EGU24-12753, updated on 14 Aug 2024
https://doi.org/10.5194/egusphere-egu24-12753
EGU General Assembly 2024

Regional-scale monitoring of hillslope deformation through optical satellite imagery

Maximillian Van Wyk de Vries[1,2,3], Katherine Arrell[4], Gopi Basyal[5], Simon Dadson[3], Alexander Densmore[6], Diego Di Martire[7], Alexandre Dunant[6], Mirko Francioni[8], Luigi Guerriero[7], Erin Harvey[6], Ganesh Jimee[5], Mark Kincey[9], Sihan Li[10], Alessandro Novellino[11], Dammar Pujara[5], Ram Shrestha[5], and Nick Rosser[6]

[1]Department of Geography, University of Cambridge, UK
[2]Department of Earth Sciences, University of Cambridge, UK
[3]Department of Geography, University of Oxford, UK
[4]Geography and Environmental Sciences, Northumbria University, UK
[5]NSET, Nepal
[6]Department of Geography, Durham University, UK
[7]University of Naples, Italy
[8]University of Urbino, Italy
[9]School of Geography, Newcastle University, UK
[10]Department of Geography, University of Sheffield, UK
[11]British Geological Survey, UK

Landslides are one of the most damaging disasters and have killed tens of thousands of people over the 21st century. Slow-moving landslides (i.e., those with surface velocities on the order of 10^{-2}-10^{1} m a^{-1}) can be highly disruptive but are often overlooked in hazard inventories due to their subtle surface signatures and slow movement. Here, we discuss an approach to automatically map slow-moving landslides using feature tracking of freely- and globally-available Sentinel-2 optical satellite imagery.

We evaluate this method through case studies from different environments in the USA, Chile, Italy, and Nepal. Our workflow identifies both known landslides and previously unknown slow-moving landslides in these case studies across very different geographical environments. In particular, in a test case on the well-documented Slumgullion earthflow, our workflow successfully delineates the active portion of the earthflow with velocity magnitudes consistent with field measurements. In another test case on the margin of the Southern Patagonian Icefield, Chile, we identified a very large (>6 km^2) composite landslide in the eastern lateral moraine of Glacier Occidental, part of which catastrophically collapsed onto the glacier in early 2023. Finally, we tested our tool to the Ponzano landslide in central Italy which failed catastrophically in 2017.

We are able to detect slow-moving landslides in complex environments using 10-m resolution globally available satellite imagery, all without any manual intervention. Taken together, this means that our workflow can be applied to any region on Earth, regardless of the availability of

prior information. We leverage this workflow to conduct a preliminary national-scale survey of slow-moving landslides in Nepal, identifying over 10,000 deforming hillslopes across the country, many of which are populated. Improved mapping of the spatial distribution and surface displacement rates of slow-moving landslides will improve our understanding of their role in the multi-hazard chain and can direct detailed investigations into their dynamics.

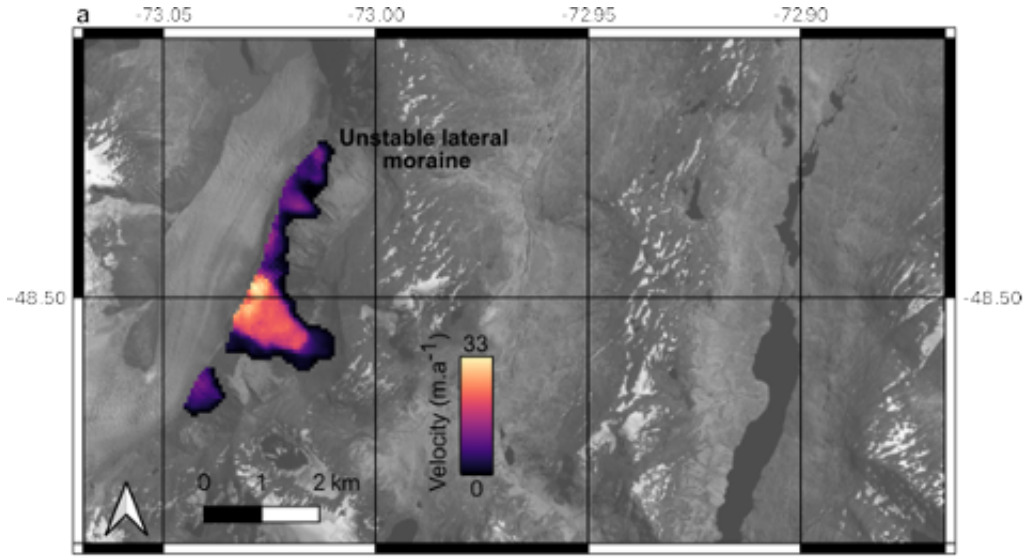

Figure: Large slow-moving landslide complex in the lateral moraine of Glaciar Oriental, Chilean Patagonia detected using our workflow.