Risk Assessment: Tsunami 2004 in Calang (Indonesia)

The Relationship Between Risk and Landscape using Web Services in ArcGIS 10

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Introduction

The tsunami on the 26th of December in 2004 had an enormous destructive force. The tsunami was caused by an earthquake in the Indian Ocean, where subduction of the Indian Plate under the Eurasion Plate takes place. Figure 1 shows the epicenter near Sumatra and the involved tectonic features. Being off the west coast of Sumatra, it caused the death of estimated 167,799 people in Indonesia.

This is the biggest amount of victims in comparison to the other seized countries.

Because of this big impact, we wanted to make a risk assessment of the 2004 tsunami in Calang, a coastal region of Indonesia. We chose Calang because of the amount of information that was available for this region.

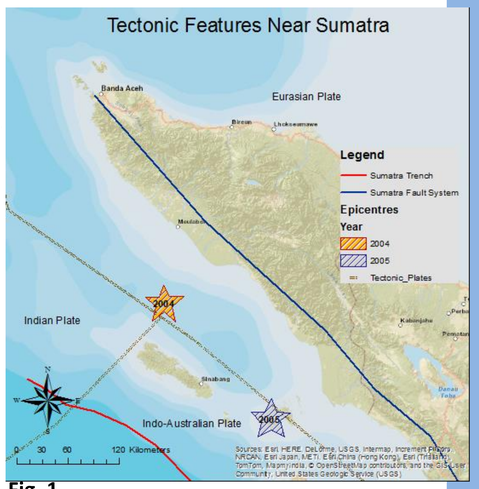

Fig. 1

Aim

The aim of our research is to inquire how the natural landscape of Calang is able or not able to mitigate the destructive power of a tsunami. Elevation and landscapes like mangrove forests could protect a country onshore. This research will therefore look at the relationship between landscape and the reach of the tsunami in 2004.

Methods – finding data

Through the University of Amsterdam's geoportal we have found on Arcgis.com;

Earth's Tectonic Plates

http://www.arcgis.com/home/item.html?id=69cb1f185afa47528708dbaa89e0729b

Land Systems of Indonesia and New Guinea (Data Basin Dataset)

http://www.arcgis.com/home/item.html?id=dae887c070b840e1bdae639a1e63260d

Methods – map making

Firstly, we used the WFS that contained the tectonic information to assess the threat of tectonic activities causing tsunamis in the region near Calang. Additionally, we added the locations of the earthquakes in 2004 and 2005 that caused a 10 meter tsunami and a 3 meter tsunami respectively (Fig. 1). After that, we used a high resolution grid in google earth to create elevation data of our region of interest. Since the 2004 tsunami was reported to reach a height of 10 meter, we decided to mark the area that is not 10 meter above the water surface with a polygon (Fig. 2). We then intersected a WFS - showing the different land types on Sumatra – with the polygon of figure 2, thereby showing the land types around this area. To be able to project the land types within the polygon we replaced the polygon by a polyline, following the border of the polygon (Fig. 3). With the maps we created we were able to arbitrarily estimate the region's vulnerability to a tsunami since the polyline should now indicate the potential reach of a 10 meter tsunami. To check if our results matched reality we used a satellite image from the day after the 2004 tsunami. Freshly deposited sediment is clearly visible and therefore this image is an accurate representation of the tsunami's actual reach. Lastly, we added the polyline from figure 3 to this map, to show the correspondence between our projected potential reach and the actual reach of the tsunami.

Relation between the WFS

We used the two WFS maps in order to assess the potential reach of a tsunami in the region near Calang. The first WFS, shows if and where oceanic earthquakes occur. These earthquakes potentially cause tsunamis and therefore their occurrence should be taken into account. The second WFS helps us estimate the maximum reach of a tsunami by showing the different land types in the region; to a tsunami estuaries are easily accessible whereas highlands are not.

Conclusion

There can be concluded that with the use of land type and elevation maps, a thorough risk assessment for the potential prone area can be made. Such an assesment could benefit future mitigation measures. This is especially interesting because it can be done with easily accessible software (ArcGIS) and open source data. Further research should be done on mangrove forests, as they are known to be a natural protector of the coast, but did not seem to have had any influence in Calang during the 2004 tsunami.

Literature

More information on our poster subject can be found on the internet:
Wikipedia
www.arcgis.com
UvA Geoportal
http://www.cns.cornell.edu/documents/ScientificPosters.pdf
Google Earth

Results

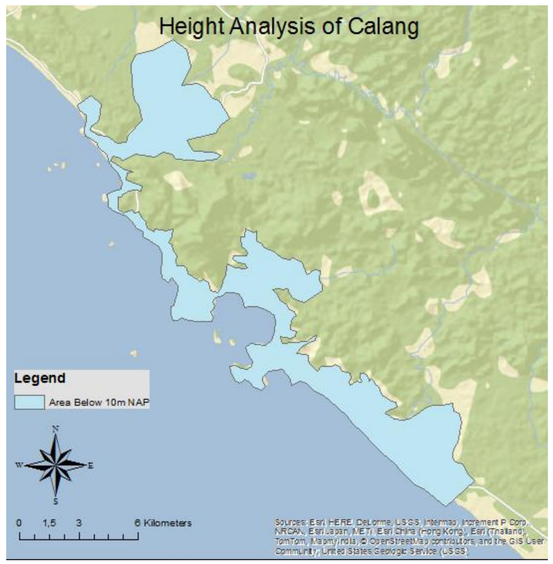

Fig. 2

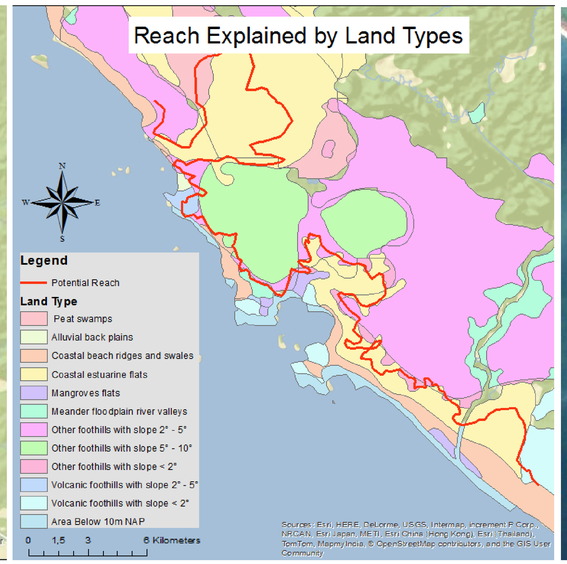

Fig. 3

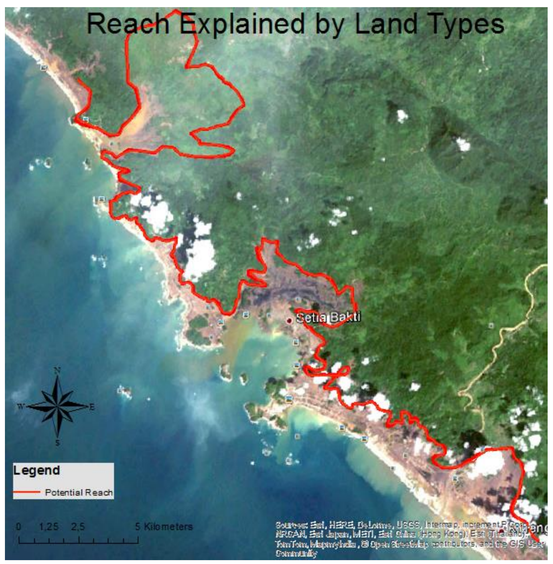

Fig. 4