ANALYSIS OF VERTICAL LAND MOTIONS ALONG THE CHILEAN COAST CONSIDERING SEA-LEVEL VARIABILITY, EARTHQUAKE, AND CRUSTAL DEFORMATION OF SUBDUCTION ZONES

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INTRODUCTION

Chile is one of the most seismic countries worldwide, with approximately 86.000 km of coastline and a permanent need for development and management. Because of the Nazca plate subducting the South American plate, coastal evolution is modeled by oceanographic variables and plate tectonics. Coastal towns are under permanent tsunami and storm risks, unregulated real estate development, and climate-driven sea-level rise (SLR). IPCC AR6 SSP5-8.5 scenario summarized future trends in absolute mean sea level (AMSL) of ~0.1 m in the near term (2021-2040), ~0.2 m in the medium term (2041-2060), and ~0.6 m in the long term (2081-2100) along the coast. However, relative sea-level is affected by large coseismic uplift and/or subsidence which may be comparable to or larger than SLR (Montecino et al., 2017). The combination of SLR, earthquake, and crustal deformation is important for long-term development.

METHODS AND RESULTS

Using satellite and tidal gauge data, a comparison between the AMSL and relative mean sea level (RMSL) was conducted for different locations along the Chilean coast between 1993 and 2020 (Figure 1). Merging the satellite altimetry and the tide gauge measurements were done (Cazenave et al., 1999) to obtain vertical land motions (VLM) rates at the tide gauge positions. A trend analysis of the monthly values was compared with GPS stations for each data set. The earthquake occurrence was analyzed by probabilistic seismic hazard assessment. With this, numerical modeling of the earthquake was conducted to obtain the coseismic displacements that can affect the behavior of the RMSL (Figure 2). Estimated empirical relationships between the earthquake's characteristics and coseismic displacements have a certain bias. A combination of RMSL estimates, coseismic displacements, and AMSL projections under the SSP5-8.5 scenario was conducted to estimate possible changes in the RMSL along the Chilean coast.

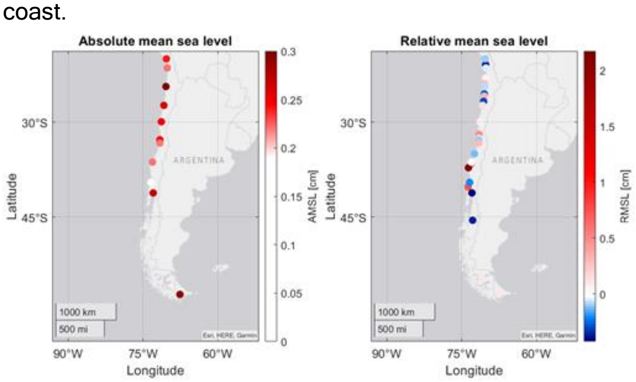

Figure 1: Comparison between the AMSL (left side) obtained from satellite analysis with the RMSL (right side) obtained from 30 tide gauge analysis along the Chilean coast.

CONCLUSIONS

RMSL strongly varies while the AMSL maintains similar values along the Chilean coast. VLMs were obtained to compare the motion rates of the crustal surface with those projected by SLR. The possibility that large earthquakes could generate coseismic displacements affecting different sites with different orders of magnitude and directions (uplift and/or subsidence) and how they can influence the RMSL was conducted. Detailed results will be presented at the conference

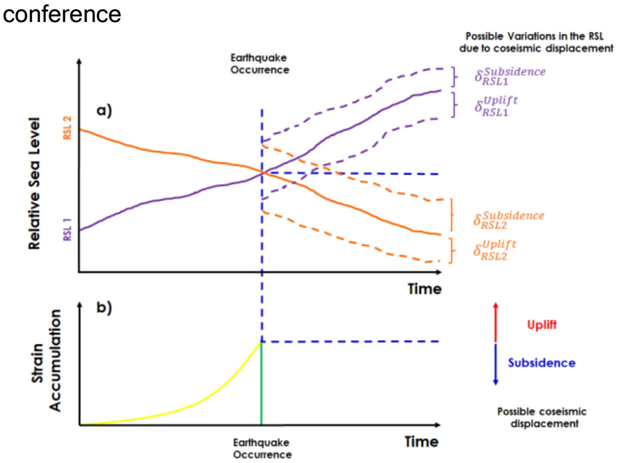

Figure 2: Schematization analysis for RMSL in two sites, before and after earthquake occurrence. a) RMSL with different tendencies can be seen. When the earthquake occurs (blue segmented line), the possible displacements (δ_{RSL1} and δ_{RSL2}) are shown by the segmented lines of each RMSL. If an uplift (subsidence) occurs, RMSL will suffer a decrease (increase). b) Strain accumulation during a seismic cycle. If the earthquake generates coseismic displacements, changes in the RMSL are shown on the left side of a).

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