

60 years of rock glacier displacements and fluxes changes over Laurichard Rock glacier, French Alps.

CR4.1 Evolution of glacial-periglacial-paraglacial landscapes and debris-covered glaciers

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Introduction and study area

- Rock glacier acceleration are largely documented in the European Alps highlighting an increase in flow speed of stable rock glaciers and some anomalous behaviors.
- Laurichard active rock glacier is located in Ecrins National parc (6.40°E, 45.02°N), 500 m long up to 100-200 m wide and area of 0.084 km², flowing from 2650 m a.s.l. at the rooting zone (foot of the rock wall) to 2450 m a.s.l. at the front. Laurichard has the longest measurement time-series in the French Alps.
- This study aims to understand the causes of the rock glacier acceleration, investigate the changes in the ice masses across longitudinal and transversal profiles in order to be able to analyze in details the differences between the upper part and the front of the glacier.

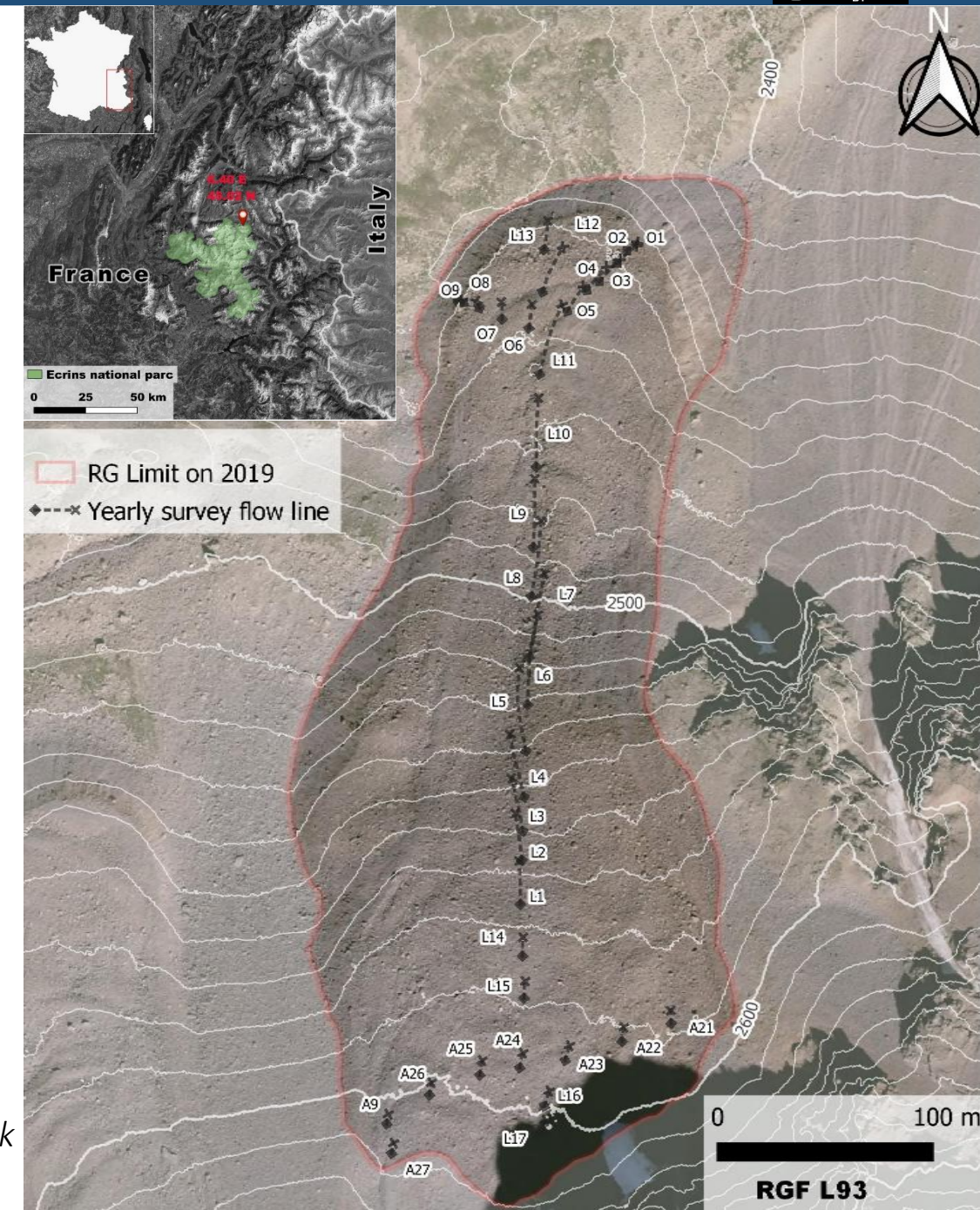
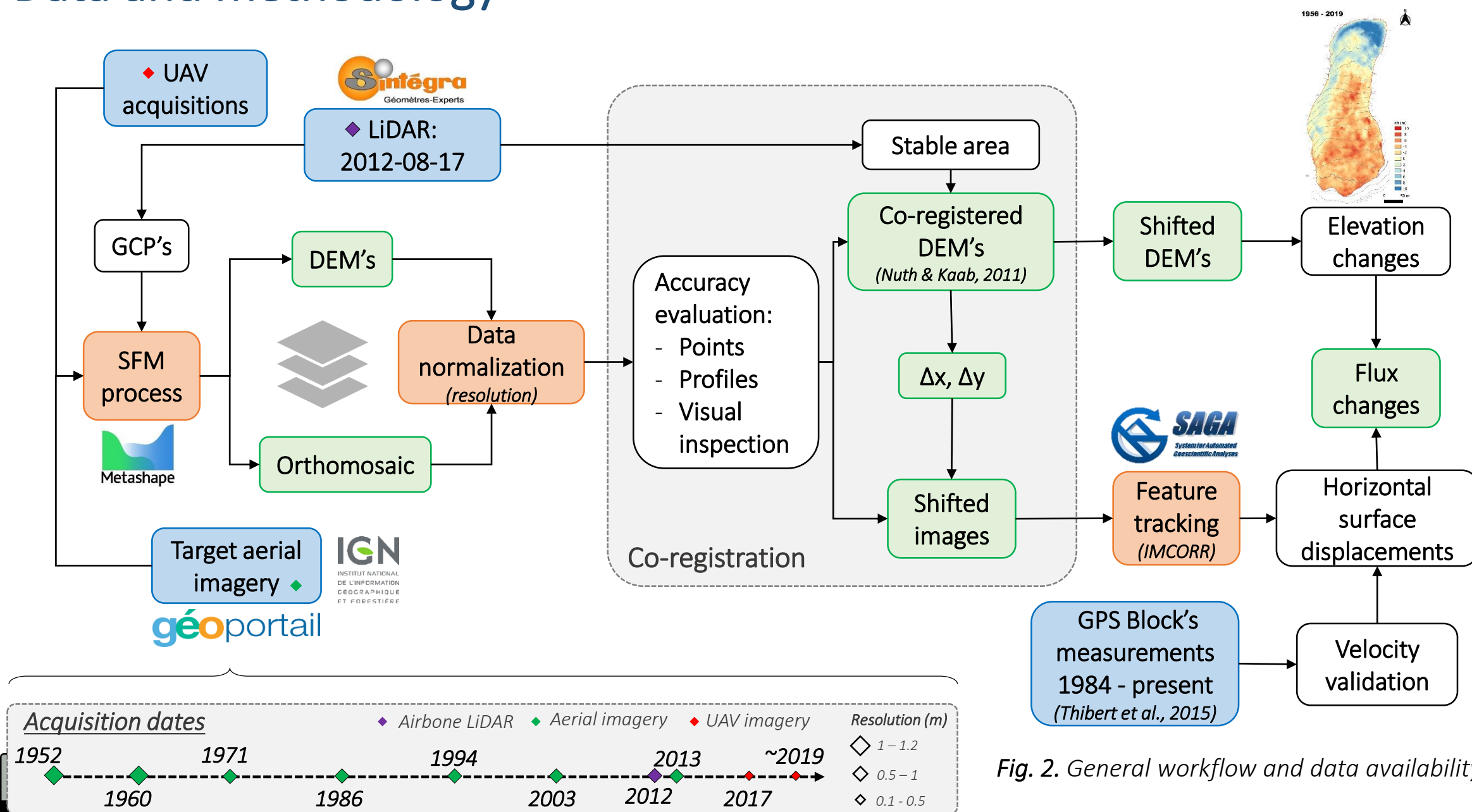
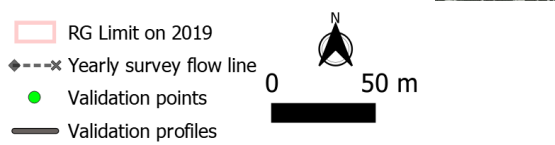
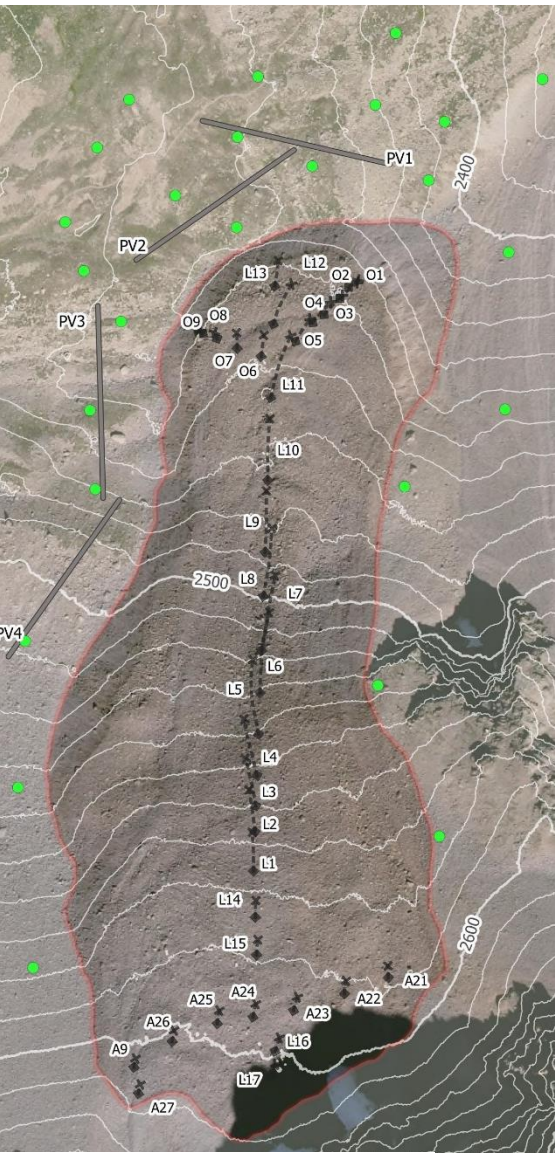


Fig. 1. Location map of Laurichard rock glacier. Image background of 2018

Data and methodology



Data validation



DEM's

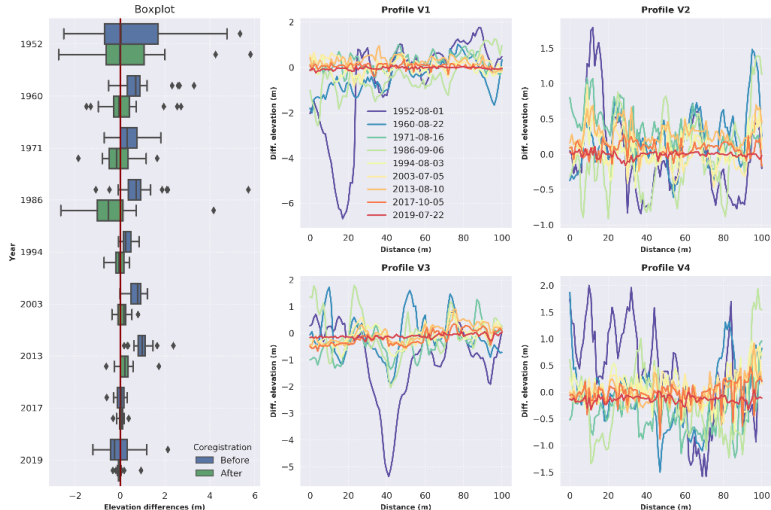


Fig. 3. A) Boxplot of Z values before and after co-registration process. B) Elevation differences for each DEM respect to reference DEM of 2012 for four validation profiles.

Mean Standard deviation (m) of elevation differences for points and profile		
Acquisition date	Before co-registration	After co-registration
1 August 1952	1.41	1.38
22 August 1960	0.73	0.71
16 August 1971	0.43	0.46
6 September 1986	0.81	0.81
3 August 1994	0.28	0.30
5 July 2003	0.26	0.28
10 August 2013	0.27	0.27
5 October 2017	0.22	0.17
23 July 2019	0.36	0.09

Velocity

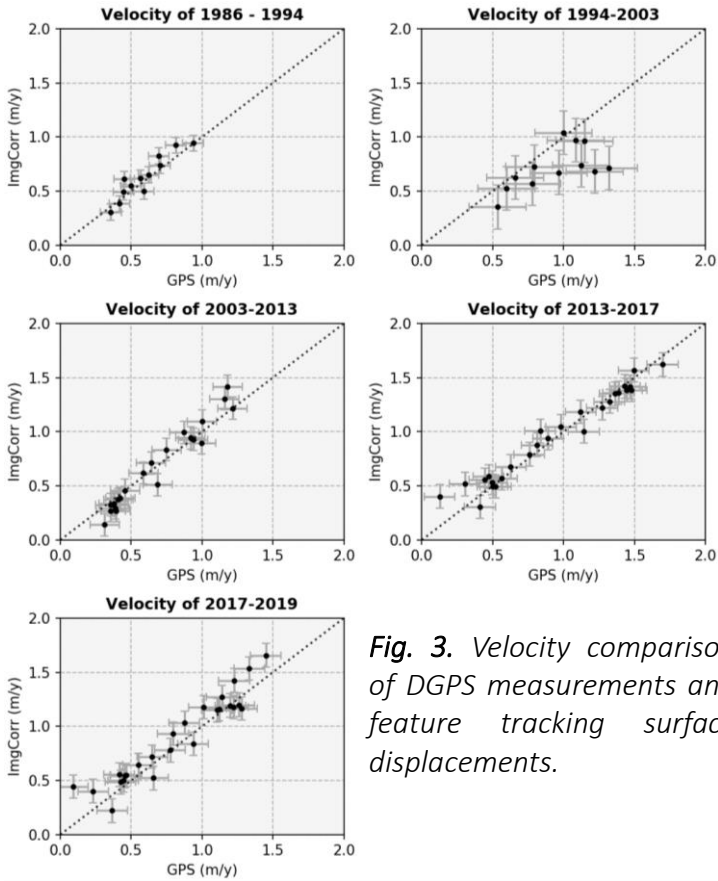


Fig. 3. Velocity comparison of DGPS measurements and feature tracking surface displacements.

Good correlation between 2D image correlation velocities and terrain measurements except for period 1994-2003 (poor correlation caused by illumination source).

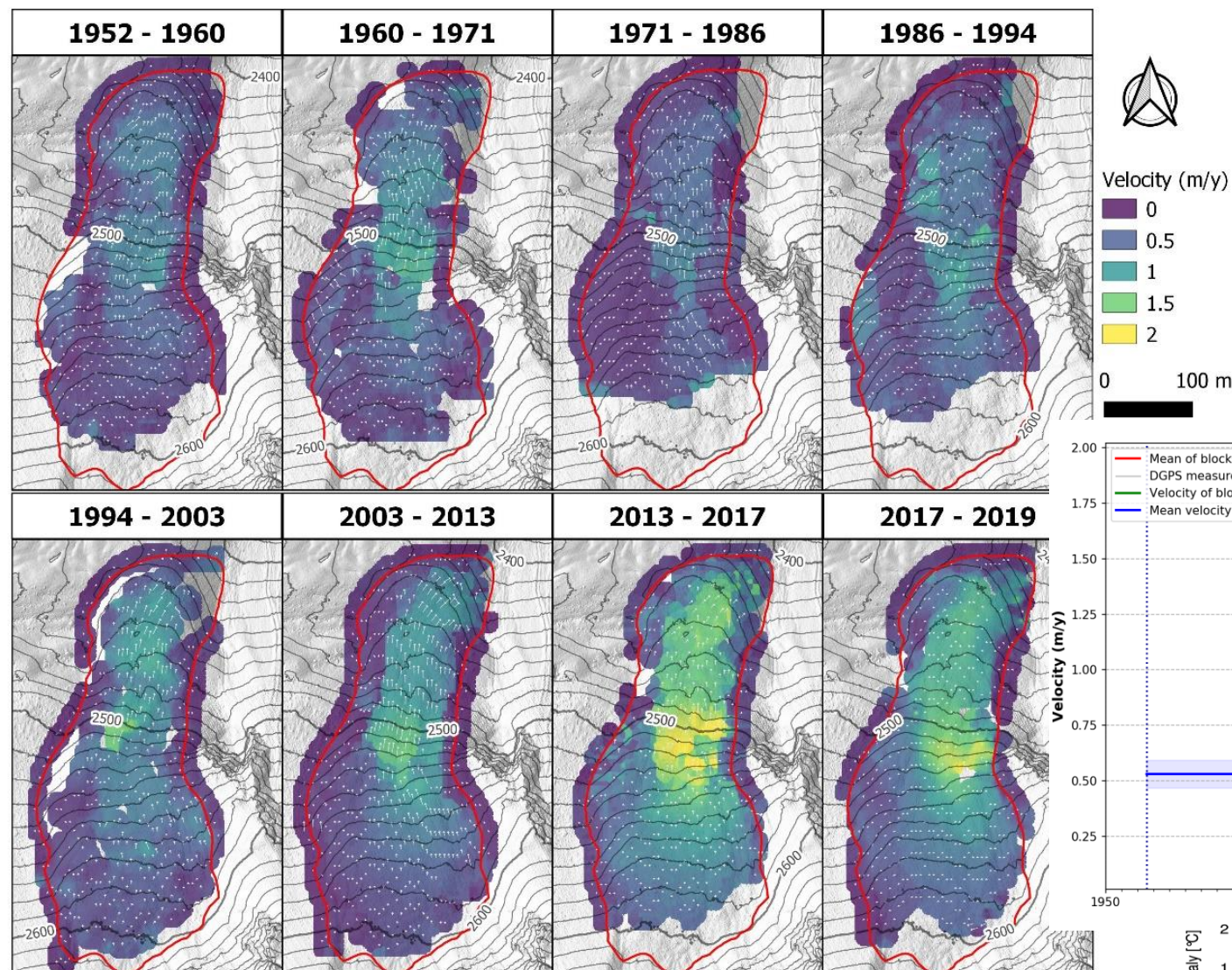


Fig. 5. Horizontal surface displacements for all study periods over Laurichard rock glacier.

Surface velocity

Horizontal surface displacements obtained from archival photogrammetry has a good spatial coverage for most of study periods (6/8).

Three periods of acceleration can be distinguished related with high temperatures in summer.

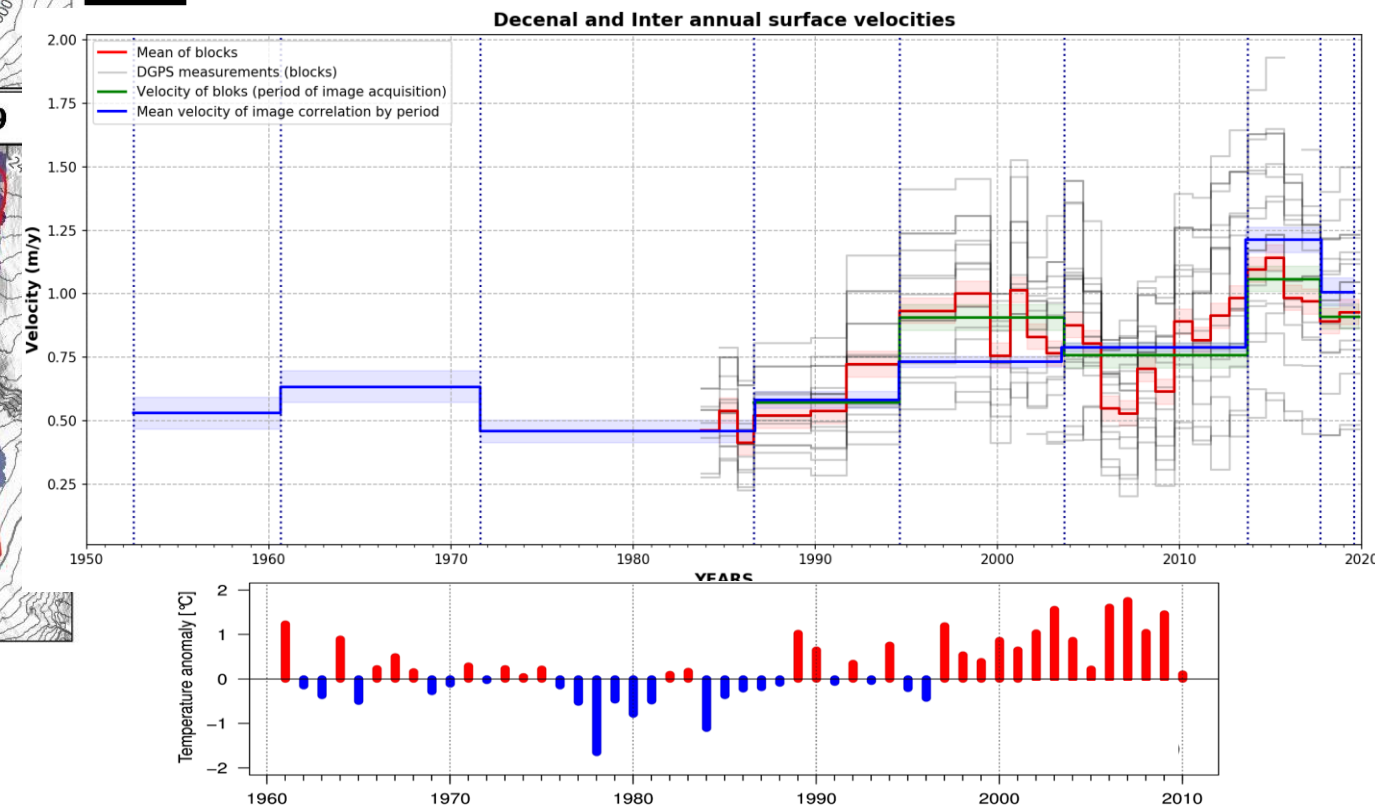


Fig. 6. Decadal and inter-annual surface velocities compared with DGPS measurements. Temperature anomaly collected from (Bodin et al 2016)

Discussion – preliminary results

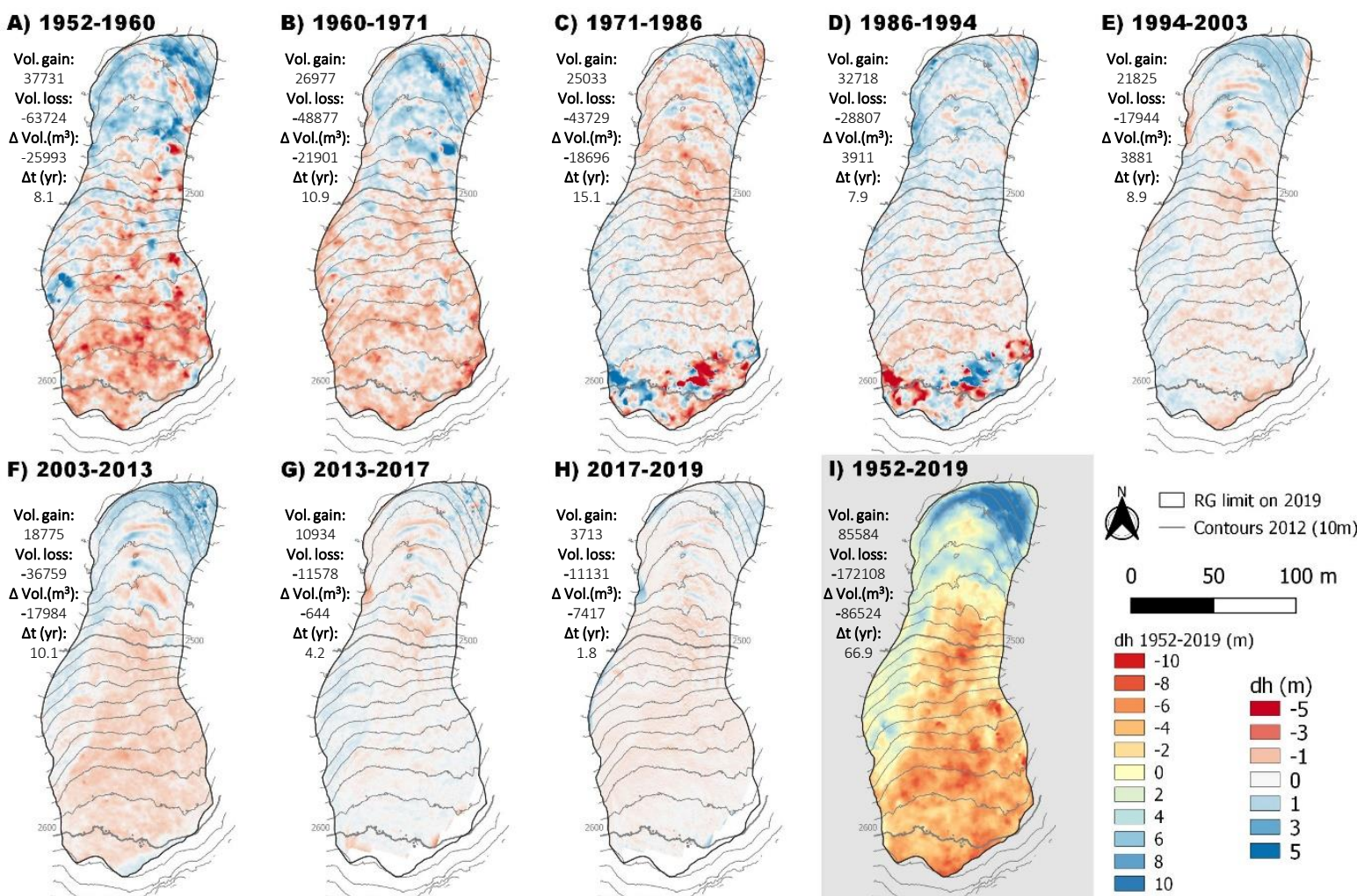


Fig. 7. Absolute elevation changes of Laurichard rock glacier for nine different periods between 1952 and 2019, derived from archival aerial photogrammetry. Volume change values computed from DEM differences are presented on each period.

- Two periods of small 'positive volume' variation: 1986 – 1994 and 1994 – 2003, mainly explain by rock glacier acceleration (Fig. 6). Period 2013-2017 characterized by a balanced budget.

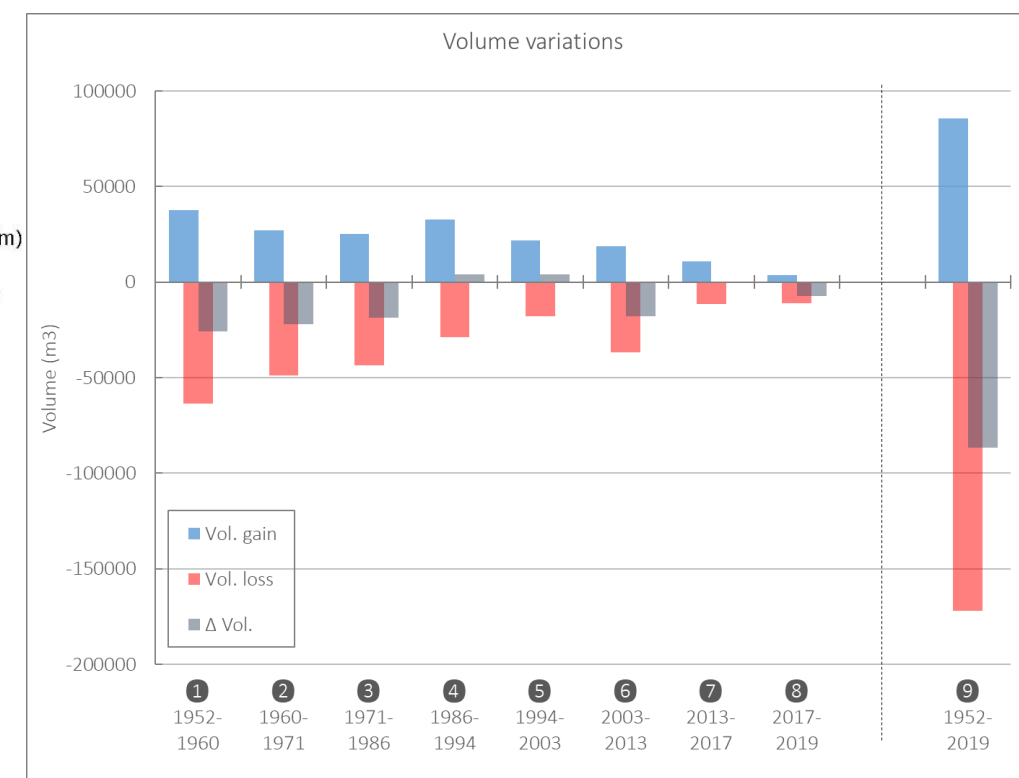


Fig. 8. Absolute elevation changes of Laurichard rock glacier for nine different periods between 1952 and 2019, derived from archival aerial photogrammetry.

Thank you very much

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