Reply to PDI Audit Report

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Issue raised by auditor:

"Another problem might be caused by the insect screen with about 50% porosity, which may cause impacts of cloud droplets. The effect on aerosol particle properties such as the particle light scattering and absorption coefficients is difficult to estimate. It might be that a part of the cloud droplet are not taken into the dilution flow. The consequence might be that that the particle light scattering and absorption coefficients are measured too low during cloud periods. Since there is no independent cloud detector or particle number size spectrometer, data cannot be flagged for the cloud periods.

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Coming back to cloud problem, the RH sensor at the inlet can be used to identify the period of cloud events. PSI should estimate the effect on a possible change of the aerosol particle parameters by looking at the data before and after cloud events (excluding time periods in this analysis when there was precipitation) "

Answer:

To identify potential losses in the measured aerosol parameters during cloud events we have filtered the hourly data as follows:

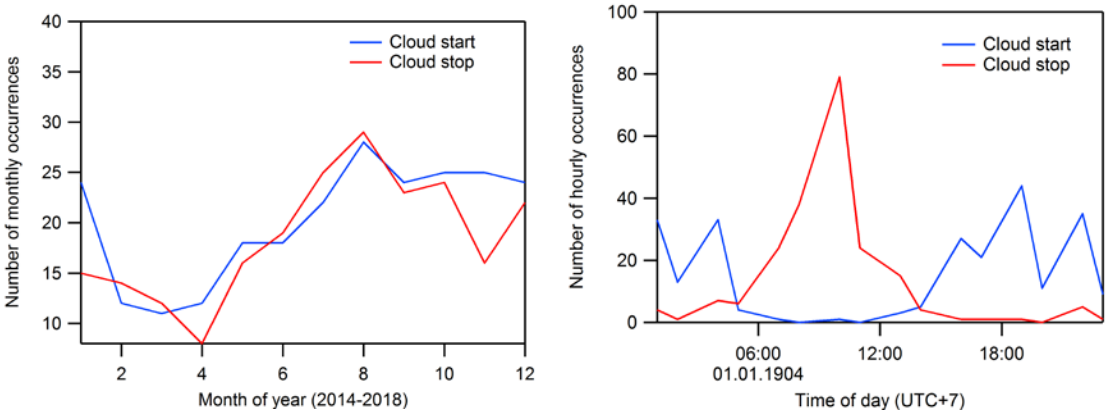
1. Days with rainfall are excluded (rainfall is measured daily)
2. Wind direction is not changing 6 hours before and after the considered hour (this prevents effects from sudden air mass changes)
3. If RH < 95% during six hours before a considered hour and RH > 95% during six hours thereafter, a cloud event starts
4. If RH > 95% during six hours before a considered hour and RH < 95% during six hours thereafter, the cloud event stops

Using these criteria, the following median ratios were obtained:

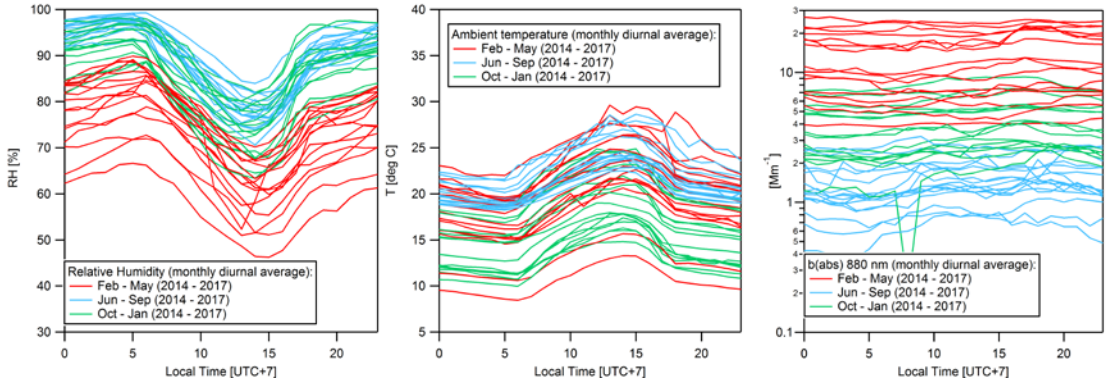
$$\frac{b_{abs}(during\ cloud)}{b_{abs}(before\ cloud)} = 0.92$$

$$\frac{b_{abs}(during\ cloud)}{b_{abs}(after\ cloud)} = 0.82$$

The diurnal and monthly distribution of the identified cloud events look as follows:



Furthermore, the following plots show the season-wise diurnal variation of RH, T and Babs:



From this loss estimate we draw the following conclusions:

- Cloud events occur nearly daily during the **wet season months (June to September)**, which show the lowest aerosol scattering and absorption coefficients in their annual cycles
- During the **NE monsoon months (October to December)** there is also a significant fraction of days with cloud events
- The cloud events start in the afternoon and persist throughout the night
- During these conditions (i.e. night time values during the wet season and NE monsoon season), the estimated losses caused by the insect mesh are in the range of 10-20%. The difference found in the estimated losses for the start and end of a cloud event are is attributed to the fact that the diurnal cycle of the aerosol is not constant.
- For the **dry season (January/February to May)** the issue is irrelevant

As the auditor already stated, RH is not an ideal parameter to define the presence of in-cloud conditions. We also confirmed this in an in-depth analysis of cloud formation at our monitoring site in the Swiss alps (Jungfraujoch), see Herrmann et al. (2015). However, for Pha Din the above analysis using RH as cloud marker has to be considered as best available estimate.

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References:

Herrmann, E., et al. (2015), Analysis of long-term aerosol size distribution data from Jungfraujoch with emphasis on free tropospheric conditions, cloud influence, and air mass transport, J. Geophys. Res. Atmos., 120, 9459–9480, doi:10.1002/2015JD023660.