

EGU21-14634

<https://doi.org/10.5194/egusphere-egu21-14634>

EGU General Assembly 2021

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## **Global glacier monitoring with TanDEM-X remote sensing – advances, challenges and requirements from the perspective of a multi-decadal approach**

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Mountain glaciers are key indicators of the changing climate conditions worldwide. Observations in recent decades suggest that their immediate atmospheric environment is changing more rapidly than it does elsewhere. Therefore, in addition to a network for measuring climatic parameters, a continuous investigation of glacier changes is indispensable.

The Terra SAR-Add-on for Digital Elevation Measurement (TanDEM-X) mission has achieved two complete space-borne surveys of the Earth's surface and thus of all existing glaciers during its mission lifetime. This study exhibits the methodological and technical findings generated over the period 2011-2019 for multi-temporal investigations – and culminates in a recommendation map for the ongoing and follow-up bi-static SAR acquisitions.

The opportunities which TanDEM-X datasets open up for glacier monitoring are demonstrated: high spatial resolution of up to ~10 m, independence of cloud cover and daylight, smooth and homogenous elevation change fields. This enables wide spatial coverage of the observations throughout climatic and altitudinal zones. However, there are also challenges and limitations to multi-temporal glacier change monitoring. We provide initial conclusions from our repeat studies in Patagonia, the tropical Andes, the Alps and Himalaya/Karakoram. Influences such as seasonality, terrain and latitude on measurement accuracy are being investigated.

The results of this work highlight the capabilities of TanDEM-X data with our current processing strategy: We show where major uncertainties arise from, where our products complement other methods, and where they surpass them. Our analysis forms a contribution to the Regional Assessments of Glacier Mass Change (RAGMAC) initiative for a better understanding of observation disparities and collaboration potentials in glacier monitoring by remote sensing techniques. Based on our findings we will point to research needs and propose strategies for a continuous global acquisition and to partially overcome some of the deficiencies, where possible.