FS METEOR Cruise M189-2

16th May – 4th June 2023

Walvis Bay (Namibia) – Las Palmas (Spanien)

3rd Weekly Report (29th May to 4th June)

Cruise M189-2 is nearing its end after an exciting week. Thanks to the exemption permit exemption permit to lift the speed limit of 10 kn last week, we reached the the predicted satellite overpass location in time on the morning of May 29th at 5am UTC. Sky conditions were clear except for the vanishing layer of Saharan dust that persisted up to an altitude of 4 km. However, as it turned out later when we got hold of the satellite measurements, the predicted orbit was not fully accurate and we missed the satellite measurement by about 35km (see Fig. 1). While the aerosol layer is not seen in the preliminary dataset (Expedited Level 1 Attenuated Backscatter V3.41) some high level stratiform clouds around 6 km altitude and different layer of cirrus clouds between 10 and 14 km were detected by the satellite instrument.

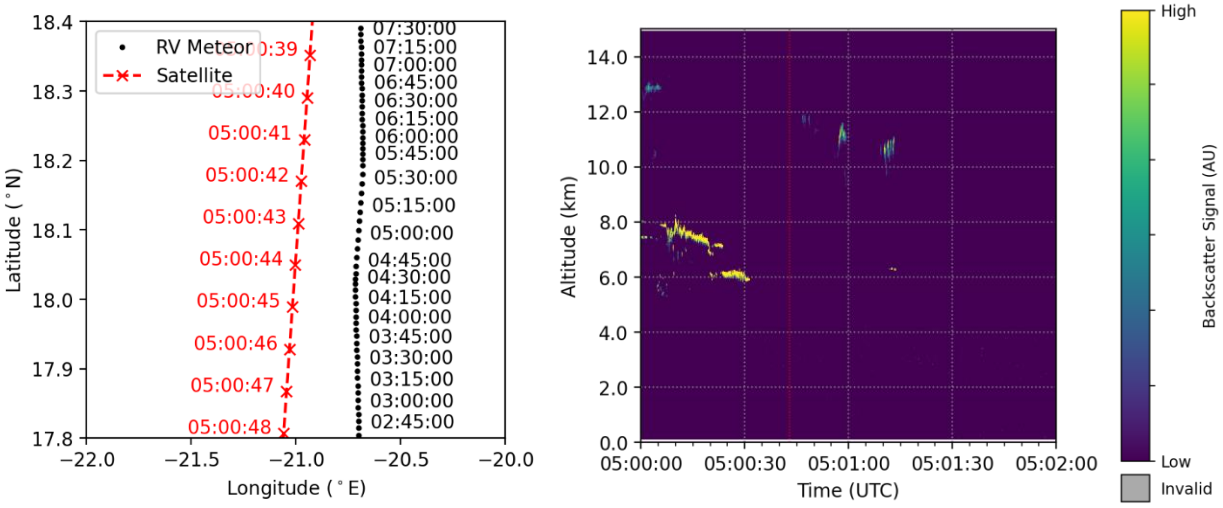

Fig. 1: CALIPSO overpass on 29th May around 5am UTC: The left panel shows the location of the RV Meteor (black) and the location of the satellite measurements (red). The shortest distance of about 35 km was reached at 5:00:43 UTC. The right panel shows the backscatter signal of the satellite instrument. The dotted red line marks the time of closest distance to the RV Meteor. CALIPSO data (Expedited Level 1 V3-41) are taken from NASA EARTHDATA website.

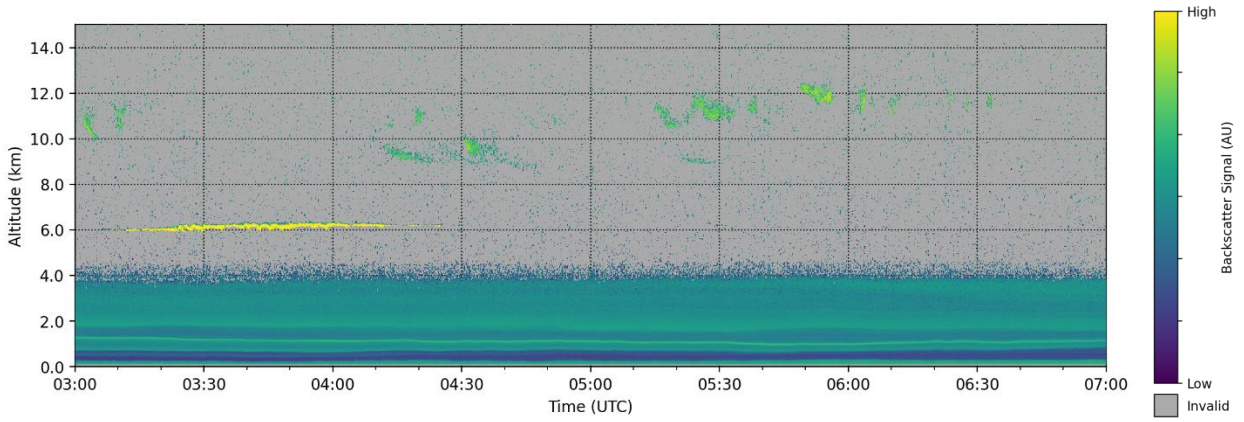

Fig. 2: Backscatter signal measured by the CHM15k Ceilometer of the Max Planck Institute for Meteorology in Hamburg on board RV Meteor for the time of the satellite overpass around 5am on May 29th.

Very similar clouds were observed by the ceilometer instrument on board of the RV Meteor, suggesting a homogeneous layering of the troposphere in the area around the vessel (Fig. 2). Overall, the ceilometer gives an impressive overview on the development of the different dust layers that evolved from a homogeneous layer stretching over the lowest 4km of the atmosphere on May 28th to a lifted, more confined layer on May 30th (see Fig. 3). While the top of the dust layer stayed the same over the whole period, some cleaner air was detected between the marine boundary layer and the lifted dust layer. On May 31st the amount of Saharan dust significantly decreased and the sky was mostly clear with the exception of some low-level cumulus and high-altitude cirrus.

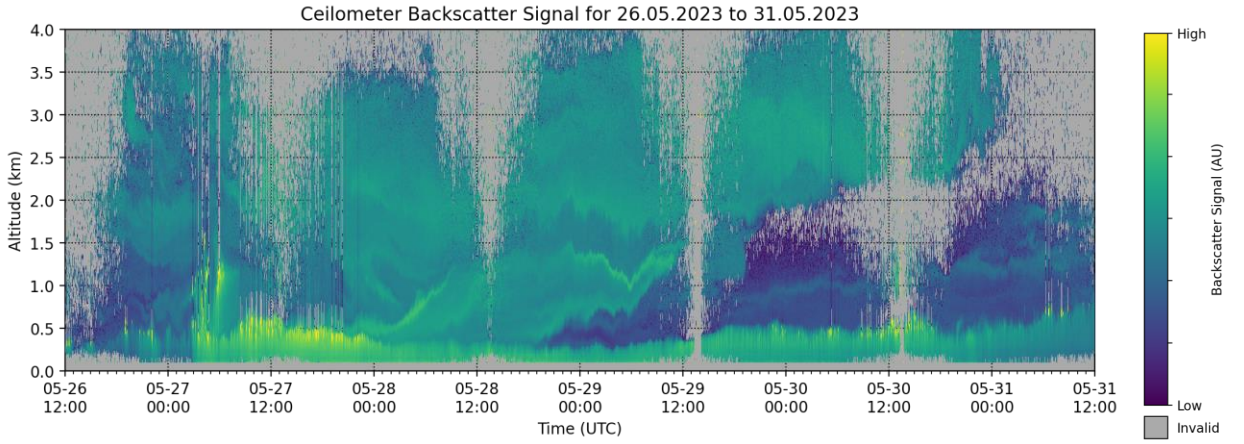

Fig. 3: Backscatter signal similar to Fig. 2 confined to altitudes below 4 km for the time range between noon of May 26th and noon of May 31st.

The analysis of trace gases using the measurements of the Tube MAX-DOAS instrument was rather uneventful for most parts of cruise M189-2 and requires a more thorough investigation as abundances are very small. However, one potential highlight was detected in the later development of the slant columns of nitrogen dioxide (NO_2). During the first half of the cruise when the wind was constantly blowing in direction of travel, the exhaust plume of the RV Meteor was occasionally detected. As to be expected, after the change of wind direction while crossing the equator, mainly background levels of NO_2 were detected. An exception was the morning of May 26th when a large convective system with heavy rain and lightning was passing. For the time of the thunderstorm, slant column densities of NO_2 increased smoothly and decreased again around noon time (see Fig. 4). This development suggests the influence of lightning produced NO_x. While the order of magnitude of the signal is quite typical for this source of nitrogen oxide, more analysis is needed to confirm this curiosity.

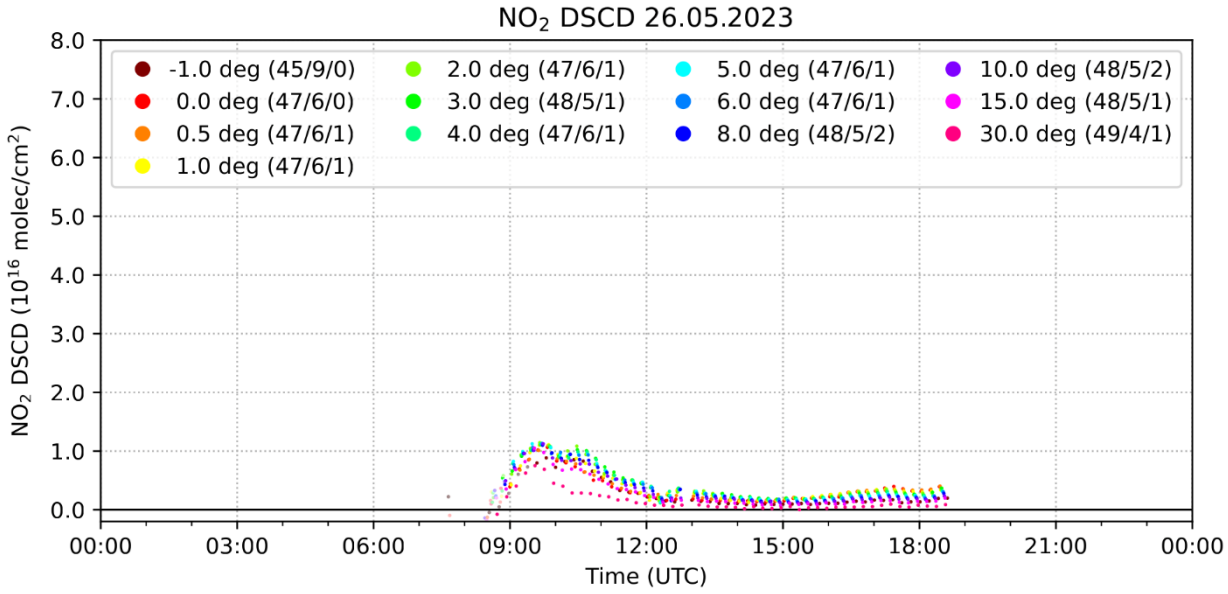

Fig. 4: Results of the Differential Optical Absorption Spectroscopy (DOAS) analysis for Nitrogen Dioxide (NO_2) on May 26th. Different colours depict the slant columns for different elevation angles. Increased values between 9 and 12 UTC coincide with a passing thunderstorm.

On June 3rd we entered the harbour and finished our work on RV METEOR. The past three weeks have been an impressive display of subtropical and tropical weather conditions. The combination of dust, clouds and clear weather of the past few days presented us two spectacular sunsets. A worthy finish of our Atlantic cruise.


Fig. 5: Spectacular sunsets on May 30th (left) when the sky lit up in a fiery red about 25 minutes after the sun was gone and on June 1st (right) when we could observe the rare phenomenon of the sun turning green right at the moment when it drops below the horizon.

With these impressions the small team of scientists thanks everyone who helped to make this cruise possible, in particular the German Research Fleet Coordination Centre, the crew of RV Meteor and captain Detlef Korte. All of us were happy to join for the transit M189-2.

Until next time…

Steffen Ziegler

(Max-Planck-Institute for Chemistry, Mainz)