Supplement of The Cryosphere, 19, 5075–5094, 2025
https://doi.org/10.5194/tc-19-5075-2025-supplement

The Cryosphere Open Access EGU

Supplement of

Glacier surge monitoring from temporally dense elevation time series: application to an ASTER dataset over the Karakoram region

Luc Beraud et al.

Correspondence to: Luc Beraud (luc.beraud@univ-grenoble-alpes.fr, luc.beraud@protonmail.com)

Supplement section 1- Additional time series

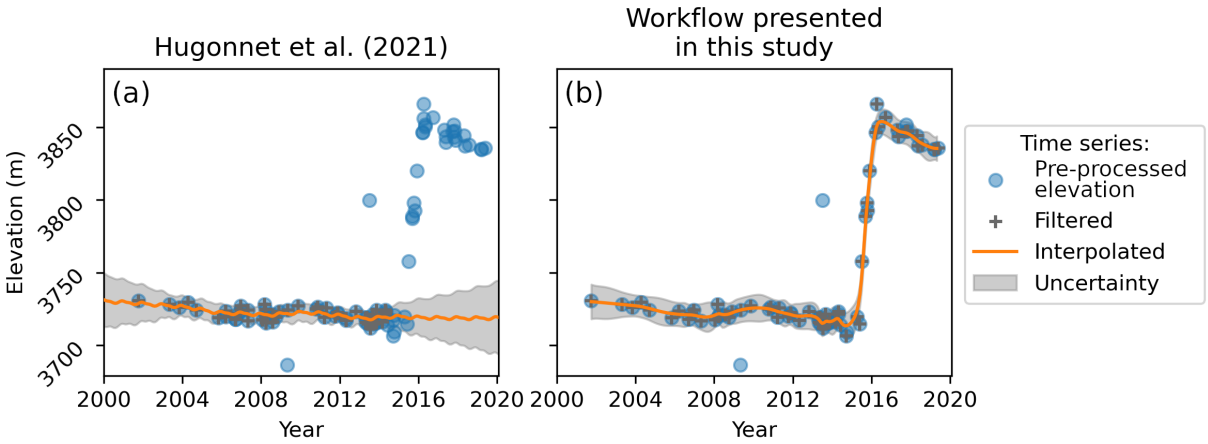

Figure S1: a-b: additional time series complementing the figure Fig. 6, at coordinates (36.126, 75.158) over the Hispar glacier.

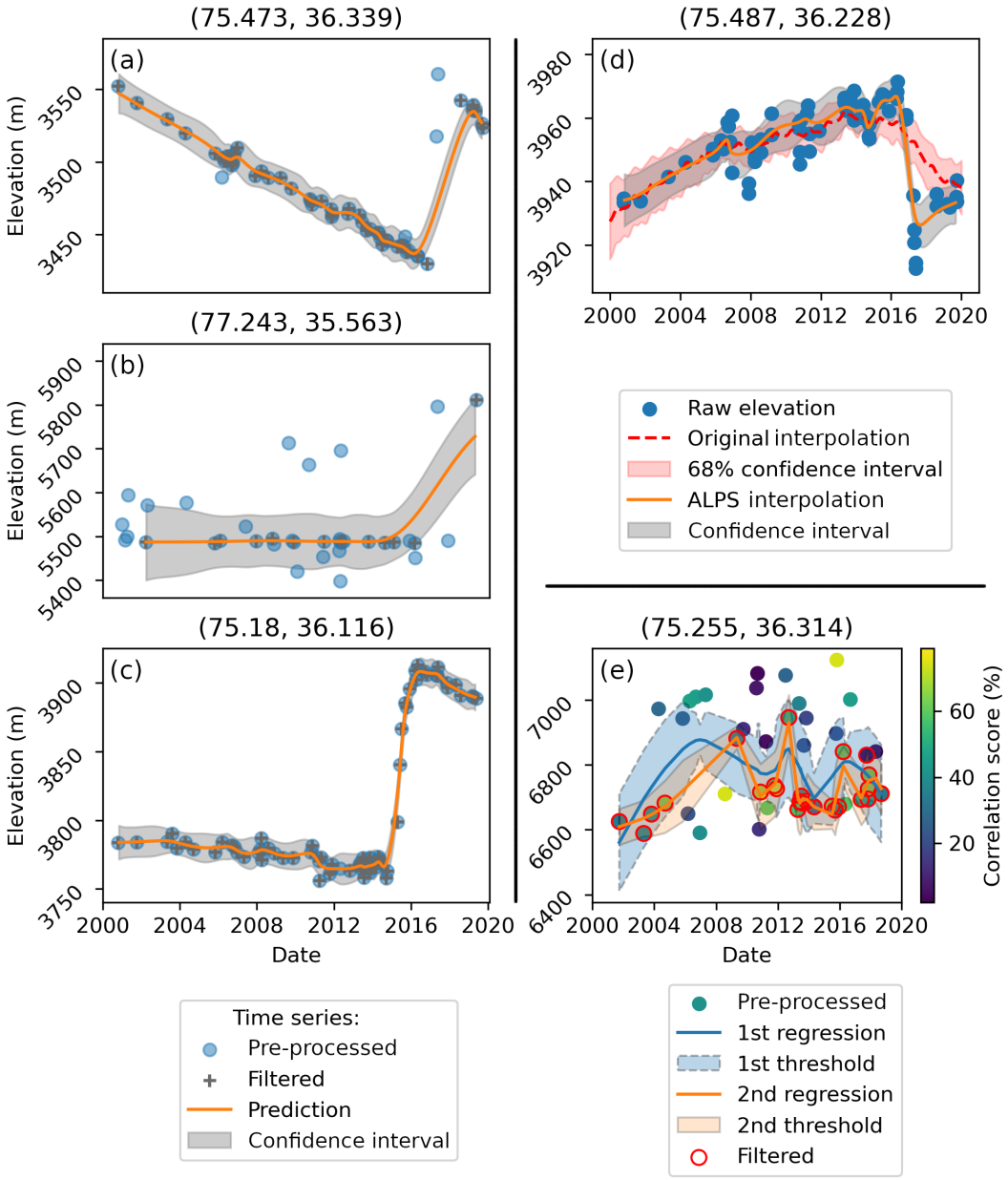

Figure S2: Additional time series. Panels a-c show more examples of ALPS-REML interpolation with distinct flaws. The panel d compares the interpolation results of Hugonnet et al. (2021) ("Original interpolation" and its 60% confidence interval) and this study ("ALPS interpolation" and its confidence t-interval). The panel e show the successive iteration of the LOWESS regression, with points coloured by their correlation score. For this time series, the estimated elevation error (which is used to weight the LOWESS algorithm) is very close to the opposite of the correlation score, in relative.

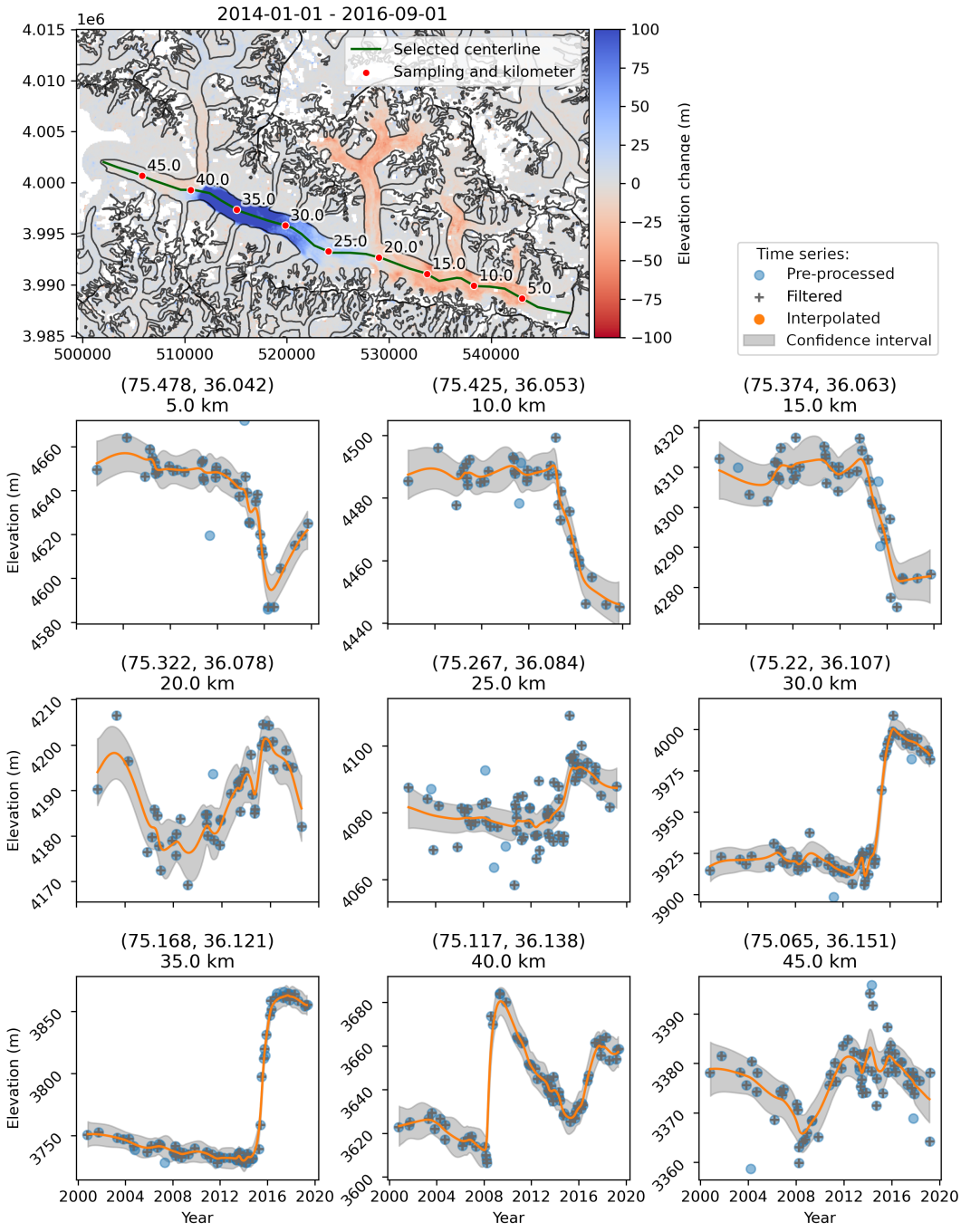

Figure S3: Additional elevation time series for Hispar glacier sampled regularly along the selected centerline. The map shows the sampling and the elevation change over the estimated surge period. The coordinate reference system of the map ticks is UTM 43N (EPSG:32643), and points coordinates in the title of time series are in WGS84 (EPSG:4326).

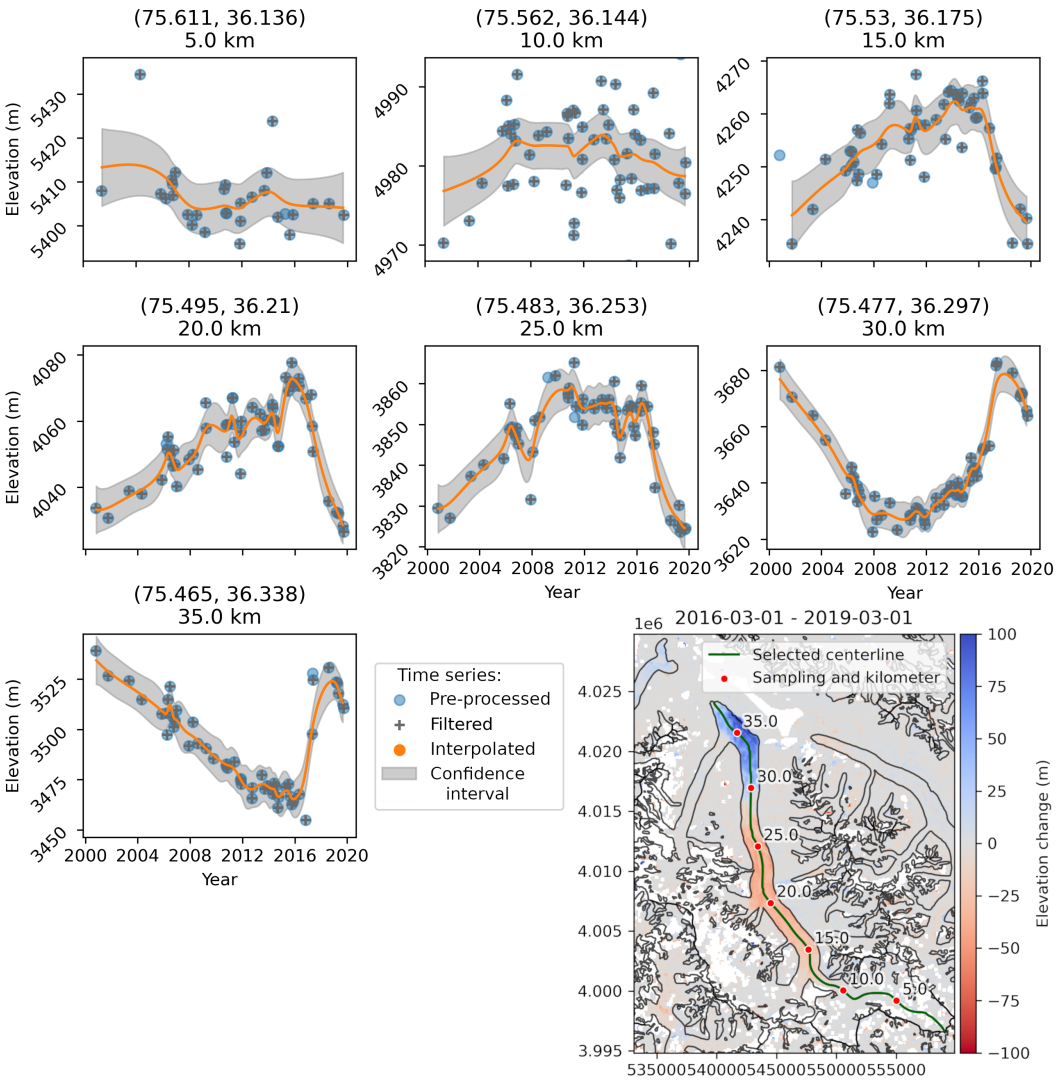

Figure S4: Additional elevation time series for Khurdopin glacier sampled regularly along the selected centerline. The map shows the sampling and the elevation change over the estimated surge period. The coordinate reference system of the map ticks is UTM 43N (EPSG:32643), and points coordinates in the title of time series are in WGS84 (EPSG:4326).

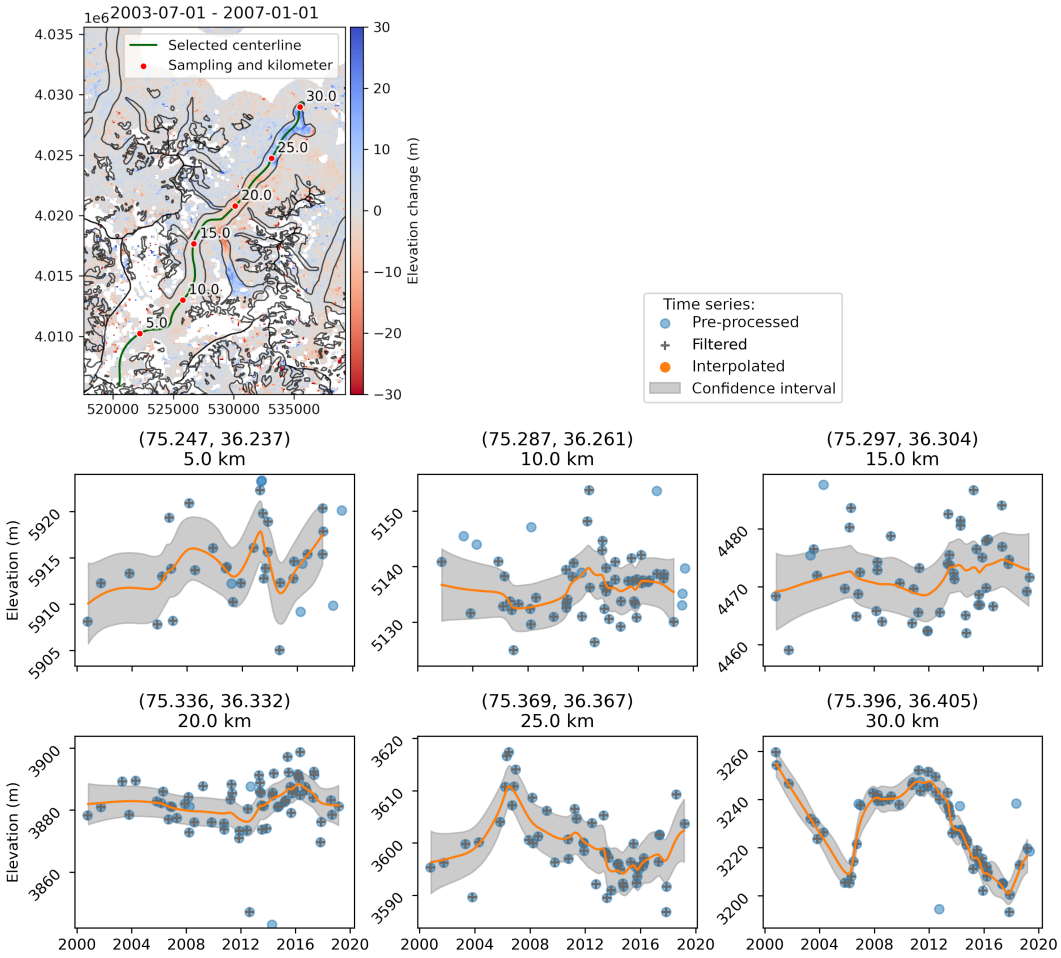

Figure S5: Additional elevation time series for Yazghil glacier sampled regularly along the selected centerline. The map shows the sampling and the elevation change over the estimated surge period. The coordinate reference system of the map ticks is UTM 43N (EPSG:32643), and points coordinates in the title of time series are in WGS84 (EPSG:4326).

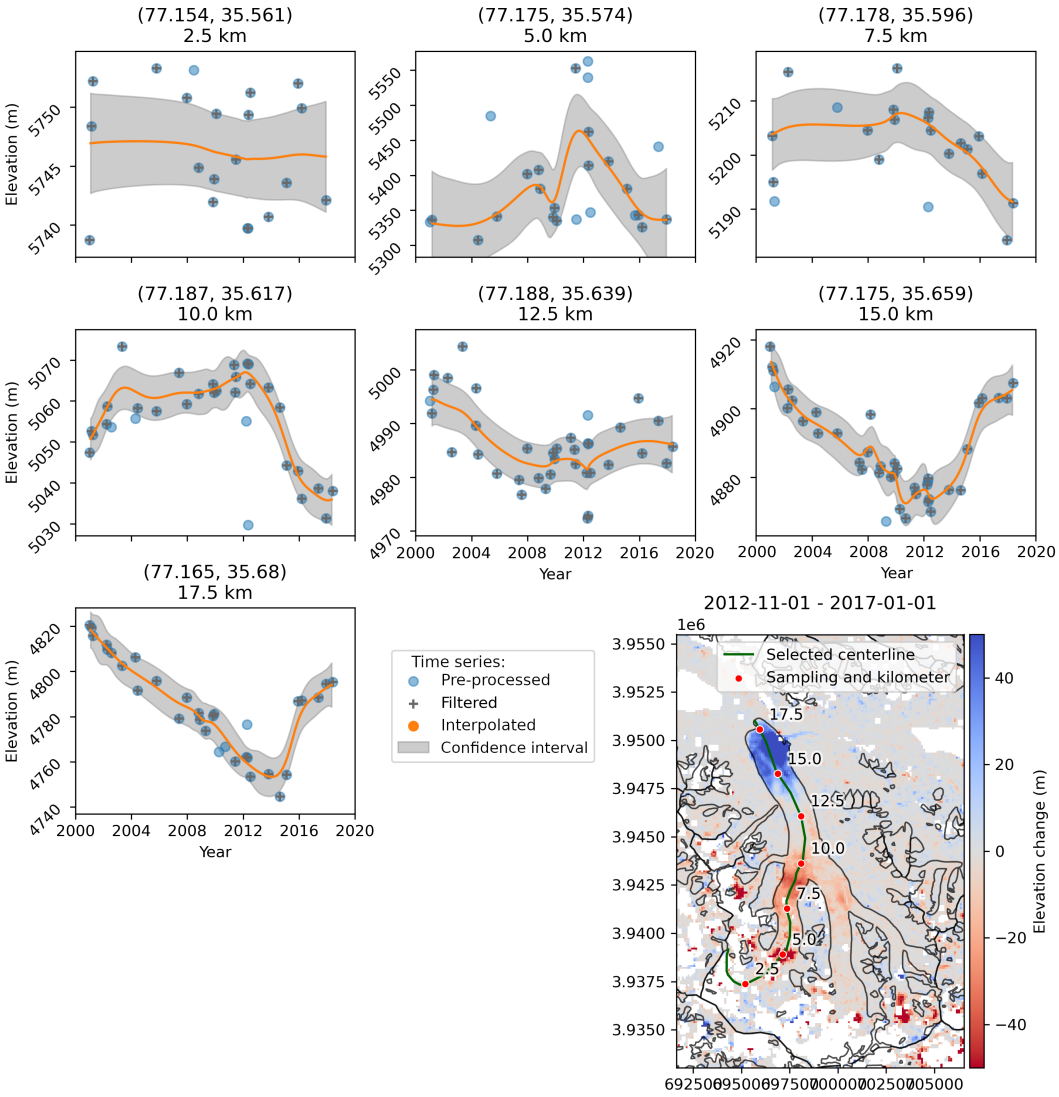

Figure S6: Additional elevation time series for Kyagar glacier sampled regularly along the selected centerline. The map shows the sampling and the elevation change over the estimated surge period. The coordinate reference system of the map ticks is UTM 43N (EPSG:32643), and points coordinates in the title of time series are in WGS84 (EPSG:4326).

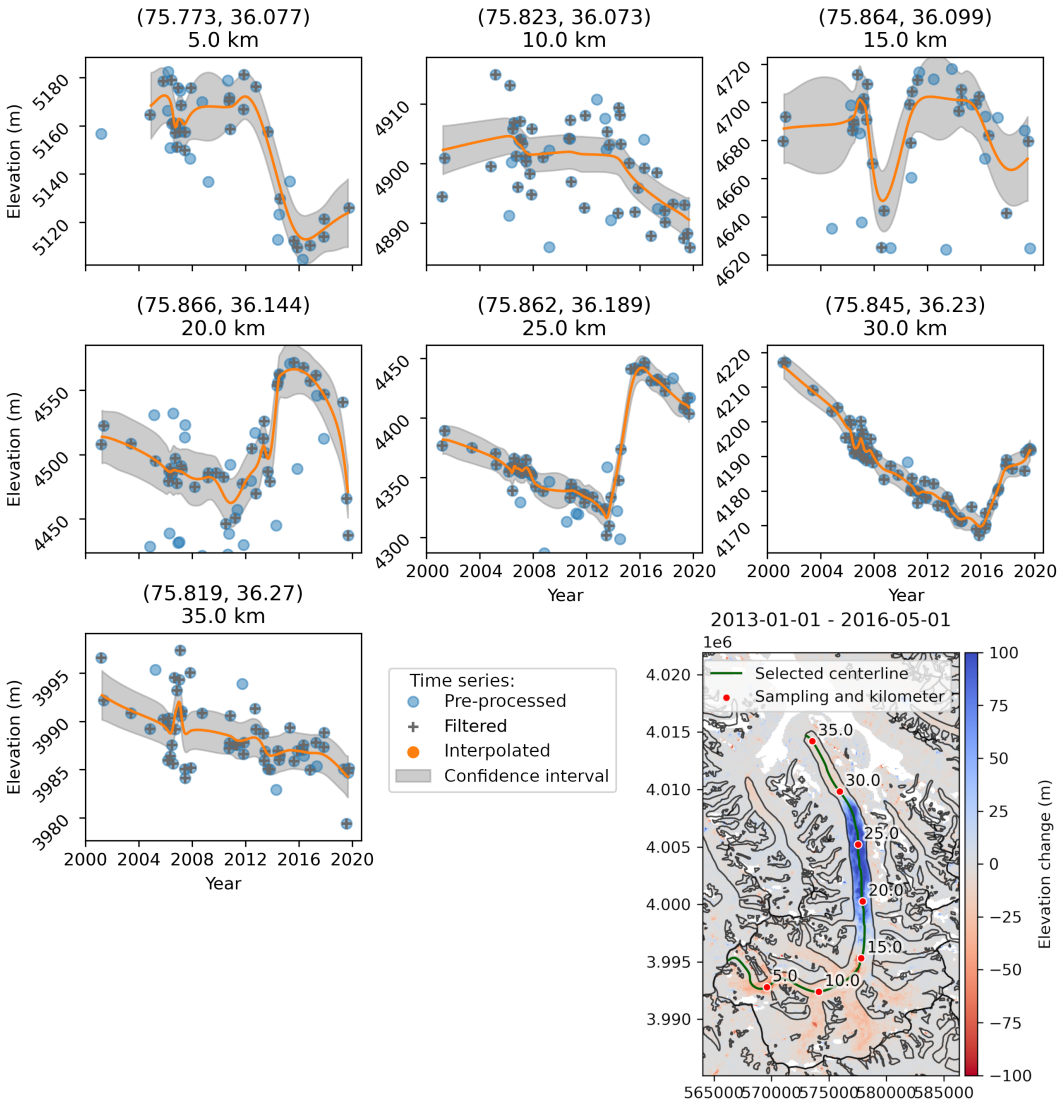

Figure S7: Additional elevation time series for Braldu glacier sampled regularly along the selected centerline. The map shows the sampling and the elevation change over the estimated surge period. The coordinate reference system of the map ticks is UTM 43N (EPSG:32643), and points coordinates in the title of time series are in WGS84 (EPSG:4326).

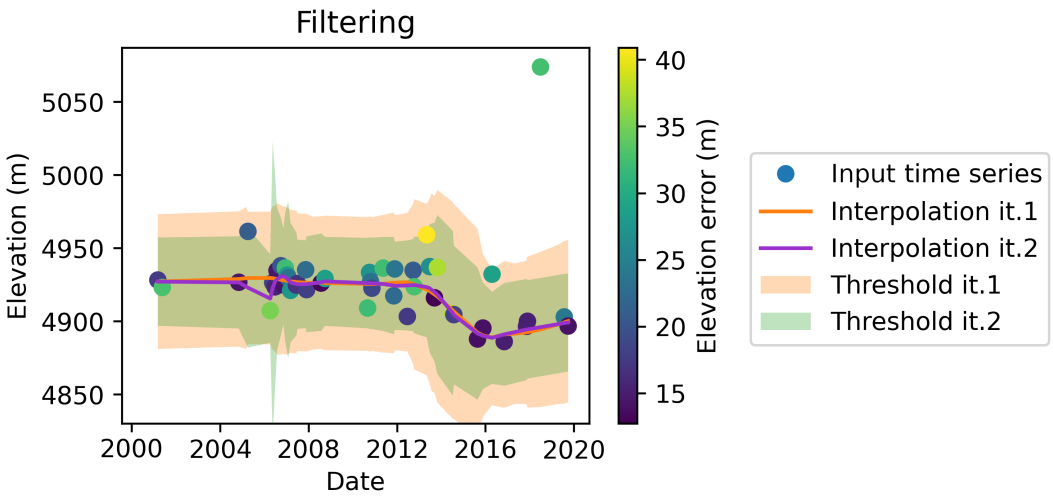

Figure S8: Filtering of the time series from Fig. 3, coloured by the elevation error estimate. The weight of the LOWESS regression is *1/"elevation error"*.

Supplement section 2- Volume transferred on original ASTER data

Glacier RGI 7.0 code	Date start	Date end	Reservoir vol. change	Receiving vol. change	Imbalance
Hispar 21670	2014-01	2016-09	-1595 ± 376 x 10^6 m^3	1122 ± 169 x 10^6 m^3	-473 ± 412 x 10^6 m^3 -2.68 m
Yazghil 21865	2003-07	2007-01	-38 ± 30 x 10^6 m^3	34 ± 25 x 10^6 m^3	-4 ± 39 x 10^6 m^3 -0.29 ± 2.73 m
Khurdopin 14958	2016-03	2019-03	-585 ± 120 x 10^6 m^3	453 ± 60 x 10^6 m^3	-132 ± 134 x 10^6 m^3 -2.80 ± 2.82 m
Kyagar 14958	2012-11	2017-01	-191 ± 79 x 10^6 m^3	198 ± 45 x 10^6 m^3	8 ± 91 x 10^6 m^3 0.27 ± 3.09 m

Table S1: Volume transferred of surges for the four selected glaciers this time according to the original interpolated ASTER dataset from Hugonnet et al. (2021), during the same period as in Table 1. For these glaciers, the percentage of data gap after the workflow presented in this study is ranging from 0 to 1.1% (median of 0.1%), and after bilinear interpolation it is of 0% for all of them. The prefix of RGI 7.0 codes is "RGI2000-v7.0-G-14-".

Supplement section 3- Volume transferred and mass balance comparison

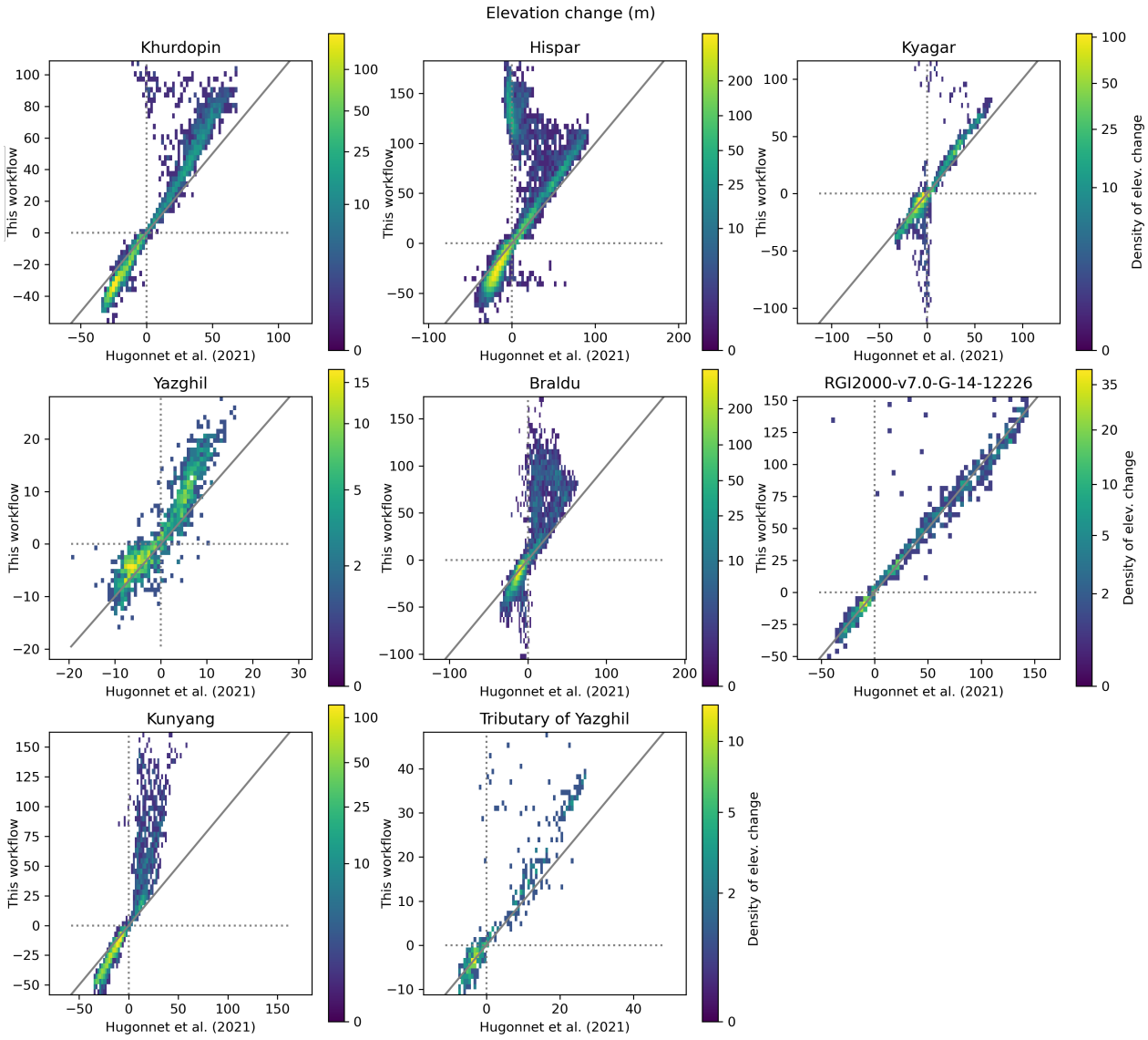

Figure S9: Individual representation of Fig. 13, elevation change comparison histogram per surge. Each surge is the single one occurring during our study period on the glacier designated, except for Yazghil glacier for which the surge is the 2003-2007 one. Note that the reservoir area of the unnamed glacier (RGI code RGI2000-v7.0-G-14-12226) is captured over only a third of its extent here.

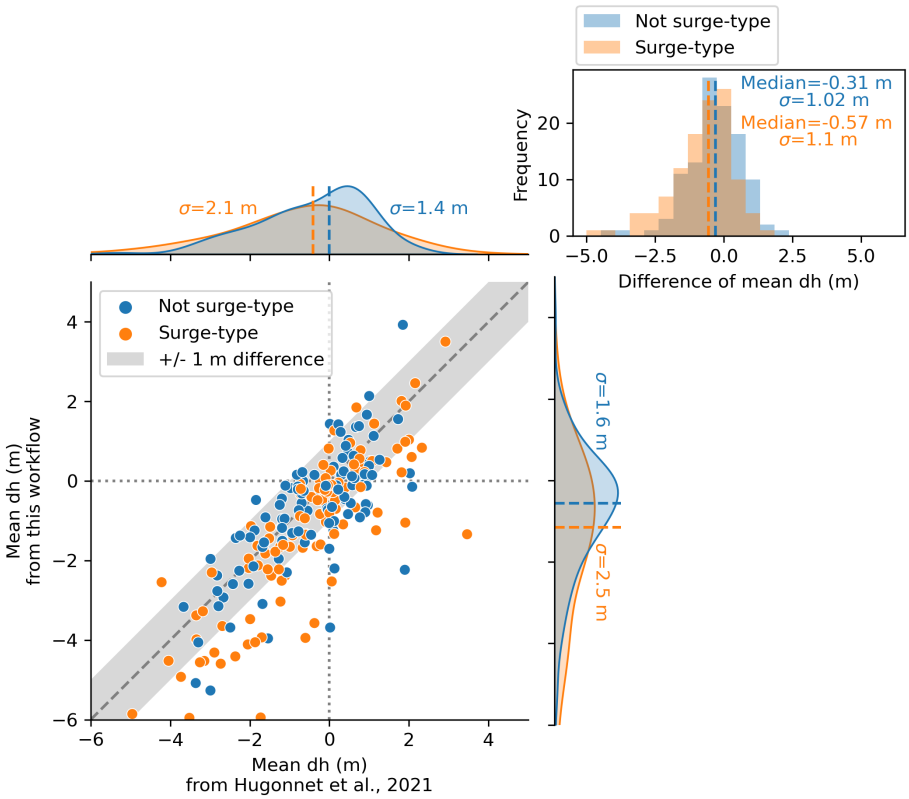

Figure S10: Comparison of mean elevation change (dh in the figure) per glacier from 2005 to 2015, between the interpolated dataset of Hugonnet et al. (2021) and this workflow. It is calculated over the same valid pixels to avoid different data gaps. It represents 224 glaciers in the center of Karakoram, with 112 glaciers in each surge and non-surge type category. We extract surge-type glaciers from the inventories of Guillet et al. (2022) and Guo et al. (2022) (categories I and II during 2000-2020). The top right histogram represents the difference of mean dh between the two datasets. The dotted lines represent the median of the distributions. The sigma symbol represents the standard deviation.

Supplement section 4- Reference DEMs

Satellite	Acquisition date
SPOT5 HRS	2008-12-03
SPOT6	2015-11-28
	2015-10-13
HMADEM	2014-01-28
	2015-05-15
	2015-10-29

Table S2: Dates of the reference DEMs used in the subsection 5.1 .

Supplement section 5- Spatial variogram

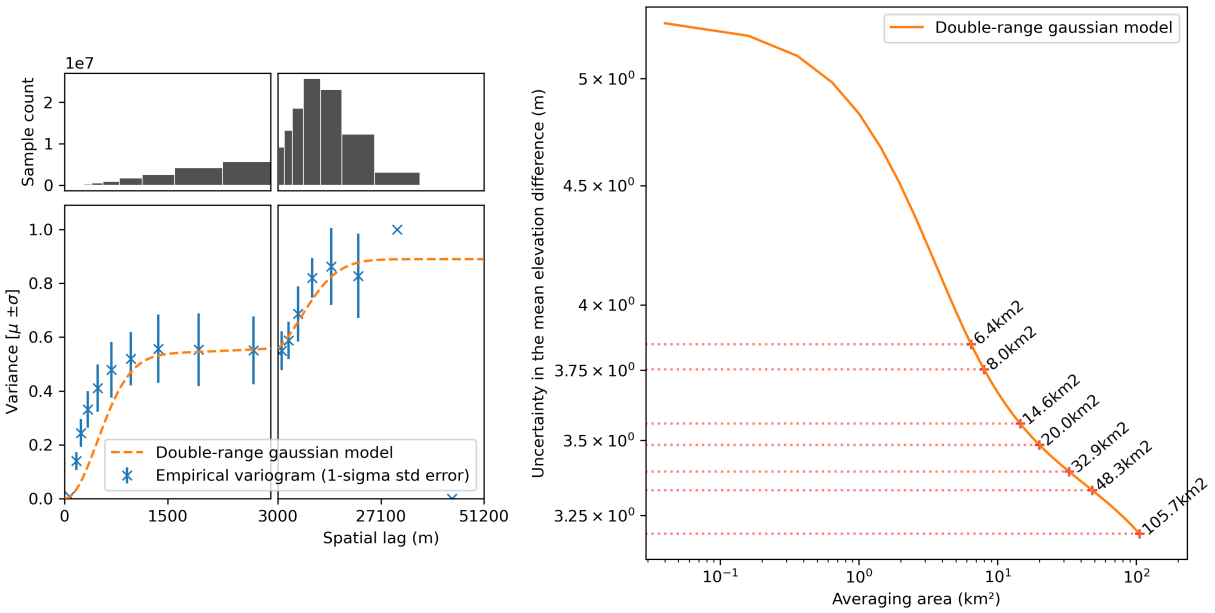

Figure S11: Left: fit of the experimental variogram with a double-range Gaussian model (fitted ranges of 1.4 and 19 km). The variogram is computed as detailed in subsection 5.1. Right: mean elevation difference uncertainty estimated from the number of effective samples calculated from the model with the *xDEM* library. We indicate the area of each delineated zone used for the transferred volume estimated in Table 1