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Supplement of

A climate-driven, altitudinal transition in rock glacier dynamics detected through integration of geomorphological mapping and synthetic aperture radar interferometry (InSAR)-based kinematics

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Table S1. Information on the Sentinel-1 interferograms used in this study.

Master image (date)	Slave image (date)	Temporal baseline (days)	Orbit
04/09/2018	16/09/2018	12	Ascending
16/09/2018	22/10/2018	36	Ascending
28/09/2018	04/10/2018	6	Ascending
28/09/2018	10/10/2018	12	Ascending
28/09/2018	22/10/2018	24	Ascending
04/10/2018	10/10/2018	6	Ascending
04/10/2018	11/09/2019	342	Ascending
10/10/2018	05/09/2019	330	Ascending
11/09/2019	23/10/2019	42	Ascending
17/09/2019	17/10/2019	30	Ascending
29/09/2019	11/10/2019	12	Ascending
29/09/2019	23/10/2019	24	Ascending
11/10/2019	17/10/2019	6	Ascending
11/10/2019	23/10/2019	12	Ascending
02/09/2018	08/09/2018	6	Descending
02/09/2018	26/09/2018	24	Descending
02/09/2018	08/10/2018	36	Descending
08/09/2018	14/09/2018	6	Descending
08/09/2018	20/09/2018	12	Descending
14/09/2018	08/10/2018	24	Descending
14/09/2018	20/10/2018	36	Descending
26/09/2018	08/10/2018	12	Descending
08/10/2018	14/10/2018	6	Descending
08/10/2018	20/10/2018	12	Descending
14/10/2018	21/09/2019	342	Descending
26/10/2018	03/10/2019	342	Descending
03/09/2019	15/09/2019	12	Descending
03/09/2019	09/10/2019	36	Descending
15/09/2019	21/09/2019	6	Descending
21/09/2019	15/10/2019	24	Descending
03/10/2019	15/10/2019	12	Descending
09/10/2019	15/10/2019	6	Descending

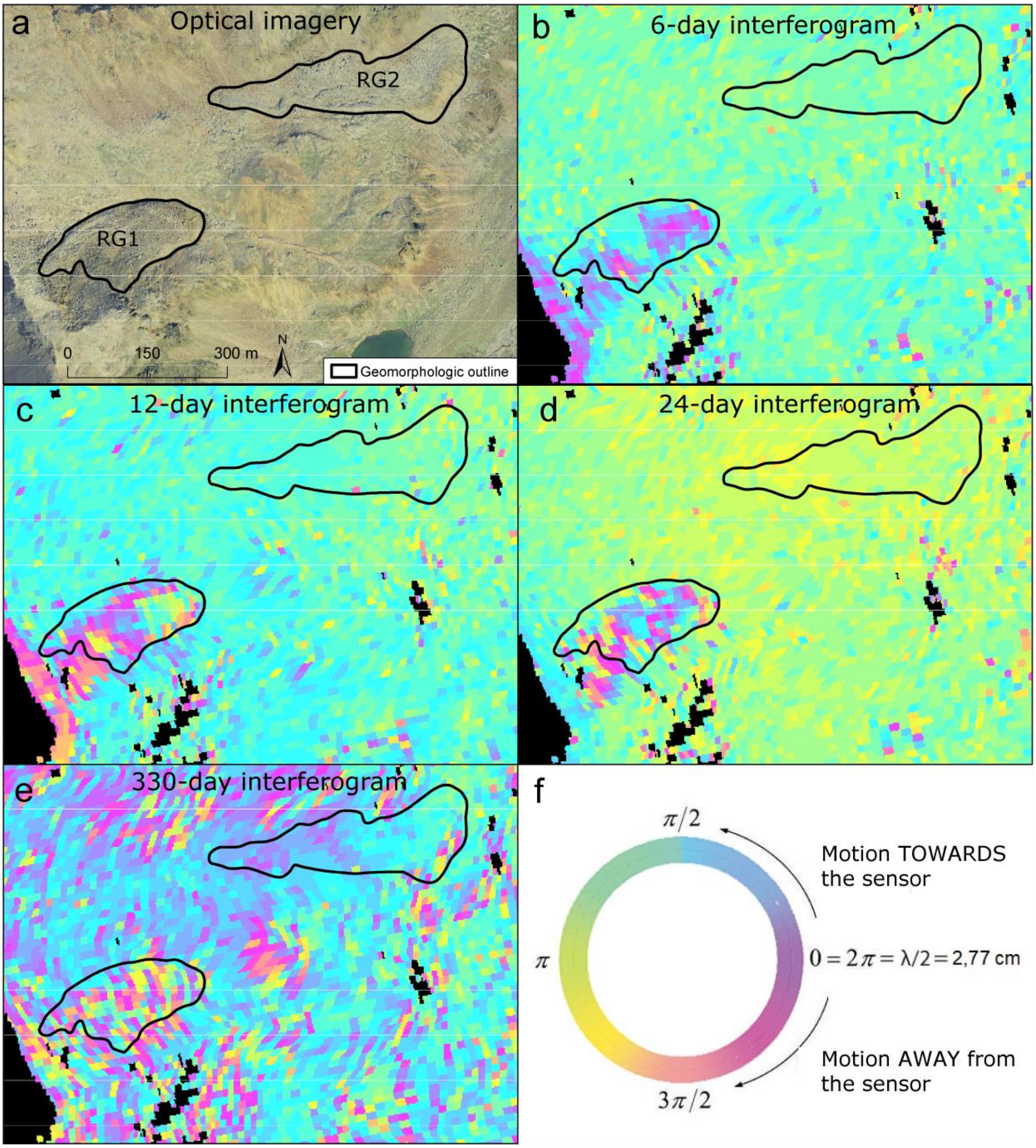

Figure S1. Sample kinematic characterization applied to two rock glaciers in Ultimo Valley 200 showing (a) initial manual delineation of rock glacier polygons (black linework) on optical imagery; Sentinel-1 interferograms calculated over (b) 6 days (2018/09/28 – 2018/10/04), (c) 12 days (2019/10/11 – 2019/10/23), (d) 24 days (2018/09/28 – 2018/10/22), and (e) 330 days (2018/10/10 – 2019/09/05). In panel f is reported the color-coded scheme used for evaluating phase difference on interferograms. Orthoimage from the Autonomous Province of Bolzano (https://geoportale.retecivica.bz.it/geodati.asp; last access: June 2023).

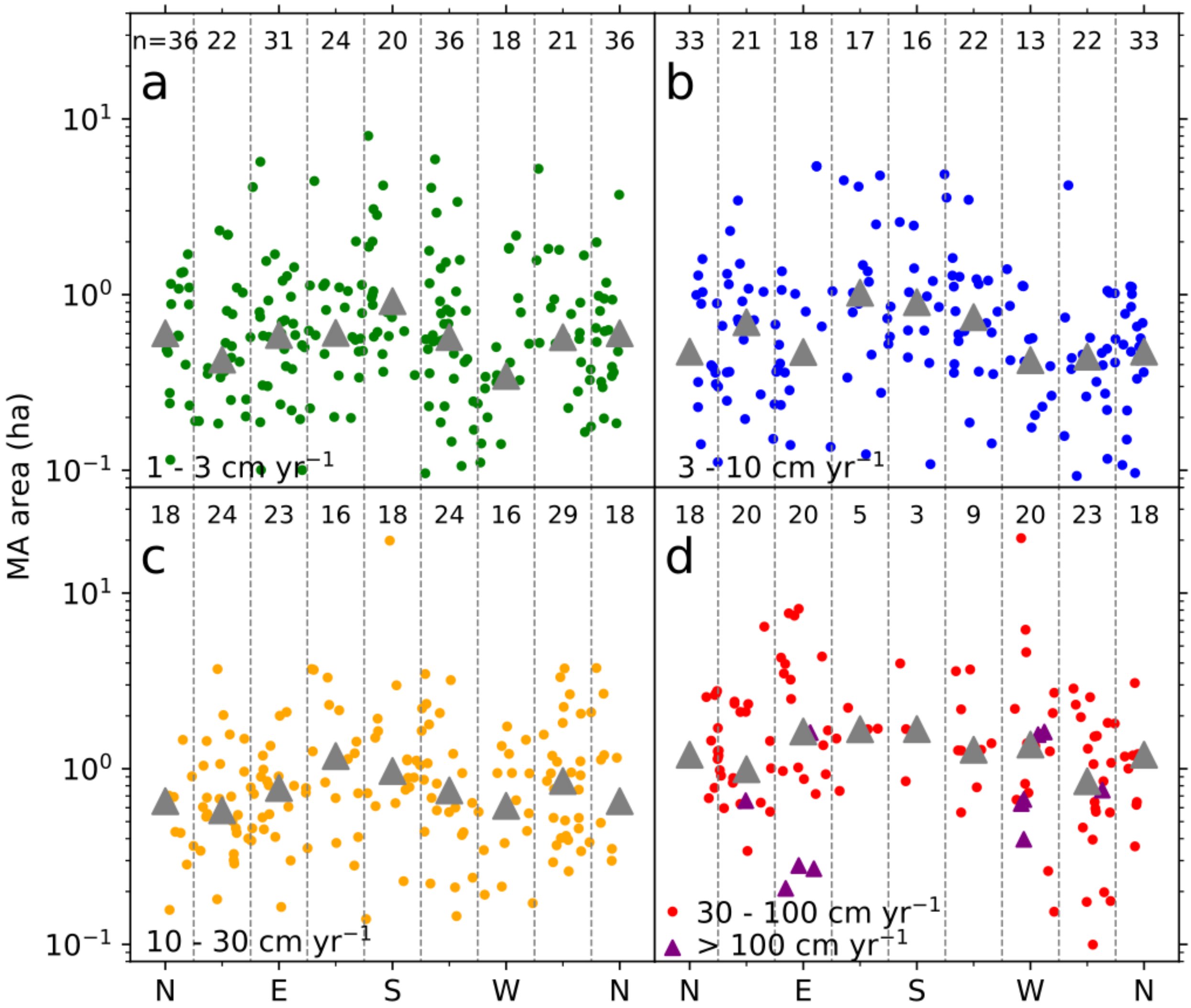

Figure S2. Moving area (MA) size represented as a function of slope aspect, stratified by moving area velocity classes: (a) 1 – 3 cm yr^{-1}; (b) 3 – 10 cm yr^{-1}; (c) 10 – 30 cm yr^{-1}; (d) 30 – 100 cm yr^{-1} and > 100 cm yr^{-1}. Grey triangles indicate median MA values across aspect sectors, bounded by dashed lines.

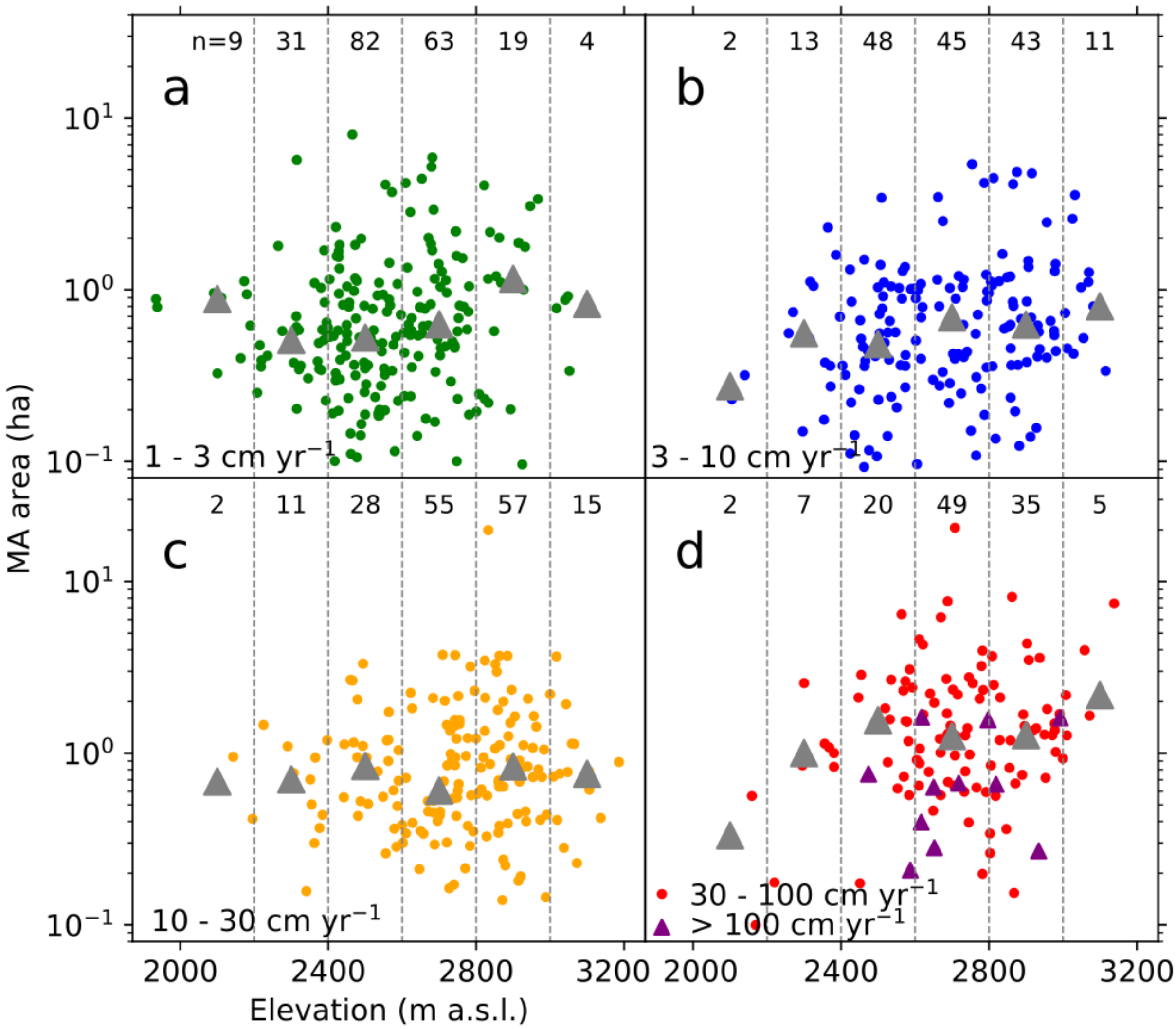

Figure S3. Moving area (MA) size represented as a function of elevation, stratified by moving area velocity classes: (a) 1 – 3 cm yr^{-1}; (b) 3 – 10 cm yr^{-1}; (c) 10 – 30 cm yr^{-1}; (d) 30 – 100 cm yr^{-1} and > 100 cm yr^{-1}. Grey triangles indicate median MA values across altitudinal zones, bounded by dashed lines.

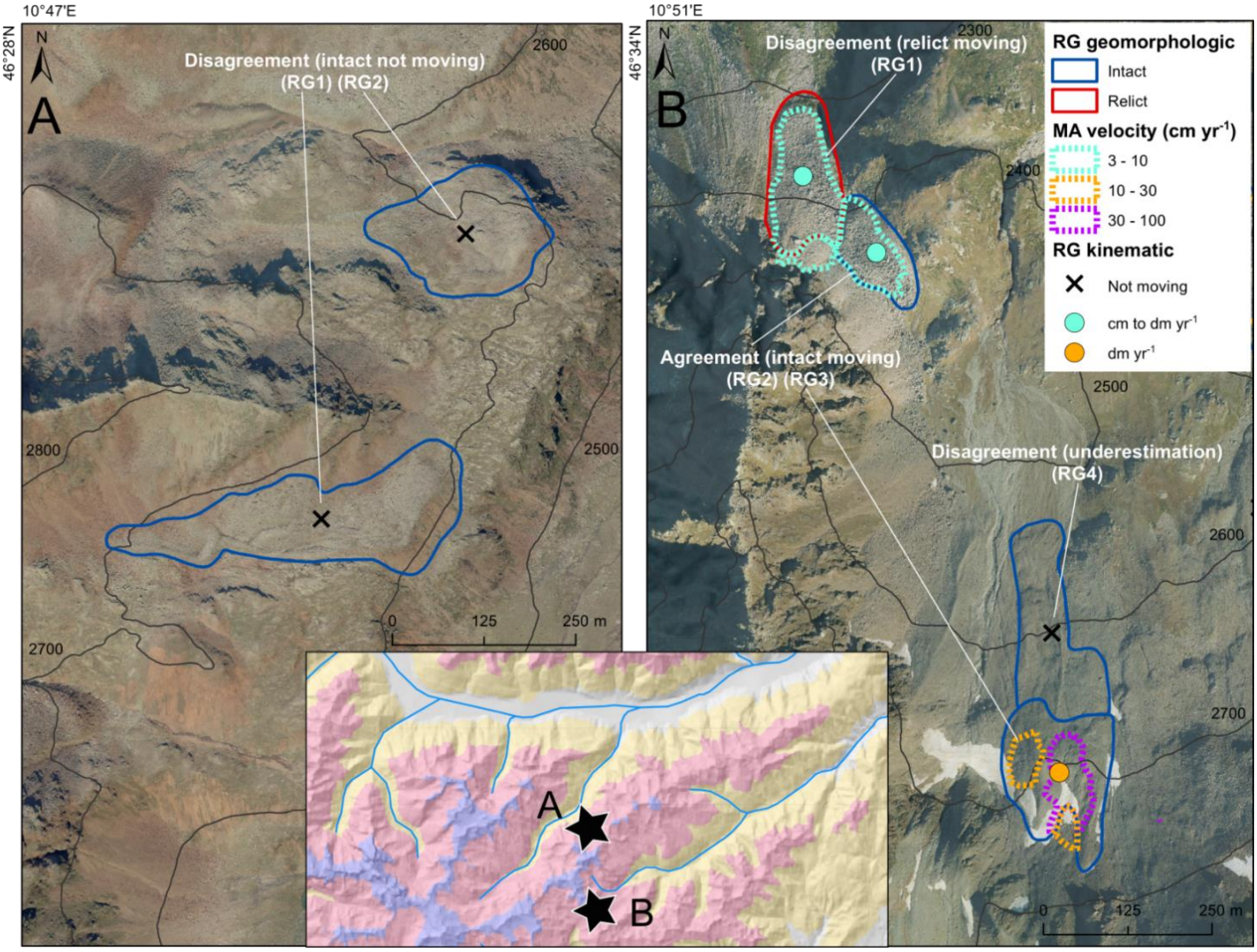

Figure S4. (a) Example of two rock glaciers in Ultental/Val d'Ultimo (RG1 and RG2) originally classified as intact. Considering the lack of moving areas and the limited SAR underestimation rate (20%), the two rock glaciers become relict (not moving) in the integrated classification. The relatively high elevation of these landforms (front elevation ranges from 2575 to 2585 m a.s.l.) contributes to increasing the median elevation of relict landforms. (b) Example of four rock glaciers in Martelltal/Val Martello affected by InSAR underestimation comprised between 39% and 57%. Despite signal underestimation, moving areas are detected on RG1, RG2 and RG3. As for originally intact RG4 (2520 m a.s.l.), the lack of moving areas may be an artefact associated with the high rate of signal underestimation and therefore uncertainty remains. Orthoimages from the Autonomous Province of Bolzano (https://geoportale.retecivica.bz.it/geodati.asp; last access: June 2023).