

Offset-Tracking as an Effective Tool for Rapid Movements Monitoring

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SUMMARY

Natural-caused terrain movements appear in all parts of the world. However, glaciers movements and landslides are of particular importance because of climate changes issues. Some of these movements are rapid or occur in areas, which are difficult to monitor. Nevertheless, their monitoring is essential to understand the mechanism, causes of movements or observe their speed changes. Lots of classical surveying methods are difficult to apply in such dynamically changing areas. Remote sensing techniques might be a solution to this problem. The aim of the presented study was to investigate possibilities of applying the SAR offset-tracking technique to monitor fast movements, such as glacier's velocity or displacement caused by a rapid landslide.

In this research, two different areas were studied, the Jakobshavn glacier located in Greenland and the Italian landslide Ponzano. For the first study area, radar images from Sentinel-1 and ICEYE satellite missions were used to determine the glacier's velocity. Values were calculated using the offset-tracking technique for January 2021. For both datasets the results were comparable. However, high-resolution data delivered more detailed information about the glacier movements, where the maximum velocity reached almost 41 m/day. The same calculation method was applied for the Italian landslide area to determine displacements that occurred after triggering the rapid landslide. In this case, Sentinel-1 and high-resolution TerraSAR-X (TSX) images were used. Due to the smaller study area, only TSX data delivered reliable results with displacements at the level of over a dozen meters. The resolution of TSX images was 8 times better than in the case of Sentinel-1 data, which made detection of displacement possible.

This research proves that the application of the SAR offset-tracking technique can improve observation of not only glacial but also landslide areas. It might be a useful monitoring method for fast and rapid ground movements. Moreover, it can be considered as an effective alternative to the

InSAR technique or classic surveying methods, which may be difficult to apply in such areas. What is more, the continuous development of SAR sensors and their increasing resolution can open new possibilities in monitoring smaller objects like the Ponzano landslide present in the study.

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