Urban resilience: the importance of coastal ecosystems (wetlands) and territorial planning for disaster risk reduction due to tsunami

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INTRODUCTION

Chile is a country located in the Pacific Ring of Fire, that is, very affected by the recurrence of earthquakes and tsunamis that strongly impact the coastal cities, causing significant material damage and loss of human lives. On September 16, 2015, the city of Coquimbo was affected by an earthquake of magnitude 8.4 (Mw), which caused a major tsunami that devastated an important part of the coastal infrastructure, housing. In the sector there is a wetland called "El Culebrón", which has been designated by the population as the main element to reduce the magnitude of the tsunami.

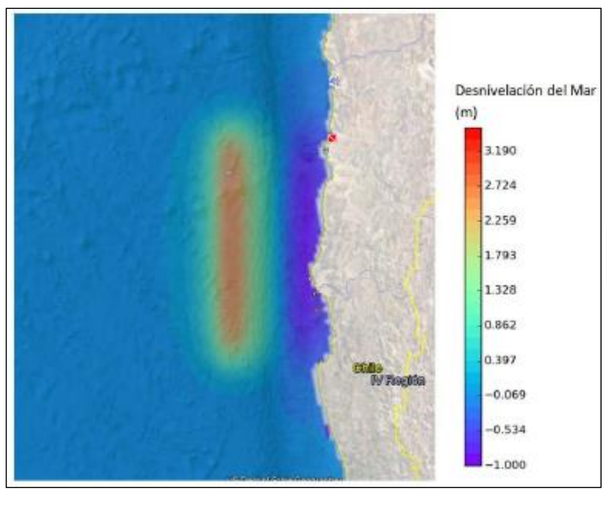
This research aims to identify and analyze the **urban resilience of the sector in its physical and natural dimensions** (ecosystems), determining how the existing wetland influences the behavior of the tsunami and, on the other hand, analyzing how urban morphology supports the processes of Evacuation of people.

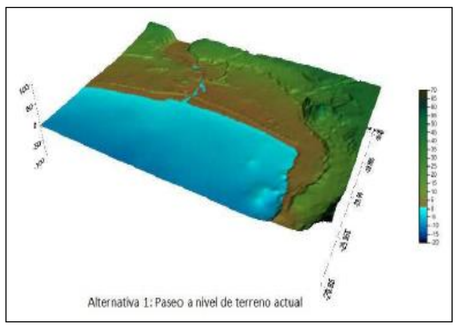
METHODS

A mathematical modeling will be carried out with the Neowave model. This model allows the calculation of the speeds, **flood heights** and run-up of tsunami waves in coastal areas, thus allowing the analysis of the behavior of the phenomenon for urbanized areas and wetlands (differentiated roughness coefficient). This model was developed by Yoshiki Yamazaki, Kwok Fai Cheng and Zygmunt Kowalik.

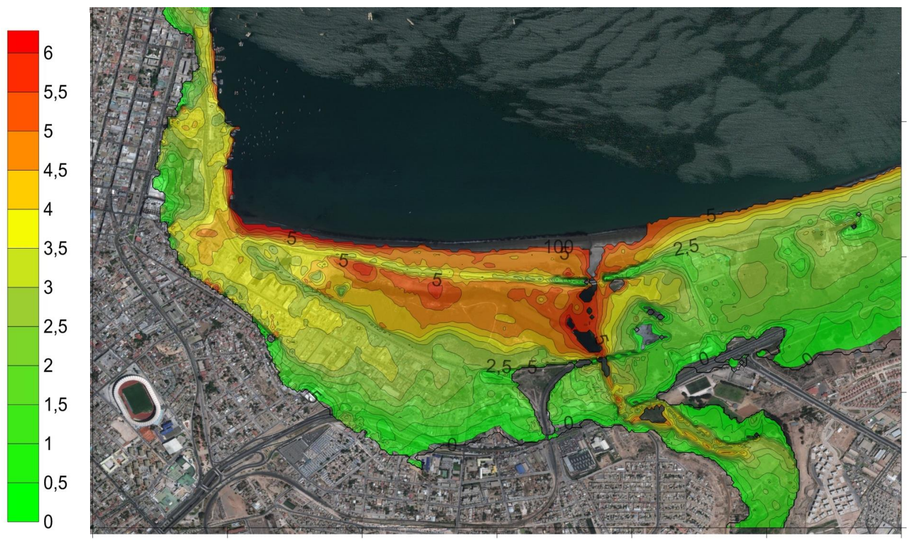
A modeling of the evacuation will be carried out through the tool created by the United States Geological Survey (USGS) called "Pedestrian Evacuation Analyst", by means of which the **evacuation times** for the people located in different sectors of the study area will be determined. This modeling will be carried out for people with normal movements and people with reduced mobility.

STUDY AREA





Inundation height (in meters)

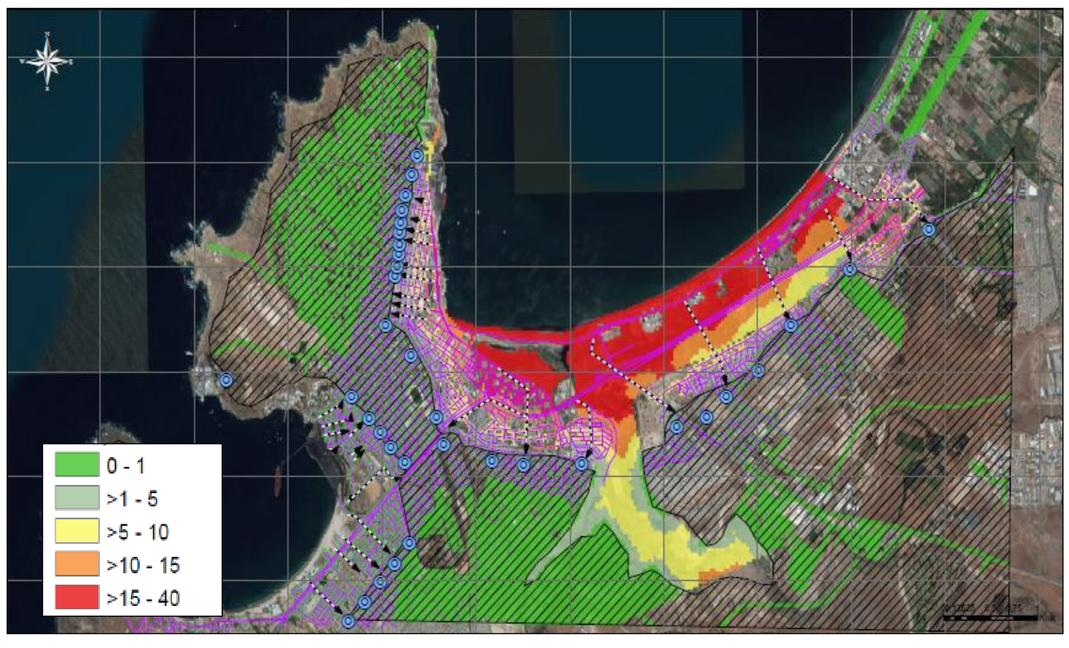


RESULTS

From the analysis it can be concluded that the **wetland** acted as a natural barrier, decreasing the height of the tsunami and **preventing further damage** to the houses and infrastructure that was behind it.

From the analysis of the pedestrian evacuation it can be pointed out that the defined evacuation routes pose an important challenge, since a large number of people could not reach a safe area before the arrival of the first wave of tsunami, which represents a significant increase of vulnerability and finally of the risk of socio-natural disasters.

Evacuation times (in minutes)



References: Yoshiki Yamazaki, Depth-integrated, non-hydrostatic model for wave breaking and run-up.
Acknowledgements: Rodrigo Filippi, Pontificia Universidad Católica de Chile.