

Supplement of Atmos. Chem. Phys., 21, 163–181, 2021
<https://doi.org/10.5194/acp-21-163-2021-supplement>
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Supplement of

Concerted measurements of free amino acids at the Cabo Verde islands: high enrichments in submicron sea spray aerosol particles and cloud droplets

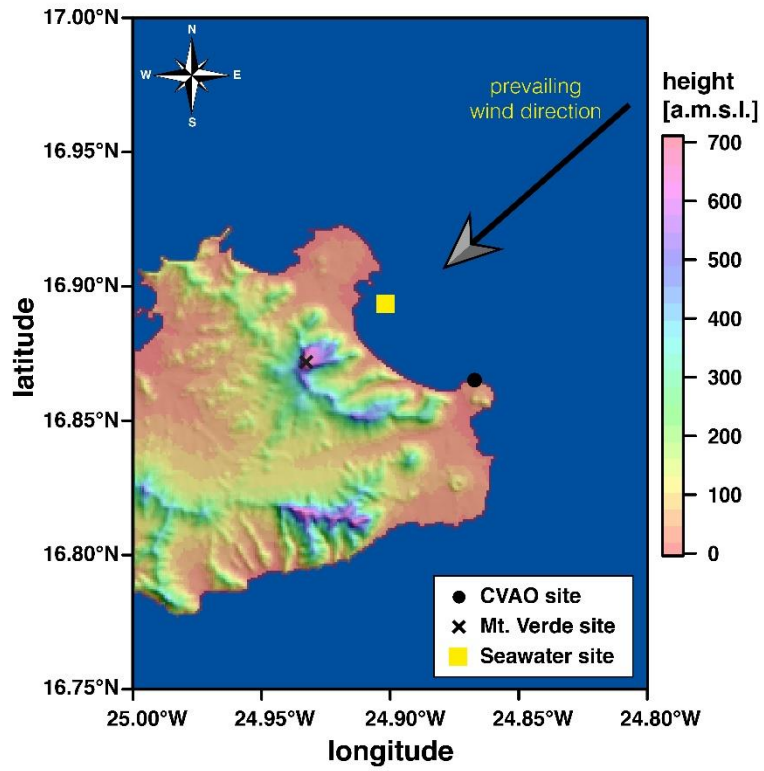
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15 **Figure S1: Overview of the sampling stations during the campaign: Mt. Verde site (MV), Cape Verde Atmospheric Observatory (CVAO) and seawater sampling site**

Table S1: Limit of quantification (LOQ) of the individual FAA in the matrices of the marine environment - on aerosol particles as atmospheric concentration in pg m^{-3} , as seawater concentration in nmol L^{-1} and as cloud water concentration in $\mu\text{g L}^{-1}$ and ng m^{-3}

| analyte | atmospheric concentration ^(a) | seawater concentration ^(b) | cloud water concentration ^(c) | |
|---------|--|---------------------------------------|--|--------------------|
| | pg m^{-3} | nmol L^{-1} | $\mu\text{g L}^{-1}$ | ng m^{-3} |
| Ser | 7.9 | 4.8 | 0.2 | 0.06 |
| Gly | 7.9 | 6.7 | 0.2 | 0.06 |
| Glu | 7.9 | 3.4 | 0.2 | 0.06 |
| Thr | 7.9 | 4.2 | 1.0 | 0.30 |
| Ala | 39.5 | 5.6 | 0.2 | 0.06 |
| GABA | 39.5 | 24.2 | 1.0 | 0.30 |
| Pro | 7.9 | 4.3 | 0.2 | 0.06 |
| Asp | 39.5 | 3.8 | 0.2 | 0.06 |
| Tyr | 7.9 | 2.8 | 1.0 | 0.30 |
| Met | 39.5 | 16.8 | 1.0 | 0.30 |
| Val | 7.9 | 4.3 | 1.0 | 0.30 |
| Phe | 7.9 | 3.0 | 1.0 | 0.30 |
| Gln | 39.5 | 3.4 | 1.0 | 0.30 |
| Ile | 39.5 | 3.8 | 1.0 | 0.30 |
| Leu | 39.5 | 3.8 | 1.0 | 0.30 |

For the LOQ, the concentration of the lowest but still quantifiable calibration stage of the external calibration was used and then extrapolated specifically for the various marine matrices:

- 5 ^(a) The following factors were taken into account for the calculation of the atmospheric concentration of individual FAAs: the enrichment factor caused by the reducing of the extract volume, the proportion of the investigated filter material (92 % of the filter material of each stage for the aqueous extract) and a median of the sampled air flow (110 m^3).
- ^(b) For the calculation of the seawater concentration, the enrichment factor caused by the reducing of the desalinated sample volume was considered.
- 10 ^(c) For the calculation of the cloud water concentration in $\mu\text{g L}^{-1}$, the enrichment factor caused by the reducing of the cloud water volume was regarded. Also, an averaged liquid water content (LWC) of 0.297 was taken into account to additionally calculate the cloud water concentration in ng m^{-3} .

Table S2: The wind speed, wind direction and chl-*a* concentration in the seawater samples as well as the FAA and sodium concentration and PM in the size-segregated aerosol particle samples (distinguished between submicron and supermicron size range) at the CVAO

| sampling date | wind speed* | wind direction* | chl- <i>a</i> concentration** | ∑FAA concentration | PM | sodium concentration |
|------------------------|-------------------|-----------------|-------------------------------|--------------------|--------------------|----------------------|
| | m s ⁻¹ | ° | µg L ⁻¹ | ng m ⁻³ | ng m ⁻³ | ng m ⁻³ |
| 20/09/2017 submicron | 2.64 | 147.4 | 0.2 | 1.53 | 3698.9 | 312.5 |
| 20/09/2017 supermicron | 2.64 | 147.4 | 0.2 | 0.84 | 61315.5 | 3903.2 |
| 22/09/2017 submicron | 8.23 | 30.9 | - | 3.01 | 2440.8 | 228.8 |
| 22/09/2017 supermicron | 8.23 | 30.9 | - | 1.36 | 23862.6 | 3444.8 |
| 28/09/2017 submicron | 4.87 | 41.2 | 0.2 | 2.45 | 5470.3 | 89.3 |
| 28/09/2017 supermicron | 4.87 | 41.2 | 0.2 | 0.56 | 38038.4 | 1471.1 |
| 1/10/2017 submicron | 8.58 | 37.9 | - | 1.28 | 5399.8 | 224.0 |
| 1/10/2017 supermicron | 8.58 | 37.9 | - | 0.47 | 32841.1 | 3408.6 |
| 4/10/2017 submicron | 5.88 | 38.8 | - | 5.02 | 4828.4 | 186.3 |
| 4/10/2017 supermicron | 5.88 | 38.8 | - | 0.39 | 25541.7 | 2378.8 |
| 6/10/2017 submicron | 5.18 | 37.4 | - | 2.89 | 4369.1 | 133.5 |
| 6/10/2017 supermicron | 5.18 | 37.4 | - | 0.21 | 19938.4 | 2251.6 |
| 7/10/2017 submicron | 7.06 | 17.4 | 0.3 | 6.32 | 6261.9 | 138.6 |
| 7/10/2017 supermicron | 7.06 | 17.4 | 0.3 | 0.50 | 36533.8 | 2661.5 |
| 10/10/2017 submicron | 7.60 | 37.6 | 0.6 | 3.11 | 2102.7 | 32.9 |
| 10/10/2017 supermicron | 7.60 | 37.6 | 0.6 | 0.66 | 17401.3 | 2002.4 |

* The mean value of the measured wind speed/wind direction during the 24 h sampling time of the aerosol particles was considered

5 ** Not on every matching sampling day the chl-*a* concentration in seawater was investigated. It was generally low but increased during the campaign from 0.1 µg L⁻¹ to 0.6 µg L⁻¹ and is discussed in more detail by van Pinxteren et al., (2020).

Table S3: Concentration of the individual FAA in the ULW and the SML samples in nmol L⁻¹ and the calculated enrichment factor (EF_{SML}) (grey background) of the individual sampling days during the campaign

| | | Gly | Ala | Ser | Glu | Thr | Pro | Tyr | Val | Phe | Asp | Ile | Leu |
|------------|-------------------|--------|--------|--------|-------|-------|-------|------|-------|------|-------|-------|-------|
| 20/09/2017 | ULW | 3.3* | n.d. | n.d. | n.d. | n.d. | 2.2 | n.d. | 1.8 | n.d. | 83.5 | n.d. | n.d. |
| | SML | 35.7 | n.d. | n.d. | n.d. | n.d. | 12.8 | n.d. | 11.9 | n.d. | 167.1 | n.d. | n.d. |
| | EF _{SML} | 10.8* | - | - | - | - | 5.9 | - | 6.5 | - | 2.0 | - | - |
| 22/09/2017 | ULW | 3.3* | 2.8* | n.d. | n.d. | n.d. | 2.2* | n.d. | 2.1* | n.d. | 67.0 | n.d. | 1.9* |
| | SML | 137.2 | 58.4 | n.d. | n.d. | n.d. | 32.7 | n.d. | 22.2 | n.d. | 222.6 | n.d. | 21.7 |
| | EF _{SML} | 41.6* | 20.9* | - | - | - | 14.9* | - | 10.6* | - | 3 | - | 11.4* |
| 27/09/2017 | ULW | 3.3* | 2.8* | 2.4* | 1.7* | 2.1* | 2.2* | 1.4* | 2.1* | 1.5* | 1.9* | 1.9* | 1.9* |
| | SML | 323.4 | 371.2 | 371.2 | 34.4 | 100.3 | 32.9 | 2.9 | 72.4 | 2.1 | 184.7 | 18.8 | 30.1 |
| | EF _{SML} | 98.0* | 132.6* | 154.7* | 20.2* | 47.8* | 15.0* | 2.1* | 34.5* | 1.4* | 97.2* | 9.9* | 15.8* |
| 28/09/2017 | ULW | n.d. | 2.8* | 2.4* | n.d. | 2.1* | 2.2* | n.d. | 2.1* | n.d. | 1.9* | n.d. | 1.9* |
| | SML | n.d. | 52.5 | 33.8 | n.d. | 12.4 | 3.4 | n.d. | 6.9 | n.d. | 14.1 | n.d. | 3.3 |
| | EF _{SML} | - | 18.7* | 14.1* | - | 5.9* | 1.5* | - | 3.3* | - | 7.4* | - | 1.8* |
| 2/10/2017 | ULW | 3.3* | 2.8* | 2.4* | 1.7* | 2.1* | 2.2* | 1.4* | 2.1* | n.d. | 1.9* | 1.9* | 1.9* |
| | SML | 410.9 | 260.2 | 742.2 | 11.8 | 111.7 | 21.1 | 3.9 | 39.7 | n.d. | 69.5 | 11.9 | 19.3 |
| | EF _{SML} | 124.5* | 92.9* | 309.2* | 6.9* | 53.2* | 9.6* | 2.8* | 18.9* | - | 36.6* | 6.3* | 10.1* |
| 3/10/2017 | ULW | 3.3* | 13.6 | 2.4* | 1.7* | 2.1* | 2.2* | n.d. | 2.0 | n.d. | 1.9* | 10.4 | 1.9* |
| | SML | 123.5 | 117.0 | 187.8 | 3.1 | 24.4 | 40.0 | n.d. | 32.8 | n.d. | 22.4 | 15.5 | 31.7 |
| | EF _{SML} | 37.4* | 9 | 78.2* | 1.8* | 11.6* | 18.2* | - | 16.2 | - | 11.8* | 1.5 | 16.7* |
| 4/10/2017 | ULW | 350.4 | 169.0 | 273.1 | 1.7* | 29.8 | 72.3 | 1.4* | 90.4 | 1.5* | 24.1 | 1.9* | 74.1 |
| | SML | 231.0 | 245.5 | 274.0 | 9.7 | 61.9 | 53.5 | 3.1 | 88.6 | 3.7 | 63.0 | 35.1 | 53.3 |
| | EF _{SML} | 0.7 | 1.5 | 1.0 | 5.7* | 2.1 | 0.7 | 2.2* | 1.0 | 2.5* | 2.6 | 18.5* | 0.7 |
| 5/10/2017 | ULW | 16.4 | 112.4 | 54.0 | n.d. | 1.1 | 13.4 | n.d. | 15.6 | n.d. | 2.7 | 3.1 | 11.4 |
| 6/10/2017 | ULW | 3.3* | 2.8* | 2.4* | 1.7* | 2.1* | 1.4 | 1.4* | 2.6 | 1.5* | 1.9* | 1.9* | 2.2 |
| | SML | 461.0 | 412.5 | 736.4 | 17.5 | 118.4 | 91.8 | 4.8 | 101.2 | 2.7 | 163.3 | 44.1 | 71.3 |

| | | | | | | | | | | | | | |
|------------|-------------------|--------|--------|--------|-------|--------|-------|-------|-------|-------|--------|-------|-------|
| | EF _{SML} | 139.7* | 147.3* | 306.8* | 10.3* | 56.4* | 64.2 | 3.4* | 38.7 | 1.8* | 86.0* | 23.2* | 32.7 |
| 7/10/2017 | ULW | 120.6 | 192.5 | 298.5 | 16.7 | 31.2 | 32.7 | 1.4* | 37.6 | 1.5* | 82.3 | 10.7 | 15.7 |
| | SML | 359.7 | 400.6 | 716.0 | 59.9 | 119.5 | 80.6 | 20.5 | 85.3 | 15.8 | 191.4 | 41.4 | 61.8 |
| | EF _{SML} | 3.0 | 2.1 | 2.4 | 3.6 | 3.8 | 2.5 | 14.6* | 2.3 | 10.5* | 2.3 | 3.9 | 3.9 |
| 9/10/2017 | ULW | 3.3* | 2.8* | 2.4* | 1.7* | 2.1* | 2.2* | 1.4* | 2.1* | 1.5* | 1.9* | 1.9* | 1.9* |
| | SML | 697.9 | 635.0 | 1237.4 | 66.5 | 224.0 | 125.8 | 26.1 | 150.6 | 25.4 | 285.5 | 70.7 | 99.1 |
| | EF _{SML} | 211.5* | 226.8* | 515.6* | 39.1* | 106.7* | 57.2* | 18.7* | 71.7* | 16.9* | 150.3* | 37.2* | 52.1* |
| 10/10/2017 | ULW | 153.3 | 166.0 | 207.5 | 1.7* | 19.6 | 38.9 | n.d. | 29.2 | n.d. | 28.8 | 3.3 | 19.5 |
| | SML | 537.9 | 361.3 | 504.5 | 12.3 | 72.2 | 62.4 | n.d. | 58.5 | n.d. | 47.2 | 12.7 | 20.5 |
| | EF _{SML} | 3.5 | 2.2 | 2.4 | 7.2* | 3.7 | 1.6 | - | 2.0 | - | 1.6 | 3.9 | 1.0 |

n.d. – not detected: if the individual FAA was not detected in the SML, the concentration in the ULW was not calculated (LOQ/2) to determine the EF_{SML}.

* For this samples, the individual FAA was quantified in the SML; however, below the LOQ in the ULW samples no quantification was possible. Therefore, the concentration of the analyte in the ULW was assumed to be LOQ/2, (LOQ is listed in Table S1).

5 Enrichment of FAA in SML

Looking at the individual amino acids (Table S3), Ser with a concentration range of 54-299 nmol L⁻¹ (ULW) and 34-1237 nmol L⁻¹ (SML) had usually the highest contribution to \sum FAA. Also Ala (ULW: 14-193 nmol L⁻¹, SML: 52-635 nmol L⁻¹), Gly (ULW: 16-350 nmol L⁻¹, SML: 36-698 nmol L⁻¹) and Asp (ULW: 3-83 nmol L⁻¹, SML: 14-286 nmol L⁻¹) were included in higher concentrations as part of \sum FAA. This observed high contribution of Ser, Ala, Gly and Asp to \sum FAA in the ULW and especially in the SML is in accordance with the results of Kuznetsova et al. (2004) and Reinthaler et al. (2008). To compare the concentration of \sum FAA in the SML with the ULW samples, the enrichment factor in SML (EF_{SML}) was calculated using Eq. (1) and is shown in Fig. 1 (stars). Regarding the EF_{SML} of \sum FAA, an enrichment of \sum FAA in SML between 1.1 and 298.4 could be observed (averaged EF_{SML} of \sum FAA: 57.2). Although there is a wide variance in the EF_{SML} for \sum FAA, our results are in good agreement with the literature. In the subtropical Atlantic, the EF_{SML} of dissolved FAA which is between 7.6 and 229.4 (59.3±68.8) and between 6.2 and 26.1 (16.5±9.1) in western Mediterranean Sea were reported by Reinthaler et al. (2008). The EF_{SML} depends on the measured concentration of \sum FAA in the SML and the ULW, and here daily variations could be observed during the campaign. Especially the higher EF_{SML} on e.g. 6/10/2017 with 298.4 resulted from higher concentrations of \sum FAA in the SML (2224.9 nmol L⁻¹) and a very low concentration in the ULW (6.23 nmol L⁻¹).

Table S4: Concentration of FAAs in a SML sample from 21/11/2013, 2pm (local time), coordinates: 16°84'68'N, 24°85'25''W

| analyte* | nmol L ⁻¹ |
|----------|----------------------|
| Asp | 57.8 |
| Glu | 18.9 |
| Ser | 212.4 |
| Gly | 168.2 |
| Arg | 39.3 |
| Thr | 7.2 |
| Ala | 60.8 |
| GABA | 6.3 |
| Tyr | 13.7 |
| Val | 20.3 |
| Ile | 14.4 |
| Phe | 9.5 |
| Leu | 13.6 |
| ∑FAA | 642.4 |

* analytes were measured with a high performance liquid chromatograph (1260 HPLC system, Agilent Technologies) using a C₁₈ column (Phenomex Kinetex) after in line ortho-phthalaldehyde derivatization with mercaptoethanol after Lindroth and Mopper (1979) and Dittmar (2009).

Table S5: DOC and TDN concentrations in the SML and the ULW samples and their enrichment in the SML (EF_{SML}) calculated using Eq. (1) and the percentage contribution of Σ FAA to DOC and TDN in seawater samples; NA – not available

| sampling date | sample type | DOC in $\mu\text{g L}^{-1}$ | EF_{SML} DOC | TDN in $\mu\text{g L}^{-1}$ | EF_{SML} TDN | Percentage of Σ FAA to DOC (**) | Percentage of Σ FAA to TDN (***) |
|---------------|-------------|-----------------------------|----------------|-----------------------------|----------------|--|---|
| 20/09/2017 | SML | 2779.0 | 2.5 | 380.3 | 0.8 | 0.4 | 0.8 |
| | ULW | 1095.3 | | 478.2 | | 0.4 | 0.3 |
| 22/09/2017 | SML | 1674.6 | 0.7 | 280.2 | 1.2 | 1.3 | 5.2 |
| | ULW | 2368.5 | | 236.7 | | 0.1 | 0.2 |
| 27/09/2017 | SML | 2020.6 | 1.9 | 193.6 | 1.0 | 3.4 | 13.0 |
| | ULW | 1073.7 | | 189.6 | | NA | NA |
| 28/09/2017 | SML | 2271.0 | 1.7 | 248.3 | 1.1 | 0.2 | 0.7 |
| | ULW | 1372.5 | | 228.5 | | NA | NA |
| 2/10/2017(*) | SML | 2017.8 | 1.5 | 270.4 | 1.3 | 3.1 | 8.8 |
| | ULW | 1340.5 | | 206.5 | | NA | NA |
| 3/10/2017 | SML | 2196.6 | 1.6 | 267.9 | 1.5 | 1.1 | 3.1 |
| | ULW | 1366.9 | | 174.4 | | NA | 0.1 |
| 4/10/2017 | SML | 2050.2 | 1.9 | 196.7 | 1.0 | 2.3 | 8.0 |
| | ULW | 1085.3 | | 196.4 | | 4.0 | 7.8 |
| 5/10/2017 | ULW | 1143.3 | | 112.4 | | 0.8 | 2.9 |
| 6/10/2017 | SML | 3327.0 | 2.6 | 496.7 | 1.9 | 2.6 | 6.3 |
| | ULW | 1291.3 | | 255.7 | | NA | 0.03 |
| 7/10/2017 | SML | 1606.6 | 1.7 | 124.7 | 0.9 | 5.5 | 24.2 |
| | ULW | 946.9 | | 140.1 | | 3.5 | 8.4 |
| 9/10/2017 | SML | 1941.0 | | 120.3 | | 7.6 | 42.4 |
| 10/10/2017 | SML | 1821.0 | 1.4 | 128.0 | 0.8 | 3.3 | 18.5 |
| | ULW | 1291.3 | | 156.1 | | 2.0 | 6.0 |

(*) For the interpretation of the concerted measurements, the seawater samples, sampled during the 24 h sampling interval of size-segregated aerosol particle samples, were considered. Consequently, the date of the sampling stop of the aerosol particle samples matched with the sampling date of seawater samples, except for the seawater sampling on 2/10/2017 which was considered for the size-segregated aerosol particle sample, collected from 30/09/2017 - 1/10/2017, as no seawater sampling was performed on 1/10/2017.

(**) For the calculation of the percentage contribution of Σ FAA to DOC, the carbon content of the individual amino acids, listed in Table S6, was considered.

(**) For the calculation of the percentage contribution of Σ FAA to TDN, the nitrogen content of the individual amino acids, listed in Table S6, was regarded.

For the analysis, sodium corresponding seawater samples (ULW and SML) with $n = 5$ were investigated. In the SML, the sodium concentration was $12.53 \pm 0.53 \text{ g L}^{-1}$ whereas it was $12.45 \pm 0.37 \text{ g L}^{-1}$ in the ULW. Because of small relative standard deviations (4.2 % for SML and 2.9 % for ULW), the mean value of the sodium concentration in SML (12.53 g L^{-1}) and ULW samples (12.45 g L^{-1}) was used for the calculation of EF_{aer} and EF_{cw} .

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Table S6: Overview of the molar mass, the molecular formula and the carbon and nitrogen content of the individual FAA

| analyte | molar mass in g mol^{-1} | molecular formula | carbon content* of the analyte in % | nitrogen content* of the analyte in % |
|---------|--------------------------------------|----------------------|--|--|
| Ser | 105.09 | C3H7NO3 | 34.28 | 13.33 |
| Gly | 75.07 | C2H5NO2 | 32.00 | 18.66 |
| Glu | 147.13 | C5H9NO4 | 40.81 | 9.52 |
| Thr | 119.12 | C4H9NO3 | 40.33 | 11.76 |
| Ala | 89.09 | C3H7NO2 | 40.44 | 15.73 |
| GABA | 103.12 | C4H9NO2 | 46.59 | 13.59 |
| Pro | 115.13 | C5H9NO2 | 52.16 | 12.17 |
| Tyr | 181.19 | C9H11NO3 | 59.66 | 7.73 |
| Met | 149.21 | C5H11NO2S | 40.25 | 9.39 |
| Val | 117.15 | C5H11NO2S | 51.26 | 11.96 |
| Phe | 165.19 | C9H11NO2 | 65.43 | 8.48 |
| Gln | 146.15 | C5H10N2O3 | 41.09 | 19.17 |
| Asp | 133.10 | C4H7NO4 | 36.09 | 10.53 |
| Ile | 131.17 | C6H13NO2 | 54.94 | 10.68 |
| Leu | 131.17 | C6H13NO2 | 54.94 | 10.68 |

*The carbon and nitrogen content of individual FAAs was taken into account for the calculation of the $\text{FAA} / \sum \text{FAA}$ contribution to WSOC, to TDN and to the WSON concentration in the size-segregated aerosol particle samples as well as for the calculation of the $\text{FAA} / \sum \text{FAA}$ contribution to the DOC and TDN concentration in the seawater samples.

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Table S7: Percentage contribution of the amino acid groups to Σ FAA on the submicron and the supermicron aerosol particles and as an average during the campaign; hydrophilic (Glu, Asp, GABA), neutral (Ser, Gly, Thr, Pro, Tyr) and hydrophobic amino acids (Ala, Val, Phe, Ile, Leu)

| sampling date | amino acid groups in % | | |
|------------------------|------------------------|---------|-------------|
| | hydrophilic | neutral | hydrophobic |
| 20/09/2017 submicron | 0 | 97 | 3 |
| 20/09/2017 supermicron | 0 | 89 | 11 |
| 22/09/2017 submicron | 4 | 89 | 7 |
| 22/09/2017 supermicron | 0 | 88 | 12 |
| 28/09/2017 submicron | 0 | 93 | 7 |
| 28/09/2017 supermicron | 0 | 99 | 1 |
| 1/10/2017 submicron | 0 | 100 | 0 |
| 1/10/2017 supermicron | 0 | 96 | 4 |
| 4/10/2017 submicron | 12 | 74 | 14 |
| 4/10/2017 supermicron | 0 | 100 | 0 |
| 6/10/2017 submicron | 48 | 52 | 0 |
| 6/10/2017 supermicron | 0 | 100 | 0 |
| 7/10/2017 submicron | 55 | 42 | 3 |
| 7/10/2017 supermicron | 0 | 84 | 16 |
| 10/10/2017 submicron | 0 | 95 | 5 |
| 10/10/2017 supermicron | 0 | 90 | 10 |
| averaged submicron | 15 | 80 | 5 |
| averaged supermicron | 0 | 93 | 7 |

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Table S8: Atmospheric concentration of inorganic ions such as sulfate (SO₄²⁻), MSA, the MSA/sulfate ratio and sodium (Na⁺) as well as mineral dust tracer such as iron (Fe) and titanium (Ti) and the fractional 'residence time over water and ice' calculated from 96 h backward trajectories for the supermicron and submicron aerosol particle samples at the CVAO

| sampling date | ∑FAA | MSA | sulfate | MSA/sulfate ratio | sodium | Residence time over water & ice | Ti | Fe |
|---------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|---------------------------------|-------------------|-------------------|
| | ng/m ³ | ng/m ³ | μg/m ³ | | ng/m ³ | | ng/m ³ | ng/m ³ |
| 20/09/2017 submicron | 1.5 | 12.4 | 0.6 | 0.019 | 339 | 0.84 | 0.3 | 21.2 |
| 20/09/2017 supermicron | 0.8 | 18.7 | 1.9 | 0.010 | 3903 | 0.84 | 16.3 | 259.3 |
| 22/09/2017 submicron | 3.0 | 15.8 | 0.8 | 0.018 | 229 | 0.90 | 0.6 | 7.6 |
| 22/09/2017 supermicron | 1.4 | 10.5 | 1.1 | 0.021 | 3445 | 0.90 | 19.0 | 182.8 |
| 28/09/2017 submicron | 2.4 | 7.9 | 0.8 | 0.013 | 89 | 0.85 | 0.2 | 19.9 |
| 28/09/2017 supermicron | 0.6 | 5.2 | 0.8 | 0.006 | 1471 | 0.85 | 12.6 | 404.5 |
| 1/10/2017 submicron | 1.3 | 10.1 | 0.9 | 0.011 | 224 | 0.67 | 1.0 | 19.1 |
| 1/10/2017 supermicron | 0.5 | 4.5 | 1.1 | 0.004 | 3409 | 0.67 | 16.8 | 203.2 |
| 4/10/2017 submicron | 5.0 | 18.4 | 1.3 | 0.016 | 186 | 0.96 | 0.1 | 7.0 |
| 4/10/2017 supermicron | 0.4 | 4.9 | 0.8 | 0.006 | 2379 | 0.96 | 9.3 | 110.2 |
| 6/10/2017 submicron | 2.9 | 20.8 | 1.2 | 0.017 | 133 | 0.97 | 0.7 | 12.1 |
| 6/10/2017 supermicron | 0.2 | 4.6 | 0.8 | 0.006 | 2252 | 0.97 | 17.8 | 160.6 |
| 7/10/2017 submicron | 6.3 | 14.9 | 0.9 | 0.021 | 139 | 0.96 | 3.8 | 40.4 |

| | | | | | | | | |
|---------------------------|-----|------|-----|-------|------|------|------|-------|
| 7/10/2017 supermicron | 0.5 | 3.8 | 0.9 | 0.004 | 2661 | 0.96 | 48.5 | 451.6 |
| 10/10/2017 submicron | 3.1 | 14.4 | 0.8 | 0.016 | 33 | 0.91 | 16.3 | 143.1 |
| 10/10/2017 supermicron | 0.7 | 2.5 | 0.6 | 0.004 | 2002 | 0.91 | 11.8 | 109.4 |
| averaged submicron | 3.2 | 14.3 | 0.9 | 0.02 | 172 | - | 2.9 | 33.8 |
| averaged supermicron | 0.6 | 6.9 | 1.0 | 0.01 | 2690 | - | 19.0 | 235.2 |

Aerosol particles: dust and marine tracers

To investigate dust and marine impacts on especially the submicron particles we regarded several indicators specifically for the sub- and supermicron particles, such as the MSA concentration, the MSA/sulfate ratio, the fractional residence time of the air masses over water and ice and the size-resolved concentrations of the mineral dust tracers iron (Fe) and titanium (Ti), listed in Table S8. Looking at the 96 h backward trajectories of the investigated air masses, it is obvious that all sampling days showed a very long (≥ 0.84) or a long (0.67) fractional residence time over water and ice. The sulfate concentration was $0.9 \pm 0.2 \mu\text{g m}^{-3}$ in the submicron size range and $1.0 \pm 0.4 \mu\text{g m}^{-3}$ in the supermicron size range. The measured sulfate concentrations in our study were in good agreement with the values of previous studies at the CVAO (Mueller et al., 2010; van Pinxteren et al., 2015). MSA, originating from the multiphase oxidation of dimethylsulfide (DMS) (Hoffmann et al., 2016), is a tracer for marine aerosol particles to estimate the magnitude of biogenic contributions to local aerosol population (Miyazaki et al., 2011; van Pinxteren et al., 2015). The MSA concentration in the submicron size range varied between 7.9-20.8 ng m^{-3} and between 2.5-18.7 ng m^{-3} in the supermicron size range. These values are again in good agreement with previous studies at the CVAO (Mueller et al., 2010). In our study, the molar ratio of MSA to sulfate was on average 0.02 ± 0.003 in the submicron and 0.01 ± 0.006 in the supermicron aerosol particles. The MSA/sulfate ratio in the submicron size range was within the MSA/sulfate ratios (0.02-0.04), reported for clean marine air over the Pacific Ocean (Nagao et al., 1999; Miyazaki et al., 2011) and consistent with the averaged MSA/sulfate ratio of PM_1 samples (0.022) (van Pinxteren et al., 2015). In order to estimate potential dust influences during the campaign, mineral dust tracer as iron (Fe) and titanium (Ti) were considered. Considering the time-resolved trend of Fe and Ti values in the size-segregated aerosol particle samples, it could be noticed that the lowest concentration of Fe (7.0 ng m^{-3} , submicron size range) was detected on 4/10/2017 ($\text{Fe}_{(\text{PM}_{10})}$: 117.2 ng m^{-3}). The Ti concentration on that day was 0.1 ng m^{-3} in the submicron aerosol particles and 9.4 ng m^{-3} for PM_{10} . When it comes to typical marine background concentrations of trace metals at the CVAO for PM_{10} aerosol particles with $< 25 \text{ ng m}^{-3}$ for Fe and $< 6 \text{ ng m}^{-3}$ for Ti (Fomba et al., 2013), especially the submicron aerosol particles on e.g. 4/10/2017 showed very low or no mineral dust influences. Moreover, it has to be noted that dust generally influences the supermicron particles to a larger extent than the

submicron particles (Fomba et al., 2013). The MSA concentrations and the MSA/sulfate ratio were generally higher for the submicron particles showing a higher potential influence of marine sources to the submicron particles. The concentrations of the dust tracers in the submicron particles were low and significantly lower than in the supermicron particles except for the ones of the last sampling day (10/10/2017). This indicated that the submicron particles were mainly of marine origin during most of the time of the campaign but exhibited a dust impact to some extent on the last sampling day.

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Table S9: Physico-chemical properties of the individual FAA including log K_{ow}, TPSA and density

| FAA | log K _{ow} [*] | TPSA in Å ² ** | density in g cm ⁻³ *** |
|-----|----------------------------------|---------------------------|-----------------------------------|
| Ser | -3.46 | 83.55 | 1.582 |
| Gly | -3.41 | 63.32 | 1.598 |
| Glu | -3.83 | 100.62 | 1.566 |
| Thr | -3.04 | 83.55 | 1.499 |
| Ala | -2.99 | 63.32 | 1.371 |
| Pro | -2.15 | 49.33 | 1.376 |
| Tyr | -1.76 | 83.55 | 1.403 |
| Val | -2.08 | 63.32 | 1.267 |
| Phe | -1.28 | 63.32 | 1.315 |
| Asp | -4.32 | 100.62 | 1.636 |
| Ile | -1.59 | 63.32 | 1.201 |
| Leu | -1.59 | 63.32 | 1.167 |

* log K_{ow} was calculated by KOWWIN by US EPA. [2011]. Estimation Programs Interface Suite™ for Microsoft® Windows, v 3.20. United States Environmental Protection Agency, Washington, DC, USA.

** TPSA was calculated using <https://www.molinspiration.com/cgi-bin/properties>

*** The values for the density are taken from Berlin and Pallansch, 1967

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Table S10: Atmospheric concentration of water-soluble organic carbon (WSOC), total dissolved nitrogen (TDN) and water-soluble organic nitrogen (WSON) on the submicron and the supermicron aerosol particles at the CVAO and the percentage contribution of Σ FAA to WSOC, TDN and WSON during the campaign and as an average; NA – not available data

| | atmospheric concentration in ng m ⁻³ | | | percentage contribution (in %) of Σ FAA to | | |
|------------------------|---|------------------|-------------------|---|------------------|-------------------|
| | WSOC | TDN ^a | WSON ^b | WSOC ^d | TDN ^e | WSON ^f |
| 20/09/2017 submicron | 93.4 | 58.9 | 14.7 | 0.04 | 0.03 | 0.11 |
| 20/09/2017 supermicron | 175.4 | 367.4 | 91.8 | 0.03 | 0.01 | 0.03 |
| 22/09/2017 submicron | 75.6 | 89.3 | 22.3 | 0.26 | 0.08 | 0.32 |
| 22/09/2017 supermicron | 96.0 | 201.7 | 50.4 | 0.15 | 0.03 | 0.11 |
| 28/09/2017 submicron | 26.5 | 109.0 | 27.2 | 0.52 | 0.05 | 0.19 |
| 28/09/2017 supermicron | 100.3 | 284.1 | 71.0 | NA | NA | NA |
| 1/10/2017 submicron | 48.1 | 124.2 | 31.1 | 0.04 | 0.01 | 0.02 |
| 1/10/2017 supermicron | 115.3 | 236.1 | 59.0 | 0.03 | 0.01 | 0.02 |
| 4/10/2017 submicron | 73.4 | 235.2 | 58.8 | 1.22 | 0.12 | 0.49 |
| 4/10/2017 supermicron | 103.0 | 327.9 | 82.0 | NA | NA | NA |
| 6/10/2017 submicron | 50.3 | 174.8 | 43.7 | 1.27 | 0.11 | 0.42 |
| 6/10/2017 supermicron | 105.4 | 268.5 | 67.1 | NA | NA | NA |
| 7/10/2017 submicron | 31.9 | 111.0 | 27.8 | 5.30 | 0.45 | 1.79 |
| 7/10/2017 supermicron | 95.4 | 219.8 | 55.0 | 0.05 | 0.01 | 0.04 |
| 10/10/2017 submicron | 83.7 | 199.6 | 49.9 | 0.12 | 0.02 | 0.08 |
| 10/10/2017 supermicron | 90.9 | 199.0 | 49.7 | 0.04 | 0.01 | 0.03 |
| averaged submicron | 60.4 ^c | 137.7 | 34.4 | 1.14 | 0.11 | 0.43 |
| averaged supermicron | 110.2 | 263.1 | 65.8 | 0.04 | 0.01 | 0.05 |

5 ^a TDN includes the parameter dissolved inorganic ammonium, nitrite, nitrate and dissolved organic nitrogen-containing compounds and these results are in good agreement with (Mueller et al., 2009)

^b calculation of the WSON content focusing on the measured TDN concentration in each Berner stage under the assumption that 25 % of marine total nitrogen consist of WSON as described in Lesworth et al. (2010); (25 % of TDN = WSON)

10 ^c the averaged WSOC concentration with $0.06 \pm 0.02 \mu\text{g m}^{-3}$ in the submicron size range at the CVAO was in the same order of magnitude as the WSOC concentration of the PM₁ samples ($0.11 \pm 0.03 \mu\text{g m}^{-3}$) collected at the same time at the CVAO

^d consideration of the carbon content of the individual amino acids (listed in Table S6) to calculate the percentage contribution of Σ FAA to WSOC

^e consideration of the nitrogen content of the individual amino acids (listed in Table S6) to calculate the percentage contribution of Σ FAA to TDN and WSON

Table S11: Atmospheric concentration (ng m⁻³) of particulate matter (PM), WSOC, sodium (Na⁺), MSA and Σ FAA in the size-segregated aerosol particle samples at the CVAO and the MV station on sampling days (4/10/2017, 6/10/2017, 7/10/2017) and as an average of these three days; NA – not available data

| | atmospheric concentration in ng m ⁻³ | | | | | | | |
|---------------------------|---|--------|---------------|------|-----------------|-------|---------------|-----|
| | PM | | WSOC | | Na ⁺ | | MSA | |
| | CVAO | MV | CVAO | MV | CVAO | MV | CVAO | MV |
| 04/10/2017 submicron | 4828.4 | 1817.3 | 73.4 | 31.8 | 186.3 | 58.2 | 18.4 | 6.5 |
| 04/10/2017 supermicron | 25541.7 | 5115.9 | 103.0 | 5.5 | 2378.8 | 260.4 | 4.9 | 3.7 |
| 06/10/2017 submicron | 4369.1 | 1243.6 | 50.3 | 3.4 | 133.5 | 21.0 | 20.8 | 3.6 |
| 06/10/2017 supermicron | 19938.4 | 6354.3 | 105.4 | 8.5 | 2251.6 | 146.8 | 4.6 | 3.1 |
| 07/10/2017 submicron | 6261.9 | 1432.5 | 31.9 | 6.8 | 138.6 | 73.8 | 14.9 | 5.8 |
| 07/10/2017 supermicron | 36533.8 | 7348.0 | 95.4 | 14.6 | 2661.5 | 184.2 | 3.8 | 2.8 |
| averaged submicron | 5153.1 | 1497.8 | 51.9 | 14.0 | 152.8 | 51.0 | 18.0 | 5.3 |
| averaged supermicron | 27338.0 | 6272.7 | 101.3 | 9.5 | 2430.6 | 197.1 | 4.4 | 3.2 |
| | ratio CVAO/MV | | ratio CVAO/MV | | ratio CVAO/MV | | ratio CVAO/MV | |
| averaged submicron | 3.44 | | 3.71 | | 2.99 | | 3.40 | |
| averaged supermicron | 4.36 | | 10.63 | | 12.33 | | 1.40 | |

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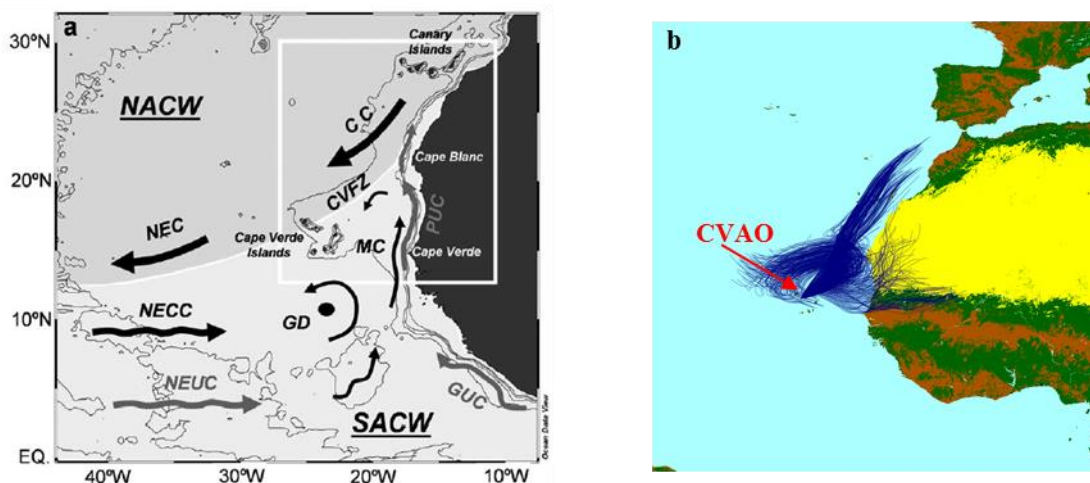
Table S12: Cloud water samples at the MV station: sampling time, measured liquid water content and the atmospheric concentration of sodium, sulfate, MSA and Σ FAA

| sampling start | sampling stop | liquid water content | atmospheric concentration of | | | |
|------------------|-----------------|----------------------|------------------------------|----------------------|--------------------|--------------------|
| | | | sodium | sulfate | MSA | Σ FAA |
| local time | local time | g m^{-3} | $\mu\text{g m}^{-3}$ | $\mu\text{g m}^{-3}$ | ng m^{-3} | ng m^{-3} |
| 27/09/2017 19:00 | 28/09/2017 7:30 | 0.424 | 1.6 | 1.8 | 11.0 | 34.3 |
| 28/09/2017 19:00 | 29/09/2017 7:30 | 0.459 | 6.4 | 3.6 | 20.7 | 45.2 |
| 5/10/2017 7:45 | 5/10/2017 10:35 | 0.249 | 5.3 | 3.6 | 33.8 | 30.7 |
| 5/10/2017 10:40 | 5/10/2017 17:38 | 0.117 | 5.4 | 2.8 | 29.2 | 37.7 |
| 5/10/2017 17:40 | 5/10/2017 20:10 | 0.373 | 5.8 | 3.2 | 39.0 | 351.6 |
| 5/10/2017 20:10 | 5/10/2017 23:30 | 0.325 | 5.1 | 3.3 | 35.3 | 63.8 |
| 5/10/2017 23:30 | 6/10/2017 4:00 | 0.205 | 4.1 | 2.4 | 22.1 | 11.2 |
| 6/10/2017 4:05 | 6/10/2017 8:00 | 0.254 | 3.9 | 2.1 | 21.1 | 443.8 |
| 7/10/2017 7:48 | 7/10/2017 11:48 | 0.198 | 5.7 | 2.6 | 25.1 | 409.4 |
| 7/10/2017 19:00 | 8/10/2017 7:00 | 0.366 | 7.2 | 3.6 | 23.9 | 489.8 |

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5 **Figure S2: Overview of (a) the water current at the Cape Verde islands (study of Peña-Izquierdo et al., 2012) and (b) the 96 h backward trajectory of an aerosol sample with ‘predominant marine’ air masses of 5/10/2017 at the CVAO**

The comparability of the different marine matrices

Spot measurements in the ocean (ULW, SML) were taken during the sampling time (24 h) of size-segregated aerosol particle samples. As a basis for a possible comparison, the origins of the aerosol particles and of the seawater samples had to be investigated in more detail. Due to the identified origin of the air masses using 96 h backward trajectories, the concentrations of inorganic ions and mineral dust tracers on the aerosol particles were considered to be mainly of marine origin (section 3.2.1 and SI page 11/12: “Aerosol particles: dust and marine tracers”). An overview of backward trajectories during the entire campaign period can be found in the study by van Pinxteren et al., (2020). Regarding the seawater, it was shown that despite of a strong variability of Σ FAA in seawater samples, the measured Σ FAA concentrations in the ULW and especially in the SML samples are representative for the investigated marine region, the tropical Atlantic Ocean (section 3.1). van Pinxteren et al. (2017) demonstrated that at the CVAO the air masses followed the water current (as described in Peña-Izquierdo et al. (2012)) enhancing the organic carbon link between the SML and the aerosol particles. As mainly winds drive the ocean currents in the upper 100 m of the ocean, a likely connection between DOCs on the aerosol particles and in the SML was concluded in van Pinxteren et al. (2017). Regarding the backward trajectories of ‘predominant marine’ aerosol particles together with the water current of Peña-Izquierdo et al. (2012) (Fig. S1), it could be concluded that there is a probable connection between FAAs as part of OM on the aerosol particles and in the SML.

Table S13: Mean lifetimes (τ) of investigated amino acids depending on the pH-value and different atmospheric scenarios of the ‘remote cloud case’ (for the MV samples) and the ‘remote aerosol case’ (for the CVAO samples) adopted from the study of Herrmann et al., 2010

| analyte | pH value | remote cloud case* | | remote aerosol case** | |
|---------|----------|--------------------|-------------|-----------------------|-------------|
| | | τ in d | τ in h | τ in d | τ in h |
| Ser | 6 | 1.64 | 39.36 | 0.01 | 0.24 |
| Gly | ~ 5.9 | 3.09 | 74.16 | 0.02 | 0.48 |
| Glu | 2 | 3.29 | 78.96 | 0.02 | 0.48 |
| Thr | 6.6 | 1.03 | 24.72 | 0.01 | 0.24 |
| Ala | ~ 5.8 | 6.83 | 163.92 | 0.05 | 1.20 |
| GABA | 6.7 | 1.2 | 28.80 | 0.01 | 0.24 |
| Pro | 6.9 | 1.7 | 40.80 | 0.01 | 0.24 |
| Tyr | 7 | 0.04 | 0.96 | 0.0003 | 0.007 |
| Met | 5.6 | 0.06 | 1.44 | 0.0005 | 0.012 |
| Val | 6.6 | 0.8 | 19.2 | 0.01 | 0.24 |
| Phe | 5.8 | 0.08 | 1.92 | 0.0006 | 0.014 |
| Gln | 6 | 0.97 | 23.28 | 0.0071 | 0.17 |
| Ile | 6.6 | 0.29 | 6.96 | 0.0021 | 0.05 |
| Leu | 6 | 0.31 | 7.44 | 0.0023 | 0.05 |

* the ‘remote cloud case’ is valid for the size-segregated aerosol particle and cloud water samples, sampled at the MV station; OH radical concentrations of $2.2 \cdot 10^{-14}$ mol L⁻¹ (Herrmann et al., 2010) were considered

** the ‘remote aerosol case’ is valid for the size-segregated aerosol particle samples, sampled at the CVAO; OH radical concentrations of $3 \cdot 10^{-12}$ mol L⁻¹ (Herrmann et al., 2010) were considered

The mean life time τ of the individual amino acids depends on the pH-dependent rate constant k (<https://kinetics.nist.gov/solution/>) and the OH radical concentration $[OH]$ of the different atmospheric scenarios:

$$\tau = \frac{1}{k \cdot [OH]} \quad \text{Eq. (3)}$$

The calculation of the mean lifetime is based on the assumption that the OH radical concentrations react preferentially with the present amino acids. Within the marine environment, the presence of many different compounds implies that the OH concentrations react not only with the amino acids but also with other compounds. Therefore, the mean lifetime given here is to be considered as a rough estimation method, which rather represents the lower limit of the lifetime of the individual amino acids.

Table S14: Aerosol enrichment factor (EF_{aer}) of WSOC at the CVAO for the case study (4/10/2017, 6/10/2017, 7/10/2017) and as an average (grey background); NA – not available data

| sampling stop | EF_{aer} of WSOC | | | | |
|------------------|---------------------------|--------|--------|--------|--------|
| | B1 | B2 | B3 | B4 | B5 |
| 4/10/2017 | 1.E+04 | 2.E+04 | 2.E+03 | 5.E+02 | 5.E+02 |
| 6/10/2017 | NA | 1.E+04 | 8.E+02 | 2.E+02 | 2.E+02 |
| 7/10/2017 | NA | 1.E+04 | 3.E+03 | 6.E+02 | 4.E+02 |
| averaged | 1E+04 | 1E+04 | 2E+03 | 4E+02 | 3E+02 |

The parameter EF_{aer} regards the transfer from the ocean onto the aerosol particles considering the enrichment processes of OM and compounds linked to OM (e.g. FAA) during bubble bursting. Chemical reaction processes during the transfer are not taken into account.

References

- 10 Berlin, E., and Pallansch, M. J.: Densities of several proteins and L-amino acids in the dry state, *The Journal of Physical Chemistry*, 72, 1887-1889, 10.1021/j100852a004, 1968.
- Dittmar, T., Cherrier, J. and Ludichowski, K. U.: The analysis of amino acids in seawater, in: *Practical guidelines for the analysis of seawater*, edited by: Wurl, O., CRC Press, Boca Raton, 67-78, 2009.
- 15 Engel, A., and Galgani, L.: The organic sea-surface microlayer in the upwelling region off the coast of Peru and potential implications for air-sea exchange processes, *Biogeosciences*, 13, 989-1007, 10.5194/bg-13-989-2016, 2016.
- Fomba, K. W., Müller, K., van Pinxteren, D., and Herrmann, H.: Aerosol size-resolved trace metal composition in remote northern tropical Atlantic marine environment: case study Cape Verde islands, *Atmos. Chem. Phys.*, 13, 4801-4814, 10.5194/acp-13-4801-2013, 2013.
- 20 Fomba, K. W., Muller, K., van Pinxteren, D., Poulain, L., van Pinxteren, M., and Herrmann, H.: Long-term chemical characterization of tropical and marine aerosols at the Cape Verde Atmospheric Observatory (CVAO) from 2007 to 2011, *Atmos. Chem. Phys.*, 14, 8883-8904, 10.5194/acp-14-8883-2014, 2014.
- Herrmann, H., Hoffmann, D., Schaefer, T., Bräuer, P., and Tilgner, A.: Tropospheric Aqueous-Phase Free-Radical Chemistry: Radical Sources, Spectra, Reaction Kinetics and Prediction Tools, *ChemPhysChem*, 11, 3796-3822, 10.1002/cphc.201000533, 25 2010.
- Hoffmann, E. H., Tilgner, A., Schrodner, R., Brauer, P., Wolke, R., and Herrmann, H.: An advanced modeling study on the impacts and atmospheric implications of multiphase dimethyl sulfide chemistry, *Proc Natl Acad Sci U S A*, 113, 11776-11781, 10.1073/pnas.1606320113, 2016.
- Kuznetsova, M., and Lee, C.: Dissolved free and combined amino acids in nearshore seawater, sea surface microlayers and foams: Influence of extracellular hydrolysis, *Aquat. Sci.*, 64, 252-268, 10.1007/s00027-002-8070-0, 2002.
- 30 Kuznetsova, M., Lee, C., Aller, J., and Frew, N.: Enrichment of amino acids in the sea surface microlayer at coastal and open ocean sites in the North Atlantic Ocean, *Limnol. Oceanogr.*, 49, 1605-1619, 10.4319/lo.2004.49.5.1605, 2004.
- Lesworth, T., Baker, A. R., and Jickells, T.: Aerosol organic nitrogen over the remote Atlantic Ocean, *Atmos. Environ.*, 44, 1887-1893, 10.1016/j.atmosenv.2010.02.021, 2010.

- Lindroth, P., and Mopper, K.: High performance liquid chromatographic determination of subpicomole amounts of amino acids by precolumn fluorescence derivatization with o-phthalaldehyde, *Analytical Chemistry*, 51, 1667-1674, 10.1021/ac50047a019, 1979.
- 5 Miyazaki, Y., Kawamura, K., Jung, J., Furutani, H., and Uematsu, M.: Latitudinal distributions of organic nitrogen and organic carbon in marine aerosols over the western North Pacific, *Atmos. Chem. Phys.*, 11, 3037-3049, 10.5194/acp-11-3037-2011, 2011.
- Mueller, C., Iinuma, Y., Karstensen, J., van Pinxteren, D., Lehmann, S., Gnauk, T., and Herrmann, H.: Seasonal variation of aliphatic amines in marine sub-micrometer particles at the Cape Verde islands, *Atmos. Chem. Phys.*, 9, 9587-9597, 2009.
- 10 Mueller, K., Lehmann, S., van Pinxteren, D., Gnauk, T., Niedermeier, N., Wiedensohler, A., and Herrmann, H.: Particle characterization at the Cape Verde atmospheric observatory during the 2007 RHaMBLe intensive, *Atmos. Chem. Phys.*, 10, 2709-2721, 10.5194/acp-10-2709-2010, 2010.
- Nagao, I., Matsumoto, K., and Tanaka, H.: Characteristics of dimethylsulfide, ozone, aerosols, and cloud condensation nuclei in air masses over the northwestern Pacific Ocean, *Journal of Geophysical Research: Atmospheres*, 104, 11675-11693, 10.1029/1998jd100108, 1999.
- 15 Peña-Izquierdo, J., Pelegrí, J. L., Pastor, M. V., Castellanos, P., Emelianov, M., Gasser, M., Salvador, J., and Vázquez-Domínguez, E.: The continental slope current system between Cape Verde and the Canary Islands, 2012, 76, 14, 10.3989/scimar.03607.18C, 2012.
- Reinthal, T., Sintes, E., and Herndl, G. J.: Dissolved organic matter and bacterial production and respiration in the sea-surface microlayer of the open Atlantic and the western Mediterranean Sea, *Limnol. Oceanogr.*, 53, 122-136, 20 10.4319/lo.2008.53.1.0122, 2008.
- van Pinxteren, M., Muller, C., Iinuma, Y., Stolle, C., and Herrmann, H.: Chemical Characterization of Dissolved Organic Compounds from Coastal Sea Surface Micro layers (Baltic Sea, Germany), *Environ. Sci. Technol.*, 46, 10455-10462, 10.1021/es204492b, 2012.
- van Pinxteren, M., Fiedler, B., van Pinxteren, D., Iinuma, Y., Körtzinger, A., and Herrmann, H.: Chemical characterization of 25 sub-micrometer aerosol particles in the tropical Atlantic Ocean: marine and biomass burning influences, *J. Atmos. Chem.*, 72, 105-125, 10.1007/s10874-015-9307-3, 2015.
- van Pinxteren, M., Barthel, S., Fomba, K. W., Muller, K., von Tümpling, W., and Herrmann, H.: The influence of environmental drivers on the enrichment of organic carbon in the sea surface microlayer and in submicron aerosol particles - measurements from the Atlantic Ocean, *Elementa-Sci. Anthropol.*, 5, 21, 10.1525/elementa.225, 2017.
- 30 van Pinxteren, M., Fomba, K. W., Triesch, N., Stolle, C., Wurl, O., Bahlmann, E., Gong, X., Voigtländer, J., Wex, H., Robinson, T. B., Barthel, S., Zeppenfeld, S., Hoffmann, E. H., Roveretto, M., Li, C., Gosselin, B., Daële, V., Senf, F., van Pinxteren, D., Manzi, M., Zabalegui, N., Frka, S., Gašparović, B., Pereira, R., Li, T., Wen, L., Li, J., Zhu, C., Chen, H., Chen, J., Fiedler, B., von Tümpling, W., Read, K. A., Punjabi, S., Lewis, A. C., Hopkins, J. R., Carpenter, L. J., Peeken, I., Rixen, T., Schulz-Bull, D., Monge, M. E., Mellouki, A., George, C., Stratmann, F., and Herrmann, H.: Marine organic matter in the 35 remote environment of the Cape Verde islands – an introduction and overview to the MarParCloud campaign, *Atmos. Chem. Phys.*, 20, 6921-6951, 10.5194/acp-20-6921-2020, 2020.