SUPPLEMENTARY INFORMATION

Free amino acids quantification in cloud water at the puy de Dôme station (France)

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Table S1. Characteristics and Concentrations of AAs for each cloud samples expressed in various units and cloud bio-physico-chemical characterization.

| Label   | Sampling date | Sampling Start | Sampling end | Category Renard et al. (2020) |
|---------|---------------|----------------|--------------|-------------------------------|
| 22 Mar  | 22-Mar-14     | 07:35          | 11:00        | Marine                        |
| 3 May   | 3-May-18      | 09:30          | 14:00        | Marine                        |
| 13 Jun  | 13-Jun-18     | 10:30          | 12:30        | Marine                        |
| 24 Aug  | 24-Aug-18     | 10:50          | 15:15        | Marine                        |
| 24 Sep  | 24-Sep-18     | 08:30          | 16:00        | Marine                        |
| 1 Oct   | 1-Oct-18      | 11:00          | 12:45        | Marine                        |
| 8 Oct   | 8-Oct-18      | 13:15          | 16:45        | Marine                        |
| 25 Sep  | 25-Sep-19     | 08:45          | 12:38        | Marine                        |
| 2 Oct   | 2-Oct-19      | 14:35          | 16:45        | Marine                        |
| 22 Oct Am| 22-Oct-19    | 10:10          | 13:37        | Marine                        |
| 22 Oct Pm| 22-Oct-19    | 13:40          | 16:30        | Marine                        |
| 11 Mar  | 11-Mar-20     | 08:40          | 13:40        | Marine                        |
| 17 Jul  | 17-Jul-20     | 11:36          | 14:40        | Continental                   |
### Table S1. Continued.

| Label      | Ala | Arg | Asn | Asp | Gln | Glu | Gly | His | Leu / I | Lys | Met | Phe | Pro | Ser | Thr | Trp | Tyr | SUM |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 22 Mar     | 17  | 8   | < LOQ | 12  | < LOQ | 32  | 8   | 12  | 26      | 16  | 4   | 1   | 8   | 22  | 11  | 4   | 7   | 188 |
| 3 May      | 19  | < LOQ | 2   | 11  | 1    | 6   | 16  | 3   | 10      | 0   | 1   | 5   | 18  | 34  | 13  | < LOQ | 5   | 143 |
| 13 Jun     | 8   | < LOQ | 102 | 4   | < LOQ | 2   | 10  | < LOQ | 12     | < LOQ | < LOQ | 10  | 8   | 2   | < LOQ | < LOQ | 158 |
| 24 Aug     | 26  | 5   | 131 | 15  | 15   | 17  | 21  | 6   | 17      | 2   | < LOQ | 11  | 15  | 33  | 28  | 4   | 5   | 352 |
| 24 Sep     | 11  | 4   | 11  | 4   | 1    | 7   | 14  | 5   | 7       | 3   | 0   | 3   | 8   | 17  | 21  | 1   | 2   | 122 |
| 1 Oct      | 69  | 1   | 31  | 45  | 3    | 22  | 42  | 22  | 41      | 9   | < LOQ | 10  | 30  | 157 | 42  | 2   | 21  | 547 |
| 8 Oct      | 27  | < LOQ | 2   | 14  | 0    | 8   | 18  | 3   | 22      | < LOQ | < LOQ | 5   | 14  | 36  | 15  | 1   | 5   | 169 |
| 25 Sep     | ND  | 8   | 21  | ND  | 6    | 10  | 87  | ND  | ND      | 8   | < LOQ | 18  | ND  | 155 | 25  | 5   | ND  | 343 |
| 2 Oct      | ND  | 3   | 67  | 65  | 2    | 22  | 121 | 26  | 68      | 19  | < LOQ | 20  | ND  | 282 | 49  | 1   | 27  | 772 |
| 22 Oct Am  | ND  | < LOQ | 2   | 22  | < LOQ | 10  | 48  | 9   | 22      | 6   | < LOQ | 6   | ND  | 78  | 18  | < LOQ | 7   | 228 |
| 22 Oct Pm  | ND  | 2   | 1   | 6   | < LOQ | 3   | 57  | 3   | 17      | 1   | < LOQ | 4   | ND  | 42  | 8   | 4   | < LOQ | 150 |
| 11 Mar     | 54  | 3   | 2   | < LOQ | < LOQ | 1   | 33  | 2   | 16      | < LOQ | < LOQ | 9   | ND  | 0   | 3   | < LOQ | 2   | 126 |
| 17 Jul     | ND  | 2   | 4   | < LOQ | 6   | 8   | 72  | < LOQ | 19      | 2   | < LOQ | 10  | 9   | 22  | 9   | < LOQ | 8   | 171 |

*: See Figure S3  
ND: Not determined  
LOQ: Limit of Quantification (= standard deviation, see Figure S3, Table S3 and Section 3.1)  
Unlike Table S3, negative values are considered as below the LOQ.
Table S1. Continued.

| Label     | Ala | Arg | Asn | Asp | Gln | Glu | Gly | His | Leu / I | Lys | Met | Phe | Pro | Ser | Thr | Trp | Tyr | SUM |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 22 Mar    | 215 | 52  | < LOQ | 97  | < LOQ | 244 | 123 | 85  | 218      | 119 | 27  | 6   | 76  | 237 | 107 | 22  | 42  | 1670|
| 3 May     | 239 | < LOQ | 17  | 92  | 8   | 44  | 234 | 22  | 83       | 0   | 4   | 34  | 177 | 358 | 121 | < LOQ | 29  | 1462|
| 13 Jun    | 96  | < LOQ | 859 | 33  | < LOQ | 19  | 144 | < LOQ | 103      | < LOQ | < LOQ | 92  | 81  | 23  | < LOQ | < LOQ | 1450|
| 24 Aug    | 320 | 33  | 1105 | 125 | 111 | 129 | 309 | 40  | 145      | 16  | < LOQ | 77  | 149 | 351 | 261 | 20  | 32  | 3223|
| 24 Sep    | 134 | 27  | 95  | 37  | 7   | 52  | 210 | 38  | 60       | 26  | 3   | 22  | 81  | 183 | 193 | 5   | 13  | 1187|
| 1 Oct     | 862 | 4   | 257 | 372 | 25  | 168 | 627 | 159 | 345      | 70  | < LOQ | 67  | 290 | 1663| 393 | 10  | 129 | 5441|
| 8 Oct     | 341 | < LOQ | 13  | 114 | 2   | 63  | 267 | 18  | 183      | < LOQ | < LOQ | 33  | 137 | 379 | 142 | 3   | 33  | 1729|
| 25 Sep    | ND  | 51  | 174 | ND  | 49  | 79  | 1281| ND  | ND       | < LOQ | 123 | ND  | 1637| 232 | 26  | ND  | 3714|
| 2 Oct     | ND  | 17  | 566 | 543 | 18  | 167 | 1787| 185 | 577      | 141 | < LOQ | 133 | ND  | 2983| 462 | 5   | 165 | 7749|
| 22 Oct Am | ND  | < LOQ | 19  | 182 | < LOQ | 74  | 706 | 62  | 182      | 48  | < LOQ | 42  | ND  | 822 | 169 | < LOQ | 46  | 2352|
| 22 Oct Pm | ND  | 14  | 8   | 53  | < LOQ | 21  | 849 | 24  | 147      | 9   | < LOQ | 29  | ND  | 439 | 74  | 23  | < LOQ | 1691|
| 11 Mar    | 676 | 18  | 19  | < LOQ | < LOQ | 6   | 491 | 16  | 132      | < LOQ | < LOQ | 58  | ND  | 4   | 32  | < LOQ | 13  | 1465|
| 17 Jul    | ND  | 10  | 36  | < LOQ | 44  | 64  | 1065| < LOQ | 158      | 12  | < LOQ | 66  | 91  | 237 | 84  | < LOQ | 50  | 1917|

ND: Not determined
LOQ: Limit of Quantification (= standard deviation, see Figure S3, Table S3 and Section 3.1)
Unlike Table S3, negative values are considered as below the LOQ.
Table S1. Continued.

| Label       | Ala | Arg | Asn | Asp | Gln | Glu | Gly | His | Leu/I | Lys | Met | Phe | Pro | Ser | Thr | Trp | Tyr | SUM |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 22 Mar      | 5   | 3   | < LOQ | 4   | < LOQ | 10  | 3   | 4   | 8    | 5   | 1   | 0   | 2   | 7   | 4   | 1   | 2   | 60  |
| 3 May       | 6   | < LOQ | 1   | 4   | 0   | 2   | 5   | 1   | 3    | 0   | 0   | 2   | 6   | 11  | 4   | < LOQ | 1   | 45  |
| 13 Jun      | 2   | < LOQ | 32  | 1   | < LOQ | 1   | 3   | < LOQ | 4    | < LOQ | < LOQ | 3   | 2   | 1   | < LOQ | < LOQ | 50  |
| 24 Aug      | 8   | 2   | 42  | 5   | 5   | 7   | 2   | 5   | 1    | < LOQ | 4   | 5   | 11  | 9   | 1   | 2   | 111 |
| 24 Sep      | 3   | 1   | 4   | 1   | 0   | 2   | 4   | 2   | 2    | 1   | 0   | 1   | 3   | 5   | 7   | 0   | 1   | 39  |
| 1 Oct       | 22  | 0   | 10  | 14  | 1   | 7   | 13  | 7   | 13   | 3    | < LOQ | 3   | 10  | 50  | 13  | 1   | 7   | 173 |
| 8 Oct       | 9   | < LOQ | 0   | 4   | 0   | 3   | 6   | 1   | 7    | < LOQ | < LOQ | 2   | 4   | 11  | 5   | 0   | 2   | 54  |
| 25 Sep      | ND  | 3   | 7   | ND  | 2   | 3   | 27  | ND  | 3    | < LOQ | 6   | ND  | 49  | 8   | 2   | ND  | 109 |
| 2 Oct       | ND  | 1   | 21  | 21  | 1   | 7   | 38  | 8   | 22   | 6    | < LOQ | 6   | ND  | 89  | 16  | 0   | 9   | 244 |
| 22 Oct Am   | ND  | < LOQ | 1   | 7   | < LOQ | 3   | 15  | 3   | 7    | 2    | < LOQ | 2   | ND  | 25  | 6   | < LOQ | 2   | 72  |
| 22 Oct Pm   | ND  | 1   | 0   | 2   | < LOQ | 1   | 18  | 1   | 5    | 0    | < LOQ | 1   | ND  | 13  | 3   | 1   | < LOQ | 47  |
| 11 Mar      | 17  | 1   | 1   | < LOQ | < LOQ | 0   | 10  | 1   | 5    | < LOQ | < LOQ | 3   | ND  | 0   | 1   | < LOQ | 1   | 40  |
| 17 Jul      | ND  | 1   | 1   | < LOQ | 2   | 3   | 23  | < LOQ | 6    | 0    | < LOQ | 3   | 3   | 7   | 3   | < LOQ | 3   | 54  |

* When LWC is not available, we consider mean LWC at PUY: 0.285 g m\(^{-3}\)

LOQ: Limit of Quantification (= standard deviation, see Figure S3, Table S3 and Section 3.1)

Unlike Table S3, negative values are considered as below the LOQ.
Table S1. Continued.

| Label    | Ala | Arg | Asn | Asp | Gln | Glu | Gly | His | Leu / I | Lys | Met | Phe | Pro | Ser | Thr | Trp | Tyr | SUM |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 22 Mar   | 7   | 3   | < LOQ | 4   | < LOQ | 13  | 3   | 5   | 14      | 8   | 1   | 1   | 4   | 8   | 5   | 3   | 4   | 83  |
| 3 May    | 8   | < LOQ | 1   | 4   | 0   | 2   | 5   | 1   | 5       | 0   | 0   | 3   | 10  | 12  | 5   | < LOQ | 3   | 60  |
| 13 Jun   | 3   | < LOQ | 37  | 1   | < LOQ | 1   | 3   | < LOQ | 7       | < LOQ | < LOQ | 5   | 3   | 1   | < LOQ | < LOQ | 61  |
| 24 Aug   | 10  | 2   | 48  | 5   | 6   | 7   | 7   | 3   | 9       | 1   | < LOQ | 7   | 8   | 11  | 11  | 2   | 3   | 142 |
| 24 Sep   | 4   | 2   | 4   | 2   | 0   | 3   | 5   | 2   | 4       | 2   | 0   | 2   | 4   | 6   | 8   | 1   | 1   | 50  |
| 1 Oct    | 28  | 0   | 11  | 16  | 1   | 9   | 14  | 10  | 22      | 5   | < LOQ | 7   | 64  | 17  | 11  | 1   | 13  | 223 |
| 8 Oct    | 11  | < LOQ | 1   | 5   | 0   | 3   | 6   | 1   | 12      | < LOQ | < LOQ | 3   | 7   | 12  | 6   | 0   | 3   | 71  |
| 25 Sep   | ND  | 3   | 7   | ND  | 3   | 4   | 28  | ND  | ND      | < LOQ | 12  | ND  | 53  | 10  | ND  | 3   | ND  | 128 |
| 2 Oct    | ND  | 1   | 24  | 23  | 1   | 9   | 39  | 12  | 37      | 9   | < LOQ | 13  | ND  | 97  | 20  | 1   | 16  | 302 |
| 22 Oct Am| ND  | < LOQ | 1   | 8   | < LOQ | 4   | 15  | 4   | 12      | 3   | < LOQ | 4   | ND  | 27  | 7   | < LOQ | 4   | 89  |
| 22 Oct Pm| ND  | 1   | 0   | 2   | < LOQ | 1   | 18  | 2   | 10      | 1   | < LOQ | 3   | ND  | 14  | 3   | 3   | < LOQ | 58  |
| 11 Mar   | 22  | 1   | < LOQ | < LOQ | 0   | 11  | 1   | 9   | < LOQ   | < LOQ | 6   | ND  | 0   | 1   | < LOQ | 1   | 53  |
| 17 Jul   | ND  | 1   | 2   | < LOQ | 2   | 3   | 23  | < LOQ | 10      | 1   | < LOQ | 6   | 5   | 8   | 4   | < LOQ | 5   | 70  |

ND: Not determined
LOQ: Limit of Quantification (= standard deviation, see Figure S3, Table S3 and Section 3.1)
Unlike Table S3, negative values are considered as below the LOQ.
## Table S1. Continued.

| Label       | Ala | Arg | Asn | Asp | Gln | Glu | Gly | His | Leu/I | Lys | Met | Phe | Pro | Ser | Thr | Trp | Tyr |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----|-----|-----|-----|-----|-----|-----|-----|
| 22 Mar      | 13% | 3%  | < LOQ | 6%  | < LOQ | 15% | 7%  | 5%  | 13%   | 7%  | 2%  | 0%  | 5%  | 14% | 6%  | 1%  | 3%  |
| 3 May       | 16% | < LOQ | 1%  | 6%  | 1%  | 3%  | 16% | 2%  | 6%   | 0%  | 0%  | 2%  | 12% | 24% | 8%  | < LOQ | 2%  |
| 13 Jun      | 7%  | < LOQ | 59% | 2%  | < LOQ | 1%  | 10% | < LOQ | 7%   | < LOQ | < LOQ | 6%  | 6%  | 2%  | < LOQ | < LOQ |
| 24 Aug      | 10% | 1%  | 34% | 4%  | 3%  | 4%  | 10% | 1%  | 5%   | 0%  | < LOQ | 2%  | 5%  | 11% | 8%  | 1%  | 1%  |
| 24 Sep      | 11% | 2%  | 8%  | 3%  | 1%  | 4%  | 18% | 3%  | 5%   | 2%  | 0%  | 2%  | 7%  | 15% | 16% | 0%  | 1%  |
| 1 Oct       | 16% | 0%  | 5%  | 7%  | 0%  | 3%  | 12% | 3%  | 6%   | 1%  | < LOQ | 1%  | 5%  | 31% | 7%  | 0%  | 2%  |
| 8 Oct       | 20% | < LOQ | 1%  | 7%  | 0%  | 4%  | 15% | 1%  | 11%  | < LOQ | < LOQ | 2%  | 8%  | 22% | 8%  | 0%  | 2%  |
| 25 Sep      | ND  | 1%  | 5%  | ND  | 1%  | 2%  | 35% | ND  | ND   | 2%  | < LOQ | 3%  | ND  | 44% | 6%  | 1%  | ND  |
| 2 Oct       | ND  | 0%  | 7%  | 7%  | 0%  | 2%  | 23% | 2%  | 7%   | 2%  | < LOQ | 2%  | ND  | 38% | 6%  | 0%  | 2%  |
| 22 Oct Am   | ND  | < LOQ | 1%  | 8%  | < LOQ | 3%  | 30% | 3%  | 8%   | 2%  | < LOQ | 2%  | ND  | 35% | 7%  | < LOQ | 2%  |
| 22 Oct Pm   | ND  | 1%  | 0%  | 3%  | < LOQ | 1%  | 50% | 1%  | 9%   | 1%  | < LOQ | 2%  | ND  | 26% | 4%  | 1%  | < LOQ |
| 11 Mar      | 46% | 1%  | 1%  | < LOQ | < LOQ | 0%  | 33% | 1%  | 9%   | < LOQ | < LOQ | 4%  | ND  | 0%  | 2%  | < LOQ | 1%  |
| 17 Jul      | ND  | 1%  | 2%  | < LOQ | 2%  | 3%  | 56% | < LOQ | 8%   | 1%  | < LOQ | 3%  | 5%  | 12% | 4%  | < LOQ | 3%  |

ND: Not determined
LOQ: Limit of Quantification (= standard deviation, see Figure S3, Table S3 and Section 3.1)
Unlike Table S3, negative values are considered as below the LOQ.
### Table S1. Continued.

| Label          | Sea surface (<ABLH)* | Sea surface (>ABLH) | Continental surface (<ABLH) | Continental surface (>ABLH) | SSW  | WSW  | WNW  | NNW  | NNE  | ENE  | ESE  | SSE  | NEAR |
|----------------|----------------------|----------------------|----------------------------|----------------------------|------|------|------|------|------|------|------|------|------|
| 22 Mar         | 11.99%               | 76.38%               | 0.81%                      | 10.82%                     | 0.00%| 77.37%| 21.18%| 0.00%| 0.00%| 0.00%| 0.00%| 0.00%| 1.44%|
| 3 May          | 10.74%               | 46.87%               | 0.88%                      | 41.51%                     | 0.00%| 49.24%| 26.28%| 12.16%| 9.71%| 0.00%| 0.00%| 0.00%| 2.61%|
| 13 Jun         | 0.02%                | 40.33%               | 1.53%                      | 58.13%                     | 0.00%| 0.00%| 11.50%| 56.40%| 29.34%| 0.00%| 0.00%| 0.00%| 2.77%|
| 24 Aug         | 27.26%               | 40.96%               | 6.63%                      | 25.16%                     | 0.00%| 0.91% | 96.68%| 0.00%| 0.00%| 0.00%| 0.00%| 0.00%| 2.41%|
| 24 Sep         | 0.00%                | 55.88%               | 0.80%                      | 43.31%                     | 0.00%| 0.00%| 27.61%| 30.30%| 25.13%| 15.02%| 0.00%| 0.00%| 1.94%|
| 1 Oct          | 27.41%               | 32.81%               | 11.21%                     | 28.56%                     | 0.00%| 0.00%| 60.44%| 37.65%| 0.00%| 0.00%| 0.00%| 0.00%| 1.91%|
| 8 Oct          | 0.00%                | 7.44%                | 1.07%                      | 91.50%                     | 0.00%| 0.00%| 0.00%| 0.00%| 0.00%| 55.94%| 34.12%| 5.73%| 4.21%|
| 25 Sep         | 48.82%               | 41.32%               | 0.00%                      | 9.86%                      | 0.00%| 19.16%| 79.53%| 0.00%| 0.00%| 0.00%| 0.00%| 0.00%| 1.31%|
| 2 Oct          | 62.87%               | 4.55%                | 8.43%                      | 24.15%                     | 0.00%| 7.57% | 10.40%| 55.43%| 24.24%| 0.00%| 0.00%| 0.00%| 2.36%|
| 22 Oct Am      | 1.06%                | 35.76%               | 6.25%                      | 56.94%                     | 12.76%| 5.88% | 0.00%| 0.00%| 0.00%| 0.00%| 22.50%| 56.69%| 2.17%|
| 22 Oct Pm      | 0.00%                | 26.00%               | 8.95%                      | 65.05%                     | 4.50%| 0.00%| 0.00%| 0.00%| 0.00%| 0.00%| 20.25%| 73.63%| 1.62%|
| 11 Mar         | 0.00%                | 86.48%               | 0.00%                      | 13.52%                     | 0.00%| 67.70%| 29.22%| 0.00%| 0.00%| 0.00%| 0.00%| 0.00%| 3.08%|
| 17 Jul         | 0.00%                | 46.50%               | 0.00%                      | 53.50%                     | 0.00%| 0.00%| 51.20%| 35.10%| 10.50%| 0.00%| 0.00%| 0.00%| 3.20%|

* Computing Atmospheric Trajectory Tool

† ABLH: Atmosphere Boundary Layer Height
### Table S1. Continued.

| Label    | LWC (g m\(^{-3}\)) | Effective Radius (µm) | Temp. (°C) | pH  | Na\(^+\) (µM) | NH\(_4\)\(^+\) (µM) | Mg\(^{2+}\) (µM) | K\(^+\) (µM) | Ca\(^{2+}\) (µM) | SO\(_4^{2-}\) (µM) | NO\(_3^{-}\) (µM) | Cl\(^-\) (µM) | TOC (mgC L\(^{-1}\)) | H\(_2\)O\(_2\) (µM) | Bacteria (17°C) CFU mL\(^{-1}\) | ATP conc. (nM) |
|----------|---------------------|-----------------------|------------|-----|---------------|----------------------|------------------|--------------|----------------|----------------|----------------|------------|----------------------|----------------|-------------------------------|-----------------|
| 22 Mar   | 0.38                | 9.03                  | 0          | 6.67| 20.92         | 87.56                | 12.38            | 2.33         | 4.72           | 34.77          | 24.68          | 65.73     | 2.90                 | 18.00         | ND                              | ND              |
| 3 May    | 0.08                | 3.49                  | 3          | 5.50| 32.90         | 51.70                | 10.50            | 11.10        | 38.40          | 10.70          | 36.00          | 10.60     | 6.80                 | 13.89         | 20                              | 0.06            |
| 13 Jun   | ND                  | ND                    | 6.9        | 5.00| 22.70         | 125.60               | 10.60            | 4.10         | 49.30          | 6.20           | 30.60          | 15.40     | 10.60                | 29.26         | 150                             | 0.12            |
| 24 Aug   | ND                  | ND                    | 10.3       | 5.00| 22.80         | 17.30                | 6.50             | 11.70        | 42.50          | 13.60          | 76.10          | 13.20     | 7.20                 | 6.28          | 235                             | 0.21            |
| 24 Sep   | ND                  | ND                    | 2.4        | 4.70| 14.20         | 21.40                | 5.70             | 6.20         | 40.50          | 9.60           | 32.80          | 4.50      | 3.00                 | 2.95          | 216                             | 0.01            |
| 1 Oct    | 0.06                | 2.94                  | 0.8        | 5.00| 30.20         | 21.30                | 14.20            | 7.40         | 61.00          | 26.60          | 37.20          | 11.80     | 6.70                 | 0.72          | 340                             | 0.03            |
| 8 Oct    | 0.17                | 2.75                  | 8          | 4.50| 21.40         | 78.90                | 8.60             | 7.10         | 52.40          | 15.30          | 132.00         | 26.40     | 9.80                 | 14.64         | 277                             | 0.05            |
| 25 Sep   | ND                  | ND                    | 6.8        | 5.21| 105.26        | 3.00                 | 7.56             | 15.42        | 10.59          | 14.34          | 6.14           | 114.18    | 6.90                 | 19.20         | 179                             | 0.68            |
| 2 Oct    | ND                  | ND                    | 6.1        | 5.15| 120.38        | 4.18                 | 7.48             | 39.01        | 19.35          | 13.23          | 42.60          | 108.97    | 6.80                 | 5.75          | 212                             | 0.84            |
| 22 Oct Am| ND                  | ND                    | 5.8        | 5.80| 68.66         | 0.00                 | 3.90             | 14.17        | 7.44           | 11.69          | 10.04          | 52.01     | 3.20                 | 34.65         | 134                             | 0.40            |
| 22 Oct Pm| ND                  | ND                    | 6.3        | 5.80| 46.09         | 0.00                 | 4.23             | 13.85        | 9.61           | 19.67          | 0.10           | 35.12     | 11.20                | 31.64         | 120                             | 0.34            |
| 11 Mar   | ND                  | ND                    | 5.7        | 5.13| 53.02         | 61.75                | 4.13             | 16.48        | 6.03           | 21.51          | 12.83          | 37.78     | 4.00                 | 0.50          | 186                             | 0.30            |
| 17 Jul   | 0.07                | 11.20                 | 10.3       | 5.44| 54.66         | 339.76               | 13.25            | 12.61        | 36.23          | 39.99          | 162.06         | 39.62     | ND                   | ND            | 196                             | 2.25            |

*CFU: Colony-Forming Unit
| Amino Acid  | Abbrev. | Molecular formula | Monoisotopic mass (Da) | m/z $[\text{M+H}]^+$ | Mean retention time (min) |
|------------|---------|-------------------|------------------------|----------------------|--------------------------|
| Alanine    | Ala     | $\text{C}_3\text{H}_7\text{NO}_2$ | 89.0477               | 90.0557             | 3.66                     |
| Arginine   | Arg     | $\text{C}_6\text{H}_14\text{N}_2\text{O}_2$ | 174.1117             | 175.1194            | 6.84                     |
| Asparagine | Asn     | $\text{C}_4\text{H}_7\text{N}_2\text{O}_3$ | 132.0535             | 133.0612            | 5.3                      |
| Aspartic acid | Asp    | $\text{C}_4\text{H}_7\text{NO}_4$ | 133.0375             | 134.0452            | 4.92                     |
| Glutamine  | Gln     | $\text{C}_4\text{H}_7\text{N}_2\text{O}_3$ | 146.0691             | 147.0768            | 5.13                     |
| Glutamic acid | Glu   | $\text{C}_5\text{H}_8\text{NO}_4$ | 147.0532             | 148.0608            | 4.47                     |
| Glycine    | Gly     | $\text{C}_3\text{H}_6\text{NO}_2$ | 75.0320              | 76.0401             | 4.14                     |
| Histidine  | His     | $\text{C}_6\text{H}_9\text{N}_2\text{O}_2$ | 155.0695             | 156.0772            | 6.95                     |
| Isoleucine | Ile     | $\text{C}_6\text{H}_13\text{NO}_2$ | 131.0946             | 132.1023            | 1.66                     |
| Leucine    | Leu     | $\text{C}_6\text{H}_13\text{NO}_2$ | 131.0946             | 132.1023            | 1.66                     |
| Methionine | Met     | $\text{C}_6\text{H}_11\text{NO}_2\text{S}$ | 149.0511             | 150.0588            | 2.79                     |
| Phenylalanine | Phe    | $\text{C}_9\text{H}_19\text{NO}_2$ | 165.0790             | 166.0867            | 2.33                     |
| Proline    | Pro     | $\text{C}_6\text{H}_13\text{NO}_2$ | 115.0633             | 116.0711            | 4.19                     |
| Serine     | Ser     | $\text{C}_5\text{H}_7\text{NO}_3$ | 105.0426             | 106.0504            | 5.14                     |
| Threonine  | Thr     | $\text{C}_4\text{H}_9\text{NO}_3$ | 119.0582             | 120.0660            | 4.43                     |
| Tryptophan | Trp     | $\text{C}_9\text{H}_11\text{N}_2\text{O}_2$ | 204.0899             | 205.0978            | 2.00                     |
| Tyrosine   | Tyr     | $\text{C}_9\text{H}_11\text{NO}_3$ | 181.0739             | 182.0815            | 3.65                     |
| Valine     | Val     | $\text{C}_5\text{H}_11\text{NO}_2$ | 117.0790             | 118.0868            | 2.85                     |
Table S3. Concentration (µg L⁻¹ with dilution 9:1, detailed in Figure S3), calibration curve and R² data for the 18 amino acids (AA) analyzed in the 13 clouds sampled at PUY. The calculation method (detailed in Figure S3) might mathematically provide negative values for the concentration. However, if the concentration (Conc) may turn out to be positive due to a higher STD (STD > |Conc|), the values are left as is (e.g., Asn -1 ± 4). Otherwise (STD < |Conc|), we assume to be below the limit of quantification (< LOQ). ND: Not Determined.

### 22 Mar

| AA   | Concentration (µg L⁻¹) | Eq. of calibration curve | R²   |
|------|------------------------|--------------------------|------|
| Ala  | 17 ± 4                 | y = 9.6E+4 x + 1.7E+6    | 0.9984 |
| Arg  | 8 ± 1                  | y = 3.7E+5 x + 3.0E+6    | 0.9999 |
| Asn  | -1 ± 4                 | y = 8.0E+4 x - 9.8E+4    | 0.9977 |
| Asp  | 12 ± 3                 | y = 5.2E+4 x + 6.1E+5    | 0.9989 |
| Gln  | -4 ± 4                 | y = 1.1E+5 x - 4.8E+5    | 0.9984 |
| Glu  | 32 ± 9                 | y = 1.7E+5 x + 5.4E+6    | 0.9916 |
| Gly  | 8 ± 2                  | y = 1.2E+5 x + 9.6E+5    | 0.9997 |
| His  | 12 ± 4                 | y = 3.4E+5 x + 4.1E+6    | 0.9985 |
| Leu/I| 26 ± 7                 | y = 3.3E+5 x + 8.4E+6    | 0.9943 |
| Lys  | 16 ± 7                 | y = 7.7E+4 x + 1.2E+6    | 0.9970 |
| Met  | 4 ± 3                  | y = 2.8E+5 x + 1.0E+6    | 0.9989 |
| Phe  | 0.9 ± 0.8              | y = 4.8E+5 x + 6.5E+5    | 0.9999 |
| Pro  | 8 ± 2                  | y = 4.6E+5 x + 3.6E+5    | 0.9933 |
| Ser  | 22 ± 9                 | y = 1.1E+5 x + 2.5E+6    | 0.9911 |
| Thr  | 11 ± 4                 | y = 8.6E+4 x + 9.8E+5    | 0.9983 |
| Trp  | 4 ± 3                  | y = 1.5E+5 x + 6.1E+5    | 0.9984 |
| Tyr  | 7 ± 3                  | y = 2.0E+5 x + 1.4E+6    | 0.9985 |

### 13 Jun

| AA   | Concentration (µg L⁻¹) | Eq. of calibration curve | R²   |
|------|------------------------|--------------------------|------|
| Ala  | 8 ± 5                  | y = 1.9E+4 x + 1.5E+5    | 0.9981 |
| Arg  | -2 ± 7                 | y = 4.1E+5 x - 1.0E+6    | 0.9954 |
| Asn  | 102 ± 4                | y = 4.5E+4 x + 4.6E+6    | 0.9995 |
| Asp  | 4 ± 5                  | y = 2.1E+4 x + 8.3E+4    | 0.9977 |
| Gln  | -1 ± 5                 | y = 9.9E+4 x - 1.3E+5    | 0.9975 |
| Glu  | 2 ± 5                  | y = 7.9E+4 x + 1.9E+5    | 0.9971 |
| Gly  | 10 ± 6                 | y = 4.5E+4 x + 4.3E+5    | 0.9949 |
| His  | -4 ± 6                 | y = 3.8E+5 x - 1.6E+6    | 0.9976 |
| Leu/I| 12 ± 4                 | y = 1.8E+5 x + 2.2E+6    | 0.9983 |
| Lys  | -5 ± 6                 | y = 5.6E+4 x - 2.8E+5    | 0.9965 |
| Met  | < LOQ                  | y = 1.7E+5 x - 1.1E+6    | 0.9977 |
| Phe  | -2 ± 4                 | y = 3.6E+5 x - 8.7E+5    | 0.9982 |
| Pro  | 10 ± 5                 | y = 3.3E+5 x + 3.2E+6    | 0.9980 |
| Ser  | 8 ± 5                  | y = 5.5E+4 x + 4.2E+5    | 0.9979 |
| Thr  | 2 ± 4                  | y = 4.6E+4 x + 1.2E+5    | 0.9983 |
| Trp  | -4 ± 5                 | y = 1.1E+5 x - 4.7E+5    | 0.9977 |
| Tyr  | -4 ± 5                 | y = 1.3E+5 x - 4.7E+5    | 0.9975 |

### 24 Aug

| AA   | Concentration (µg L⁻¹) | Eq. of calibration curve | R²   |
|------|------------------------|--------------------------|------|
| Ala  | 26 ± 2                 | y = 2.4E+4 x + 6.2E+5    | 0.9994 |
| Arg  | 5 ± 3                  | y = 2.8E+5 x + 1.5E+6    | 0.9992 |
| Asn  | 130 ± 17               | y = 5.8E+4 x + 7.6E+6    | 0.9899 |
| Asp  | 15 ± 4                 | y = 1.5E+4 x + 2.3E+5    | 0.9979 |
| Gln  | 15 ± 5                 | y = 5.9E+4 x + 8.7E+5    | 0.9964 |
| Glu  | 17 ± 11                | y = 5.6E+4 x + 9.6E+5    | 0.9894 |
| Gly  | 21 ± 4                 | y = 3.4E+4 x + 7.2E+5    | 0.9978 |
| His  | 6 ± 1                  | y = 2.3E+5 x + 1.3E+6    | 0.9999 |
| Lys  | 17 ± 3                 | y = 1.4E+5 x + 2.4E+6    | 0.9990 |
| Met  | -1 ± 4                 | y = 3.3E+4 x + 7.0E+4    | 0.9999 |
| Phe  | 11 ± 5                 | y = 2.2E+5 x + 2.5E+6    | 0.9968 |
| Pro  | 15 ± 3                 | y = 2.5E+5 x + 3.9E+6    | 0.9987 |
| Ser  | 33 ± 5                 | y = 4.0E+4 x + 1.3E+6    | 0.9975 |
| Thr  | 28 ± 4                 | y = 3.3E+4 x + 9.3E+5    | 0.9981 |
| Trp  | 3.7 ± 0.9              | y = 6.3E+4 x + 2.3E+5    | 0.9999 |
| Tyr  | 5 ± 4                  | y = 7.9E+4 x + 4.1E+5    | 0.9979 |
### 24 Sep

| AA  | Concentration (µg L\(^{-1}\)) | Eq. of calibration curve | R\(^2\) |
|-----|-------------------------------|--------------------------|--------|
| Ala | 10.7 ± 0.6                    | y = 2.8E+4 x + 3.0E+5     | 0.9987 |
| Arg | 4.3 ± 0.8                     | y = 2.2E+5 x + 9.5E+5     | 0.9985 |
| Asn | 11 ± 2                        | y = 4.2E+4 x + 4.7E+5     | 0.9994 |
| Asp | 4.4 ± 0.6                     | y = 1.9E+4 x + 8.3E+4     | 0.9988 |
| Gln | 1.0 ± 0.6                     | y = 6.7E+4 x + 6.5E+4     | 0.9989 |
| Glu | 6.8 ± 0.8                     | y = 6.4E+4 x + 4.4E+5     | 0.9977 |
| Gly | 14.2 ± 0.6                    | y = 3.8E+4 x + 5.4E+5     | 0.9989 |
| His | 5 ± 1                         | y = 2.6E+5 x + 1.4E+6     | 0.9964 |
| Leu/I | 7.1 ± 0.8                   | y = 1.6E+5 x + 1.1E+6     | 0.9978 |
| Lys | 3.4 ± 0.8                     | y = 3.4E+4 x + 1.2E+5     | 0.9981 |
| Met | 0.4 ± 0.7                     | y = 1.5E+5 x + 5.9E+4     | 0.9983 |
| Phe | 3 ± 1.1                       | y = 3.0E+5 x + 9.9E+5     | 0.9953 |
| Pro | 8.4 ± 1.0                     | y = 3.2E+5 x + 2.7E+6     | 0.9968 |
| Ser | 17.3 ± 0.8                    | y = 4.9E+4 x + 8.5E+5     | 0.9976 |
| Thr | 20.7 ± 1.0                    | y = 4.0E+4 x + 8.2E+5     | 0.9970 |
| Trp | 0.9 ± 0.6                     | y = 7.7E+4 x + 7.3E+4     | 0.9986 |
| Tyr | 2.2 ± 0.8                     | y = 1.1E+5 x + 2.4E+5     | 0.9975 |

### 8 Oct

| AA  | Concentration (µg L\(^{-1}\)) | Eq. of calibration curve | R\(^2\) |
|-----|-------------------------------|--------------------------|--------|
| Ala | 27 ± 2                        | y = 7.5E+4 x + 2.1E+6     | 0.9996 |
| Arg | -4 ± 6                        | y = 4.0E+5 x - 1.6E+6     | 0.9952 |
| Asn | 1.5 ± 1.0                     | y = 9.7E+4 x + 1.5E+5     | 0.9999 |
| Asp | 13.7 ± 0.3                    | y = 5.2E+4 x + 7.1E+5     | 1.0000 |
| Gln | 0 ± 2                         | y = 1.7E+5 x + 4.7E+4     | 0.9994 |
| Glu | 8 ± 3                         | y = 1.3E+5 x + 1.1E+6     | 0.9988 |
| Gly | 18.0 ± 0.6                    | y = 1.2E+5 x + 2.2E+6     | 1.0000 |
| His | 3 ± 2                         | y = 4.0E+5 x + 1.0E+6     | 0.9996 |
| Leu/I | 21.6 ± 0.7                   | y = 3.5E+5 x + 7.6E+6     | 0.9999 |
| Lys | -1 ± 3                        | y = 8.3E+4 x - 8.8E+4     | 0.9988 |
| Met | -0.7 ± 0.6                    | y = 2.9E+5 x - 2.2E+5     | 1.0000 |
| Phe | 5 ± 1                         | y = 4.6E+5 x + 2.3E+6     | 0.9998 |
| Pro | 14.2 ± 0.9                    | y = 3.9E+5 x + 5.6E+6     | 0.9999 |
| Ser | 36 ± 1                        | y = 1.3E+5 x + 4.6E+6     | 0.9999 |
| Thr | 15 ± 1                        | y = 8.9E+4 x + 1.4E+6     | 0.9998 |
| Trp | 0.6 ± 0.5                     | y = 1.7E+5 x + 9.5E+4     | 1.0000 |
| Tyr | 5 ± 3                         | y = 1.9E+5 x + 1.0E+6     | 0.9984 |

### 1 Oct

| AA  | Concentration (µg L\(^{-1}\)) | Eq. of calibration curve | R\(^2\) |
|-----|-------------------------------|--------------------------|--------|
| Ala | 69 ± 5                        | y = 3.0E+4 x + 2.1E+6     | 0.9978 |
| Arg | 1 ± 6                         | y = 4.1E+5 x + 2.5E+5     | 0.9952 |
| Asn | 31 ± 7                        | y = 4.2E+4 x + 1.3E+6     | 0.9960 |
| Asp | 45 ± 7                        | y = 2.1E+4 x + 9.4E+5     | 0.9950 |
| Gln | 3 ± 1                         | y = 7.9E+4 x + 2.6E+5     | 0.9998 |
| Glu | 22 ± 3                        | y = 7.4E+4 x + 1.6E+6     | 0.9988 |
| Gly | 42 ± 2                        | y = 4.3E+4 x + 1.8E+6     | 0.9993 |
| His | 22 ± 4                        | y = 3.5E+5 x + 6.7E+6     | 0.9980 |
| Leu/I | 41 ± 4                       | y = 1.6E+5 x + 6.3E+6     | 0.9983 |
| Lys | 9 ± 4                         | y = 4.9E+4 x + 4.5E+5     | 0.9981 |
| Met | -0 ± 1                        | y = 1.7E+5 x - 6.5E+4     | 0.9998 |
| Phe | 10 ± 3                        | y = 3.5E+5 x + 3.5E+6     | 0.9989 |
| Pro | 30 ± 3                        | y = 3.3E+5 x + 9.9E+6     | 0.9991 |
| Ser | 157 ± 8                       | y = 5.4E+4 x + 8.5E+6     | 0.9974 |
| Thr | 42 ± 2                        | y = 4.5E+4 x + 1.9E+6     | 0.9995 |
| Trp | 2 ± 1                         | y = 8.4E+4 x + 1.5E+5     | 0.9998 |
| Tyr | 21 ± 5                        | y = 1.1E+5 x + 2.2E+6     | 0.9972 |

### 5 Oct

| AA  | Concentration (µg L\(^{-1}\)) | Eq. of calibration curve | R\(^2\) |
|-----|-------------------------------|--------------------------|--------|
| Ala | ND                           |                          |        |
| Arg | 8 ± 4                         | y = 2.5E+4 x + 2.0E+5     | 0.9831 |
| Asn | 21 ± 3                        | y = 6.2E+3 x + 1.3E+5     | 0.9778 |
| Asp | ND                           |                          |        |
| Gln | 6 ± 2                         | y = 9.7E+3 x + 6.2E+4     | 0.9965 |
| Glu | 10 ± 1                        | y = 9.2E+3 x + 9.6E+4     | 0.9957 |
| Gly | 87 ± 8                        | y = 1.6E+3 x + 1.4E+5     | 0.9781 |
| His | ND                           |                          |        |
| Leu/I | ND                           |                          |        |
| Lys | 8 ± 1                         | y = 7.6E+3 x + 6.2E+4     | 0.9978 |
| Met | < LOQ                         | y = 4.1E+3 x - 2.8E+4     | 0.9566 |
| Phe | 18 ± 5                        | y = 2.3E+4 x + 4.2E+5     | 0.9783 |
| Pro | ND                           |                          |        |
| Ser | 150 ± 22                      | y = 4.1E+3 x + 6.3E+5     | 0.9384 |
| Thr | 25 ± 3                        | y = 6.0E+3 x + 1.5E+5     | 0.9918 |
| Trp | 5 ± 2                         | y = 3.7E+3 x + 1.8E+4     | 0.9488 |
| Tyr | ND                           |                          |        |
### 2 Oct

| AA | Concentration (µg L⁻¹) | Eq. of calibration curve | R² |
|----|------------------------|--------------------------|----|
| Ala | ND                     |                          |    |
| Arg | 3 ± 4 | y = 2.7E+5 x + 7.4E+5 | 0.9978 |
| Asn | 67.3 ± 0.9 | y = 1.5E+4 x + 1.6E+6 | 0.9999 |
| Asp | 65 ± 2 | y = 7.2E+3 x + 4.7E+5 | 0.9994 |
| Gln | 2.43 ± 2 | y = 2.4E+4 x + 5.9E+4 | 0.9994 |
| Glu | 22.0 ± 0.9 | y = 2.5E+4 x + 5.6E+5 | 0.9999 |
| Gly | 121 ± 3 | y = 4.6E+3 x + 5.5E+5 | 0.9994 |
| His | 25.9 ± 0.7 | y = 1.5E+5 x + 3.8E+6 | 0.9999 |
| Leu/I | 68 ± 1 | y = 5.3E+4 x + 3.6E+6 | 0.9998 |
| Lys | 19 ± 1 | y = 3.8E+4 x + 7.1E+5 | 0.9997 |
| Met | -0 ± 1 | y = 3.5E+4 x - 6.4E+3 | 0.9998 |
| Phe | 19.7 ± 0.3 | y = 1.2E+5 x + 2.3E+6 | 0.9999 |
| Pro | ND        |                          |    |
| Ser | 282 ± 6 | y = 1.5E+4 x + 4.3E+6 | 0.9985 |
| Thr | 49 ± 1 | y = 1.3E+4 x + 6.5E+5 | 0.9998 |
| Trp | 1.0 ± 0.2 | y = 4.1E+4 x + 4.1E+4 | 0.9999 |
| Tyr | 27 ± 3 | y = 3.3E+4 x + 8.9E+5 | 0.9984 |

### 22 Oct Am

| AA | Concentration (µg L⁻¹) | Eq. of calibration curve | R² |
|----|------------------------|--------------------------|----|
| Ala | ND                     |                          |    |
| Arg | -2 ± 4 | y = 2.6E+5 x - 4.7E+5 | 0.9973 |
| Asn | 2.3 ± 0.6 | y = 1.4E+4 x + 3.2E+4 | 0.9999 |
| Asp | 21.8 ± 1.0 | y = 6.4E+3 x + 1.4E+5 | 0.9998 |
| Gln | < LOQ | y = 2.1E+4 x - 4.0E+4 | 0.9992 |
| Glu | 9.7 ± 0.7 | y = 2.4E+4 x + 2.3E+5 | 0.9999 |
| Gly | 48 ± 2 | y = 4.0E+3 x + 1.9E+5 | 0.9994 |
| His | 8.7 ± 0.5 | y = 1.3E+5 x + 1.1E+6 | 0.9999 |
| Leu/I | 21.5 ± 0.5 | y = 6.9E+4 x + 1.5E+6 | 1.0000 |
| Lys | 6 ± 1 | y = 3.4E+4 x + 2.2E+5 | 0.9996 |
| Met | < LOQ | y = 3.6E+4 x - 7.2E+4 | 1.0000 |
| Phe | 6.19 ± 0.37 | y = 1.4E+5 x + 8.4E+5 | 0.9997 |
| Pro | ND        |                          |    |
| Ser | 78 ± 2 | y = 1.5E+4 x + 1.2E+6 | 0.9995 |
| Thr | 18.1 ± 0.7 | y = 1.2E+4 x + 2.2E+5 | 0.9999 |
| Trp | -0.2 ± 0.3 | y = 4.4E+3 x - 9.0E+3 | 1.0000 |
| Tyr | 7 ± 2 | y = 3.2E+4 x + 2.4E+5 | 0.9996 |

### 22 Oct Pm

| AA | Concentration (µg L⁻¹) | Eq. of calibration curve | R² |
|----|------------------------|--------------------------|----|
| Ala | ND                     |                          |    |
| Arg | 2.2 ± 0.6 | y = 1.8E+5 x + 4.0E+5 | 0.9992 |
| Asn | 1.0 ± 0.4 | y = 1.4E+4 x + 1.3E+4 | 1.0000 |
| Asp | 6 ± 1 | y = 6.6E+3 x + 4.2E+4 | 0.9998 |
| Gln | < LOQ | y = 2.1E+4 x - 4.6E+4 | 0.9994 |
| Glu | 2.8 ± 0.5 | y = 2.4E+4 x + 6.6E+4 | 1.0000 |
| Gly | 57 ± 5 | y = 3.5E+3 x + 2.0E+5 | 0.9966 |
| His | 3.4 ± 1.0 | y = 1.3E+5 x + 4.4E+5 | 0.9998 |
| Leu/I | 17 ± 3 | y = 6.9E+4 x + 1.2E+6 | 0.9983 |
| Lys | 1 ± 2 | y = 3.3E+4 x + 3.8E+4 | 0.9995 |
| Met | < LOQ | y = 4.0E+4 x - 5.2E+4 | 1.0000 |
| Phe | 4 ± 1 | y = 1.5E+5 x + 6.4E+5 | 0.9961 |
| Pro | ND        |                          |    |
| Ser | 42 ± 1 | y = 1.5E+4 x + 6.3E+5 | 0.9998 |
| Thr | 8.0 ± 0.5 | y = 1.2E+4 x + 9.5E+4 | 1.0000 |
| Trp | 4 ± 3 | y = 4.3E+4 x + 1.8E+5 | 0.9985 |
| Tyr | -1 ± 3 | y = 3.2E+4 x - 1.7E+4 | 0.9983 |

### 3 Mar

| AA | Concentration (µg L⁻¹) | Eq. of calibration curve | R² |
|----|------------------------|--------------------------|----|
| Ala | 54 ± 10 | y = 1.5E+3 x + 8.0E+4 | 0.9906 |
| Arg | 3 ± 3 | y = 1.4E+5 x + 3.9E+5 | 0.9894 |
| Asn | 2.3 ± 0.9 | y = 1.0E+4 x + 2.3E+4 | 0.9998 |
| Asp | < LOQ | y = 1.8E+3 x + 4.4E+3 | 0.9996 |
| Gln | -0.5 ± 0.6 | y = 1.8E+4 x - 9.1E+3 | 0.9995 |
| Glu | 1 ± 2 | y = 1.4E+4 x + 1.1E+4 | 0.9993 |
| Gly | 33 ± 3 | y = 4.1E+2 x + 1.4E+4 | 0.9986 |
| His | 2 ± 4 | y = 1.1E+5 x + 2.6E+5 | 0.9970 |
| Leu/I | 15.6 ± 0.7 | y = 4.4E+4 x + 6.8E+5 | 0.9999 |
| Lys | -1 ± 2 | y = 3.8E+4 x - 5.1E+4 | 0.9994 |
| Met | < LOQ | y = 2.3E+4 x - 2.3E+5 | 0.9995 |
| Phe | 9 ± 2 | y = 5.3E+4 x + 4.6E+5 | 0.9995 |
| Pro | ND        |                          |    |
| Ser | 0 ± 3 | y = 5.1E+3 x + 1.8E+3 | 0.9989 |
| Thr | 3 ± 3 | y = 6.9E+3 x + 2.4E+4 | 0.9983 |
| Trp | < LOQ | y = 3.5E+4 x - 1.8E+4 | 0.9996 |
| Tyr | 2 ± 2 | y = 1.7E+4 x + 3.6E+4 | 0.9990 |
| AA | Concentration (µg L⁻¹) | Eq. of calibration curve | R² |
|----|-------------------------|--------------------------|----|
| Ala | ND                      |                          |    |
| Arg | 2 ± 2                   | y = 1.8E+4 x + 2.9E+4    | 0.9971 |
| Asn | 4 ± 1                   | y = 2.6E+3 x + 1.1E+4    | 0.9991 |
| Asp | -1 ± 2                  | y = 8.6E+2 x - 8.4E+2    | 0.9983 |
| Gln | 6 ± 1                   | y = 4.8E+3 x + 2.8E+4    | 0.9988 |
| Glu | 8 ± 1                   | y = 4.5E+3 x + 3.8E+4    | 0.9987 |
| Gly | 72 ± 8                  | y = 3.8E+2 x + 2.7E+4    | 0.9829 |
| His | < LOQ                   | y = 1.5E+4 x - 3.8E+4    | 0.9979 |
| Leu/I | 19 ± 1                  | y = 5.6E+3 x + 1.1E+5    | 0.9985 |
| Lys | 2 ± 1                   | y = 4.4E+3 x + 6.7E+3    | 0.9985 |
| Met | < LOQ                   | y = 5.8E+3 x - 1.0E+4    | 0.9991 |
| Phe | 9.8 ± 0.9               | y = 1.3E+4 x + 1.2E+5    | 0.9994 |
| Pro | 9.4 ± 0.6               | y = 3.4E+4 x + 3.1E+5    | 0.9997 |
| Ser | 22 ± 3                  | y = 1.9E+3 x + 4.3E+4    | 0.9960 |
| Thr | 9 ± 1                   | y = 3.0E+3 x + 2.7E+4    | 0.9989 |
| Trp | < LOQ                   | y = 6.3E+3 x - 2.9E+4    | 0.9980 |
| Tyr | 8 ± 2                   | y = 4.2E+3 x + 3.5E+4    | 0.9981 |
Table S4. FAAs concentrations in atmospheric samples: Cloud, fog, rain and aerosol particles (non-exhaustive).

| Localization                          | Environment           | Period / Samples                  | Method Separation                  | Concentration range FAAs                  | Distribution (major FAAs)                      | Reference                          |
|---------------------------------------|------------------------|-----------------------------------|------------------------------------|-------------------------------------------|------------------------------------------------|--------------------------------------|
| Puy de Dôme Mountain, France (1465 m) | Rural + marine influence (Cloud) | 03/2014 - 05/2018 09, 10/2019 03, 07/2020 13 samples | HPLC-MS/MS Standard addition       | Range: 39 - 244 ng m⁻³                     | Ser > Gly > Ala > Asn > Leu/I                  | This work                           |
| Puy de Dôme Mountain, France (1465 m) | Rural + marine influence (Cloud) | 03-04/2014 (spring) 11/2014 (winter) 25 samples | HPLC-Fluorescence OPA-Derivatization | Mean: 118.6 ± 97.6 ng m⁻³                   | Trp > Ile/Leu > Phe > Ser                    | Bianco et al. (2016)                 |
| Cabo Verde islands (744 m)            | Marine (Cloud)         | 09-10/2017 (winter) 10 samples    | HPLC-MS OPA-Derivatization         | Range: 11.2 - 489.9 ng m⁻³                  | Ser > Asp > Ala > Gly > Thr                   | Triesch et al. (2021)               |
| Davis, CA, US (10 m)                  | Rural (Fog)            | 1997 - 1999 (winter) 11 samples   | HPLC-Fluorescence OPA-Derivatization | Mean: 40.8 ± 38.0 ng m⁻³ (FAAs, protein type) | Ser > Gly > Leu > Ala > Val                  | Zhang and Anastasio (2003)          |
| Atlantic Ocean, Golf Mexico (Cruise)  | Marine (Rain)          | 09-10/1985 02, 06, 09/1986 7 samples | HPLC-Fluorescence OPA-Derivatization | Mean: 604 ± 585 µg L⁻¹                    | Gly > Ser > Ala > acidic AAs                  | Mopper and Zika (1987)              |
| Seoul, South Korea (17 m)             | Urban (Rain)           | 03/2012 - 04/2014 36 samples     | HPLC-Fluorescence OPA-Derivatization | Mean: 21.0 ± 17.9 µg L⁻¹ (Seoul)           | Gly > Glu > Asp > Ser                         | Yan et al. (2015)                   |
| Uljin, South Korea (30 m)             | Marine (Rain)          | 02/2011 - 01/2012 31 samples     | HPLC-Fluorescence OPA-Derivatization | Mean: 100.9 ± 110.2 µg L⁻¹ (Uljin)         |                                               |                                     |
| Guiyang, China (1300 m)               | Suburban (Rain)        | 05/2017 - 04/2018 65 samples      | HPLC-Fluorescence OPA-Derivatization | Total: 1.1 - 10.1 µM Mean: 3.7 µM Range Summer: 1.3 - 6.6 µM Mean Summer: 2.9 µM Range Autumn: 1.1 - 8.8 µM Mean Autumn: 4.4 µM Range Winter: 3.4 µM Mean Winter: 5.2 µM | Glu + Gln, Gly, Pro > Asp, Ala      | Xu et al. (2019)                    |
| Location | Type (Aerosol) | Date | Size | Technique | Derivatization | Results | Amino Acid Order | Reference |
|----------|----------------|------|------|-----------|----------------|---------|------------------|-----------|
| Erdemli, Eastern Mediterranean coast, Turkey (21 m) | Marine | 03-05/2000 (spring) | 39 samples | HPLC-UV-Vis | DABS-Cl- Derivatization | Mean: 33.8 ng m$^{-3}$ Range: 3.65 - 102 ng m$^{-3}$ | Gly > Arg > Val > Pro | Mace et al. (2003a) |
| Cape Grim Baseline Air, Tasmania (94 m) | Marine | 11/2000 (winter) | 13 samples | HPLC-UV-Vis | DABS-Cl- Derivatization | Mean: 8.74 ng m$^{-3}$ Range: 1.83 - 20 ng m$^{-3}$ | Arg > Gly > Pro > Ala > Val | Mace et al. (2003b) |
| Davis, CA, US (10 m) | Rural | 08/1997 - 07/1998 | 41 PM$_{2.5}$ samples | HPLC-Fluorescence | OPA-Derivatization | Mean: 58.5 ng m$^{-3}$ Range: 8.62 - 236 ng m$^{-3}$ | Ornithine > Gly > Thr > Ser > Ala | Zhang and Anastasio (2003) |
| Western Pacific Ocean (Cruise) | Marine | 05-06/2000 (spring) | Fine p. d < 2.5 µm 15 samples | HPLC-Fluorescence | OPA-Derivatization | Mean: 0.98 ng m$^{-3}$ Range: 0.14 - 2.81 ng m$^{-3}$ | Gly > Ser > Asp > Ala | Matsumoto and Uematsu (2005) |
| Atlantic (Cruise) | Marine | 05-06/2003 (spring) | Total suspended particles | HPLC-Fluorescence | OPA-Derivatization | Mean: 1.83 ng m$^{-3}$ Range: 0.27 - 9.13 ng m$^{-3}$ | Gly > Ala > Ser > Leu | Wedyan and Preston (2008) |
| Finokalia, Crete Island, Greece (250 m) | Marine | 7/2007-8/2010 (summer/autumn) | 47 daily PM$_{1}$ samples | HPLC-UV/Vis | DABS-Cl-Derivatization | Mean: 45.6 ng m$^{-3}$ | Gly > Ser > Arg + Ala > Lys > His | Violaki and Mihalopoulos (2010) |
| Finokalia, Crete Island, Greece (250 m) | Marine | 06-08/2007 (summer) | 46 samples | GC-MS | MTBSTFA-Derivatization | Mean: 16.01 ng m$^{-3}$ Range: 0.7 - 76.9 ng m$^{-3}$ | Gly > Gln > Ala > Asp ~ Glu | Mandalakis et al. (2011) |
| CVAO (0 m) Mt Verde (744m) Island of São Vicente, Cape Verde | Marine | 09-10/2017 (autumn) | 8 samples | HPLC-MS/MS | CVAO: Range PM$_{1.2}$: 1.3 - 6.3 ng m$^{-3}$ Range PM$_{3.1}$: 0.2 - 1.4 ng m$^{-3}$ MV: Range PM$_{1.2}$: 0.8 - 1.9 ng m$^{-3}$ Range PM$_{3.1}$: 0.2 - 2.9 ng m$^{-3}$ | Gly > Ala > Ser CVAO & MV | Triesch et al. (2021) |
| Location                        | Region     | Site Type      | Collection Dates | Aerosol Type   | Sampling Device Details                                                                 | Analytical Method       | TAAs Range (ng m$^{-3}$) | Gly > Glu > Val         | Reference                     |
|--------------------------------|------------|----------------|-----------------|----------------|-----------------------------------------------------------------------------------------|-------------------------|-------------------------|----------------------------|----------------------------|
| Gosan, Jeju Island, South Korea | Rural      | Aerosol        | 03-04/2001 (spring) PM$_{2.5}$ 36 samples 4 composites (9 samples grouped together) | HPLC-Fluorescence OPA-Derivatization | Range TAAs: 77 - 255 ng m$^{-3}$ FAA ~ 19% TAA | Gld > Glu > Val | Yang et al. (2004) |
| Duke Forest Research Facility NC, USA | Rural | Aerosol        | 07-08/2010 (summer) PM$_{2.5}$ 13 samples | HPLC-MS | Range: 11 - 40 ng m$^{-3}$ | Gld > Arg > Ala > Asp > Glu | Samy et al. (2011) |
| SMEAR II station, Hyytiälä, Finland | Rural    | Aerosol        | 02-10/2014 Dekati PM$_{10}$ cascade impactor (<1.0, 1-2.5, 2.5-10 and >10 µm) 69 samples | HPLC-MS/MS | Mean: PM$_{1}$: 5.22 ng m$^{-3}$ PM$_{2.5}$: 10.95 ng m$^{-3}$ PM$_{10}$: 18.45 ng m$^{-3}$ PM$_{>10}$: 27.62 ng m$^{-3}$ | Gld > Arg > Pro > Gln | Helin et al. (2017) |
| Tianhu, Guangzhou, China | Rural      | Aerosol        | 03/2012 - 02/2013 PM$_{2.5}$ 52 samples | HPLC-Fluorescence OPA-Derivatization | Mean: Annual: 133 ± 48 ng m$^{-3}$ Spring: 107 ± 26 ng m$^{-3}$ Summer: 115 ± 35 ng m$^{-3}$ Autumn: 186 ± 56 ng m$^{-3}$ Winter: 123 ± 31 ng m$^{-3}$ | Gld > Val > Met > Phe | Song et al. (2017) |
| Col Margherita Atmospheric Observatory, Eastern Alps, Italy | Remote    | Aerosol        | 04, 08/2018 (spring/summer) PM$_{10}$ 7 samples | HPLC-MS/MS | Mean spring: 6 ± 5 ng m$^{-3}$ Mean summer 7 ± 2 ng m$^{-3}$ | Spring: Gld > Glu > Arg Summer: Gld > Ala | Barbaro et al. (2020) |
| SMEAR II station, Hyytiälä, Finland | Rural    | Aerosol        | 09-11/2017 Cascade impactor (PM$_{1}$ to PM$_{10}$) 84 samples | HPLC-MS/MS | Range PM$_{1}$: 2.1 - 5.4 ng m$^{-3}$ Range PM$_{2.5}$: 1.8 - 5.7 ng m$^{-3}$ Range PM$_{10}$: 11.4 - 36.9 ng m$^{-3}$ Range PM$_{>10}$: 7.1 - 46.6 ng m$^{-3}$ | PM$_{1}$: Gld > Ala > Glu PM$_{2.5}$: Gln > Arg > Glu PM$_{10}$: Leu > Arg > Gln PM$_{>10}$: Leu > Asp > Arg | Ruiz-Jimenez et al. (2021) |
| Location                        | Type          | Sampling Period    | Instrumentation                  | Mean/Range (unit)          | FAAs                   | Reference                  |
|--------------------------------|---------------|--------------------|-----------------------------------|---------------------------|------------------------|---------------------------|
| Nanjing University, China      | Urban (Aerosol) | 02/2001 (winter) - 09/2001 (autumn) | PM$_{2.5}$ 10 samples | Mean: 129 ng m$^{-3}$ (winter)  | Gly > Cys > Val        | Yang et al. (2005)        |
| Purple Mountain Observatory, Nanjing, China | Suburban (Aerosol) | 02/2001 (winter) | PM$_{2.5}$ 12 samples | Range: 81.9 - 188 ng m$^{-3}$  |                        |                           |
|                                |               | 02/2001 (winter)   | PM$_{2.5}$ 14 samples | Mean: 84.9 ng m$^{-3}$ (autumn) |                        |                           |
|                                |               |                    |                                  | Range: 39.3 - 162 ng m$^{-3}$ |                        |                           |
|                                |               | 02/2001 (winter)   | PM$_{2.5}$ 12 samples | Mean: 189 ng m$^{-3}$ (winter) |                        |                           |
|                                |               |                    |                                  | Range: 58.5 - 396 ng m$^{-3}$ |                        |                           |
| Sacco San Biagio Island, Venice, Italy | Urban (Aerosol) | 04-10/2007 Total suspended particles 10 samples | HPLC-MS/MS | Mean: 38 ng m$^{-3}$ | Gly > Gln > Pro > Ala Asn > Glu > Asp > Ser | Barbaro et al. (2011) |
| Research Triangle Park NC, US | Suburban (Aerosol) | 09-10/2010 PM$_{2.5}$ | HPLC-MS/MS | Mean: 11 ± 6 ng m$^{-3}$ | Gly > Ala = Asp = Arg > Glu > Ser | Samy et al. (2013) |
| University of Rome, Italy      | Urban (Aerosol) | 01/2013 (winter) - 09/2013 (summer) PM$_{0.1}$, PM$_{1}$, PM$_{2.5}$, PM$_{10}$ | HPLC-MS/MS | Mean: PM$_{10}$:195 ng m$^{-3}$ (winter) 272 ng m$^{-3}$ (summer) PM$_{2.5}$: 167 ng m$^{-3}$ (winter) 193 ng m$^{-3}$ (summer) PM$_{1}$: 129 ng m$^{-3}$ (winter) 145 ng m$^{-3}$ (summer) PM$_{0.1}$: 48 ng m$^{-3}$ (winter) 94 ng m$^{-3}$ (summer) | Gly > Ser > His > Asp | Di Filippo et al. (2014) |
| Institute of Atmospheric, Physics, Beijing, China | Urban (Aerosol) | 04-05/2013 (spring) Total suspended particles 29 samples | HPLC-Fluorescence OPA-Derivatization | Range TAA: Whole year: 72 - 3820 ng m$^{-3}$ Spring: 374 - 3195 ng m$^{-3}$ Summer: 154 - 2262 ng m$^{-3}$ Fall: 161 - 2067 ng m$^{-3}$ Winter: 340 - 2405 ng m$^{-3}$ FAA = 25% TAA | Gly > Ala > Val | Ren et al. (2018) |
| Nanchang, China                | Urban Town Suburban Airport Forested site (Aerosol) | 04-05/2019 PM$_{2.5}$ | GC-MS tBDMS-Derivatization | Range total FAAs: 57 - 1238 pmol m$^{-3}$ Mean: Airport: 321 ± 200 pmol m$^{-3}$ Town: 350 ± 267 pmol m$^{-3}$ Urban: 307 ± 131 pmol m$^{-3}$ Suburban: 264 ± 113 pmol m$^{-3}$ Forest: 226 ± 132 pmol m$^{-3}$ | Gly > Ala = Pro | Zhu et al. (2021) |
| Location                                      | Sampling Period                  | Methodology               | Mean PM$_{10}$: | Range (ng m$^{-3}$) | Amino Acid | Reference                                      |
|-----------------------------------------------|----------------------------------|----------------------------|------------------|---------------------|------------|-----------------------------------------------|
| Gruvenbadet observatory, Svalbard, Arctic     | 04/09/2010 (boreal summer)       | HPLC-MS/MS                 | 102.42           | 15.66 - 308.65      | Gly > Ser > Ala | Scalabrin et al. (2012)                        |
| Faraglione Camp, MZS, Antarctica              | 11/2010-01/2011 (summer)         | HPLC-MS/MS                 | 1.51             | 0.11 - 10.8         | Arg > Gly   | Barbaro et al. (2015)                         |
| Dome C station, Antarctic (3233 m)            | 11/2011-01/2012 (summer)         | HPLC-MS/MS                 | 0.11             | 0.02 - 1417         | Gly > Asp > Ala |                                               |
| Rose Sea (Cruise)                             | 11-12/2011 TSP                   | HPLC-MS/MS                 |                   | 0.48 ng m$^{-3}$   | Gly > Pro = Glu |                                               |
| Gruvebadet observatory, Svalbard, Arctic     | 04/06/2015 Cascade impactor      | HPLC-MS/MS                 | 6.1 ± 3.4 pmol m$^{-3}$ | 2.0 - 10.8 pmol m$^{-3}$ | Gly > Ala > Asp | Feltracco et al. (2019)                       |
| Zeppelin observatory Svalbard, Arctic        | 09-12/2015 (winter)              | HPLC (MS/MS)               | Range TAA:       |                     | Leu > Ala > Val | Mashayekhy Rad et al. (2019)                  |

Lists of acronyms

- **AQC**: Molecular composition of the water-soluble fraction of atmospheric carbonaceous
- **C$_4$-NA-NHS**: N-butylic nicotinic acid Nhydroxysuccinimide ester
- **DABS-Cl**: 4-dimethylaminoazobenzene-40-sulfonyl chloride
- **MTBSTFA**: N-(t-butyldimethylsilyl)-N-methyltrifluoroacetamide
- **OPA**: ortho-phthalaldehyde
- **tBDMS**: Gly-tert-butyl dimethylsilyl
- **TSP**: Total suspended particles
- **GC**: Gas chromatography
- **HPLC**: High performance liquid chromatography
- **IRMS**: Isotope Ratio Mass Spectrometry
**Estimated lifetimes of AAs: Description of the calculations performed in Table 4.**

1- Calculations of the lifetimes considering theoretical HO\(^-\), O\(_3\) and \(^3\)O\(_2\) concentrations (column (A) in Table 4)

Aqueous concentrations of HO\(^-\), O\(_3\) and \(^3\)O\(_2\) are respectively equal to 10\(^{-14}\), 5.0 \(10^{-10}\) and 1.0 \(10^{-12}\) M. The concentration of HO\(^-\) derives from the study of Arakaki et al. (2013); the concentration of O\(_3\) is calculated considering a 50 ppb concentration of gaseous O\(_3\) and its Henry’s law constant (H(O\(_3\)) = 10\(^3\) M atm\(^{-1}\)). \(^3\)O\(_2\) concentration is estimated to be 2 orders of magnitude more concentrated than HO\(^-\). All the kinetic constants derive from the Jaber et al. (2021) study (considering T and pH-dependency when necessary and available). The lifetimes for individual AA are calculated as following:

\[
\tau = \frac{1}{k_{HO} \times [HO^-] + k_{O_3} \times [O_3] + k_{1O_2} \cdot [^3O_2^+]} 
\]

2- Calculations of the lifetimes using irradiation experiments in artificial cloud medium (column (D) in Table 4)

Experimental irradiation of 19 amino acids at a concentration of 1 \(\mu\)M each in an artificial cloud medium were conducted in Jaber et al. (2021). HO\(^-\) production was performed using Fe-Ethlenediamine-N,N'-disuccinic acid (EDDS) complex solution. HO\(^-\) concentration of 8.3 \(10^{-13}\) M was estimated during the experiment. Abiotic transformation rates (\(R_{\text{photo,exp}}\)) are evaluated during the experiment in mol L\(^{-1}\) h\(^{-1}\) (see Table 2 in Jaber et al., 2021). For Arg, Asn, Asp, Gln, Gly, Lys and Pro, lifetimes cannot be calculated since a production is observed during the experiment.

The lifetimes for individual AA are calculated as follows:

\[
\tau = \frac{[AA]}{R_{\text{photo,exp}} \cdot [HO^-]_{\text{cloud}}} \quad [\text{mol L}^{-1} \text{ h}^{-1}] 
\]

\([AA]\) represents the initial AA concentration in the experiment, i.e., 1 \(\mu\)M.

Since the experiments were conducted with HO\(^-\) concentrations likely higher than ambient ones in cloud water, we correct these abiotic rates to HO\(^-\) concentrations in clouds by \([HO^-]_{\text{cloud}} = 8.3 \times 10^{-13}\) M and \([HO^-]_{\text{photo,exp}} = 10^{-14}\) M. This correction has been considered as in Jaber et al. (2021) to fit the abiotic rates to an HO\(^-\) concentration of 10\(^{-14}\)M.

3- Calculations of the lifetimes using biodegradation experiments in artificial cloud medium (column (F) in Table 4)

Biodegradation experiments of 19 amino acids were performed by Jaber et al. (2021) using 4 microbial strains (Rhodococcus enclensis PDD-23b-28, Pseudomonas graminis PDD-13b-3, Pseudomonas syringae PDD-32b-74 and Sphingomonas sp. PDD-32b-11) in artificial cloud water. Biodegradation rates are evaluated experimentally in mol cell\(^{-1}\) h\(^{-1}\) (see Table 1 in Jaber et al., 2021). These values are multiplied by 6.8 \(10^7\) cells L\(^{-1}\) which corresponds to the average concentration of microorganisms in cloud water reported at PUY (Vaïtilingom et al., 2012). This leads to the values \(R_{23b-28}, R_{13b-3}, R_{32b-74}, R_{32b-11}\) in mol L\(^{-1}\) h\(^{-1}\). Rhodococcus enclensis PDD-23b-28, Pseudomonas graminis PDD-13b-3, Pseudomonas syringae PDD-32b-74 and Sphingomonas sp. PDD-32b-11 contributes respectively to 6.3 \%, 14.9 \%, 14.9 \% and 16.2 \% of the total cell concentration. The remaining 47.7 \% belongs to other phyla or classes. We scale up each contribution by a factor 1.91 (=100/52.3), implying that the four bacteria types are representative for the remainder (47.7 \%) of the bacteria population.

Therefore, we calculate the atmospheric lifetimes for individual AA as following:

\[
\tau = \frac{[AA]}{0.063 R_{23b-28} \cdot 1.91 - 0.149 R_{13b-3} \cdot 1.91 - 0.149 R_{32b-74} \cdot 1.91 - 0.162 R_{32b-11} \cdot 1.91} 
\]

\([AA]\) represents the initial AA concentration in the experiment, i.e., 1 \(\mu\)M.
Figure S1. Chromatograms and MS spectra of: (a) Ser, (b) Trp and (c) Val (+ Betaine) measured by UPLC-HRMS (11 Mar Cloud).
Figure S2. a. MS/MS of the compounds at m/z 118.0866 $[\text{M+H}]^+$ detected on 11 Mar cloud, and the characteristic product ions: b. Predicted structures and values of Betaine fragments m/z = 58.0651 and 59.0730 $[\text{M+H}]^+$; c. Predicted structures and values of Valine fragments m/z = 55.0548 and 72.0813 $[\text{M+H}]^+$. Predicted values and structures are issued from MetLIN Mass Spectral Database.
Figure S3. Quantification of amino acid concentrations (11 Mar cloud sample) using the addition standard method: case study of glycine (Gly).

Quantification and uncertainty (Figure S3)

In standard addition, known quantities of analyte (AA) are added to the unknown quantity in the sample. From the increase in signal, we deduce how much analyte was originally in the sample. This method requires a linear response to analyte (Broekaert, 2015).

The magnitude of the intercept on the x-axis is the original concentration of Gly. The equation of the trendline is \( y = a \times x + b \). The \( x_{\text{intercept}} \) is obtained by setting \( y = 0 \): \( x = -\frac{b}{a} \), with \( a = \) slope of the curve, \( b = y_{\text{intercept}} \), \( x = \) the concentration of the AA, \( y = \) the mass spectral area:

Gly: \( a = 410.49; \ b = 13607 \quad \rightarrow \quad |x_{\text{intercept}}| = [\text{Gly}] = 33.1 \ \mu g \ \text{L}^{-1} \) (negative value)

The obtained values are then corrected by the dilution factor of 10% (due to the ratio 9:1 volume cloud: volume added standard). Final value is: \([\text{Gly}]= 33.1 \times \frac{10}{9} = 36.8 \ \mu g \ \text{L}^{-1} \).

The uncertainty in the \( x_{\text{intercept}} \) is \( s_x \):

\[
s_x = \frac{s_y}{|a|} \sqrt{\frac{1}{n} + \frac{\bar{y}^2}{a^2 \times \sum(x_i - \bar{x})^2}}
\]

where \( a \) is the absolute value of the slope of the trendline, \( n \) is the number of data points, \( \bar{y} \) is the mean value of \( y \) for the points, \( x_i \) are the individual values of \( x \), \( \bar{x} \) is the mean value of \( x \) for the points, and \( s_y \) is the standard deviation for \( y \):

\[
s_y = \sqrt{\frac{1}{(n-2)} \times \left[ \sum(y - \bar{y})^2 - \frac{[\sum(x - \bar{x})(y - \bar{y})]^2}{\sum(x - \bar{x})^2} \right]}
\]
Figure S4. Individual CAT model back trajectories of each of the 13 cloud events reaching PUY. Colors correspond to the air mass height minus the atmospheric boundary layer height (ABLH). Positive values (> ABLH, red) indicate the air mass is in the free troposphere. Negative values (< ABLH, blue) indicate the air mass is in the boundary layer.
Figure S5. Correlation between total concentration of 18 AAs (TCAA) and the percentage of time spent above: in blue, the Sea surface (< ABLH); and in orange, the Sea plus the Continental surfaces (< ABLH).
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