OCEANET Atmosphere − an autonomous measurement platform for the observation of interaction of aerosol, clouds, dynamic, and radiation

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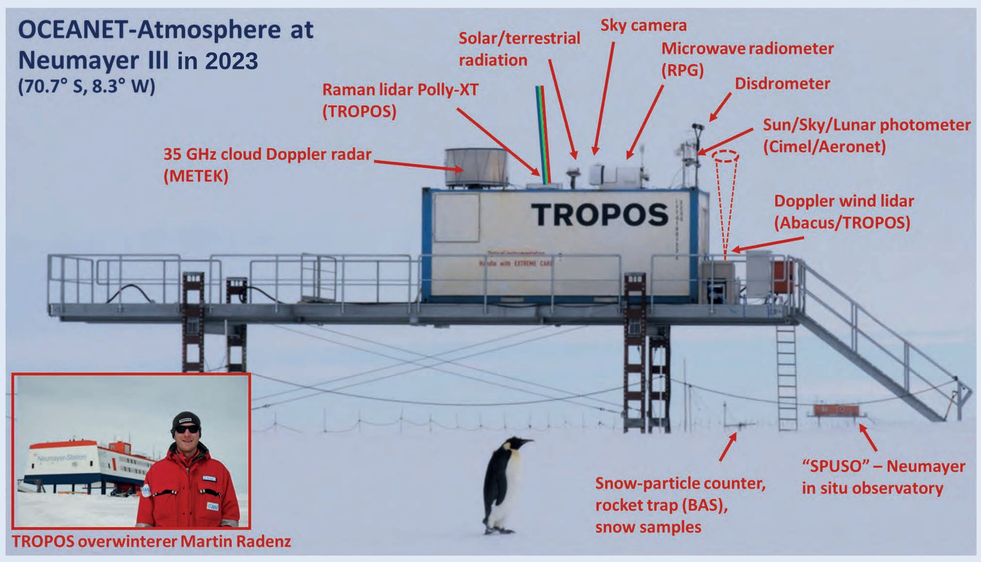
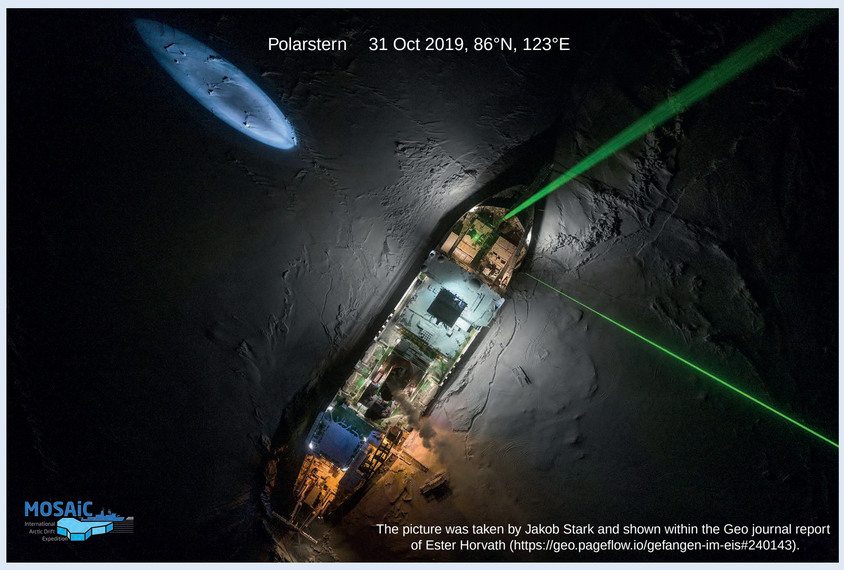
Mobile OCEANET Atmosphere platform

State of the art aerosol and cloud remote sensing



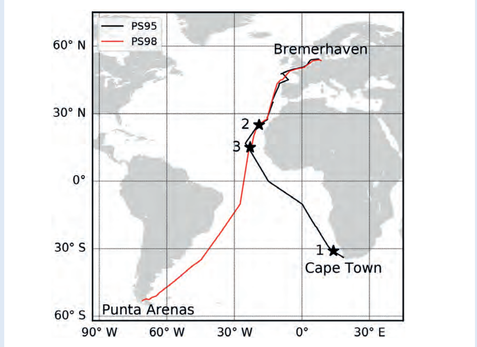
- Container-based observation platform with modern remote-sensing instruments.
- Installation on Polarstern, Sonne, Meteor, but also at field sites like Neumayer III.
- Long-term observations at remote locations possible − valuable data for atmospheric research.
- Atlantic transects for repeated measurements, for training of young researchers, and for testing purposes.
-Satellite Cal/Val activities possible.



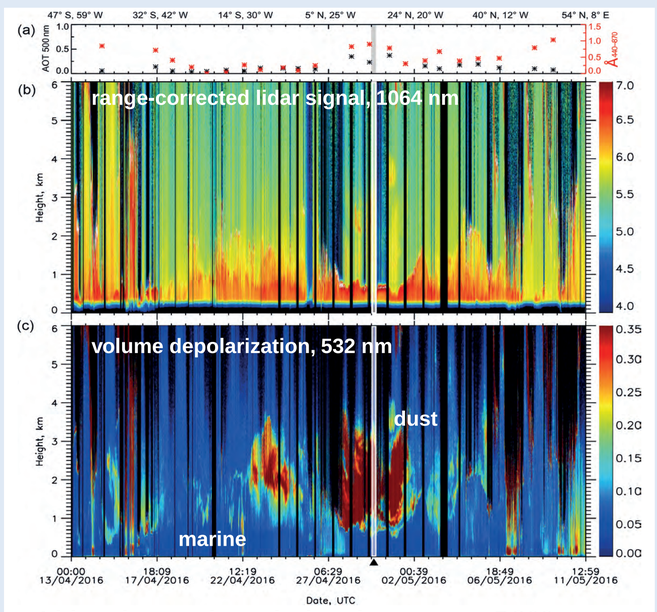
Saharan mineral dust profiling over the Atlantic [1]

Outflow of fresh Saharan dust plumes over the Atlantic

- Optical properties of dust
- Radiative impact
- Dust-model validation

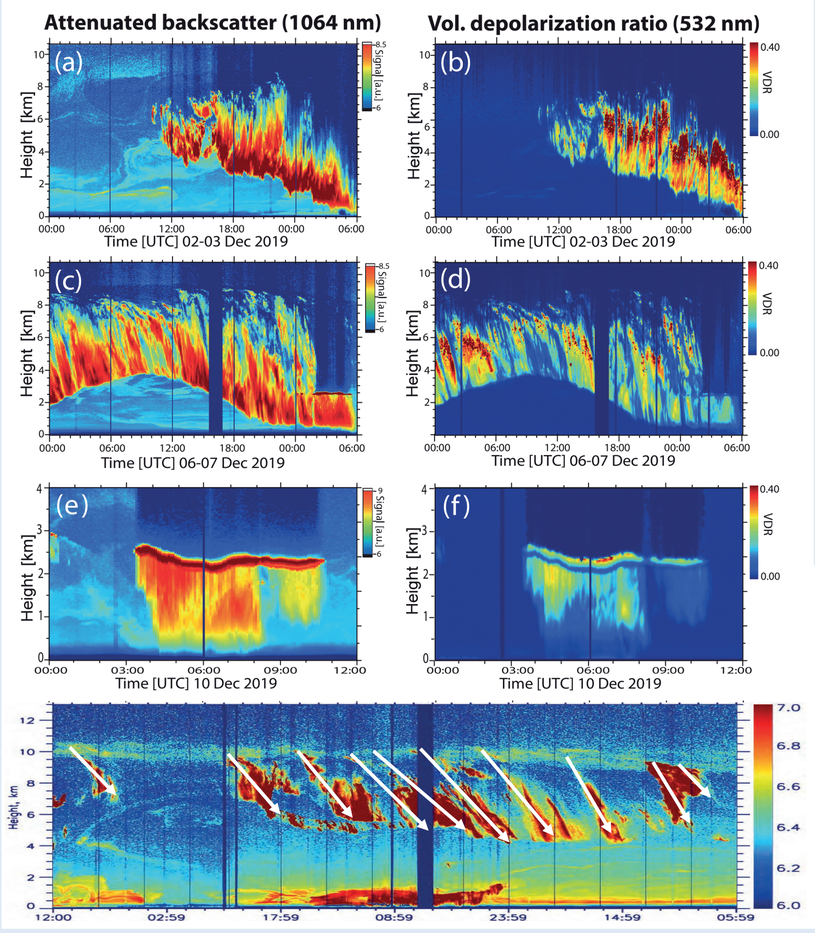


Typical Atlantic transects to monitor Saharan dust and marine aerosol.



Lidar observations during the transect PS98 (Punta Arenas - Bremerhaven)

Arctic aerosol, cloud and smoke profiling [2, 3, 5]



Heterogeneous ice formation in wildfire smoke

-During MOSAiC, we observed frequent formation of ice clouds in Sibirian fire smoke.

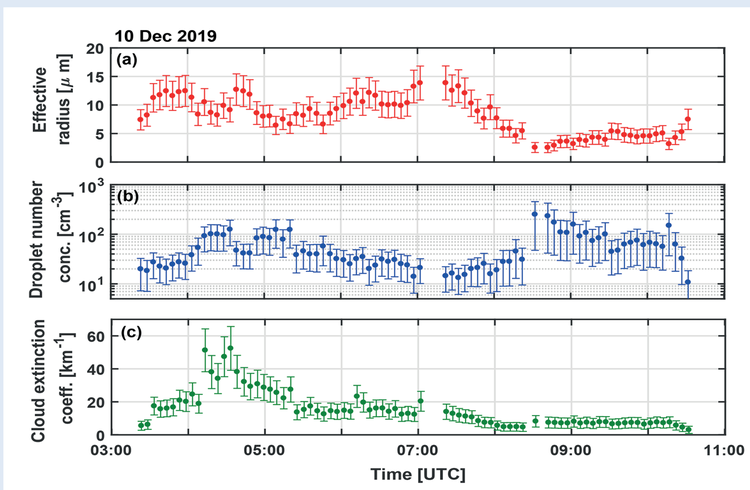
- Approx. 65 individual ice cloud systems have been identified and analyzed during the winter half year.

Lidar-backscatter (a,c,e) and depolarisation (b,c,f) of Arctic clouds that have been formed in Arctic Haze and wildfire-smoke particles during MOSAiC. From 25 - 29 Feb 2020, several cirrus clouds formed under the direct influence of wildfire smoke (bottom).

Cloud micro physics: CCNC, INPC, CDNC, and ICNC [2]

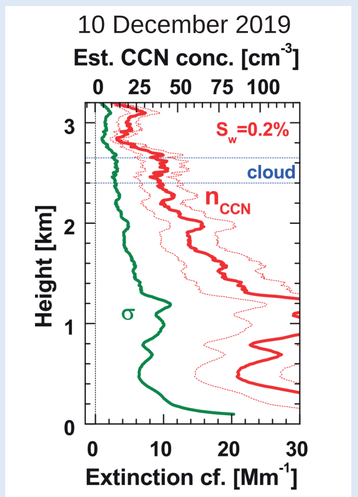
Polarisation lidar with dual field-of-view capability

With this new lidar technique (DFOV), micro physical cloud parameters can be derived at cloud base where aerosol cloud interaction is most dominant [4].



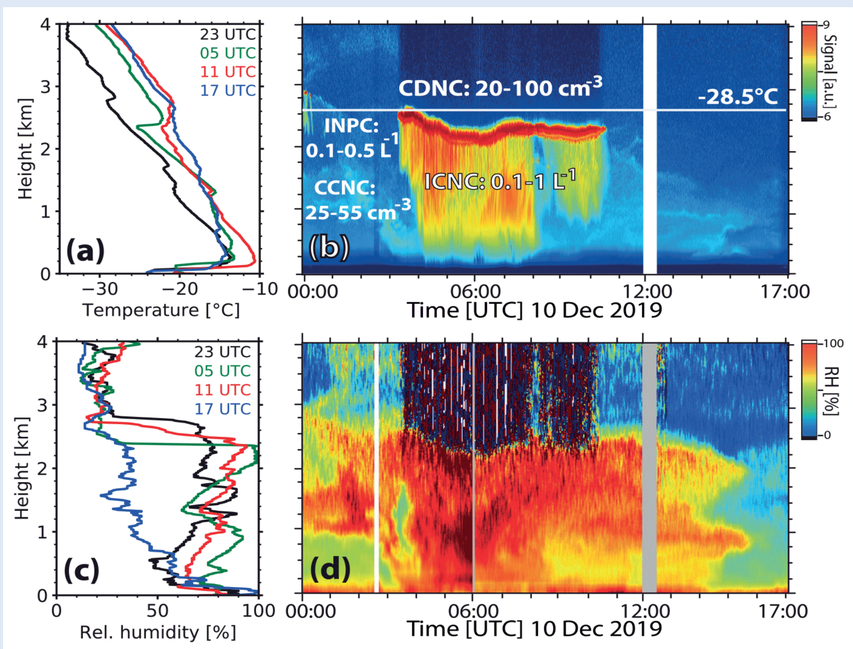
Cloud microphysical parameters. Effective radius (a), cloud-droplet number concentration (b), cloud extinction (c) from DFOV lidar observations during MOSAiC.

Cloud condensation nucleii derived with lidar



CCNC, derived from lidar extiction following [6].

Closure of aerosol and cloud micro physics [2, 6]



-Dependence of cloud particle parameters on aerosol properties can be studied.

-Effect of specific particle types (dust vs. biogenic).

Particle- and cloud micro physics of a mixed-phase cloud (b). Temperature- (a) and humidity profiles (c) from radiosondes, and from Raman lidar (d).

Cruise participation and future plans

27 cruises to date

PS69 (ANT-23/10), Cape Town - Bremerhaven, 12.4.-3.5.2007
PS71 (ANT-24/1), Bremerhaven – Cape Town, 29.10.-23.11.2007
PS71 (ANT-24/4), Punta Arenas – Bremerhaven, 19.4.-18.5.2008
PS72 (ARK-23/1), Bremerhaven - Longyearbyen, 15.6.-30.6.2008
PS73 (ANT-25/1), Bremerhaven – Cape Town, 31.10.-2.12.2008
PS73 (ANT-25/2), Cape Town- Cape Town, 2.12.2008-4.1.2009
PS73 (ANT-25/5), Punta Arenas – Bremerhaven, 10.4.-21.5.2009
PS74 (ARK-24/3), Reykjavik - Bremerhaven, 6.8.-23.9.2009
PS75 (ANT-26/1), Bremerhaven - Punta Arenas, 17.10.-24.11.2009
PS75 (ANT-26/2), Punta Arenas - Wellington, 25.11.2009-26.1.2010
PS75 (ANT-26/3), Wellington - Punta Arenas, 29.1.- 11.2.2010
PS75 (ANT-26/4), Punta Arenas – Bremerhaven, 6.4.-15.5.2010
PS77 (ANT-27/1), Bremerhaven - Cape Town, 24.10.-23.11.2010
PS77 (ANT-27/4), Cape Town - Bremerhaven, 22.4.-18.5.2011
PS79 (ANT-28/1), Bremerhaven - Cape Town, 28.10.-29.11.2011
PS79 (ANT-28/5), Punta Arenas - Bremerhaven, 10.4.-15.5.2012
PS81 (ANT-29/1), Bremerhaven - Cape Town, 26.10.-24.11.2012
M96, Guadeloupe - Cabo Verde, 28.4.2013-23.05.2013
PS83 (ANT-29/10), Cape Town - Bremerhaven, 6.3.-11.4.2014
PS95 (ANT-31/1), Bremerhaven - Cape Town, 28.10.-30.11.2015
PS98 (ANT-31/4), Punta Arenas - Bremerhaven, 11.4.-11.5.2016
PS102 (ANT32/1), Bremerhaven - Cape Town, 11.11.-10.12.2016
PS106 (ARK-32/1), Bremerhaven - Tromsø, 25.5.-17.7.2017
PS113 (ANT-33/4), Punta Arenas - Bremerhaven, 9.5.2018-9.6.2018
PS116, Bremerhaven - Cape Town, 10.11.-10.12.2018
PS122, Tromsø - Arctic - Bremerhaven, 20.09.2019-12.10.2020
SO284, Bremerhaven - Tropical Atlantic - Bremerhaven, 28.6.- 16.8.2021

ACTRiS GERMANY

Within ACTRIS-D (2nd phase) we will establish permanent aerosol and cloud remote-sensing observations on Polarstern II for continous en-route data collection.

References

[1] Bohlmann, S. et al.: Ship-borne aerosol profiling with lidar over the Atlantic Ocean: from pure marine conditions to complex dust–smoke mixtures, ACP, 2018.
[2] Engelmann, R. et al.: Wildfire smoke, Arctic haze, and aerosol effects on mixed-phase and cirrus clouds over the North Pole region during MOSAiC: an introduction, ACP., 21, 13397–13423, 2021.
[3] Ohneiser, K. et al.: The unexpected smoke layer in the High Arctic winter stratosphere during MOSAiC 2019–2020, ACP, 21, 15783–15808, 2021.
[4] Jimenez, C. et al.: The dual-field-of-view polarization lidar technique: a new concept in monitoring aerosol effects in liquid-water clouds – theoretical framework, ACP., 20, 15247–15263, 2020.
[5] Ansmann, A. et al.: Annual cycle of aerosol properties over the central Arctic during MOSAiC 2019–2020 – light-extinction, CCN, and INP levels from the boundary layer to the tropopause, ACP, 2023.
[6] Ansmann, et al.: Tropospheric and stratospheric wildfire smoke profiling with lidar: mass, surface area, CCN, and INP retrieval, ACP, 21, 9779–9807, 2021.