

*Water Resources Research*

Supporting Information for

**Stable isotope composition of Cyclone Mekunu rainfall, Southern Oman**

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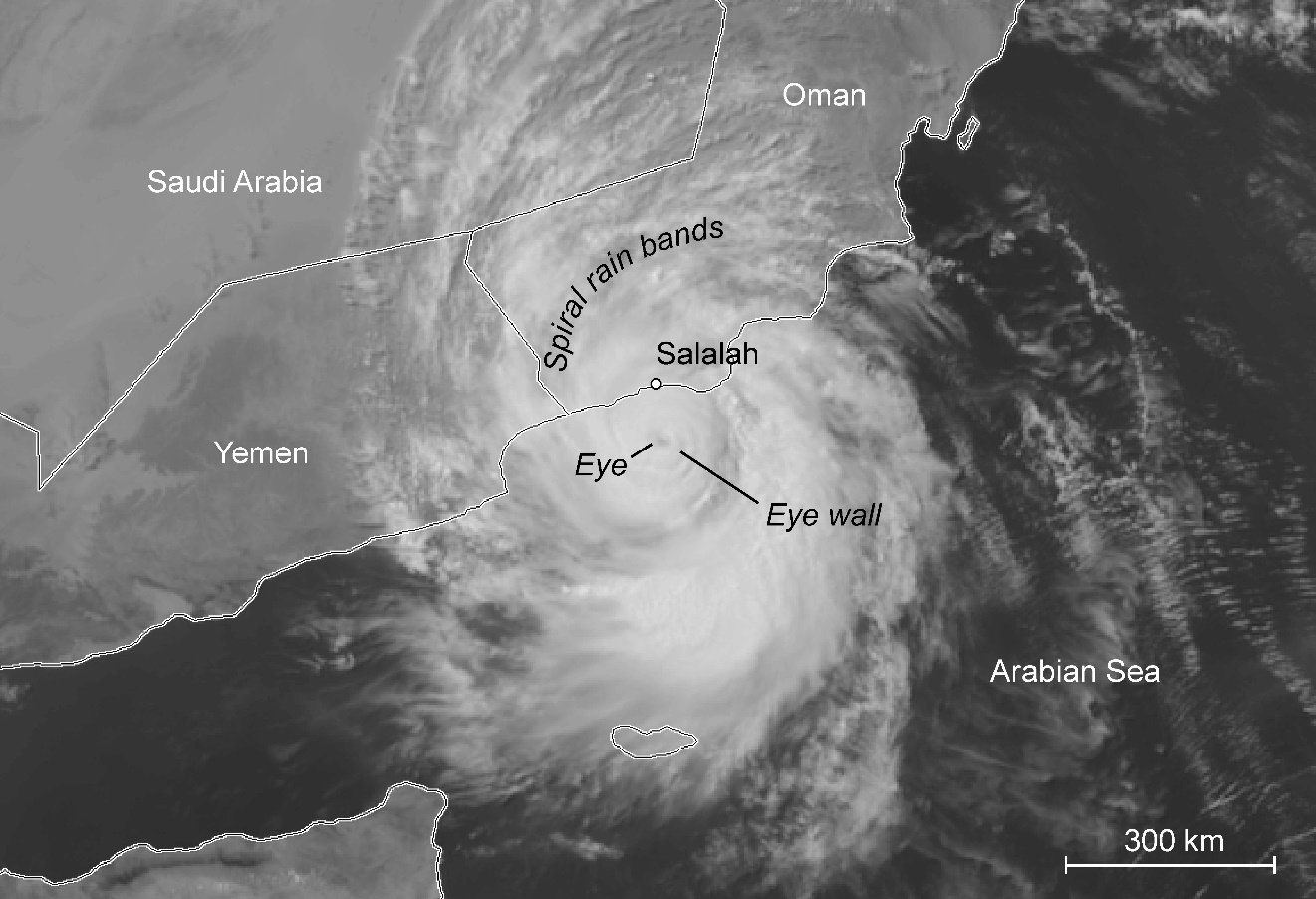
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Table S1 - Coordinates of the rainfall stations.

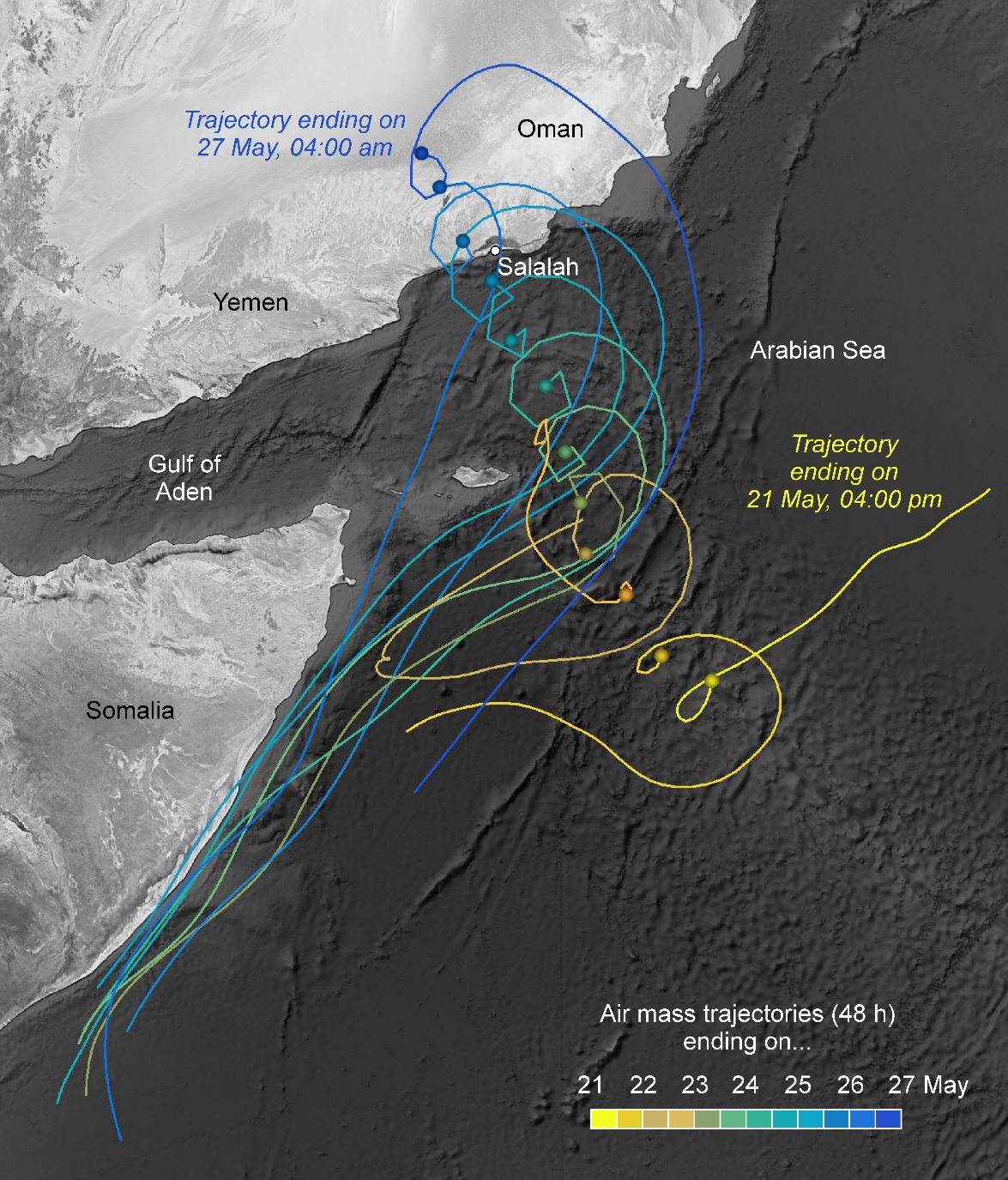
Table S2 - Results of the hydrochemical analyses for station M1

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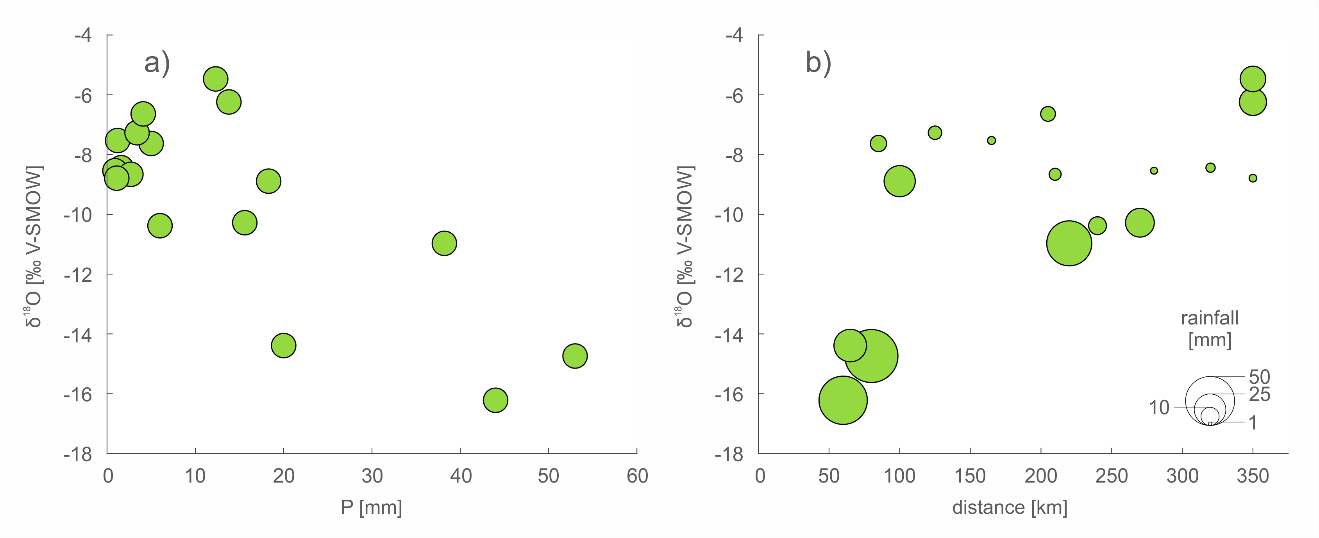
Table S4 - Results of the hydrochemical analyses for station M3.



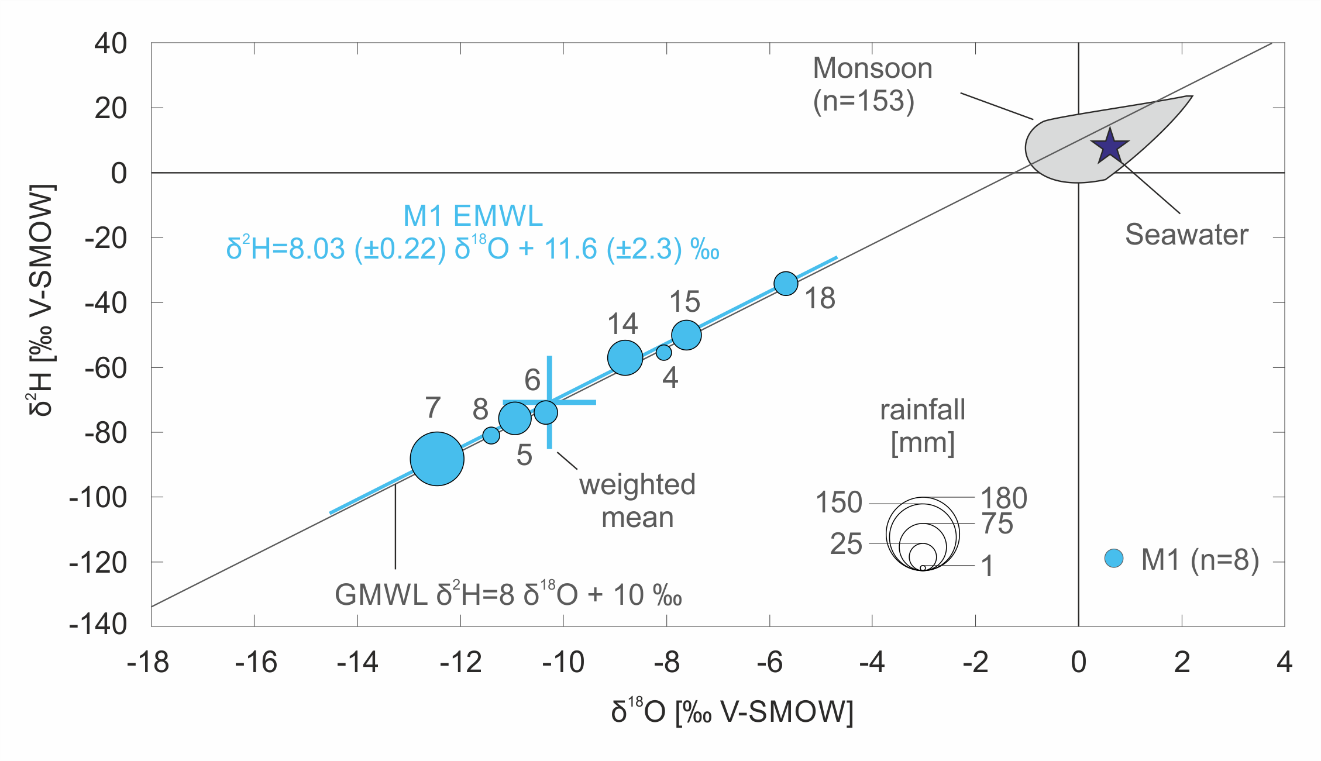
**Figure S1.** Meteosat-8 imagery (visible 0.6 µm) from 02:45 pm (local time) on 25 May 2018 (CIMSS, 2018, modified). Note the eye, eye wall, and spiral rain bands, as well as the large diameter of the system.

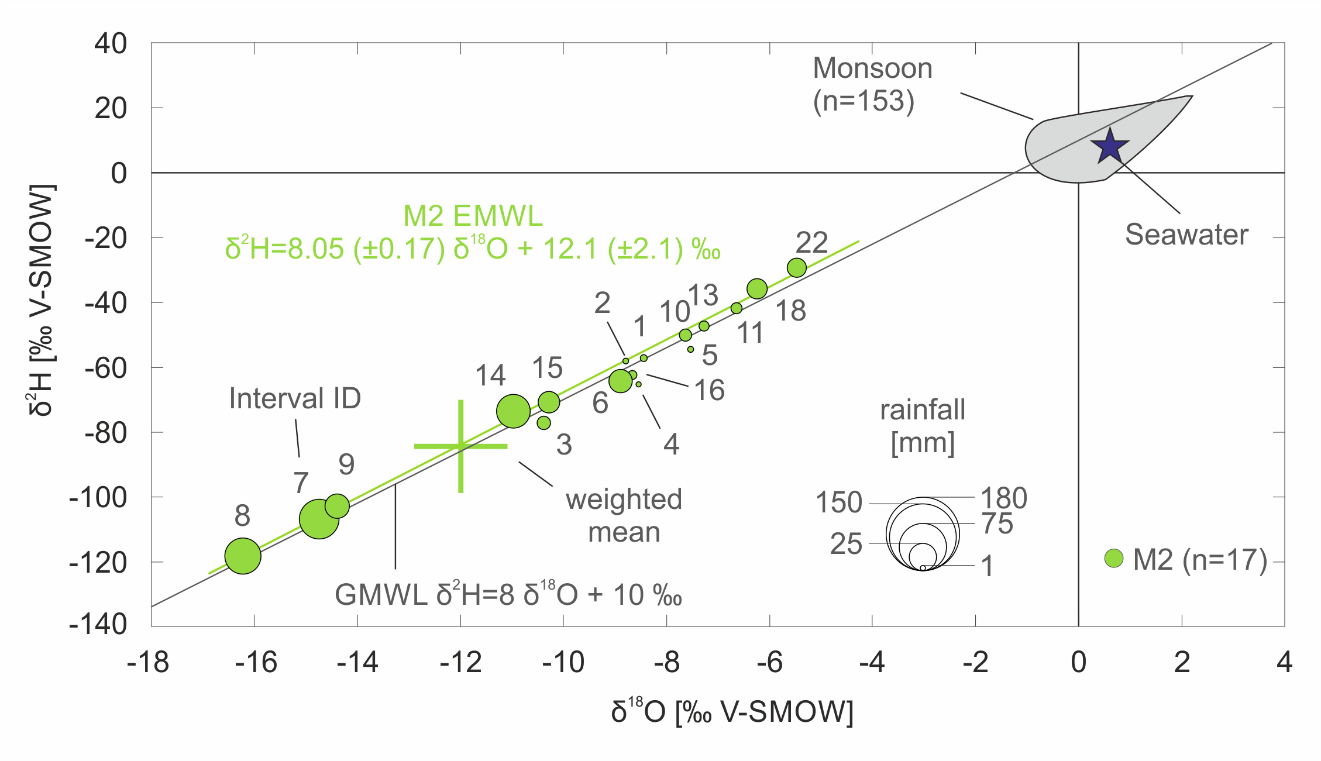
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**Figure S2.** Results of air mass back-trajectory modeling for 48 h (HYSPLIT with GDAS 0.5° meteorology data set; Stein et al., 2015; Rolph et al., 2017). Trajectories were calculated every 12 h (04:00 am and 04:00 pm local time) for air masses reaching the moving storm (about 1,400 km track length) at an altitude of 500 m amsl. Note that contributing air masses mostly originate from the Western Arabian Sea.

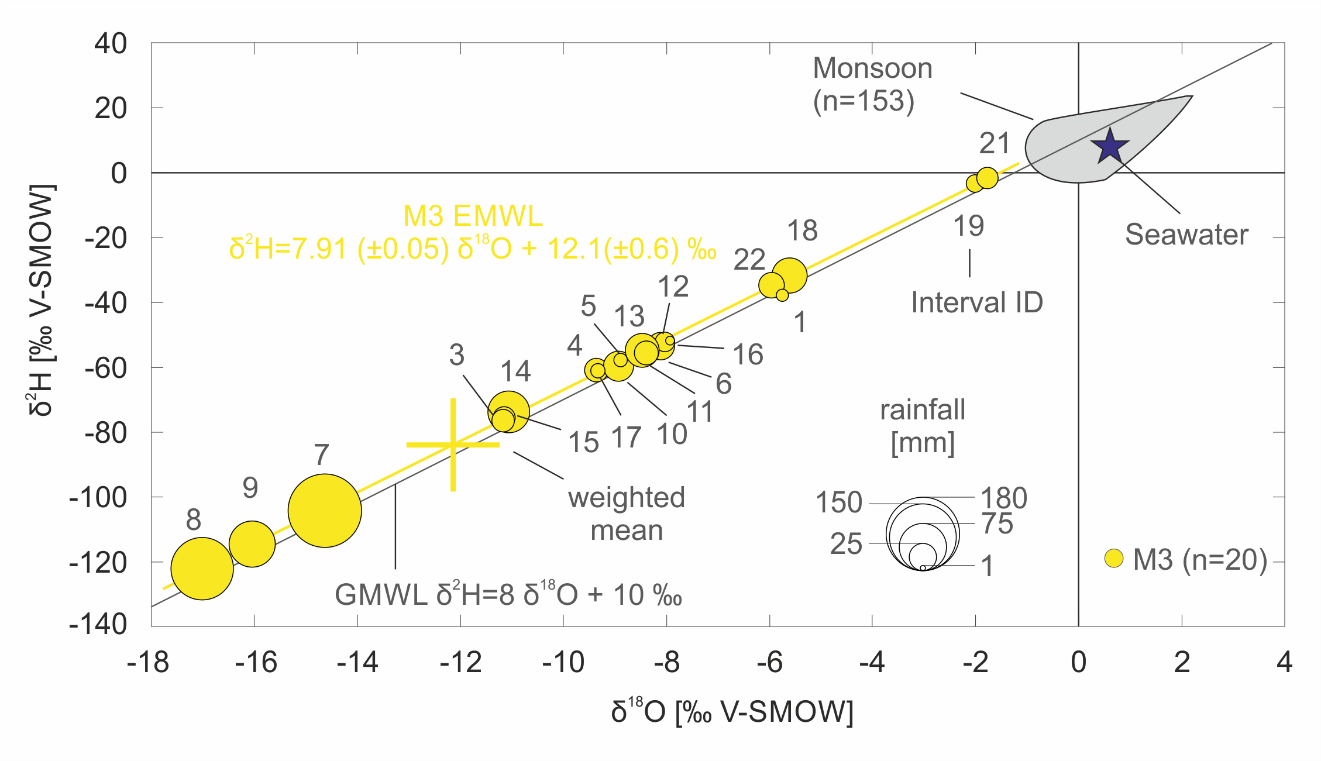


**Figure S3.** a) δ18O vs rainfall amount for station M2 and b) δ18O vs distance between storm eye and station M2. While the R² values for linear regressions are relatively low (not shown), the lightest isotopic signatures are clearly associated with higher rainfall amounts and smaller distances to the cyclone eye.

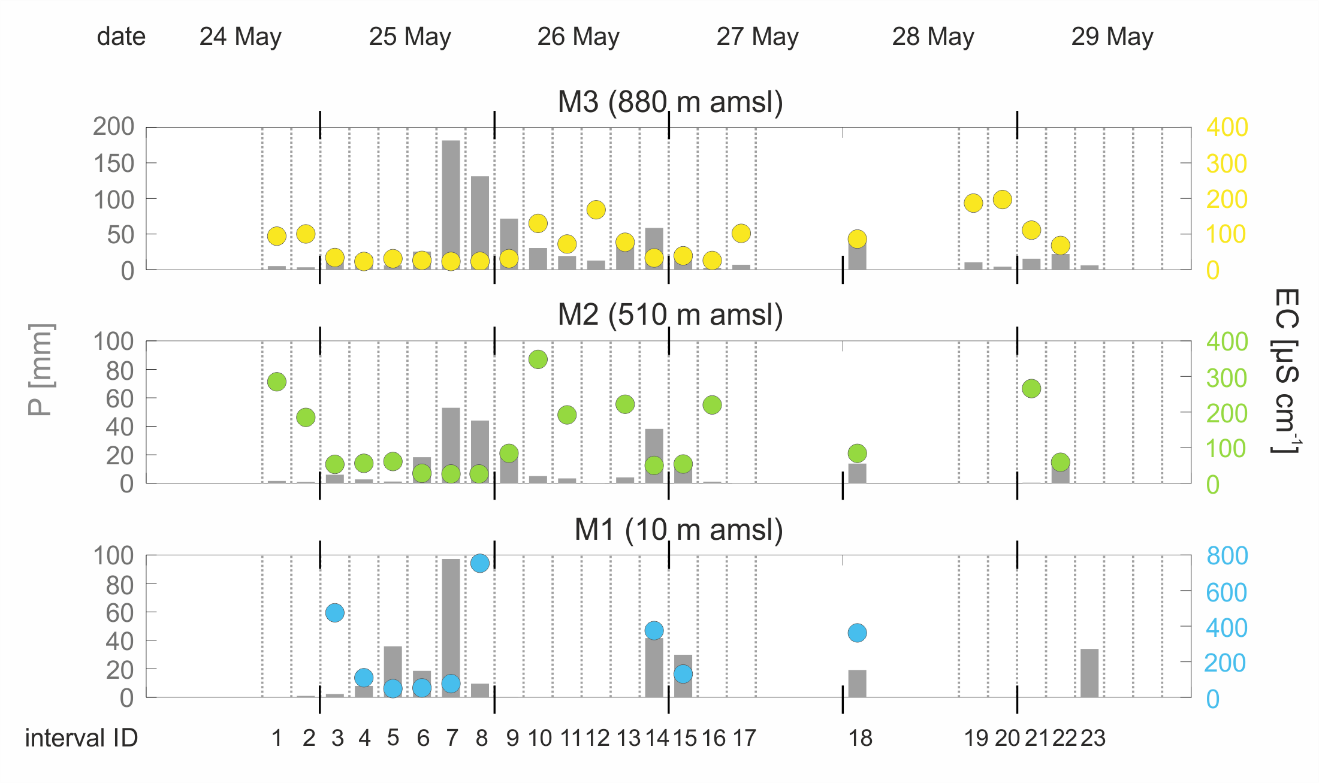
**Figure S4.** δ2H-δ18O relation of Cyclone Mekunu rainfall at station M1. The sampling intervals (IDs next to the data points) cover 4 h, except for interval 18 (28 h). The Event Meteoric Water Line (EMWL; calculated according to Crawford et al., 2014) closely follows the Global Meteoric Water Line (GMWL; Craig, 1961).



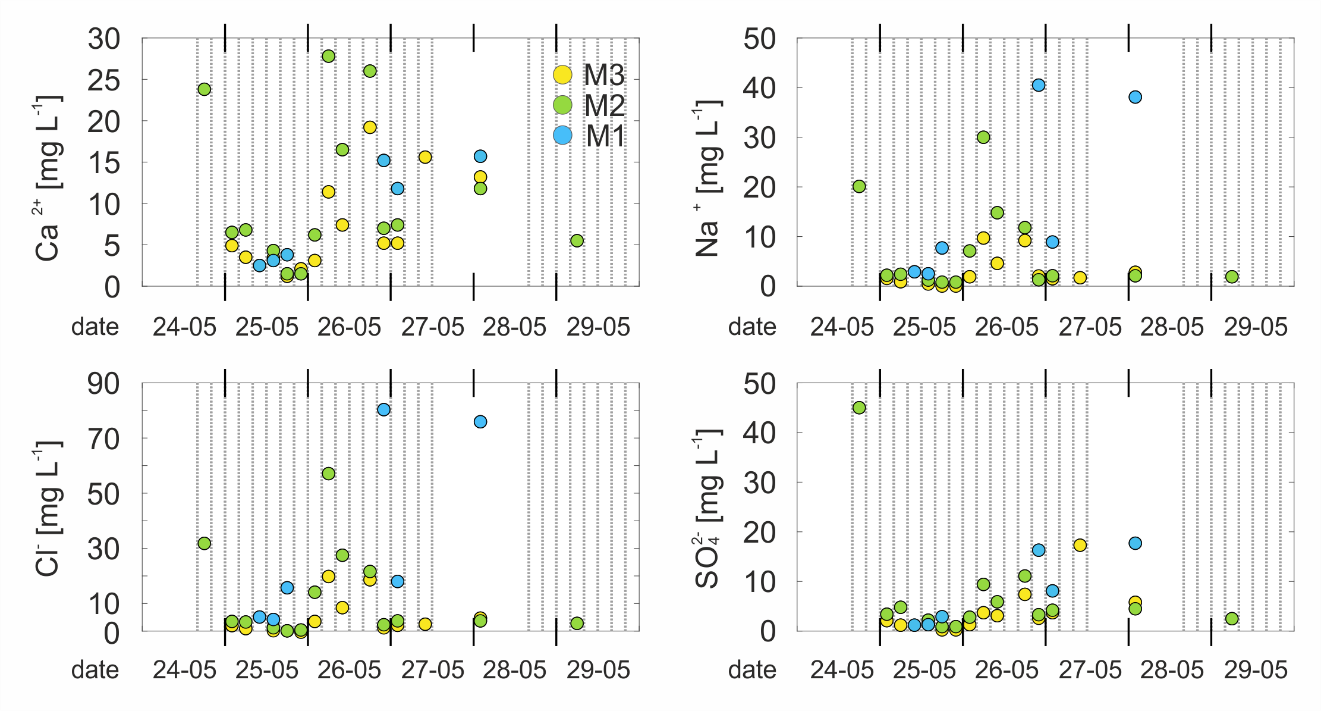
**Figure S5.** δ2H-δ18O relation of Cyclone Mekunu rainfall at station M2. The sampling intervals (IDs next to the data points) cover 4 h, except for interval 18 (28 h). The Event Meteoric Water Line (EMWL; calculated according to Crawford et al., 2014) closely follows the Global Meteoric Water Line (GMWL; Craig, 1961).



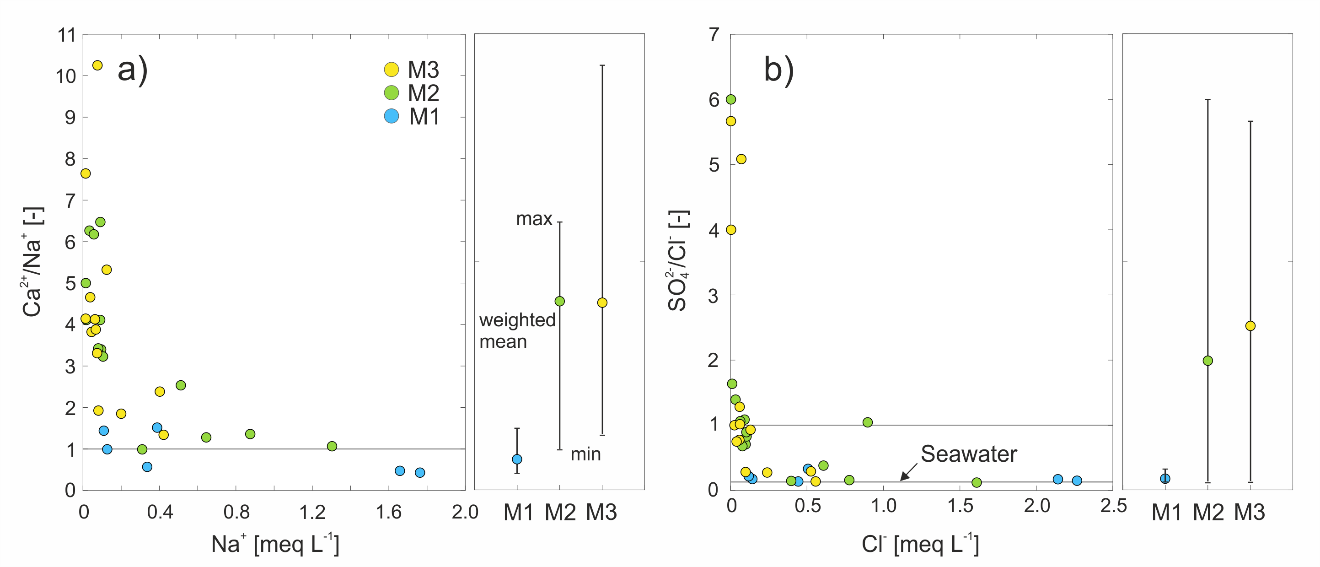
**Figure S6.** δ2H-δ18O relation of Cyclone Mekunu rainfall at station M3. The sampling intervals (IDs next to the data points) cover 4 h, except for interval 18 (28 h). The Event Meteoric Water Line (EMWL; calculated according to Crawford et al., 2014) closely follows the Global Meteoric Water Line (GMWL; Craig, 1961).



**Figure S7.** Temporal development of rainfall amounts and electrical conductivities. Decreasing EC values can be observed at the rainfall peak.



**Figure S8.** Temporal development of selected major ion concentrations for all stations. Lower concentrations are observed during the rainfall peak, higher concentrations in the following dry intervals.



**Figure S9.** Relation between a) the ion ratio Ca2+/Na+ and the Na+ concentration and b) between the ion ratio SO42-/Cl- and the Cl- concentration (ion ratios calculated on a meq-basis). The station at the sea (M1) shows a substantial Na+ contribution (sea spray proxy), compared to Ca2+ (lithogenic proxy), resulting in relatively low Ca2+/Na+ values (weighted mean < 1). The stations in the mountains (M2 and M3) exhibit higher ratios, indicating a stronger lithogenic component. Accordingly, the ions Cl- (sea spray proxy) and SO42- (lithogenic proxy) show the same effect, i.e., SO42-/Cl- values are much lower for M1 (weighted mean < 1) than for M2 and M3.

|  |  |  |
| --- | --- | --- |
| Station | Easting | Northing |
| M1 | 198873 | 1883001 |
| M2 | 193400 | 1902200 |
| M3 | 190000 | 1909800 |

**Table S1.** Coordinates of the rainfall stations.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | date | EC  [µS cm-1] | Ca2+  [mg L-1] | Mg2+  [mg L-1] | Na+  [mg L-1] | K+  [mg L-1] | Cl-  [mg L-1] | SO42-  [mg L-1] | Ca2+/ Na+ | SO42-/ Cl- |
| [-] | [-] |
| 1 | 24 May |  |  |  |  |  |  |  |  |  |
| 2 | 24 May |  |  |  |  |  |  |  |  |  |
| 3 | 24 May |  |  |  |  |  |  |  |  |  |
| 4 | 25 May |  |  |  |  |  |  |  |  |  |
| 5 | 25 May | 33 | 2.5 | 0.4 | 2.9 | 0.1 | 5.1 | 1.2 | 0.99 | 0.18 |
| 6 | 25 May | 33 | 3.1 | 0.3 | 2.5 | 0.2 | 4.2 | 1.3 | 1.44 | 0.22 |
| 7 | 25 May | 77 | 3.8 | 1.1 | 7.7 | 0.6 | 15.7 | 2.9 | 0.57 | 0.14 |
| 8 | 25 May |  |  |  |  |  |  |  |  |  |
| 9 | 25 May |  |  |  |  |  |  |  |  |  |
| 10 | 26 May |  |  |  |  |  |  |  |  |  |
| 11 | 26 May |  |  |  |  |  |  |  |  |  |
| 12 | 26 May |  |  |  |  |  |  |  |  |  |
| 13 | 26 May |  |  |  |  |  |  |  |  |  |
| 14 | 26 May | 375 | 15.2 | 6.3 | 40.5 | 1.7 | 80.3 | 16.3 | 0.43 | 0.15 |
| 15 | 26 May | 131 | 11.8 | 1.5 | 8.9 | 0.4 | 18.0 | 8.1 | 1.51 | 0.33 |
| 16 | 27 May |  |  |  |  |  |  |  |  |  |
| 17 | 27 May |  |  |  |  |  |  |  |  |  |
| 18 | 27 May | 362 | 15.7 | 5.8 | 38.1 | 1.8 | 75.9 | 17.7 | 0.47 | 0.17 |
| 19 | 28 May |  |  |  |  |  |  |  |  |  |
| 20 | 28 May |  |  |  |  |  |  |  |  |  |
| 21 | 28 May |  |  |  |  |  |  |  |  |  |
| 22 | 29 May |  |  |  |  |  |  |  |  |  |
| 23 | 29 May |  |  |  |  |  |  |  |  |  |
|  | Min |  | 2.5 | 0.3 | 2.5 | 0.1 | 4.2 | 1.2 | 0.43 | 0.14 |
|  | Max |  | 15.7 | 6.3 | 40.5 | 1.8 | 80.3 | 17.7 | 1.51 | 0.33 |
|  | Weighted mean |  | 7.5 | 2.3 | 14.8 | 0.8 | 29.4 | 6.6 | 0.78 | 0.18 |
|  |  |  |  |  |  |  |  |  |  |  |

**Table S2.** Results of the hydrochemical analyses for station M1. Ion ratios are calculated on a meq-basis.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | date | EC  [µS cm-1] | Ca2+  [mg L-1] | Mg2+  [mg L-1] | Na+  [mg L-1] | K+  [mg L-1] | Cl-  [mg L-1] | SO42-  [mg L-1] | Ca2+/ Na+ | SO42-/ Cl- |
| [-] | [-] |
| 1 | 24 May | 285 | 23.8 | 2.7 | 20.1 | 4.8 | 31.8 | 45.0 | 1.36 | 1.05 |
| 2 | 24 May |  |  |  |  |  |  |  |  |  |
| 3 | 24 May | 53 | 6.5 | 0.5 | 2.2 | 0.5 | 3.5 | 3.4 | 3.39 | 0.71 |
| 4 | 25 May | 56 | 6.8 | 0.5 | 2.4 | 0.6 | 3.3 | 4.8 | 3.24 | 1.08 |
| 5 | 25 May |  |  |  |  |  |  |  |  |  |
| 6 | 25 May | 28 | 4.3 | 0.3 | 0.8 | 0.2 | 1.2 | 2.2 | 6.19 | 1.41 |
| 7 | 25 May | 8 | 1.5 | 0.1 | 0.4 | 0.1 | 0.1 | 0.9 | 4.90 | 5.34 |
| 8 | 25 May | 8 | 1.5 | 0.1 | 0.4 | 0.1 | 0.4 | 0.9 | 3.98 | 1.62 |
| 9 | 25 May | 84 | 6.2 | 1.3 | 7.1 | 0.7 | 14.1 | 2.8 | 0.99 | 0.15 |
| 10 | 26 May | 348 | 27.8 | 5.1 | 30.0 | 1.3 | 57.1 | 9.4 | 1.07 | 0.12 |
| 11 | 26 May | 192 | 16.5 | 3.3 | 14.8 | 0.7 | 27.5 | 5.9 | 1.28 | 0.16 |
| 12 | 26 May |  |  |  |  |  |  |  |  |  |
| 13 | 26 May | 222 | 26.0 | 3.5 | 11.8 | 0.5 | 21.6 | 11.1 | 2.54 | 0.38 |
| 14 | 26 May | 50 | 7.0 | 0.8 | 1.3 | 0.1 | 2.3 | 3.3 | 6.16 | 1.07 |
| 15 | 26 May | 54 | 7.4 | 0.8 | 2.1 | 0.5 | 3.7 | 4.2 | 4.13 | 0.83 |
| 16 | 27 May |  |  |  |  |  |  |  |  |  |
| 17 | 27 May |  |  |  |  |  |  |  |  |  |
| 18 | 27 May | 84 | 11.8 | 1.3 | 2.1 | 0.3 | 3.7 | 4.5 | 6.44 | 0.89 |
| 19 | 28 May |  |  |  |  |  |  |  |  |  |
| 20 | 28 May |  |  |  |  |  |  |  |  |  |
| 21 | 28 May |  |  |  |  |  |  |  |  |  |
| 22 | 29 May |  |  |  |  |  |  |  |  |  |
| 23 | 29 May | 59 | 5.5 | 0.9 | 1.9 | 0.2 | 2.8 | 2.5 | 3.41 | 0.67 |
|  | Min |  | 1.5 | 0.1 | 0.4 | 0.1 | 0.1 | 0.9 | 1.0 | 0.1 |
|  | Max |  | 27.8 | 5.1 | 30.0 | 4.8 | 57.1 | 45.0 | 6.4 | 5.3 |
|  | Weighted mean |  | 5.7 | 0.7 | 2.6 | 0.3 | 4.6 | 2.9 | 4.4 | 1.97 |

**Table S3.** Results of the hydrochemical analyses for station M2. Ion ratios are calculated on a meq-basis.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | date | EC  [µS cm-1] | Ca2+  [mg L-1] | Mg2+  [mg L-1] | Na+  [mg L-1] | K+  [mg L-1] | Cl-  [mg L-1] | SO42-  [mg L-1] | Ca2+/ Na+ | SO42-/ Cl- |
| [-] | [-] |
| 1 | 24 May |  |  |  |  |  |  |  |  |  |
| 2 | 24 May |  |  |  |  |  |  |  |  |  |
| 3 | 24 May | 34 | 4.9 | 0.3 | 1.7 | 0.6 | 2.0 | 2.1 | 3.31 | 0.77 |
| 4 | 25 May | 23 | 3.5 | 0.2 | 0.9 | 0.3 | 0.9 | 1.2 | 4.60 | 0.97 |
| 5 | 25 May |  |  |  |  |  |  |  |  |  |
| 6 | 25 May | 26 | 3.4 | 0.2 | 1.0 | 0.4 | 1.4 | 1.4 | 3.84 | 0.75 |
| 7 | 25 May | 6 | 1.2 | 0.1 | 0.3 | 0.1 | 0.1 | 0.8 | 4.11 | 4.80 |
| 8 | 25 May | 12 | 2.1 | 0.2 | 0.3 | 0.1 | 0.1 | 0.8 | 7.63 | 4.25 |
| 9 | 25 May | 31 | 3.1 | 0.4 | 1.9 | 0.3 | 3.5 | 1.3 | 1.92 | 0.28 |
| 10 | 26 May | 130 | 11.4 | 1.6 | 9.7 | 0.7 | 19.8 | 3.7 | 1.34 | 0.14 |
| 11 | 26 May | 72 | 7.4 | 1.1 | 4.6 | 0.5 | 8.5 | 3.1 | 1.85 | 0.27 |
| 12 | 26 May |  |  |  |  |  |  |  |  |  |
| 13 | 26 May | 77 | 19.2 | 1.8 | 9.2 | 1.1 | 18.6 | 7.4 | 2.38 | 0.29 |
| 14 | 26 May | 33 | 5.2 | 0.5 | 1.5 | 0.4 | 2.2 | 3.0 | 3.88 | 1.01 |
| 15 | 26 May | 39 | 5.2 | 0.5 | 1.5 | 0.3 | 2.1 | 3.7 | 4.11 | 1.27 |
| 16 | 27 May |  |  |  |  |  |  |  |  |  |
| 17 | 27 May | 102 | 15.6 | 1.2 | 1.7 | 0.3 | 2.5 | 17.3 | 10.31 | 5.10 |
| 18 | 27 May | 86 | 13.2 | 1.5 | 2.8 | 0.7 | 4.7 | 5.8 | 5.33 | 0.92 |
| 19 | 28 May |  |  |  |  |  |  |  |  |  |
| 20 | 28 May |  |  |  |  |  |  |  |  |  |
| 21 | 28 May |  |  |  |  |  |  |  |  |  |
| 22 | 29 May |  |  |  |  |  |  |  |  |  |
| 23 | 29 May |  |  |  |  |  |  |  |  |  |
|  | Min |  | 1.2 | 0.1 | 0.3 | 0.1 | 0.1 | 0.8 | 1.34 | 0.14 |
|  | Max |  | 19.2 | 1.8 | 9.7 | 1.1 | 19.8 | 17.3 | 10.31 | 5.10 |
|  | Weighted mean |  | 4.91 | 0.5 | 2.0 | 0.3 | 3.4 | 2.3 | 4.39 | 2.55 |

**Table S4.** Results of the hydrochemical analyses for station M3. Ion ratios are calculated on a meq-basis.