# *Site audit report Finokalia, Greece*

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***Summary:***

Measurements of physical aerosol properties at the EUSAAR site Finokalia have been audited by Dr. Thomas Tuch of the WWCAP on June 15th and 16th 2009. The station is operated by the Environmental Chemical Processes Laboratory, Department of Chemistry - University of Crete located in Heraklion about 1.5 hours drive away from the site. It serves both as a EUSAAR station and as a contributing station in WMO RA VI in the GAW framework.

The sampling station is situated at 35.3379° N 25.6696° E (Fig. 1) in the northern coast of Crete. The station is located at the top of a hilly elevation (250 m) facing the sea within a sector 270° to 90°. The nearest village with 10 inhabitants is at a distance of 3 km to the south of the station. The nearest largest urban centre is Heraklion with 150 000 inhabitants located 70 km west of Finokalia. No human activities can be found at a distance shorter than 15km within the above mentioned sector.


Figure 1. Finokalia station and Google earth view of the site.

Great effort is made by the station personal to provide useful data for EUSAAR and GAW.

***Documentation:***

All instrument manuals were available at the site during the audit. Written instrument logs do not contain sufficient information e.g. about instrument calibration dates. Online documentation could not be checked because it is written in Greek language (Figure 2). We recommend continuing a more thorough online logbook in English.

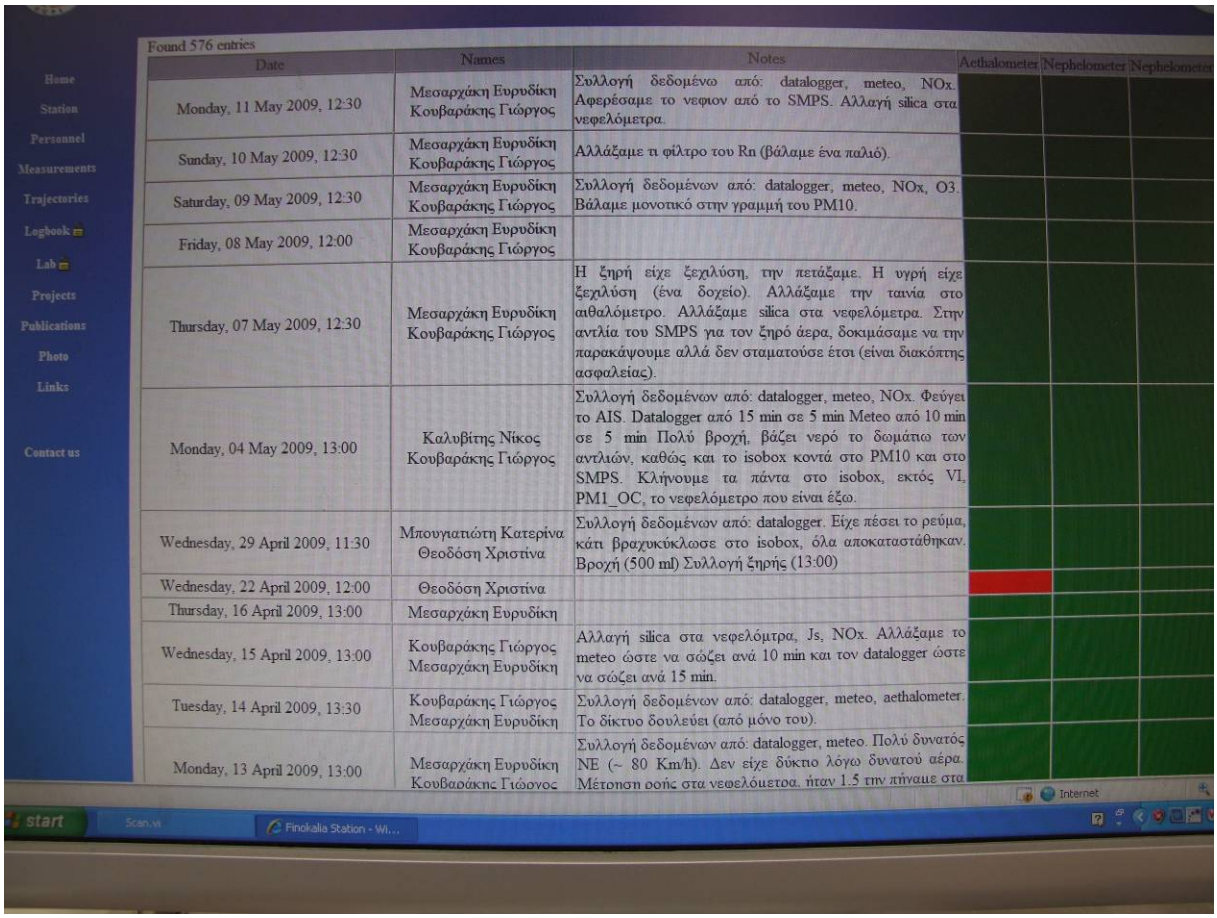


Figure 2: Online logbook at Finokalia.

**Documentation at Finokalia can be improved.**

***Data handling and submission:***

Instrument data from the site can be checked online from Heraklion. **Data from the site are submitted on time to the EMEP data center.**

**Data handling and submission at Finokalia comply with EUSAAR standards.**

***Primary flow standard:***

A BIOS Defender 520 S/N 113020 is available as primary flow standard at the site. This instrument has been verified against the WCCAP reference during this audit. (Figure 3) and is in good agreement with the reference instrument.

It needs to be noted, that this instrument is not suitable for the calibration of the flow sensors of the SMPS. Adjusted to a sheath air flow of 5 l/min with the BIOS a sheath air flow of 5.687 l/min was measured with the Gilibrator. This deviation due to the pressure drop of the BIOS did cause a significant shift in the sizing of the SMPS (200 nm Latex was measured at 225 nm).

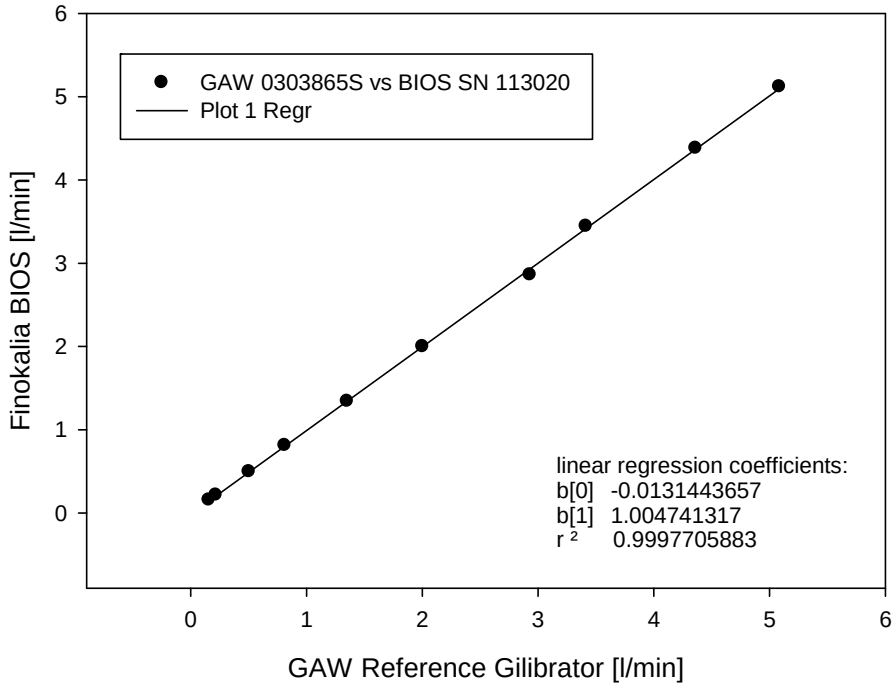


Figure 3: Intercomparison of flow standards

**The flow standards aggrees with GAW and Eusaar recommendations.**

**THE BIOS DRY CALIBRATOR IS NOT SUITABLE FOR FLOW MEASUREMENTS OF THE SMPS!**

Aerosol inlet:

Commercially available PM10 inlets (Figure 4) are used for aerosol sampling. Humidity conditioning of the aerosol is not available albeit not necessary under the

climatic conditions at Finokalia. Almost all aerosol lines are made of stainless steel, only one aerosol line was to a Nephelometer was made of Teflon tubing which is not recommended for aerosol sampling tubes. The flow splitter (Figure 5) was designed similar to the recommendations by the WCCAP. Unfortunately the diameter of the outer housing of this flow splitter has been manufactured too narrow causing inhomogeneous aerosol concentrations at different ports of the splitter if operated at the nominal flow rate of 16.67 l/min. At the time of the audit the inlet was therefore operated at a flow of 9 l/min to avoid these inhomogeneities. A new outer housing with sufficient diameter according to drawings supplied by the WCCAP will be constructed at Heraklion and will be installed as soon as possible.

Figure 4: Aerosol inlets.

Figure 5: Flow splitter.

The aerosol inlets at Finokalia comply with EUSAAR requirements.

*SMPS:*

The SMPS at Finokalia was built by the IfT. It fulfills all requirements for EUSAAR particle size spectrometers. During the audit the aerosol dryer of the system was not installed because of a leak in the Nafion membrane. Flows had been calibrated three months ago.

Flow calibration of EUSAAR size spectrometers should be performed at least once per month

The initial zero test with an absolute filter at the inlet of the instrument gave 0 to 4 particles false counts per 5 minute scan of the instrument.

The initial test with 200 nm Latex spheres revealed a severe sizing offset of the instrument. The Latex peak was found at about 250 nm (Fig. 6).

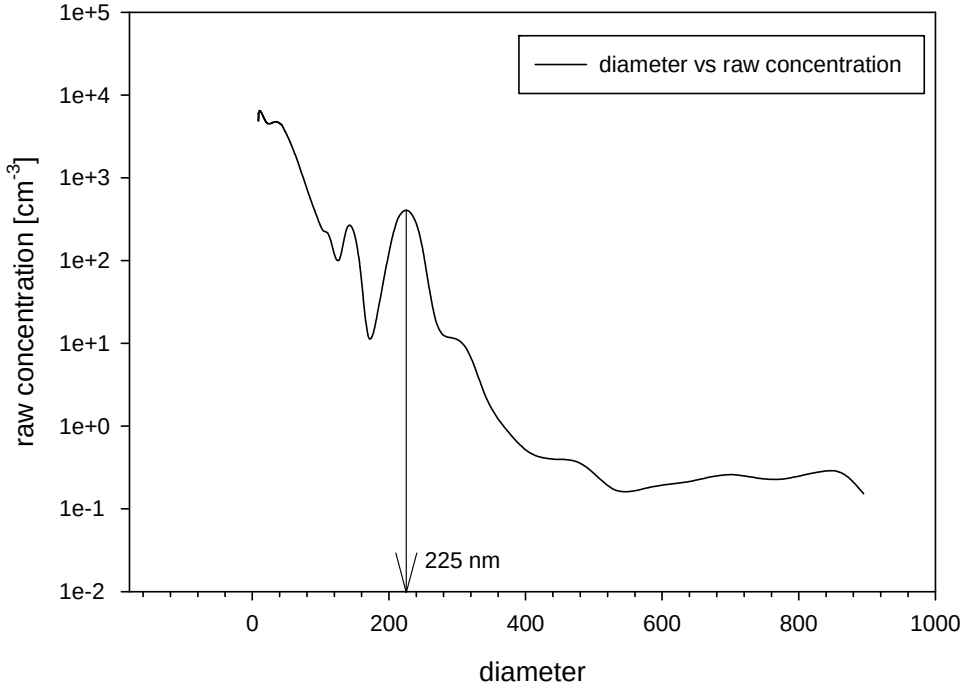


Figure 6: Initial sizing of 200 +- 4 nm Latex spheres at Finokalia

This severe oversizing was due to several different problems:

Sheath air flow was calibrated with the BIOS DryCal resulting in a real sheath air flow of 5.7 l/min instead of the 5 l/min used to calculate diameters.

Ambient pressure used for calculation was set to 1013 hPa instead of the average 840 hPa.

In addition to these problems particle sizing started only at about 20 nm (Fig.7). This problem was due to an offset of almost 7 Volts of the 12.5 kV high voltage supply to the DMA. Because the high voltage supply could not be adjusted at Finokalia a new scaling factor is now used in the software of the instrument to provide proper sizing at small diameters (Fig. 8).

After identification of all problems of the instrument the latest software version of the SMPS measuring software was installed. Flows were adjusted according to nominal values and setup parameters were calculated using correct settings for all parameters. After these settings the SMPS was working according to specifications (see figure 9 for 200 nm Latex particles after corrections).

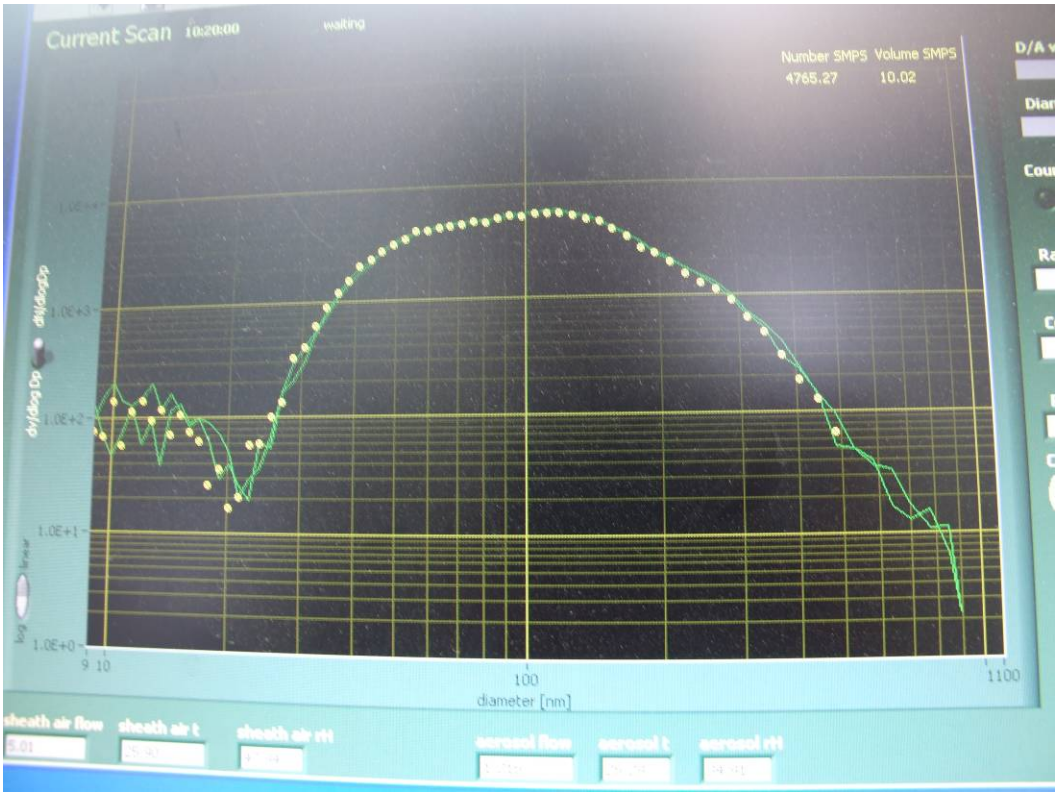


Figure 7: No sizing of particles smaller than 20 nm in diameter (Initial measurements).

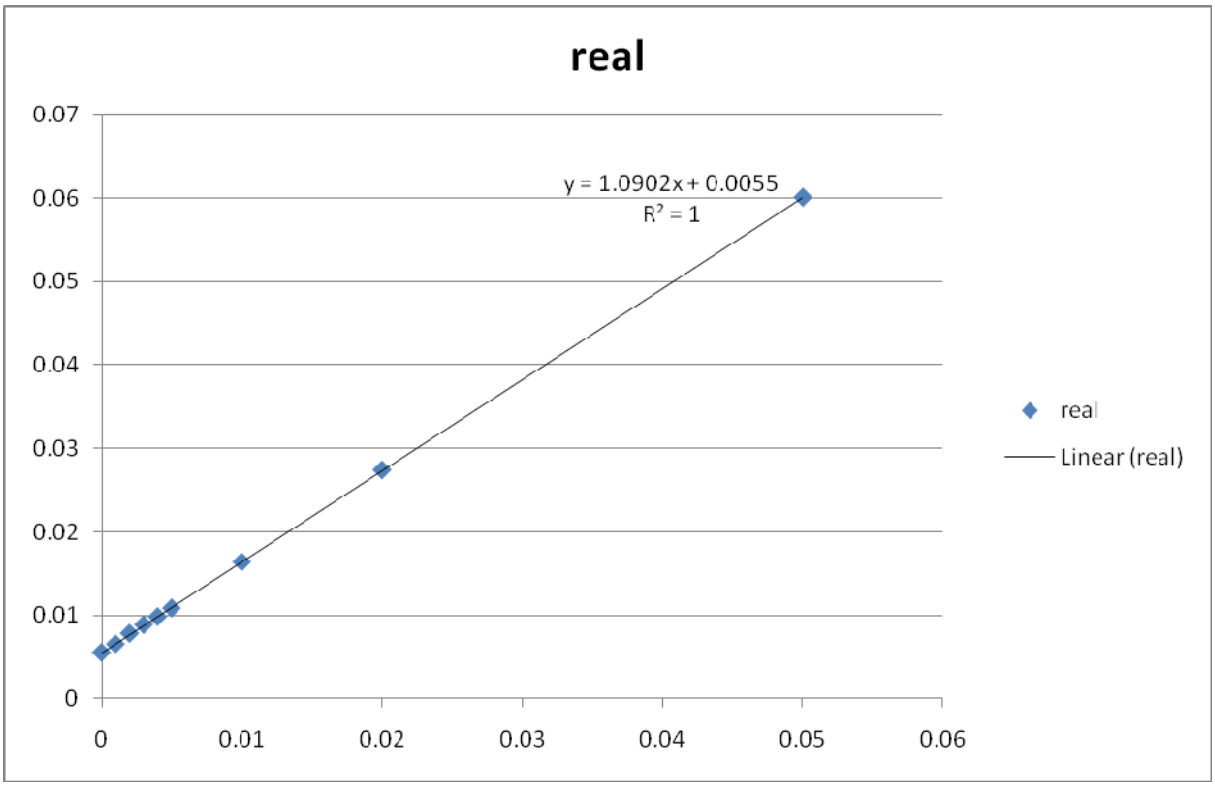


Figure 8: New scale for HV of the SMPS at Finokalia

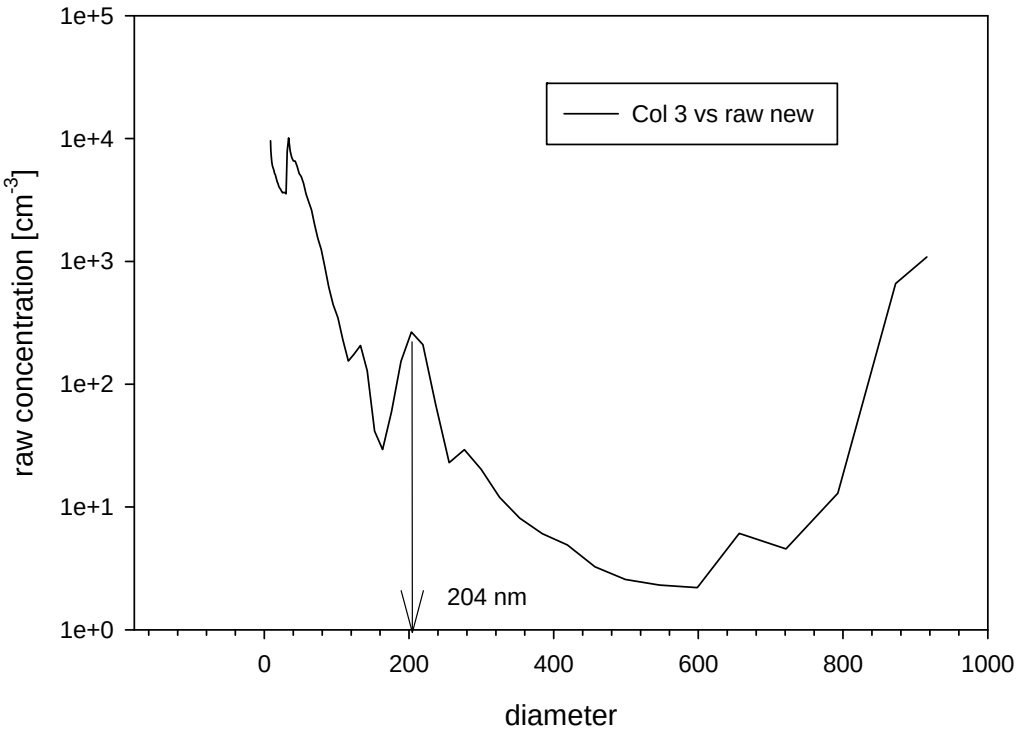


Figure 9: Sizing of 200 nm particles after correction of all problems.

At the beginning of the audit the SMPS was not running according to EUSAAR requirements.

After adjustment and repair the instrument is now running according to specifications.

The audit of the SMPS has shown that more frequent checks of the operation parameters are necessary to ensure data quality.

***CPC and LPC:***

In addition to the SMPS a TSI Laser Particle Counter LPC 3753a S/N 1507 and a TSI CPC 3760 S/N 175 are available at Finokalia. Flow rates of both instruments where according to manufacturer specifications. Both counted zero particles/cc with an absolute filter attached.

***Nephelometer:***

Three Radiance Research Nephelometers are used at Finokalia. Two of the instruments are operated in the measurement container. One of these instruments is measuring dry aerosol scattering coefficient. The second instrument is measuring at quasi ambient humidity. The third instrument is placed outside to measurement container for inter-comparison with indoor humid Nephelometer. This third instrument exhibited a (known) offset of the zero measurements as shown in figure 10. Statistical parameters of the zero measurements with the three Nephelometers are summarized in table 1. To compensate for differences in the calibration slope of the three instruments long term correlation analysis is used. Results for such an analysis are shown in figures 11 and 12.

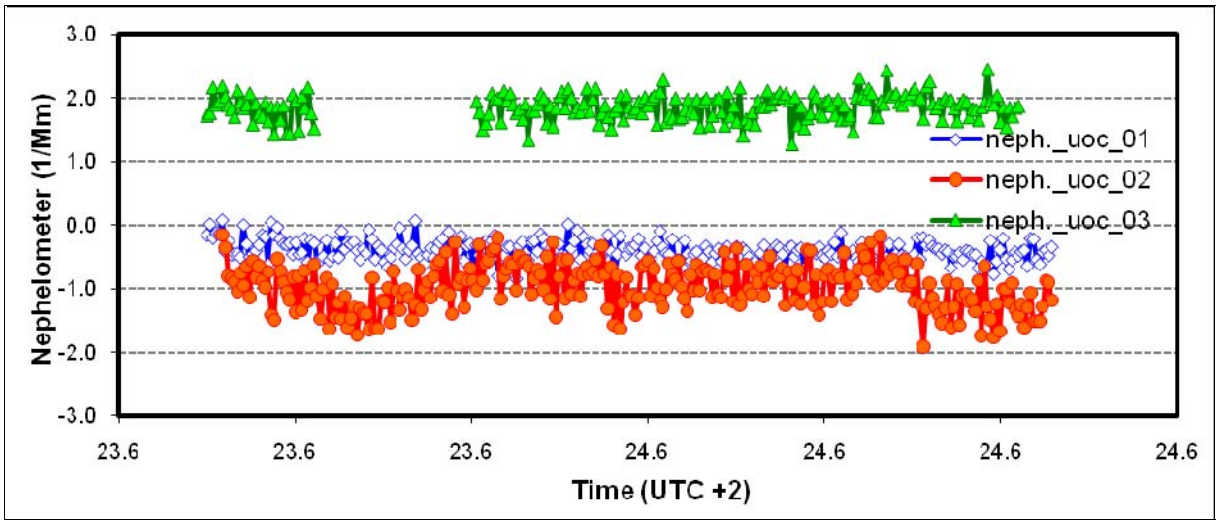


Figure 10: Measurements of all three Nephelometers at Finokalia with an absolute filter.

| | neph._uoc_01 Nephelometer (1/Mm) | neph._uoc_02 Nephelometer (1/Mm) | neph._uoc_03 Nephelometer (1/Mm) |
|---|---|---|---|
| Average | -0.40 | -0.97 | 1.86 |
| Median | -0.41 | -0.93 | 1.88 |
| Stdev | 0.16 | 0.35 | 0.20 |

Table 1: Statistical parameters of the zero measurements

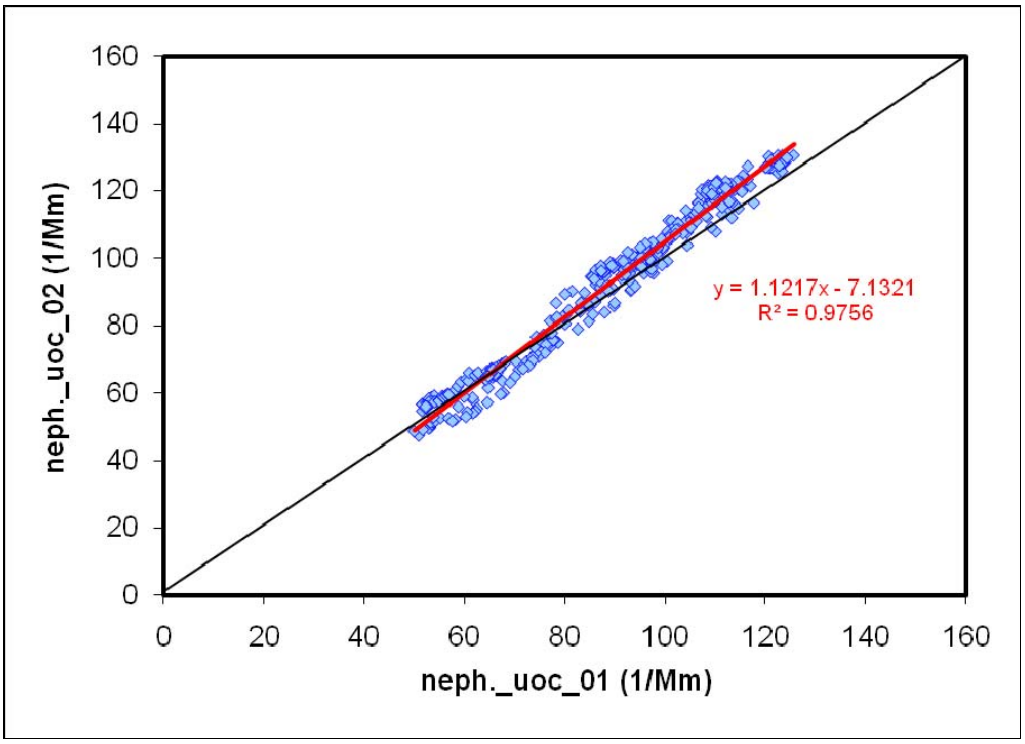


Figure 11: Correlation between Nephelometer 1 and 2.

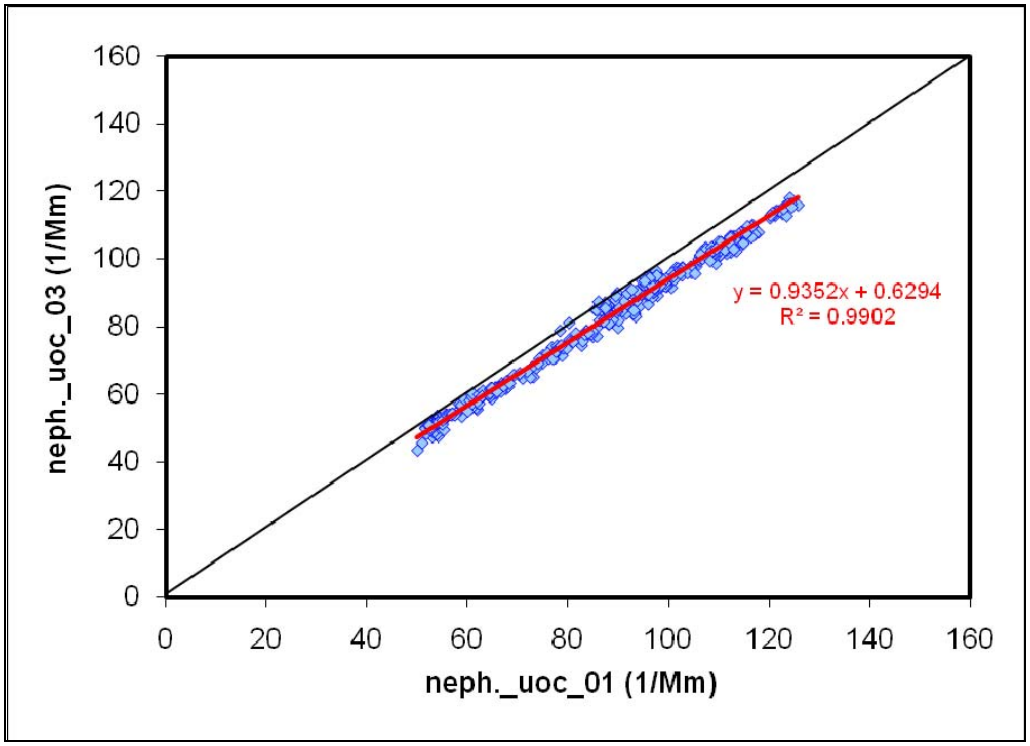


Figure 12: Correlation between Nephelometer 1 and 3.

Using these correlation functions to correct raw data all three Nephelometers are in good agreement as shown in figure 13.

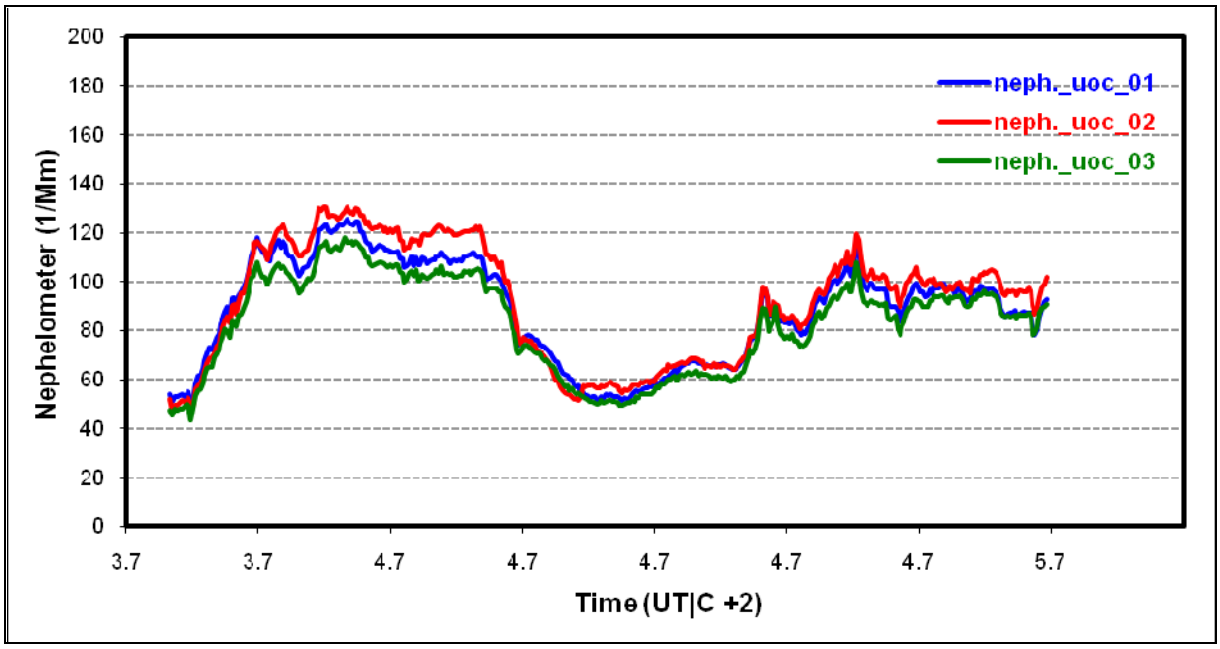


Figure 13: Paralle measuremen of all three Nephelometers at Finokalia

With respect to the non ideal instruments

**Nephelometers at Finokalia measure according to EUSAAR requirements.**

***Aethalometer:***

A Magee Scientific dual wavelength Aethalometer AE22 S/N 426:0307 is available at Finokalia for absorption measurements. At an indicated flow of 1.5 l/min we measured a 1.495 l/min. The instrument was run overnight with a zero filter attached (Fig. 14). During nighttime zero measurements are nominal, however before sunset and after sunrise the noise was increased. Reasons for this effect need to be further investigated in the future.

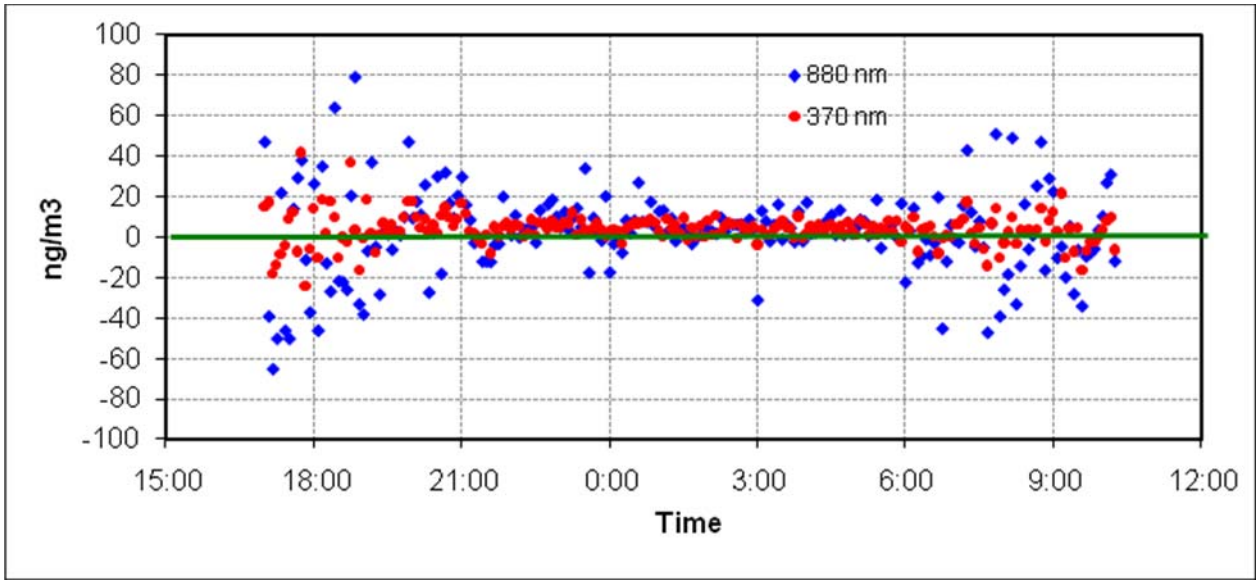


Figure 14: Time series of zero measurements with the Aethalometer at Finokalia

| | 880 nm ng/m3 | 370 nm ng/m3 |
|---|---|---|
| Average | 2.8 | 4.1 |
| Median | 4.0 | 4.3 |
| Stdev | 20.3 | 7.6 |

Table 2: Summary statistics of Aethalometer zero measurements.

***Summary:***

Finokalia is a valuable station within the EUSAAR network. It needs to be noticed that there still some room for improvement of measurements at the site necessary. On the other hand the responsible scientist had only finished his compulsory military service a few weeks prior to this audit leaving little time to improve measurements at the site after coming be. We are therefore confident that this station will provide good quality data in the future.

We wish to thank our hosts for the great hospitality encountered on Crete.