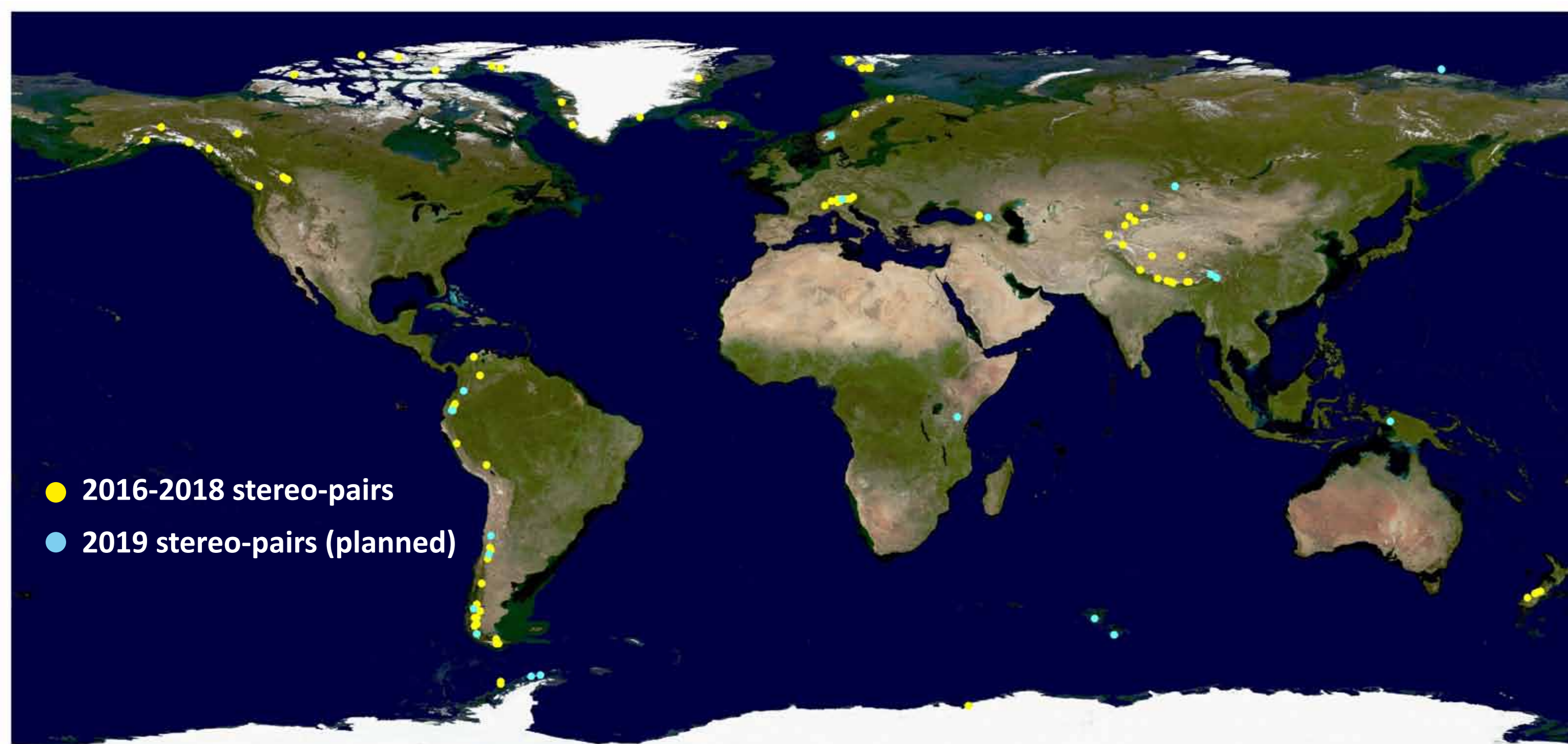


1. WHAT IS THE PLEIADES GLACIER OBSERVATORY (PGO) ?

- ▶ An initiative by the French Space Agency (CNES) and LEGOS to facilitate access to Pléiades satellite stereo-imagery and DEMs for glaciologists.
- ▶ Pléiades sub-meter imagery acquired on ~20 glacierized targets each season at the right time of the year (i.e. the end of the melt season), to generate 2- to 4-m digital elevation models (DEMs) and 0.5 m ortho-images.
- ▶ Data are freely available (under specific conditions) to all science users. Contact isis-pleiades@cnes.fr to access the data
- ▶ Six acquisition campaigns already took place during summers 2016, 2017 and 2018 in the North hemisphere; 2017, 2018 and 2019 in the South hemisphere.
- ▶ Repeat acquisitions are planned after five years to build a catalogue of geodetic mass balances based on Pleiades DEM differencing.
- ▶ Box 2 shows the distribution of the selected targets and example of DEMs.
- ▶ Box 3 illustrates the accuracy/precision of the elevation changes and mass balance

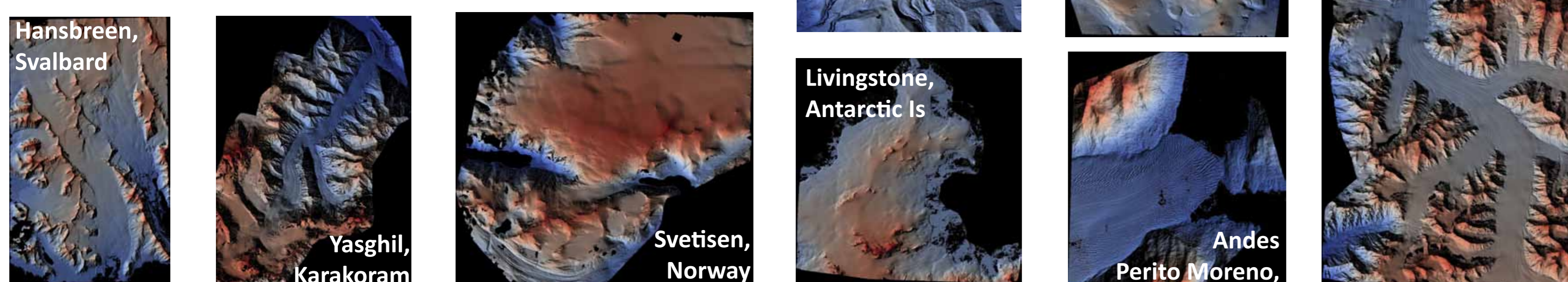
2. STEREO-IMAGES ACQUIRED SINCE 2016



Sites where Pléiades stéréo-data have been acquired between 2016 and 2018 (yellow dots, 5 campaigns) and where acquisitions will be attempted in 2019 (blue dots, 2 campaigns)

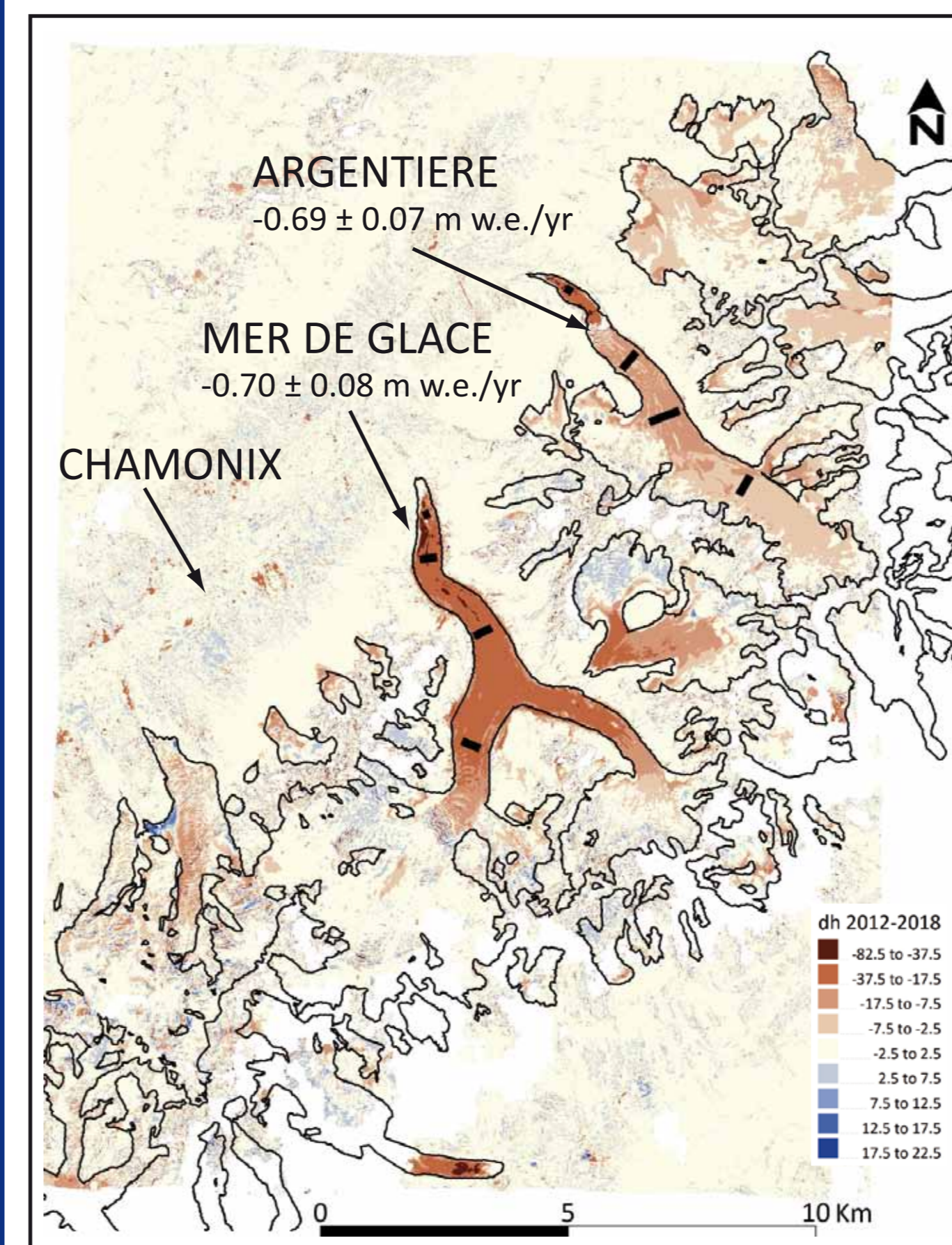
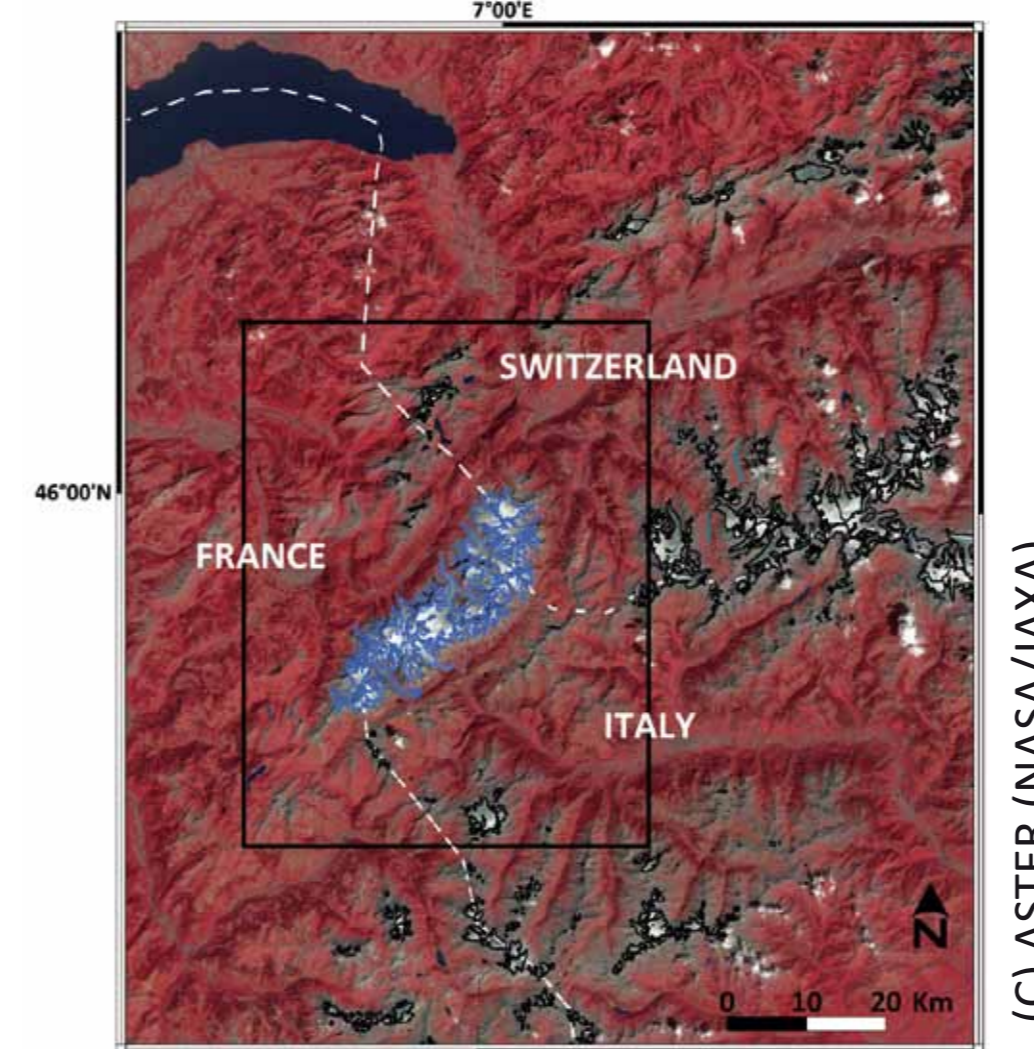
Statistics after 5 acquisition campaigns:

- ▶ High rate of success (>95%)
- ▶ nearly 30 000 km² of terrain acquired
- ▶ Stereo-images (DEMs) available over 84 sites
- ▶ Examples of DEMs



3. ACCURACY OF ELEVATION DIFFERENCES FROM PLEIADES DEMS

MONT-BLANC AREA

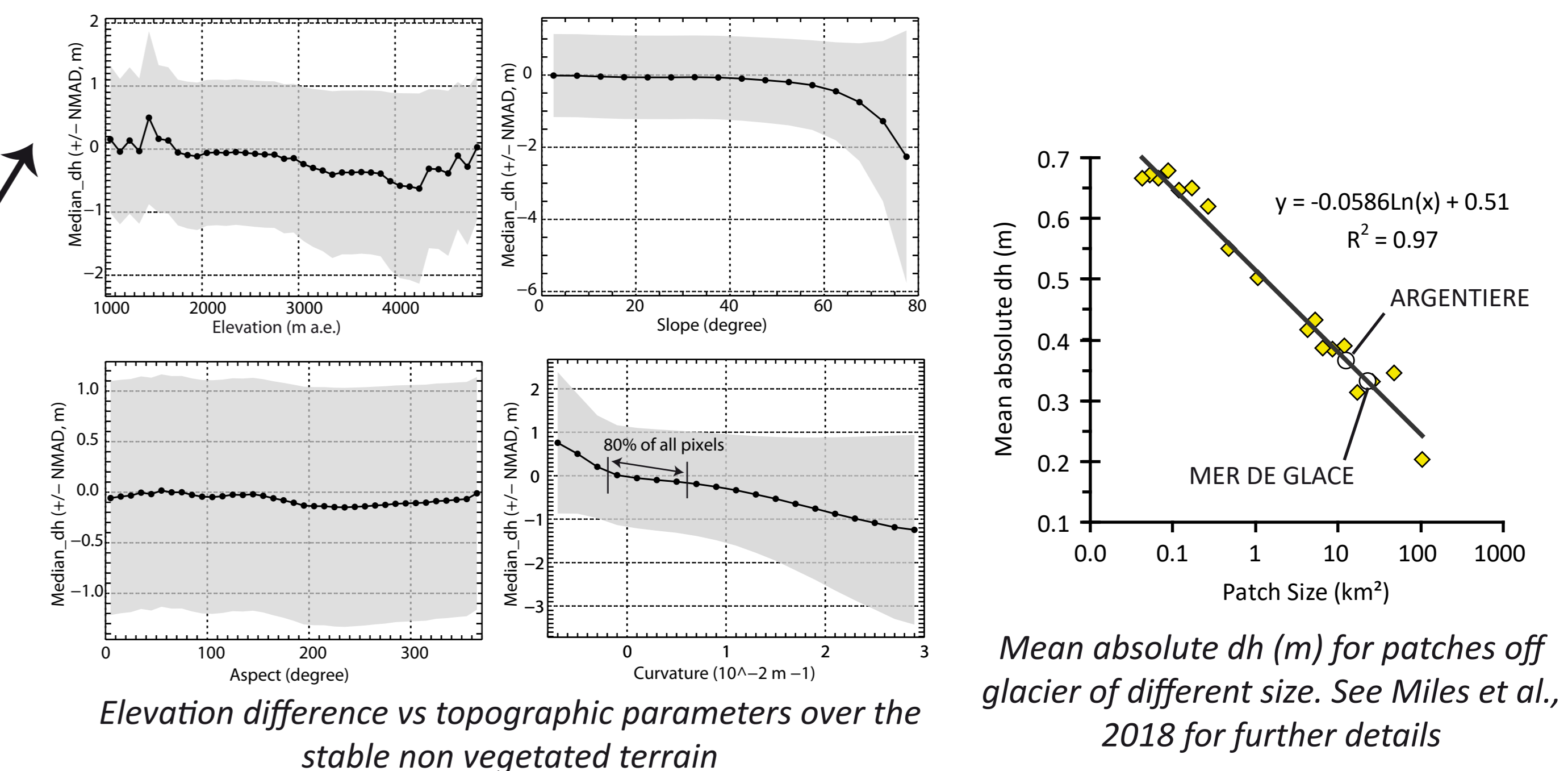


Map of elevation change (m) between August 2012 and August 2018. Dark thick lines indicate the location of the profiles where elevations are measured every September using DGPS by IGE

METHODS

- ▶ Stereo pairs acquired 19/08/2012 and 12/08/2018 (no seasonal lag)
- ▶ DEMs generated using the AMES stereo pipeline (ASP, Shean et al., 2016)
- ▶ 3D-coregistration masking out glaciers and végétation (Berthier et al., 2007). Shifts of $\Delta x=3.4$, $\Delta y=-3.6$, $\Delta z=-1.0$ (in meters).

EVALUATION OFF GLACIER



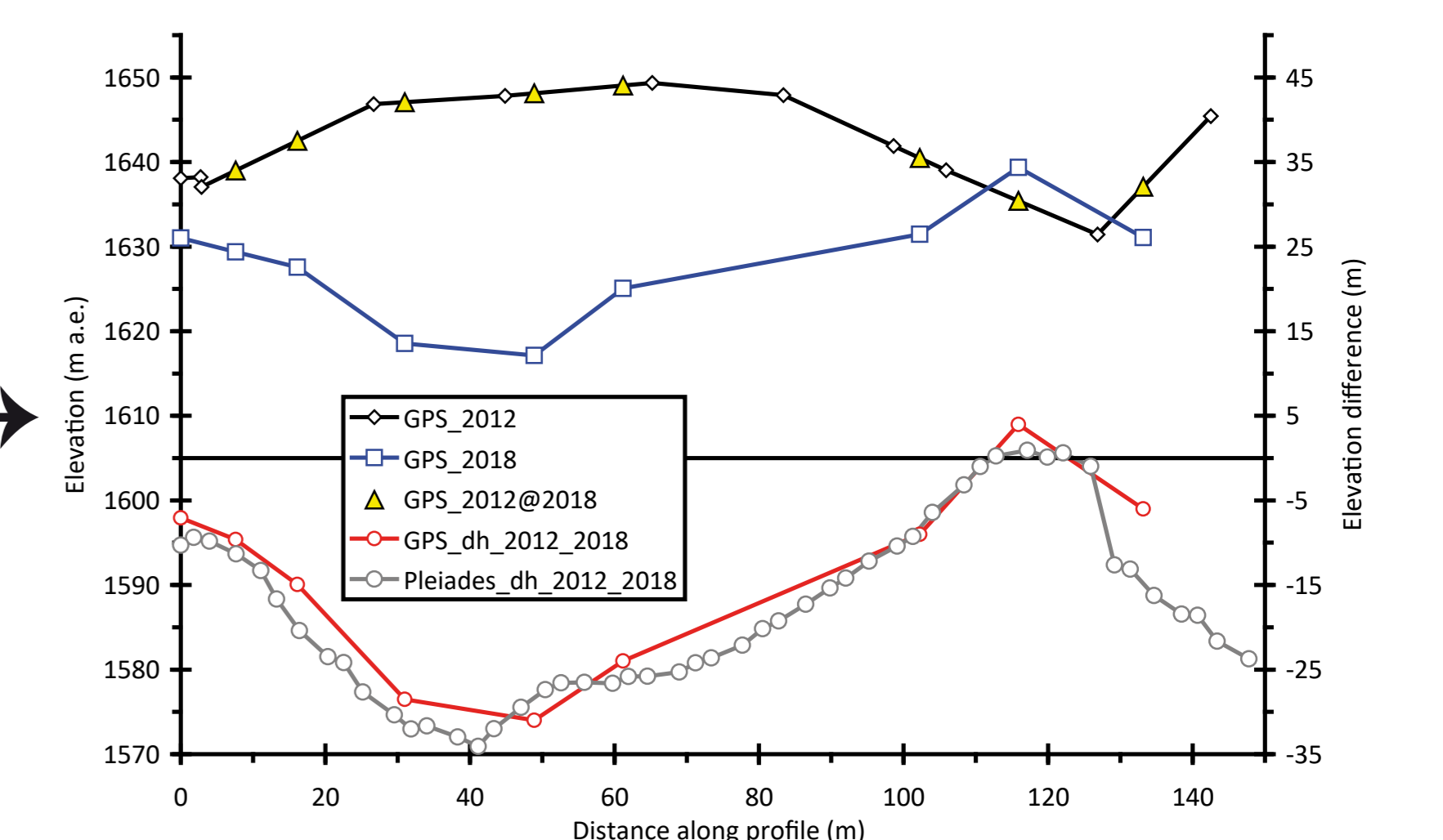
Elevation difference vs topographic parameters over the stable non vegetated terrain

Mean absolute dh (m) for patches of glacier of different size. See Miles et al., 2018 for further details

EVALUATION ON GLACIER vs GPS

Profil	GPS	SAT	Diff
P2	-29.8	-29.3	0.5
P4	-7.8	-7.3	0.5
P5	-8.8	-8.3	0.5
P7	-6.5	-6.4	0.1
MON	-15.9	-17.9	-2.0
ECH	-32.1	-31.8	0.3
TRE	-30.5	-31.2	-0.7
TAC	-20.4	-20.0	0.4
Mean_Dh_all			0.0 ± 0.9
Mean_Dh_withoutMON			0.2 ± 0.4

Mean elevation difference along the 8 profiles from repeat DGPS surveys and repeat PGO DEMs (P2-P7 on ARG; MON-TAC on MDG)



Elevation (top) and elevation difference (down) along the Mont-tenvers profile (Mer de Glace), the rougher one

4. OUTLOOKS, POTENTIALS OF PGO DATA

- ▶ Two years left (four campaigns) before the PGO enters in repeat survey mode. **Do not hesitate to propose rapidly your study site.**
- ▶ Accuracy of the elevation changes measured from these DEMs is on the order of 0.5-1 m, implying a precision of, typically, ~0.1 w.e. /yr for the geodetic mass balance over a 5-yr period. Useful for the re-analysis of field data
- ▶ Very high resolution DEMs and ortho-images can also be used as source of ground control points to process aerial photos (Papasodoro et al., 2015) or declassified satellite imagery (Belart et al. in press)
- ▶ Also some ongoing efforts to measure seasonal mass balance from Pléiades DEMs (Belart et al., 2017; Ruiz et al. in progress).

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