

**Table S1: Allowable parameter ranges and resulting averaged parameter characteristics for behavioural simulations retained from the three model calibrations (KPN43, REMOiso, and static inputs). Parameters are summarized as: median (minimum, maximum).**

<b>Parameter</b>	<b>Allowable Range</b>	<b>KPN43</b>	<b>REMOiso</b>	<b>static</b>
<b>Jean Marie Sub-basin</b>				
<b>flz</b>	[1x10 <sup>-7</sup> , 1x10 <sup>-4</sup> ]	8.60x10 <sup>-6</sup> (1.49x10 <sup>-7</sup> , 9.32x10 <sup>-5</sup> )	8.60x10 <sup>-6</sup> (2.03x10 <sup>-7</sup> , 9.86x10 <sup>-5</sup> )	8.60x10 <sup>-6</sup> (2.03x10 <sup>-7</sup> , 9.86x10 <sup>-5</sup> )
<b>pwr</b>	[1, 4]	3.05 (1.33, 4.00)	3.38 (1.12, 4.00)	3.39 (1.12, 3.96)
<b>theta</b>	[0.1, 1.0]	0.60 (0.13, 0.96)	0.61 (0.13, 1.0)	0.60 (0.13, 0.98)
<b>kcond</b>	[0.1, 1.5]	0.79 (0.17, 1.46)	0.68 (0.17, 1.46)	0.86 (0.17, 1.46)
<b>Blackstone Sub-basin</b>				
<b>flz</b>	[1x10 <sup>-7</sup> , 1x10 <sup>-4</sup> ]	2.30x10 <sup>-5</sup> (4.19x10 <sup>-7</sup> , 9.41x10 <sup>-5</sup> )	4.91x10 <sup>-5</sup> (5.36x10 <sup>-7</sup> , 9.95x10 <sup>-5</sup> )	1.67x10 <sup>-5</sup> (3.02x10 <sup>-7</sup> , 9.86x10 <sup>-5</sup> )
<b>pwr</b>	[1, 4]	3.34 (1.82, 3.96)	3.21 (1.35, 3.96)	3.57 (2.28, 3.91)
<b>theta</b>	[0.1, 1.0]	0.55 (0.11, 1.0)	0.60 (0.13, 1.0)	0.52 (0.24, 1.0)
<b>kcond</b>	[0.1, 1.5]	0.69 (0.11, 1.41)	0.80 (0.21, 1.48)	0.69 (0.17, 1.49)
<b>Land Cover Weighted-Average Parameter results: median (minimum, maximum)</b>				
<b>fratio</b>	[0.1, 2.5]	0.70 (0.12, 2.22)	0.70 (0.15, 2.16)	0.80 (0.12, 2.23)
<b>ak</b>	[1, 50]	21.6 (2.1, 47.6)	25.8 (2.4, 47.5)	23.6 (1.2, 46.9)
<b>akfs</b>	[0.005, 2]	0.212 (.006, 1.878)	0.059 (0.006, 1.724)	0.203 (0.006, 1.850)
<b>rec</b>	[0.05, 1]	0.47 (0.08, 0.90)	0.46 (0.08, 0.88)	0.43 (0.09, 0.90)
<b>retn</b>	[10, 200]	122 (18, 189)	119 (23, 181)	114 (20, 186)
<b>ak2</b>	[.001, 0.2]	0.013 (0.001, 0.188)	0.008 (0.001, 0.172)	0.021 (0.001, 0.184)
<b>fm</b>	[0.075, 0.2]	0.117 (0.076, 0.189)	0.119 (0.078, 0.190)	0.112 (0.076, 0.189)
<b>base</b>	[-3.5, 3.5]	-0.20 (-3.28, 3.14)	0.34 (-2.81, 3.13)	-0.35 (-3.11, 2.85)
<b>sub</b>	[0.1, 1.1]	0.53 (0.11, 1.05)	0.43 (0.13, 1.05)	0.50 (0.11, 1.05)

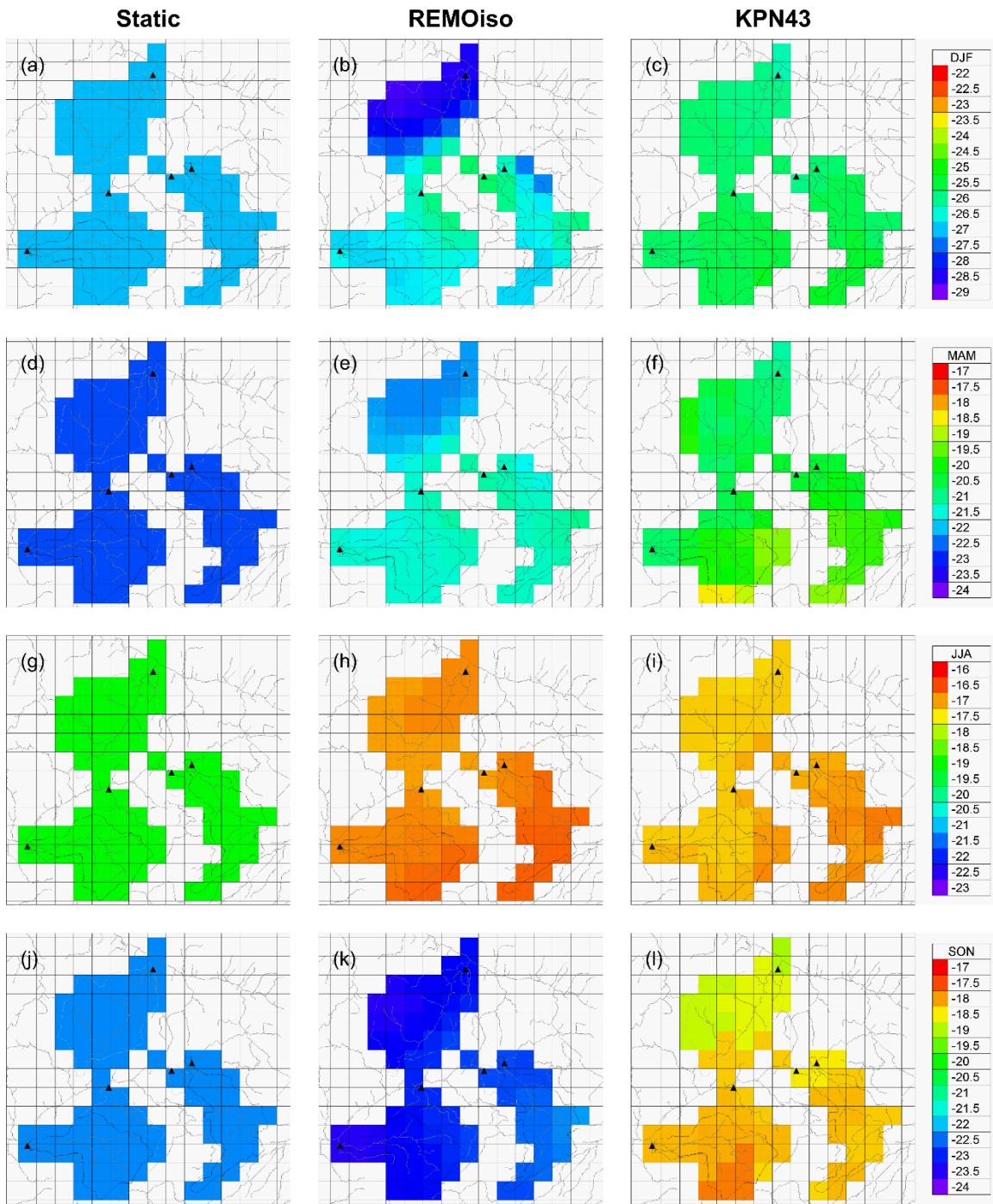


Figure S-1: Spatial distribution of precipitation isotope product  $\delta^{18}\text{O}_{\text{ppt}}$  input to isoWATFLOOD (10 km resolution) for static (first column), REMOiso (second column) and KPN43 (third column).  $\delta^{18}\text{O}_{\text{ppt}}$  was flux-weighted using gridded WATFLOOD precipitation input and averaged daily by season over the study period (1997-1999): DJF (a to c), MAM (d to f), JJA (g to i) and SON (j to l).