

Table S1: Names and corresponding watershed area of hydrometric stations located on Figure 1 in main manuscript

Code	Longitude	Latitude	Name	Basin	Area size (km ²)	% glaciers in 2015	Elevation station (meters)	Station network
CH002009	6.91	46.34	Rhône à Porte du Scex	Upper Rhône	5220	10.5	393	GRDC
CH002011	7.34	46.22	Rhône à Sion	Upper Rhône	3349	13.7	483	
CH002024	7.08	46.12	Rhône à Branson	Upper Rhône	3728	12.6	461	GRDC
CH002053	7.06	46.1	Drance à Martigny	Upper Rhône	672	10.7	482	
CH002161	8	46.38	Massa à Blatten bei Naters	Upper Rhône	195	54.7	1472	Robin, GRDC
CH002170	6.16	46.18	Arve à Genève Bout du Monde	Arve	1976	4.6	393	
CH002203	6.97	46.31	Grande Eau à Aigle	Upper Rhône	132	0.7	402	GRDC
CH002268	8.36	46.56	Rhône à Gletsch	Upper Rhône	38.9	39	1742	Robin, GRDC
CH002269	7.81	46.42	Lonza à Blatten	Upper Rhône	77.8	23	1497	Robin, GRDC
CH002342	7.99	46.32	Saltina à Brig	Upper Rhône	77.7	2.4	687	GRDC
CH002346	7.97	46.31	Rhône à Brig	Upper Rhône	913	18.4	664	
CH002351	7.88	46.27	Vispa à Visp	Upper Rhône	778	23.1	680	
CH002419	8.24	46.47	Rhône à Reckingen	Upper Rhône	215	10.3	1316	
CH002606	6.14	46.2	Rhône à Genève Halle de l'île	Upper Rhône	7987	6.8	393	
CH002623	8.34	46.53	Rhône à Oberwald	Upper Rhône	95	17.2	1358	
V0002010	6.86	45.92	Arve à Chamonix-Mont-Blanc [Pont des Favrandes]	Arve	205	30.1	1024	
V0032010	6.64	45.94	Arve à Sallanches	Arve	514	15.8	543	
V014401	6.55	46.11	Giffre à Taninges	Arve	325	0.3	609	

0			[Pressy]					
V022201 0	6.27	46.15	Arve à Arthaz-Pont- Notre-Dame	Arve	166 4	5.5	433	Robin, GRDC
V100001 0	5.95	46.14	Rhône à Pougny	Rhône	103 20	6.1	393	
V102001 0	5.81	46.03	Rhône à Injoux- Génissiat [Bognes]	Rhône	109 10	5.8	290	
V144002 0	5.7	45.7	Rhône à Brens	Rhône	139 60	4.6	217	
V313002 0	4.8	45.6	Rhône à Ternay	Rhône	505 60	1.3	155	
V401001 0	4.87	44.93	Rhône à Valence	Rhône	664 50	1.1	149	
V453001 0	4.7	44.48	Rhône à Viviers	Rhône	709 00	1.1	62	
V720001 0	4.62	43.75	Rhône à Beaucaire	Rhône	955 90	0.8	4	GRDC
W000001 0	6.98	45.44	Isère à Val-d'Isère	Isère	46	6.8	1854	GRDC
W011001 0	6.53	45.48	Isère à Moûtiers	Isère	907	1.8	485	
W030001 0	6.52	45.49	Isère à Aigueblanche	Isère	158 2	2.3	482	
W100601 0	7.06	45.3	Avérole à Bessans [Avérole]	Isère	45.4	7.8	1913	
W102401 0	6.76	45.22	Arc à Bramans	Isère	635	5	1222	
W103401 0	6.51	45.21	Arc à Saint-Michel-de- Maurienne [La Saussaz]	Isère	939	3.7	818	
W141001 0	5.72	45.19	Isère à Grenoble [Bastille]	Isère	572 0	1.3	217	
W202201 0	6.26	44.68	Drac à Saint-Jean- Saint-Nicolas [Les Ricous]	Drac	207	0.1	1160	
W211401 0	6.13	44.82	La Séveraisse à Villar- Loubière	Drac	133	1.6	1011	GRDC
W231401 0	5.95	44.9	La Bonne à Entraigues [Pont Battant]	Drac	143	0.1	803	GRDC
W271401 0	6.18	45.04	La Romanche à Mizoën [Chambon amont]	Drac	220	7.5	1086	GRDC
W275501	6.02	45.12	L'eau d'Olle à	Drac	172	0.6	719	GRDC

0			Allemond [La Pernière]					
W2764010	5.97	45.12	La Romanche à Bourg-d'Oisans [Champeau]	Drac	1000	4.1	719	
W2832020	5.68	45.19	Le Drac à Fontaine	Drac	3550	1.2	209	
W3200010	5.46	45.21	Isère à Saint-Gervais [Le Port]	Isère	9910	1.2	201	
X0100010	6.63	44.89	Durance à Briançon [aval]	Durance	548	0.8	1192	
X0310010	6.47	44.55	Durance à Embrun [La Clapière]	Durance	2170	0.8	775	Robin, GRDC
X0434010	6.65	44.38	Ubaye à Barcelonnette [Abattoir]	Durance	549	0.1	1130	Robin, GRDC
X0454010	6.39	44.45	Ubaye à Lauzet-Ubaye [Roche Rousse]	Durance	946	0.04	781	Robin, GRDC
X0500010	6.27	44.47	Durance à Espinasses [Serre-Ponçon QNR]	Durance	3580	0.5	762	Robin, GRDC
X1130010	6.01	44.08	Durance à Oraison [Escale]	Durance	6760	0.3	413	GRDC
X3000010	5.72	43.7	Durance à Saint-Paul-lès-Durance [Jouques-Cadarache]	Durance	11700	0.2	240	

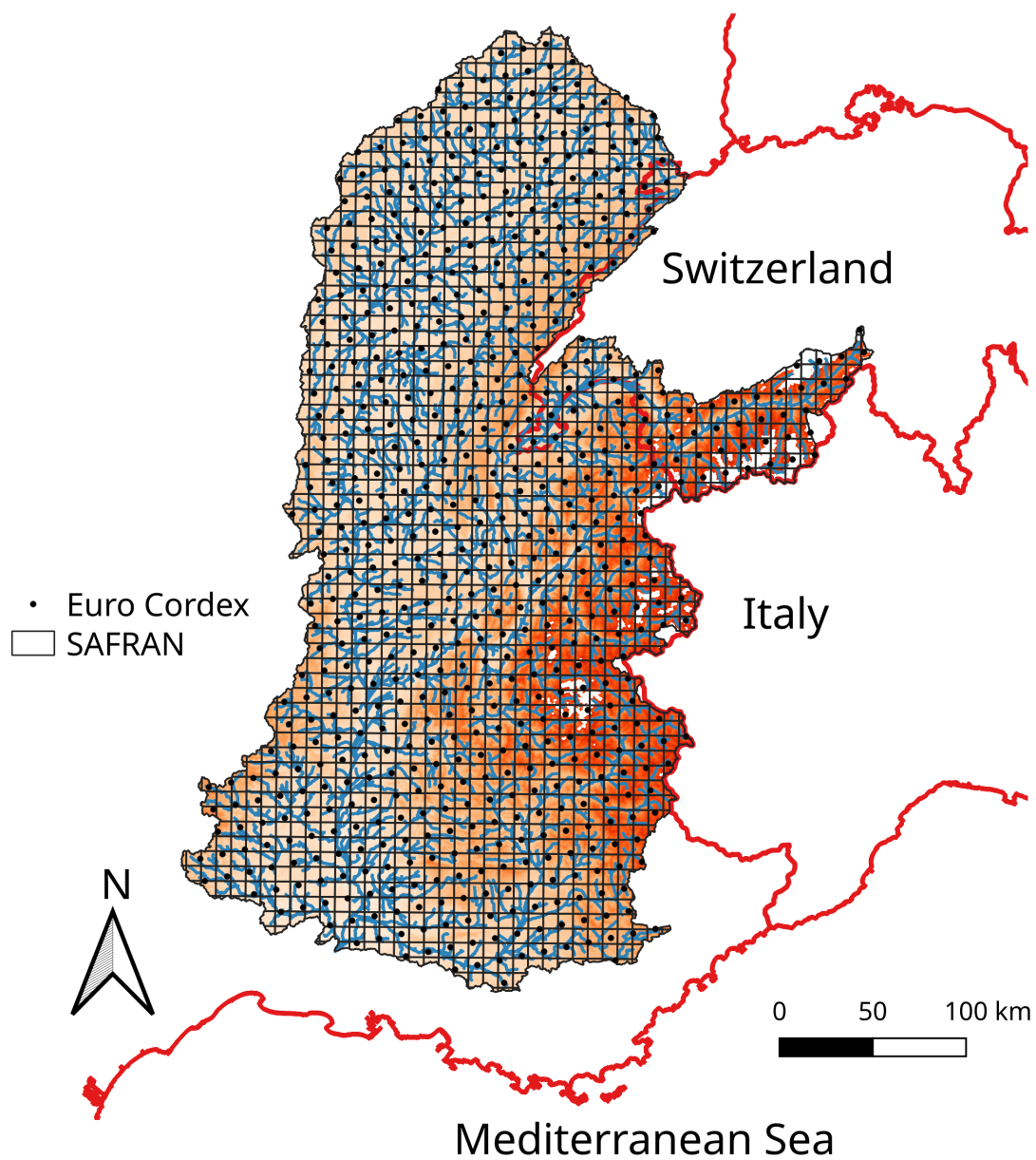


Figure S1: Grid of SAFRAN reanalysis and grid centroids of Euro-Cordex

Table S2: GCMs and RCMs models used in the study

Short name	Global model	Institution	Regional model	Institution
EARTH-RCA4	EC-EARTH	Irish Centre for High-End Computing (ICHEC)	RCA4	Swedish Meteorological and Hydrological Institute (SMHI)
HadGE M-CCLM	HadGEM2-ES	Met Office Hadley Centre (MOHC)	CCLM4-8-17	Climate Limited-area Modelling Community (CLM-com)
IPSL-RCA4	IPSL-CM5A-MR	Institut Pierre-Simon Laplace (IPSL)	RCA4	Swedish Meteorological and Hydrological Institute (SMHI)
MPI-CCLM	MPI-ESM-LR	Max-Planck-Institute for Meteorology (MPI-M)	CCLM4-8-17	Climate Limited-area Modelling Community CLM-com
MPI-REMO	MPI-ESM-LR	Max-Planck-Institute for Meteorology (MPI-M)	REMO-2009	Center for Science (CSC)
NorESM - HIRHAM5	NorESM1-M	Norwegian Climate Centre (NCC)	HIRHAM5	Danish Meteorological Institute (DMI)

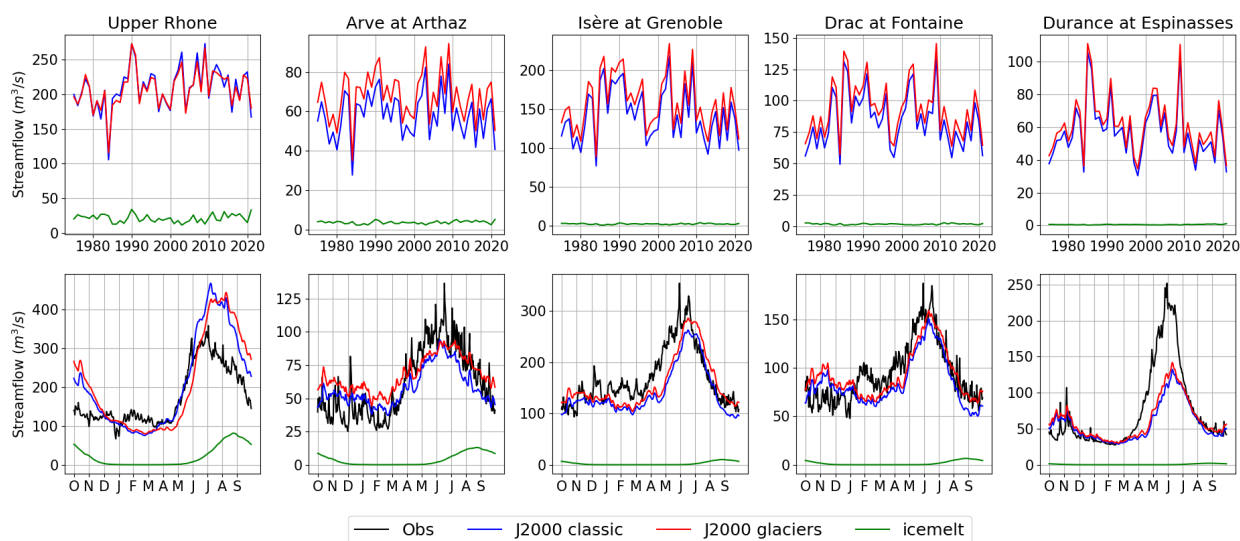


Figure S2: annual (first row) and seasonal (second row) streamflow for the observations, the simulations with J2000-Rhône-classic (blue) and simulations with J2000-Rhône-glaciers (red) in the period 1976-2022

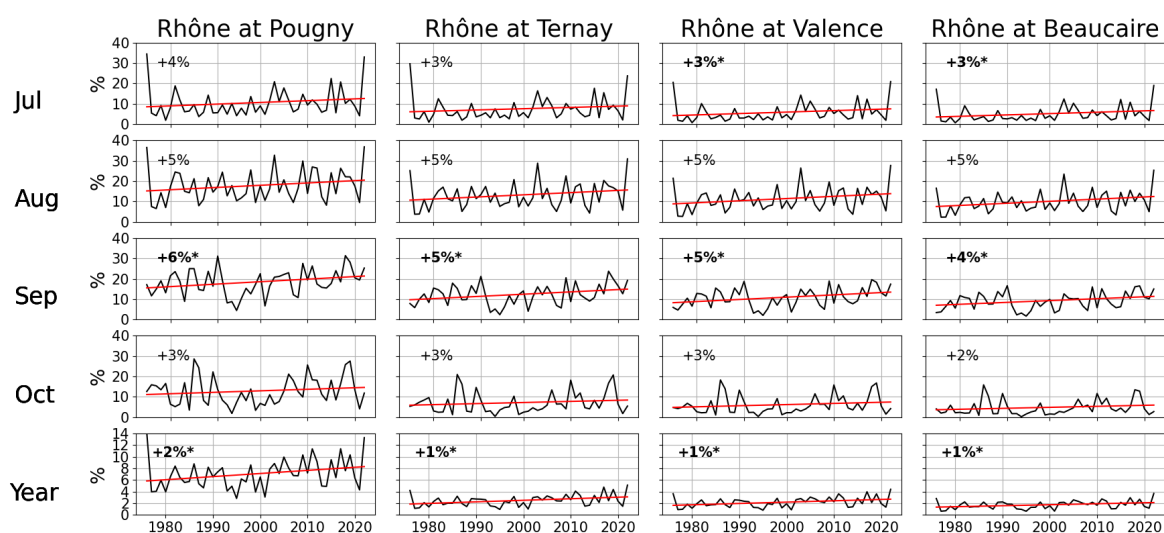


Figure S3: yearly Contribution (black) and linear regression (red) of icemelt to total streamflow in summer months and the entire year. The numbers represent the evolution of the linear regression from the first to the last year that is significant when bolded with a star.

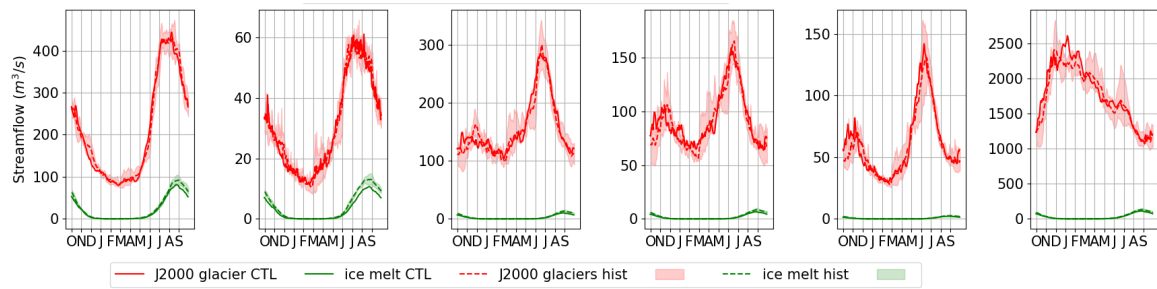


Figure S4: Comparison between J2000 simulations using SAFRAN reanalysis (solid lines) and using climate models (5 models average in dotted lines, spread of the 5 models in shaded areas) in the period 1976-2005

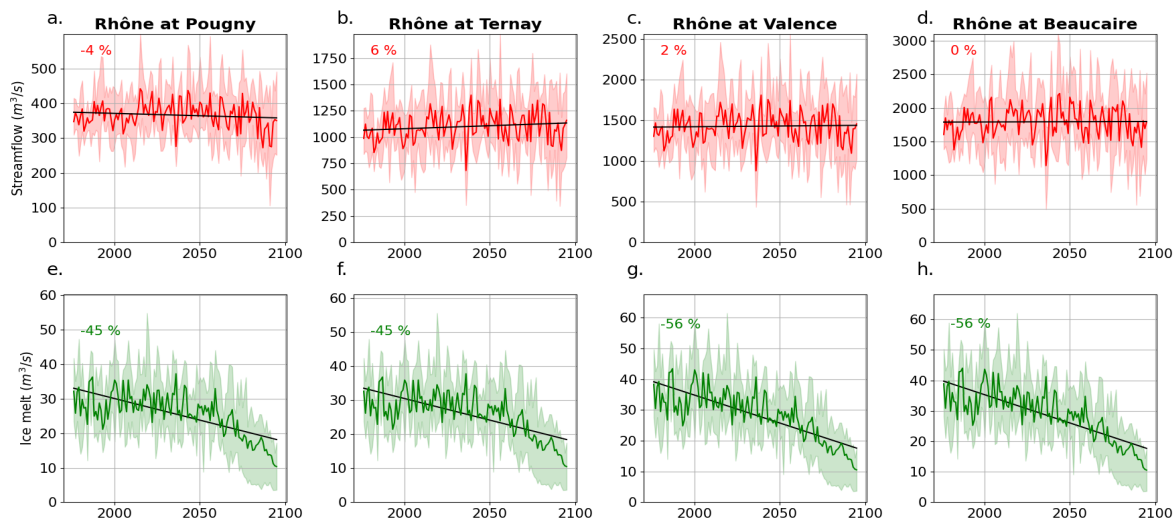


Figure S5: evolution of mean (lines) and range (shades) of a-f annual streamflow and g-l annual icemelt simulated by J2000-Rhône-glaciers using 5 climate chains under RCP 8.5 scenario.

Table S3: Evolution (in %) of streamflow over the period 1975-2095. The bold and underlines values are significant at the Mann-kendall statistical test

	Upper Rhône	Arve	Isère	Drac	Durance	Beaucaire
EARTH-RCA4	<u>-18</u>	<u>-39</u>	<u>-46</u>	<u>-45</u>	<u>-44</u>	<u>-21</u>
HadGEM-CCLM	<u>-17</u>	<u>-17</u>	<u>-18</u>	<u>-18</u>	<u>-27</u>	-8
IPSL-RCA4	-1	<u>-26</u>	<u>-28</u>	<u>-30</u>	<u>-35</u>	+7
MPI-CCLM	-3	-11	-11	-5	-6	+10
MPI-REMO	<u>+17</u>	+2	+3	+9	-4	+15

Table S4: Evolution (in %) of icemelt over the period 1975-2095. The bold and underlines values are significant at the Mann-kendall statistical test

	Upper Rhône	Arve	Isère	Drac	Durance	Beaucaire
EARTH-RCA4	<u>-24</u>	<u>-59</u>	<u>-100</u>	<u>-100</u>	<u>-82</u>	<u>-45</u>
HadGEM-CCLM	<u>-81</u>	<u>-44</u>	<u>-100</u>	<u>-100</u>	<u>-76</u>	<u>-82</u>
IPSL-RCA4	+7	<u>-61</u>	<u>-100</u>	<u>-100</u>	<u>-72</u>	<u>-25</u>
MPI-CCLM	<u>-46</u>	<u>-71</u>	<u>-100</u>	<u>-100</u>	<u>-80</u>	<u>-60</u>
MPI-REMO	<u>-47</u>	<u>-70</u>	<u>-100</u>	<u>-100</u>	<u>-78</u>	<u>-62</u>

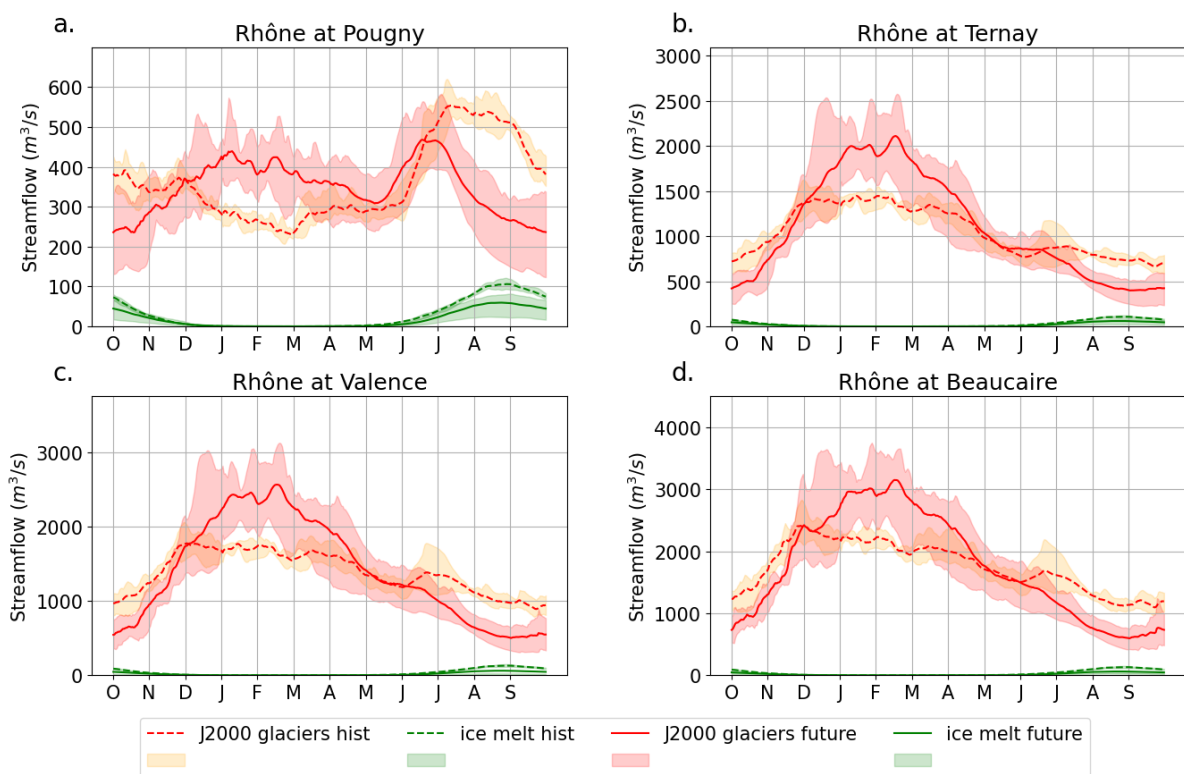


Figure S6: mean (lines) and range (shades) of seasonal streamflow (red) and icemelt (green) for the period 1976-2005 (dashed lines) and the period 2066-2095 (solid lines).

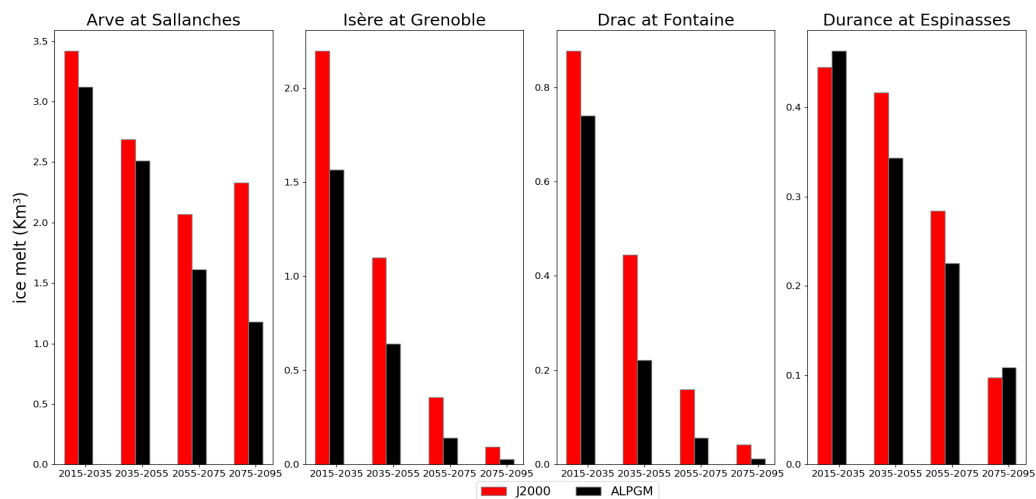


Figure S7: Total volume of ice melted in 20 years period as simulated by J2000 and ALPGM (factor of 0.9 to transform volume of Ice in water equivalent)