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Short Cruise Report RV METEOR – Cruise M 189-2

Walvis Bay (Namibia) – Las Palmas (Spain)

16. 05. 2023 – 04. 06. 2023

Chief Scientist: Dr. Steffen Ziegler

Captain: Detlef Korte





Fig 1: Cruise track of RV METEOR cruise M189-2,

Objectives

The focus of the transit M189-2 is on atmospheric measurements of clouds, aerosols and trace gases. These data sets are mainly used for the validation of satellite measurements over the ocean, but are also fundamentally important for gaining knowledge of chemical processes in the marine boundary layer. For this purpose, we use the available weather station and ceilometer data on board of the RV Meteor and additionally deploy an infra-red cloud camera, a Tube MAX-DOAS and a MICROTOPS. An additional objective is to capture a satellite overpass for a more detailed quantitative validation.

Narrative

Our small scientific crew installed the cloud camera and the Tube MAX-DOAS instrument directly on the 15th May when we arrived at the research vessel. After leaving port as planned on the early morning of the 16th we had two more days for preparing the data analysis and making sure the instruments will be working when measurements start on May 18th. Fog and dense clouds that persisted above the cold Benguela current and made direct sunlight measurements with the MICROTOPS difficult in the beginning. A quick rise of temperatures in the first days from 13 °C to about 20 °C caused fog and clouds to dissolve and created ideal measurement conditions for all instruments. Between 22nd and 24th May, the instruments detected the first Aerosol event: A smoke plume most likely to originate from biomass burning events in central Africa. According to the Navy Aerosol Analysis and Prediction System (NAAPS), we barely scratched the edge of the plume but could still detect a small increase in aerosol optical depth (AOD) and the Angstrom parameter indicated small aerosol particle sizes. In the evening of May 24th RV Meteor entered the tropics. Around about that time, the MICROTOPS instrument broke and could from then on only be used sporadically. The first high cirrus clouds were detected by the CHM15k ceilometer around 6 pm UTC, followed by deep convective systems that resulted in thunderstorms and rain in the following two days. After leaving the tropical convection, low- and mid-level clouds were again less abundant. However, Saharan dust obscured the sun. A strong increase in AOD was detected by Tube MAX-DOAS instrument and the backscatter signal measured by the ceilometer showed a multitude of dust layers. While the dust became less dense each day, individual layers could be detected until May 31st. In the remaining days before entering the harbor, the sky remained mostly clear with occasional cumulus clouds in the lower troposphere and some high cirrus clouds.

As the satellite instrument that should have been used for the overpass comparison (AEOLUS) was unexpectedly decommissioned end of April, we had to switch to a different satellite: CALIPSO. The lidar instrument CALIOP on board of this satellite has a narrow swath of just 90 m which makes finding an overpass location very challenging. Possible overpass locations were calculated each day using the current ship location and speed. On May 24th a possible location was identified that required to accelerate the ship to full speed in order to be at the satellite measurement position at the right time. Thankfully, an exemption permit granted by the German Research Fleet Coordination Centre and the satellite overpass was reached on May 29th at 5 am. Later analysis showed that the measurement location of the satellite was missed by about 35 km caused by uncertainty in the predicted CALIPSO orbit. However, this distance is probably negligible as the aerosol layer was homogeneous and persistent over multiple hours.

Acknowledgements

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List of Participants

Name	Discipline	Institution
Steffen Ziegler, PhD	Chief Scientist / Atmosphere	MPIC
Stefan Kinne	Atmosphere	MPIC
Lucas Reischmann	Atmosphere	MPIC
Kristina Rapp	Atmosphere	MPIC
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Stations list

Activity No.	Date / Time [UTC]	Device	Action	Latitude	Longitude	Ocean Depth [m]	Rope Length m
M189/2_1-1	24.05.2023 10:00	Weather station	PIRATA buoy comparison measurements	0° 0,720' N	09° 52,920' W	-	-
M189/2_1-2	29.05.2023 05:00	Ceilometer and Cloud Camera	CALIPSO Satellite overpass	18° 6,720' N	20° 42,000' W	-	-
M189/2_1-3	30.05.2023 11:35	Weather station	PIRATA buoy comparison measurements	21° 13,560' N	21° 31,200' W	-	-