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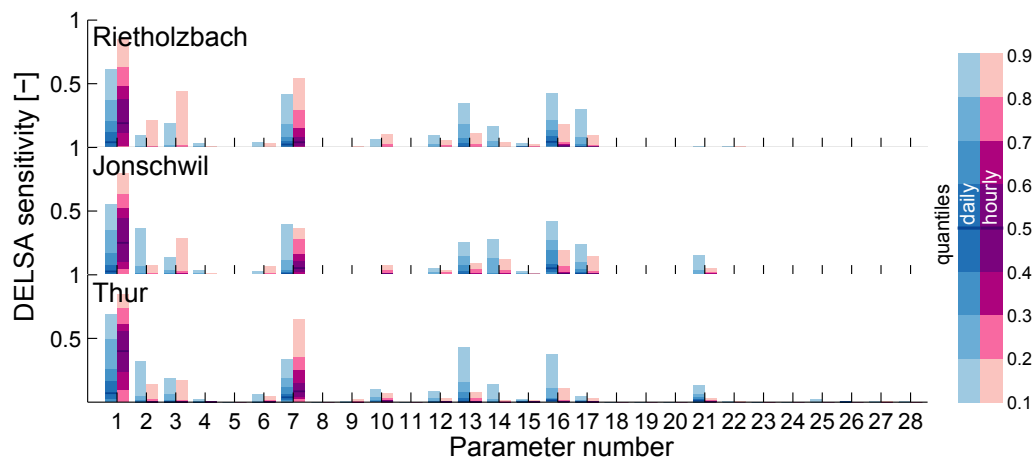
*Supplement of*

## **Representation of spatial and temporal variability in large-domain hydrological models: case study for a mesoscale pre-Alpine basin**

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**Figure S1.** DELSA parameter sensitivity (scaled from 0 to 1) for three nested basins with a different size (Ri-etholzbach; 3.3 km<sup>2</sup>, Jonschwil; 493 km<sup>2</sup>, Thur; 1703 km<sup>2</sup>). The numbers on the x-axis refer to the parameters in Table 1. The sensitivity as shown in this figure is based on the NSE(Q) as objective function. Results are shown based on a daily and hourly time interval.

**Table S1.** Description and boundary values of parameters that have been considered in the DELSA sensitivity analysis.

Nr.	Parameter	Units	Lower value	Upper value	Description
<b>Soil parameter file</b>					
1	$b_i$	-	$10^{-5}$	0.4	Variable infiltration curve parameter
2	Ds	-	$10^{-4}$	1	Fraction of Dsmax where non-linear baseflow starts
3	Dsmax	mm d <sup>-1</sup>	1	50	Maximum velocity of the baseflow
4	Ws	-	0.5	1	Fraction of maximum soil moisture where non-linear baseflow starts
5	c	-	1	4	Exponent used in the baseflow curve
6	expt1	-	5	30	Exponent of the Brooks-Corey drainage equation layer 1
7	expt2	-	5	30	Exponent of the Brooks-Corey drainage equation layer 2
8	expt3	-	5	30	Exponent of the Brooks-Corey drainage equation layer 3
9	Ksat1	mm d <sup>-1</sup>	100	1000	Saturated hydrologic conductivity layer 1
10	Ksat2	mm d <sup>-1</sup>	100	1000	Saturated hydrologic conductivity layer 2
11	Ksat3	mm d <sup>-1</sup>	100	1000	Saturated hydrologic conductivity layer 3
12	Depth <sub>1</sub>	m	0.01	0.5	Thickness of soil layer 1
13 <sup>†</sup>	Depth <sub>2</sub>	m	Depth <sub>1</sub> +0.1	Depth <sub>1</sub> +4	Thickness of soil layer 2
14	Depth <sub>3</sub>	m	0.1	4	Thickness of soil layer 3
15	bulk density1	kg m <sup>-3</sup>	1500	2685	Bulk density of soil layer 1
16	bulk density2	kg m <sup>-3</sup>	1500	2685	Bulk density of soil layer 2
17	bulk density3	kg m <sup>-3</sup>	1500	2685	Bulk density of soil layer 3
18	Wcr-FRACT1	-	0.30	0.47	Fractional soil moisture content at critical point layer 1
19	Wcr-FRACT2	-	0.30	0.47	Fractional soil moisture content at critical point layer 2
20	Wcr-FRACT3	-	0.30	0.47	Fractional soil moisture content at critical point layer 3
21	snow-rough	m	$5 \cdot 10^{-5}$	0.5	Surface roughness of the snow pack
<b>Vegetation parameter file</b>					
22	Root depth 1	m	0.1	3	Root zone thickness layer 1
23	Root depth 2	m	0.1	3	Root zone thickness layer 2
24	Root depth 3	m	0.1	3	Root zone thickness layer 3
<b>Vegetation library file</b>					
25	rmin	s m <sup>-1</sup>	30	300	Minimum stomatal resistance of vegetation
26*	LAI	-	0.7	1.3	Leaf Area Index
<b>Global parameter file</b>					
27	$T_{min}$	°C	-1.5	0.0	Minimum temperature at which rain can fall
28 <sup>†</sup>	$T_{max}$	°C	$T_{min}+0.5$	$T_{min}+1.5$	Maximum temperature at which snow can fall

<sup>†</sup> Value of this parameter must be greater than the related parameter mentioned in the parameter boundaries.

\* Implemented as a multiplication factor to the default parameter values.

**Table S2.** Transferability of parameters across spatial resolution, expressed as percentage agreement in detected behavioural runs based on KGE(Q). The results are shown for three different sample sizes for the behavioural runs; the highest 1% of the runs, the highest 2% of the runs, and the highest 5% of the runs.

	Uniform forcing (% agreement)			Distributed forcing (% agreement)		
<b>HOUR</b>						
	1%	2%	5%	1%	2%	5%
1 × 1 vs 5 × 5	78	89	85	88	84	89
1 × 1 vs 10 × 10	72	77	78	78	70	83
5 × 5 vs 10 × 10	94	83	92	88	86	91
1 × 1 vs lumped	78	88	85			
5 × 5 vs lumped	91	89	92			
10 × 10 vs lumped	88	84	90			
<b>DAY</b>						
	1%	2%	5%	1%	2%	5%
1 × 1 vs 5 × 5	94	84	86	91	86	89
1 × 1 vs 10 × 10	84	78	79	78	84	81
5 × 5 vs 10 × 10	91	91	92	89	94	88
1 × 1 vs lumped	91	86	87			
5 × 5 vs lumped	91	89	90			
10 × 10 vs lumped	84	84	90			
<b>MONTH</b>						
	1%	2%	5%	1%	2%	5%
1 × 1 vs 5 × 5	75	86	85	84	89	86
1 × 1 vs 10 × 10	66	69	73	66	69	74
5 × 5 vs 10 × 10	88	83	86	78	73	83
1 × 1 vs lumped	78	70	70			
5 × 5 vs lumped	78	75	77			
10 × 10 vs lumped	78	72	79			

**Table S3.** Transferability of parameters across temporal resolution, expressed as percentage agreement in detected behavioural runs based on KGE(Q). The results are shown for three different sample sizes for the behavioural runs; the highest 1% of the runs, the highest 2% of the runs, and the highest 5% of the runs.

	Uniform forcing (% agreement)			Distributed forcing (% agreement)		
$1 \times 1$ km						
	1%	2%	5%	1%	2%	5%
hour vs day	56	77	83	69	72	78
hour vs month	3	3	6	6	16	15
day vs month	3	3	4	6	9	17
$5 \times 5$ km						
	1%	2%	5%	1%	2%	5%
hour vs day	66	70	80	69	73	79
hour vs month	3	2	8	9	13	15
day vs month	3	3	6	9	9	22
$10 \times 10$ km						
	1%	2%	5%	1%	2%	5%
hour vs day	63	73	79	59	84	79
hour vs month	3	3	8	13	16	16
day vs month	0	3	8	13	16	24
lumped						
	1%	2%	5%	1%	2%	5%
hour vs day	66	72	82			
hour vs month	3	6	9			
day vs month	3	3	8			