Supplementary material

Table S1 Information about 19 large concrete arch hydropower dams located in Switzerland

N	Name of the dam	Dam height H (m)	Length of the dam crest, L_{cr} (m)	Volume of the dam reservoir, V ($10^3 m^3$)	Name of the locality	Distance to the locality (km)	Distance relative to the dam height (m/m)	Population of the locality (Year reported)	Elevation at the dam site (m.a.s.l.)	Elevation at the locality (m.a.s.l.)
1	Contra	220	380	105,000	Locarno	1.298	5.9	16,122 (2016)	315	282
2	Curnera	153	350	41,100	Sedrun (Tujetsch)	5.809	37.97	1,838 (2008)	1,829	1,422
3	Gebidem	122	327	9,200	Bitsch	4.888	40.07	894 (2015)	1,364	750
4	Gigerwald	147	430	35,600	Vättis	3.807	25.90	410 (-)	1,296	952
5	Hongrin North	125	325	53,200	Albeute, Lessoc	13.421	107.37	761 (-)	1,213	769
6	Limmern	146	375	93,000	ARGE Kraftwerk	4.095	*28.05*	*industrial area*	1,735	812
7	Luzzone	225	600	108,000	Olivone	4.502	20.01	867 (-)	1498	918
8	Mauvoisin	250	520	211,500	Bagnes	13.604	54.42	8,057 (2016)	1,809	1,098
9	Moiry	148	610	78,000	Grimentz	4.04	27.30	475 (2007)	2,130	1,600
10	Nalps	127	480	45,000	Sedrun (Tujetsch)	5.5	43.31	1,838 (2008)	1,830	1,373
11	Sambuco	130	363	63,000	Brontallo (Lavarizza)	13.734	105.65	520 (2000)	1400	583
12	St. Maria	117	560	67,300	Disentis	14.461	123.60	2,058 (2014)	1,835	1,051
13	Zervreila	151	504	100,500	Vals	5.205	34.47	990 (2015)	1,742	1,310
14	Zeuzier	156	256	51,000	Saint-Léonard	11.809	75.70	2,269 (-)	1,685	516
15	Cavagnoli	very remote area, possible cascade events with the Robiei dam, requires different assessment								
16	Emosson	downstream area is partially in France (suitable digital data is not available)								
17	Valle di Lei	downstream area is in Italy (suitable digital data is not available)								
18	Punt dal Gall	digital data on the slope and landcover is not provided								
19	Spitallamm	possible cascade event with the Oberaar dam, requires different assessment								

Note: In Switzerland, there are 19 concrete arch hydropower dams taller than 100 m. The list of these 19 dams is given in the table below, of which only 14 dams with their downstream valleys were assessed in this study and the other five were excluded due to the reasons given in the same table.

Table S2 The degree of PCE and values of $\boldsymbol{\epsilon_{LOO}}$ and MSE errors (expressed as a fraction) calculated for each model output using different sizes of the experimental design

Full model evaluations [#]	Q_{peak}			t_{peak}			t_{ar}			k			v_{max}			h_{max}		
	PCE	ϵ_{LOO}	MSE	PCE	ϵ_{LOO}	MSE	PCE	ϵ_{LOO}	MSE	PCE	ϵ_{LOO}	MSE	PCE	ϵ_{LOO}	MSE	PCE	ϵ_{LOO}	MSE
200	4	0.14	0.24	7	0.15	0.67	5	0.06	0.14	4	0.24	0.21	6	0.14	0.28	7	0.24	0.27
300	5	0.08	0.24	4	0.10	0.12	5	0.04	0.09	6	0.18	0.17	7	0.09	0.16	14	0.18	0.26
400	7	0.07	0.11	6	0.07	0.10	7	0.03	0.07	5	0.15	0.15	8	0.08	0.21	10	0.15	0.13
500	5	0.05	0.07	5	0.06	0.09	7	0.03	0.09	5	0.14	0.09	8	0.07	0.11	12	0.12	0.13
600	6	0.04	0.07	7	0.05	0.04	8	0.02	0.08	8	0.12	0.08	10	0.08	0.09	10	0.10	0.09
700	8	0.04	0.09	9	0.05	0.05	9	0.02	0.08	8	0.12	0.08	10	0.07	0.07	10	0.09	0.09
800	7	0.03	0.06	9	0.04	0.05	9	0.02	0.06	11	0.11	0.12	11	0.06	0.09	10	0.08	0.08
900	8	0.03	0.07	9	0.04	0.07	11	0.02	0.06	10	0.11	0.09	11	0.05	0.07	12	0.07	0.06
1,000	8	0.04	0.04	9	0.04	0.05	15	0.02	0.12	12	0.10	0.09	12	0.05	0.08	15	0.07	0.07
1,100	8	0.04	0.03	11	0.04	0.05	9	0.02	0.10	11	0.10	0.10	9	0.05	0.06	10	0.08	0.06
1,200	10	0.04	0.04	7	0.05	0.07	9	0.03	0.08	15	0.11	0.10	12	0.07	0.07	12	0.07	0.05
1,300	7	0.04	0.04	6	0.05	0.07	10	0.03	0.07	9	0.11	0.05	15	0.07	0.10	13	0.06	0.05
1,400	8	0.04	0.05	12	0.05	0.04	7	0.03	0.05	8	0.10	0.05	9	0.07	0.06	12	0.06	0.04
1,500	10	0.03	0.03	6	0.04	0.03	15	0.02	0.10	9	0.10	0.05	9	0.07	0.07	14	0.06	0.05
1,600	8	0.03	0.04	6	0.04	0.03	15	0.02	0.09	9	0.10	0.05	15	0.07	0.08	14	0.05	0.05
1,700	12	0.03	0.03	7	0.05	0.04	10	0.03	0.07	10	0.10	0.05	9	0.07	0.06	14	0.05	0.04
1,800	8	0.03	0.03	12	0.04	0.03	7	0.03	0.06	15	0.10	0.05	12	0.07	0.07	13	0.05	0.04

1,900	9	0.03	0.03	8	0.04	0.07	15	0.03	0.10	8	0.10	0.03	9	0.07	0.06	13	0.05	0.04

Protocol S1 Calculation of the repeatability error, RE, for each model output

The repeatability error, RE, helps to assess the closeness of the agreement between the results of successive runs of the computational model. For this purpose, all six of the defined model outputs were computed ten times using the same values for all nine input parameters; all other conditions were kept the same. Using these ten values for each output parameter the repeatability error was calculated as following (the results are given in the table below):

$$RE = \frac{\sigma(Y_j^{(1:10)})}{\left|\mu(Y_j^{(1:10)})\right|}, where\ Y_j^{(1:10)}\ are\ ten\ values\ of\ each\ model\ output, Y_j$$

Parameter	Q_{peak}	t_{peak}	t_{ar}	k	v_{max}	h_{max}
Repeatability error, RE	2.48 E-04	1.41E-08	1.59 E-05	1.87E-05	2.52E-06	3.06E-05