

**Supporting information 1 – Statistics of travel time distribution and field observations**

Here we display more information regarding the travel time distribution of groundwater calculated from particle tracking of 1000 years. The results are shown in table S1. The table include both non-transformed and lognormal transformed data. Approximately 2.0 million particles were released the first simulated year, and at the end of the calculation 55 % had entered the stream network, and less than 1 % of the particles were still left in the model. The skew, standard deviation (SD), standard error of the mean (SEM) is based on the non-transformed data set.

**Table S1 Statistics of particle tracking Test 2.** Statistics of particle tracking results, weekly release calculation time 1000 years. The statistics are calculated for each sub-catchment, including the artesian mean, the back-transformed artesian mean of the lognormal distribution (Geometric mean) and the confidence interval.

	Arithmetic mean	Q1	Q2	Q3	Skew	SD	SEM	Geometric mean	Confidence interval	
	y	y	y	y				y	y	
C1	10.8	0.3	0.8	2.6	3.8	26.3	0.2	1.1	1.1	1.2
C2	1.8	0.2	0.4	1.0	6.2	5.2	0.1	0.5	0.4	0.5
C4	5.0	0.3	1.0	2.7	9.3	15.5	0.3	1.1	1.1	1.2
C5	5.7	0.4	0.9	1.9	11.3	25.3	0.2	1.0	1.0	1.1
C6	6.1	0.3	0.9	2.1	10.8	23.2	0.2	1.0	1.0	1.0
C7	7.6	0.3	0.9	6.4	4.6	16.6	0.2	1.3	1.3	1.4
C9	11.3	0.4	1.0	9.5	5.7	28.4	0.1	1.6	1.6	1.7
C10	9.3	0.4	1.0	3.9	7.3	26.4	0.1	1.3	1.3	1.3
C12	11.9	0.4	1.0	7.8	5.5	29.3	0.1	1.6	1.6	1.7
C13	10.6	0.4	1.0	6.1	7.0	28.8	0.1	1.5	1.4	1.5
C14	17.4	0.8	3.6	14.2	8.7	47.2	0.1	3.2	3.2	3.3
C15	12.7	0.4	1.2	11.5	7.3	30.8	0.1	1.9	1.9	1.9
C16	14.5	0.7	2.9	12.9	9.9	37.9	0.0	2.8	2.8	2.8
C20	22.1	0.7	2.7	27.1	8.0	50.2	0.3	3.6	3.5	3.7

<sup>a</sup> The confidence interval is based on the log-normal distribution and is calculated as:

Confidence level= $Z \cdot \sigma / \sqrt{n}$

Z=confidence coefficient based on alpha/2 whereas alpha=0.05,  $\sigma$ =standard deviation and n=sample size

In this section we also display more information about the winter (table S1b) and yearly (table S1c) chemistry data of the streams in Krycklan, including isotope data, base cation (BC) concentration and pH. Note that the BC constitutes approximately of 40-50 % Ca, 5-10 % K, 5-10 % Mg and 25-35 % Na. The isotopic signature was calculated according to:

$$\delta = \left( \frac{R_{sample}}{R_{standard}} - 1 \right) * 1000\text{‰} , \text{ whereas } R = \frac{^{18}O}{^{16}O} \text{ or } R = \frac{^2H}{^1H} \quad (\text{Eq. S1})$$

**Table S1b: Winter chemistry data.** Extended statistics of isotope and average chemistry data for all sites in Krycklan.

$\delta^{18}\text{O}^{\text{a}}$ - winter						$\delta^2\text{H}^{\text{b}}$ winter					
%o	Mean	Min	Max	SD	SEM	%o	Mean	Min	Max	SD	SEM
C1	-13.0	-13.5	-12.3	0.3	0.05	C1	-93.4	-97.2	-90.1	2.0	0.38
C2	-12.8	-13.6	-10.7	0.6	0.11	C2	-93.2	-98.0	-85.4	2.6	0.48
C4	-12.9	-13.7	-11.8	0.5	0.08	C4	-93.9	-99.5	-87.7	3.1	0.57
C5	-12.9	-14.1	-11.8	0.6	0.10	C5	-93.1	-100.8	-87.4	3.5	0.65
C6	-13.0	-13.8	-11.7	0.5	0.08	C6	-93.8	-99.5	-86.9	2.7	0.50
C7	-13.0	-13.6	-12.5	0.3	0.05	C7	-94.1	-98.1	-90.5	1.9	0.35
C9	-13.0	-14.0	-12.2	0.4	0.07	C9	-94.3	-100.3	-89.7	2.4	0.44
C10	-13.2	-13.7	-12.4	0.3	0.05	C10	-95.8	-99.8	-92.0	1.9	0.35
C12	-13.1	-13.7	-12.4	0.3	0.06	C12	-95.1	-99.2	-91.4	2.1	0.40
C13	-13.1	-13.7	-12.6	0.3	0.05	C13	-95.1	-98.7	-91.3	1.8	0.34
C14	-13.4	-13.9	-12.9	0.2	0.05	C14	-97.3	-100.5	-94.3	1.5	0.24
C15	-13.3	-13.9	-11.6	0.4	0.08	C15	-96.6	-100.8	-90.8	2.3	0.37
C16	-13.4	-14.4	-11.9	0.4	0.08	C16	-97.5	-104.5	-92.0	2.1	0.39
C20	(-)	(-)	(-)	(-)	0.05	C20	(-)	(-)	(-)	(-)	0.38
P	-13.5	-30.4	-1.6	4.6		P	-99.0	-226.3	-26.4	34.6	
Base cations <sup>c</sup> winter						pH - winter					
( $\mu\text{eq/L}$ )	Mean	Min	Max	SD	SEM	(-)	Mean	Min	Max	SD	SEM
C1	277	210	349	34	7.61	C1	5.7	5.2	6.1	0.3	0.06
C2	257	175	593	99	19.48	C2	5.3	4.8	5.7	0.3	0.06
C4	250	179	428	40	8.13	C4	4.4	4.1	4.9	0.2	0.05
C5	257	193	311	16	3.87	C5	4.7	4.3	5.2	0.2	0.05
C6	321	239	452	42	8.79	C6	5.7	5.0	6.2	0.3	0.07
C7	271	225	399	33	7.54	C7	5.3	4.7	5.9	0.3	0.08
C9	350	273	487	48	10.84	C9	6.1	5.4	6.4	0.3	0.06
C10	315	247	419	35	7.81	C10	5.8	5.2	6.4	0.3	0.08
C12	319	259	413	35	7.66	C12	6.1	5.6	6.5	0.3	0.06
C13	338	262	462	50	10.58	C13	5.7	5.3	6.4	0.2	0.05
C14	358	303	419	32	6.93	C14	6.5	6.3	6.8	0.1	0.03
C15	347	292	432	34	7.27	C15	6.5	6.2	6.7	0.1	0.03
C16	481	349	601	61	12.95	C16	6.6	6.4	7.0	0.1	0.03
C20	520	420	723	58	12.66	C20	6.6	6.4	6.9	0.1	0.03
P	70	4	1214	145		P	(-)	(-)	(-)	(-)	

<sup>a</sup> Average winter isotope signature, sub-catchments with lakes have been adjusted according to equation 1

<sup>b</sup> Average winter isotope signature, sub-catchments with lakes have been adjusted according to equation 2

<sup>c</sup> Average winter cation signature, sub-catchments been mire adjusted according to equation 3

**Table S1c: Yearly stream chemistry data**

Base cations <sup>a</sup> yearly ( $\mu\text{eq/L}$ )						pH - yearly					
	Mean	Min	Max	SD	SEM	(-)	Mean	Min	Max	SD	SEM
<b>C1</b>	258	101	452	39	7.61	<b>C1</b>	5.4	4.6	6.8	0.3	0.03
<b>C2</b>	229	72	1353	99	19.48	<b>C2</b>	5.0	4.4	5.9	0.3	0.03
<b>C4</b>	248	17	1250	41	8.13	<b>C4</b>	4.4	4.0	5.8	0.2	0.03
<b>C5</b>	228	33	179	19	3.87	<b>C5</b>	4.8	4.2	6.4	0.2	0.03
<b>C6</b>	291	58	697	45	8.79	<b>C6</b>	5.4	2.9	6.5	0.3	0.04
<b>C7</b>	246	87	397	38	7.54	<b>C7</b>	4.9	4.2	6.1	0.3	0.03
<b>C9</b>	303	106	597	55	10.84	<b>C9</b>	5.7	4.8	6.6	0.3	0.04
<b>C10</b>	288	67	720	40	7.81	<b>C10</b>	5.2	4.3	6.4	0.4	0.04
<b>C12</b>	277	96	373	39	7.66	<b>C12</b>	5.5	4.6	6.5	0.3	0.04
<b>C13</b>	284	124	470	54	10.58	<b>C13</b>	5.5	5.0	6.4	0.2	0.02
<b>C14</b>	338	162	889	35	6.93	<b>C14</b>	6.2	4.5	6.8	0.1	0.02
<b>C15</b>	324	132	1745	37	7.27	<b>C15</b>	6.3	4.5	6.9	0.1	0.03
<b>C16</b>	383	133	605	66	12.95	<b>C16</b>	6.5	5.6	7.2	0.1	0.03
<b>C20</b>	495	219	1190	63	12.66	<b>C20</b>	6.4	4.4	6.9	0.1	0.02
<b>P</b>	70	4	1214	145		<b>P</b>	(-)	(-)	(-)		

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<sup>a</sup> Average yearly cation signature, sub-catchments been mire adjusted according to Eq. 3