Acid Mine Drainage Analysis of the Samarco Mine Tragedy in Brazil
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Introduction

On November 5th, 2015, the Fundão Dam failed in Minas Gerais, Brazil, releasing the storage tailings pond for an open pit iron mine run by Samarco Mineração. Somewhere between 55 and 60 million cubic meters of water and tailings sludge flooded the nearby cities of Bento Rodrigues and Paraíba, proceeding down the Rio Doce out to the river delta at Regência, and into the Atlantic Ocean.

The coast of Regência is home to the Reserva Biológica Cambuí, a protected nesting ground for loggerhead and leatherback sea turtles. Just north is the Abrolhos Marine Protected Area, one of the most biodiverse areas in the Atlantic Ocean.

The Rio Doce is severely impacted by the consequences of this dam failure, and now some of the richest, most diverse regions of Brazil’s coast are threatened by substantial sedimentation, acid drainage, and anoxic conditions. The effects will likely remain for decades and accumulate up the food chain, while riverine, estuarine and marine ecosystems will likely lose diversity and functionality.

We’ve presented a series of images that show the expansion of the sediment plume, indicating where settling and deposition are the most significant. This demonstrates the direction of the ocean currents, which indicates what coastal areas and biological reserves are threatened.

Methods

- Mosaicked Path 215 Row 73 & 74 of Landsat 8 OLI together
- Generated a cloud mask using density slices in ENVI using Band 4
- Calculated the Total Suspended Material (TSM) of each image using Mao et al., (2012)
- Analyzed previous findings of suspended material values in order to estimate the different TSM concentrations for the density slice
- Constructed an Arbitrary profile from the river mouth outwards to observe the relationship between TSM concentration and distance from the river mouth

Results

Total Suspended Matter - Mouth of Rio Doce Landsat 8 OLI: Path 215 Row 73 & 74

10 Months Before Disaster

Figure 3: Image taken Jan. 30, 2015 of Rio Doce river mouth. Shows the concentration of material is non-existent in the ocean near the mouth. The deeper water does not represent the material accurately.

25 Days Post Disaster

Figure 4: Image taken Nov. 30, 2015. The black marks across the image is the mask that was created for the clouds present in the image. It shows the suspended material is leaving the river and moving closer to the biological reserve.

41 Days Post Disaster

Figure 5: Taken December 16, 2015. Shows that the concentration of material has increased and moved toward the biological reserve.

Unsurprisingly, there was an extreme increase in TSM concentrations following the disaster. The concentration of sediment before the disaster (Figure 3) is 5 times less than the concentration of sediment after the disaster.

Conclusions

- Magnitude of the sediment released in the ocean has threatened the protected habitat as well as water, food and economic resources
- Combination of the dangers of mining and current regulations, mean the monitoring process needs to be reassessed on a major scale
- Sediment is depositing directly offshore, with large amounts settling along the Reserva Cambuí coast to the south (see Figure 1), and measurable quantities drifting north, towards the Abrolhos Marine Sanctuary

Future Work

- The next step for monitoring is to measure the effects these metal contaminants are having in these regions, and develop an assessment of the full scope of the damage to be used for both current damages and future regulation.

References