



## ***Interactive comment on “InSAR-based characterization of rock glacier movement in the Uinta Mountains, Utah, USA” by George Brencher et al.***

### **Anonymous Referee #3**

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In this manuscript the authors used satellite SAR interferometry to identify and monitor active rock glaciers in the Uinta Mountains (Utah, USA). Velocity maps derived from Sentinel-1 data were considered to generate an inventory of active rock glaciers. A number of relationships with topographic and climatic drivers were calculated and analysed. Mean LOS velocities are in the order of a few cm/yr. The paper is very well structured and written. However, there are some important missing information that should be included in a revised version.

I. 10. According to the ongoing work of the IPA Action Group: Rock glacier inventories and kinematics

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(<https://www.unifr.ch/geo/geomorphology/en/research/ipa-action-group-rock-glacier>) regarding the definition of standard guidelines for inventorying rock glaciers (<https://bigweb.unifr.ch/Science/Geosciences/Geomorphology/Pub/Website/IPA/Guidelines/>) the following updated categorization of activity are proposed: - An active rock glacier shows coherent downslope movement over most of its surface. As an indication, the displacement rate can range from a decimeter to several meters per year. - Transitional rock glacier shows little to no downslope movement over most of its surface. As an indication, the average displacement rate is less than a decimeter per year in an annual mean over most of the rock glacier. Downslope movement must not be confused with subsidence. The rock glaciers in the study area seem thus to be rather transitional and not active.

I. 25-26. Also the other way round is valid: rock glaciers might be considered as indicators of climate change, see again the work of the IPA Action Group: Rock glacier inventories and kinematics and in particular the Task 2 activities "Rock glacier kinematics as an associated parameter of ECV Permafrost", <https://bigweb.unifr.ch/Science/Geosciences/Geomorphology/Pub/Website/IPA/RGK/200121>

I. 65-75. Add further references, e.g.: Strozzi et al. Detecting and quantifying mountain permafrost creep from in situ inventory, space-borne radar interferometry and airborne digital photogrammetry. *Int. J. Rem. Sens.* 2004, 25, 2919–2931. Barboux et al. Inventorying slope movements in an Alpine environment using DinSAR. *Earth Surf. Process. Landf.* 2014, 39, 2087–2099. Rick et al. Detection and inventorying of slope movements in the Brooks Range, Alaska using DinSAR: A test study. In *Proceedings of the GEOQuébec 2015: 68th Canadian Geotechnical Conference and 7th Canadian Permafrost Conference*, Quebec City Convention Centre, Québec, QC, Canada, 20–23 September 2015. Necsoiu et al. Rock glacier dynamics in Southern Carpathian Mountains from high-resolution optical and multi-temporal SAR satellite imagery. *Remote Sens. Environ.* 2016, 177, 21–36. Strozzi et al. Monitoring Rock Glacier Kinematics with Satellite Synthetic Aperture Radar, *Remote Sens.* 2020, 12(3), 559.

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I. 125. Why only selected one-year pairs and not all?

I. 136-145. This methodological part is not well explained: - What do you mean at I. 136 with "InSAR velocity maps"? One ascending and one descending? Or for all the InSAR pairs analyzed (see Table in the appendix)? - What do you mean by "a clear and relatively high LOS velocity signal"? Be more precise and quantitative. - See IPA guidelines for the definition of the activity classes (first point above). - What do you mean by "delineated"? Manually or automatically?

I. 146-148. What is the difference between these "average annual velocities" and those of the previous section? How were these maps computed? Which pairs were considered? They could be highlighted in the table of the appendix. Any weighting (e.g. time interval, coherence) in the average?

What is shown in Figures 2 and 3? The velocities of I. 136-145 or those of I. 146-148?

I. 204. A threshold for inactive rock glaciers was not defined. Please be precise, considering also the indications of the IPA working group.

I. 207. What is the min. detectable size of an InSAR signal?

I. 212-214. Add a reference to these statements.

I. 219-221. As observed in other regions, please add appropriate references.

I. 236-239 and I. 295-298. Again, better define what is an active rock glacier, in particular considering the recent IPA guidelines. In this region we are probably at the limit of permafrost occurrence, small activity is possibly linked to the presence of permafrost.

I. 320. Why were these apparently wrong estimates (40 cm/a in 12 days versus 4 cm/a in 1 year) not masked out?

I. 333. . . . and else where, add references.

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-274>, 2020.

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