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Topographic elevation change through tracking shadow cast from mountain ridges. Showcasing Red Glacier, Mt. Iliamna.

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Continuous global monitoring of glacier elevation change over decadal timescales is difficult to establish. Dedicated stereoscopic satellite missions are scarce and had, up to recently, limited spatial coverage. By contrast, observations from monoscopic satellites providing continuous global coverage extending for several decades backwards in time, is readily available. Therefore, we explore the potential of this type of imagery for extracting elevation change. This is done through tracking of moving shadows, which is a new and simple technique we call photohypsometry. The known sun angles and clear shadow patterns on the glacier surface, establish a simple trigonometric relationship, enabling the extraction of elevation change.

Here we showcase the methodology on Red Glacier, a glacier situated on the Eastern flank of Iliamna volcano, Alaska. A tributary of this glacier has fast surface speed in its snout, slightly shifting lateral moraines, but no known surge history. Shadow from neighboring mountain ridges cast on the accumulation region of this glacier, so a clear time-series can be constructed from Sentinel-2 imagery.

This example highlights the potential of this technique. While the coverage of topographic information does not cover the whole glacial basin, it can complement other data sources. It is especially suited for small mountain glaciers and thrives in brightly reflecting snow-covered accumulation areas.

