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Intercomparison of photogrammetric platforms for spatially continuous snow depth mapping

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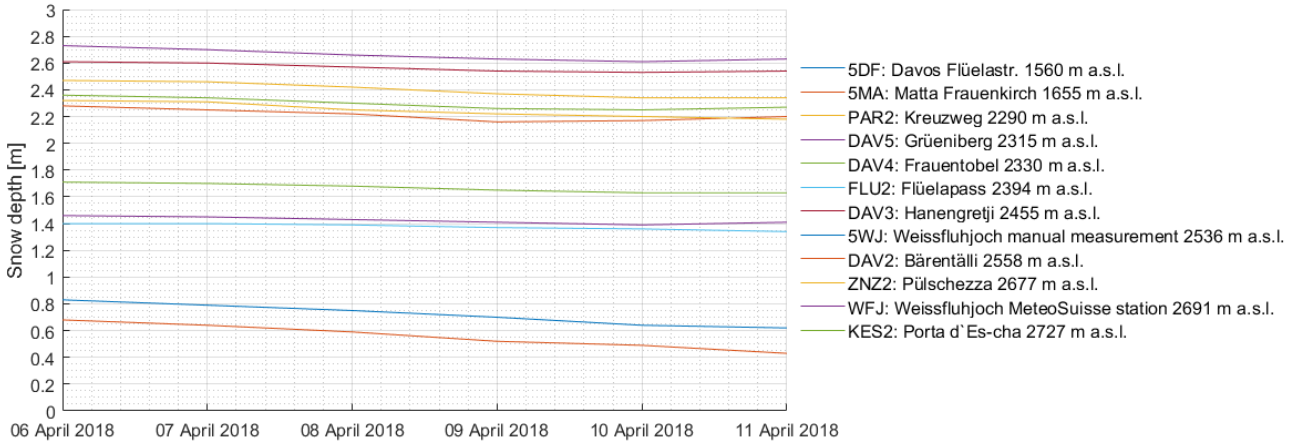

Figure S1: Overview of the measured snow depth of the automatic and manual stations around Davos for the period of the photogrammetric data acquisition (see Figure 1 for the locations). For each day and each station one value is displayed. The time for manual measurements is between 07:00 and 07:30. For the automatic stations, the most recent value within the time window 06:30 to 08:15 is displayed. Manually measured are 5DF, 5MA and 5WJ. All the other stations are automatic stations. (Data © SLF and MeteoSchweiz)

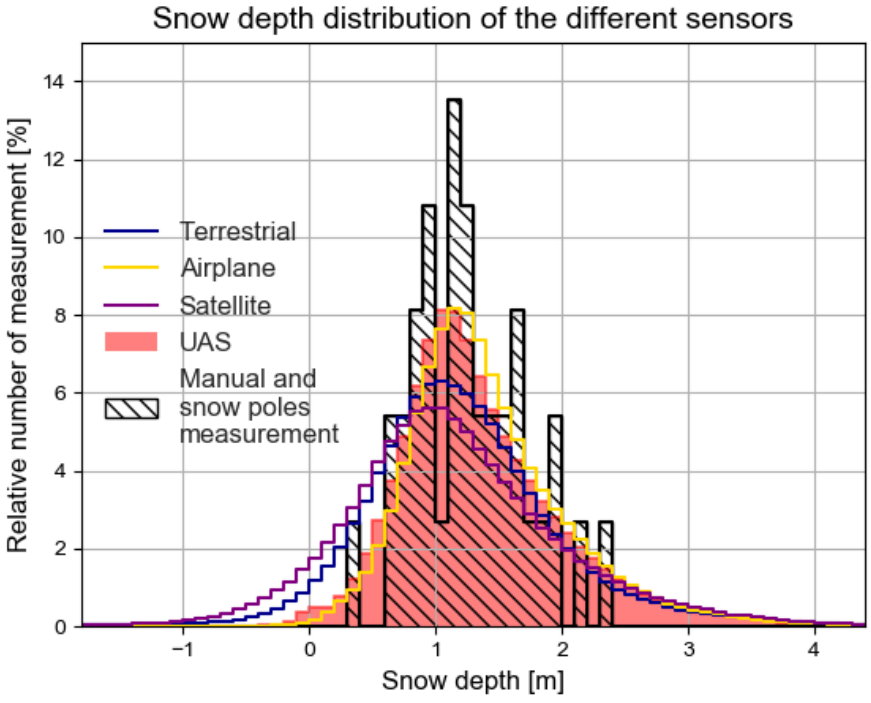

Figure S2: Normalized Histograms of the snow depth distribution from the different platforms over their entire processed extent (Figure 5). The snow depth is shown on the x-axis with a bin size of 0.1 m. The y-axis shows the relative number of measurements.

The average snow depth calculated with the satellite snow depth map is 1.15 m with a STD of 0.96 m. The average snow depth derived from the airplane snow depth map is 1.41 m with a STD of 0.67 m. The UAS data shows an average snow depth of 1.35 m measured with a STD of 0.68 m. The average snow depth of the terrestrial data is 1.22 m with a STD of 0.80 m. The manual and snow pole measurements resulted in an average snow depth of 1.27 m and a STD of 0.44 m (all not shown). The histogram illustrates the similar snow depth distribution on the Schürlialp test site measured with the different platforms. The fact that the manual and snow pole measurements do not show negative values in the histogram is due to the measurement method. Negative values for manual and snow pole measurements are gross human errors and can be excluded.

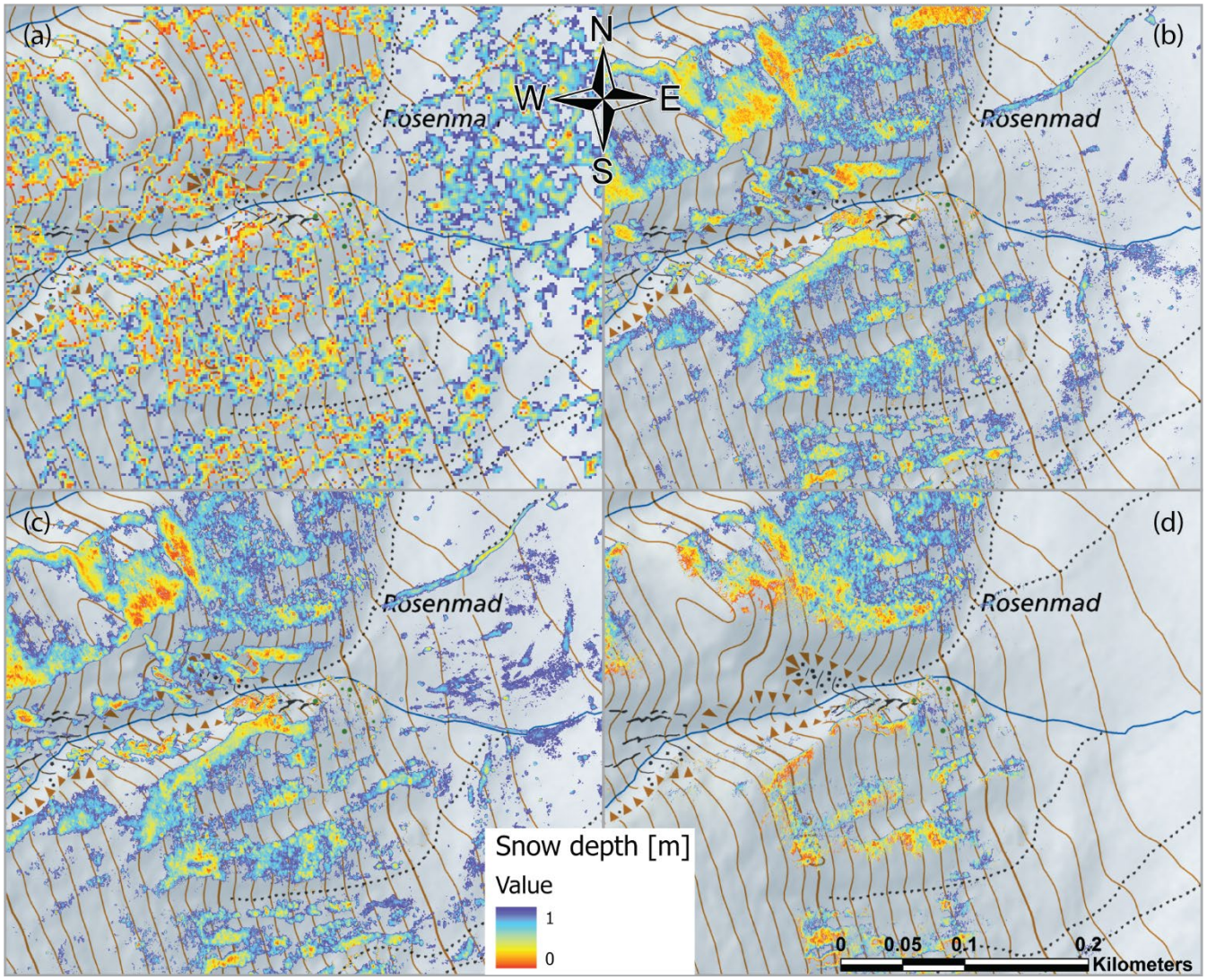

Figure S3: Extract from the snow depth maps of the Schürlialp shown in Figure 5 on a scale of 0 m to 1 m. All values less than 0 and greater than 1 were set to no data for this extract ((a) satellite, (b) airplane, (c) UAS and (d) terrestrial) (Swiss Map Raster, source: Federal Office of Topography; Pléiades data© CNES 2018, Distribution Airbus DS).

Table S1: Extended version of Table 4 where the accuracy measures are also calculated for the manual measurements and the snow poles measurements separately. The table shows that the snow pole measurements are generally better except for the satellite data.

	Satellite				Airplane			
	Manual	**Snow poles**	**All data**	**Filtered**	**Manual**	**Snow poles**	**All data**	**Filtered**
RMSE [m]	0.5	1.51	0.90	0.52	0.21	0.18	0.20	0.17
MBE [m]	-0.34	-0.79	-0.46	-0.35	0.04	0.0	0.03	0.01
STD [m]	0.37	1.29	0.77	0.39	0.2	0.18	0.20	0.17
MdBE [m]	-0.33	-0.44	-0.40	-0.36	0.01	-0.07	-0.03	-0.04
NMAD [m]	0.41	0.71	0.44	0.47	0.21	0.09	0.17	0.17
Number of measurements	27	10	37	36	20	7	27	26

	UAS				Terrestrial
	Manual	**Snow poles**	**All data**	**Filtered**	**Snow poles**
RMSE [m]	0.23	0.13	0.21	0.16	0.54
MBE [m]	-0.09	-0.03	-0.07	-0.09	0.34
STD [m]	0.21	0.13	0.20	0.13	0.42
MdBE [m]	-0.1	-0.03	-0.07	-0.07	0.35
NMAD [m]	0.14	0.08	0.14	0.12	0.51
Number of measurements	27	10	37	34	4