USING SAR, EVI, AND TEXTURE IN GOOGLE EARTH ENGINE TO IDENTIFY LANDSLIDES: A CASE STUDY IN SOUTHERN CHILE

Teodora Mitroi, Kristy Tiampo, Mike Willis

ESOC, CIRES, & Geological Sciences

Motivation and Objectives

Why? Landslide inventories in the Andes are incomplete, despite the area being prone to wasting events (Hermanns, 2012). There is a need for a tool that identifies mass movements in remote areas such as Southern Chile.

What? We aim to:

- Create a free, open-access, easy-to-use tool to accurately monitor mass movements
- Promote collaboration by tailoring this for government officials and researchers to use for emergency resource management

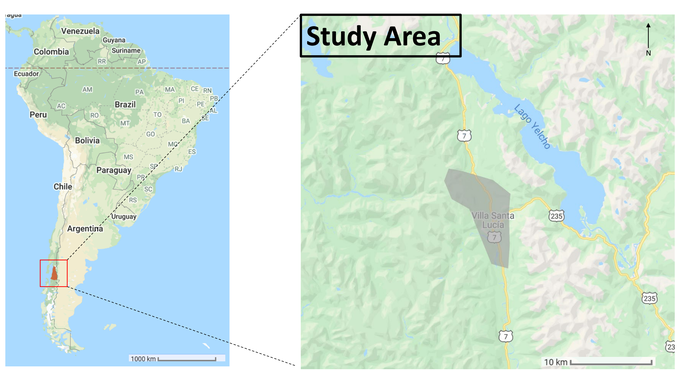
Study Area

Dec. 16, 2017: Rockslide → debris flow Estimated area affected was 900,000 m^2 (Durhart,2019)

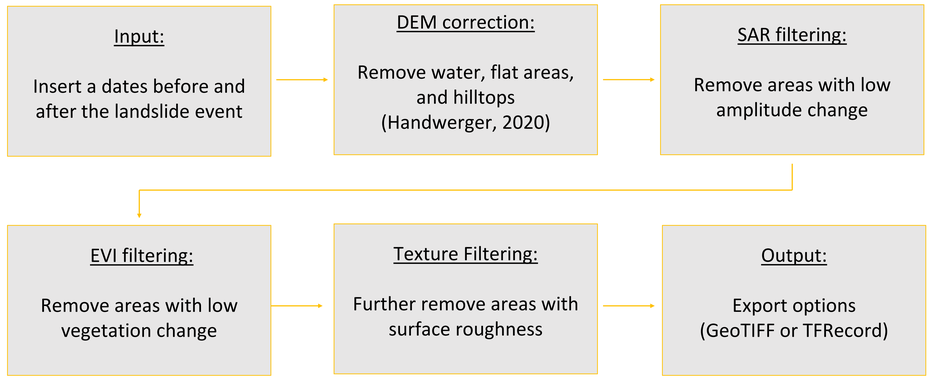
Liquiñe-Ofqui Fault Zone (LOFZ):

Area is along a 1,200 km long dextral shear fault zone that is slipping at ~11.6-24.6 mm/yr (De Pascale, 2021). Longest and fastest slipping crustal fault in the Andes (De Pascale, 2018)

Complex triggers: high slopes, fractured volcanic rock, glacial retreat, intense rainfall



Methodology



Results

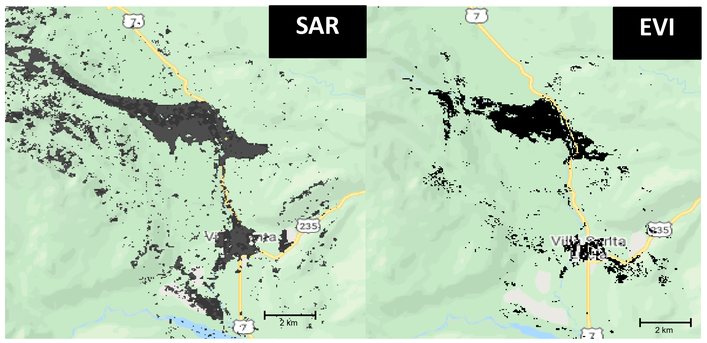


Fig. 1: Masks of the SAR and EVI

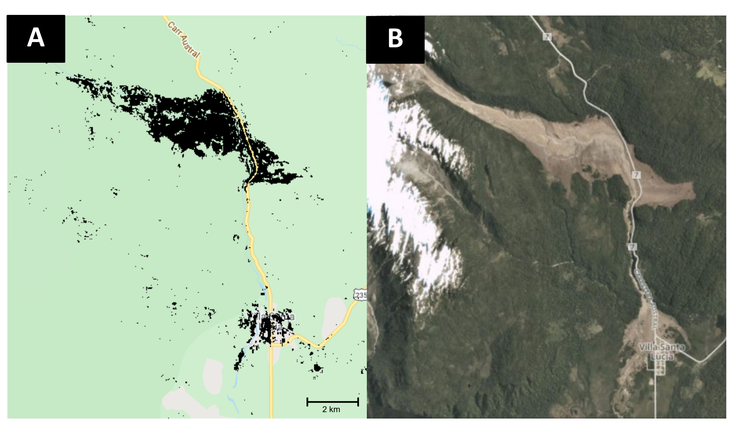


Fig. 2: Masks of the SAR and EVI

Observations

SAR vs EVI:

- SAR is noisy as the amplitude signature is sensitive
- SAR pattern corresponding to landslides very similar to Fig. 2B
- EVI is less noisy and sensitive
- EVI is not quite capturing landslide pattern

Combined map vs. imagery:

- Similar geometries, but incomplete
- EVI is affecting overall result accuracy due to masking relevant SAR pixels
- Texture filter significantly improved result
- Most reduced noise after combining all three

Future Work

- Explore different ways of incorporating optical data in the analysis, possibly using just visible light imagery
- Test GEE unsupervised machine learning algorithm (clustering) and compare
- Develop rigorous statistical analysis for accuracy assessment and verification

References

De Pascale, G.P., Froude, M., Penna, I. et al. Liquiñe-Ofqui's fast slipping intra-volcanic arc crustal faulting above the subducted Chile Ridge. Sci Rep 11, 7069 (2021). https://doi.org/10.1038/s41598-021-86413-w

De Pascale, G. P., Froude, M., Penna, I., Hermanns, R., Moncada, D., Sepulveda, S., Persico, M., Petley, D., Vargas, G., Murphy, W., & Pairoa, S. (2018, 08). Preliminary geologic slip rates along Andes fastest slipping crustal fault, the Liquiñe-Ofqui Fault Zone (LOFZ), Patagonia, Chile . Poster Presentation at 2018 SCEC Annual Meeting.

Duhart, Paul & Sepúlveda, Violchen & Garrido, Natalia & Mella, Mauricio & Quiroz, David & Fernandez, Javier & Roa, Hugo & Hermosilla, Gonzalo. (2019). The Santa Lucía landslide disaster, Chaitén-Chile: origin and effects. 7th International Conference on Debris-Flow Hazards Mitigation.

Handwerger, A. L., Jones, S. Y., Huang, M.-H., Amatya, P., Kerner, H. R., and Kirschbaum, D. B.: Rapid landslide identification using synthetic aperture radar amplitude change detection on the Google Earth Engine, Nat. Hazards Earth Syst. Sci. Discuss. [preprint], https://doi.org/10.5194/nhess-2020-315, 2020.

Handwerger, A.L, Jones, S.Y., Huang, M.-H., Amatya, P., Kerner, H.R., and Kirschbaum, D.B., Rapid landslide identification using synthetic aperture radar amplitude change detection on the Google Earth Engine, in review in Natural Hazards and Earth System Sciences

Hermanns, Reginald & Valderrama Murillo, Patricio & Fauqué, Luís & Penna, Ivanna & Sepúlveda, Sergio & Moreiras, Stella & Zavala, Bilberto. (2012). Landslides in the Andes and the need to communicate on an interandean level on landslide mapping and research. Revista de la Asociacion Geologica Argentina. 69.