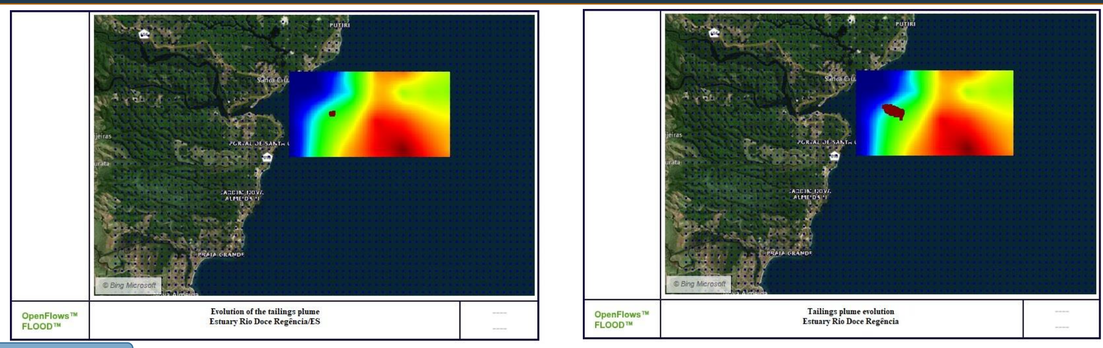

Figure 4 – Evolution of the taillings plume. Source: Mohid Water software, of the authors.

RESULTS

Considering that turbulence influences the dynamics of the sea plume towards the river (Fig.5), along with the astronomical tide, it was possible to predict that even in the absence of any current the plume continues to grow and does not reach a steady state, influenced by the ambient coastal current (Fig.6). The agitation of the sediments can have the effect of suspending the finer particles, leading to resuspension and dispersion, confirmed by the modeling of this study, and the resulting turbidity can be persistent and locally affect the growth and reproducibility of microorganisms, considering that the compounds of the Emerging pollutants are present in the bottom sediments. The resuspension of sediment deposited by currents, meteorological tides or increased wind intensity can result in intermittent contamination, even if the tailings sludge is no longer released.

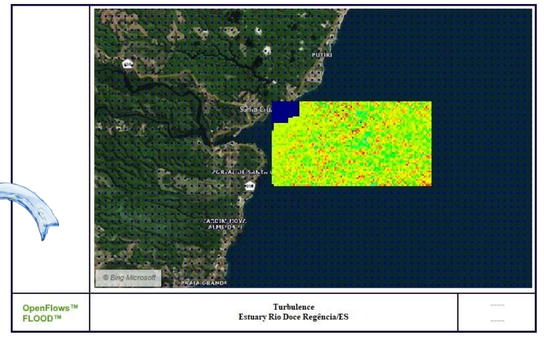

Figure 5 – Turbulence modeling influencing the simulation of the study área. Source: Mohid Water software, of the authors.

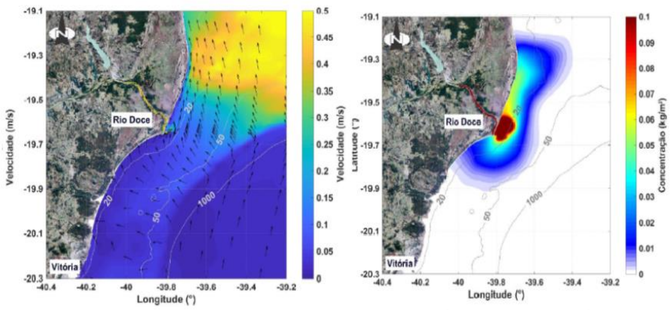

Figure 6 – effect of tidal agitation on the tailings plume. Source: of the authors, adapted from ANA.

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