

Sunphotometry in the Netherlands and Suriname

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Introduction

The Royal Netherlands Meteorological Institute (KNMI) operates two sunphotometers: one in Cabauw in the Netherlands (52.0°N, 4.9°E) and one in Paramaribo in Suriname (5.8°N, 55.2°W). Both are of the type SPUV and are manufactured by Yankee Environmental Systems (YES). The instruments are mounted on Kipp & Zonen 2AP suntrackers.

The TNO Physics and Electronic Laboratorium (FEL) has two Cimel sunphotometers that are connected to the AERONET. In order to study the land-sea transition in aerosol optical properties, one of the instruments is close to Northsea coast (The Hague, 52.1N, 4.3E) and the other in Cabauw (50 km inland).

KNMI sunphotometers

The first sunphotometer mentioned above is situated at the Cabauw Experimental Site for Atmospheric Research (CESAR). This site is equipped with instruments for research of the atmosphere and its interaction with the land surface. The main product of the instrument, aerosol optical thickness (AOT), is used for process studies (interaction between radiation and aerosols) and for the construction of an AOT climatology for the centre of the Netherlands.

The central wavelengths of the SPUV in Cabauw are: 368, 501, 675, 780, 871 nm (and the water vapour channel 940 nm). A time series of 1-minute average of AOT and Ångström coefficient exists for the period 1997 – present (first in De Bilt, from 2003 in Cabauw). Cloudy data are filtered out on the basis of the cloud filter which is described by Harrison and Michalsky (1994). As an example, Figure 1 shows a histogram of the AOT at 501 nm for De Bilt, derived from 376 Langley regressions.

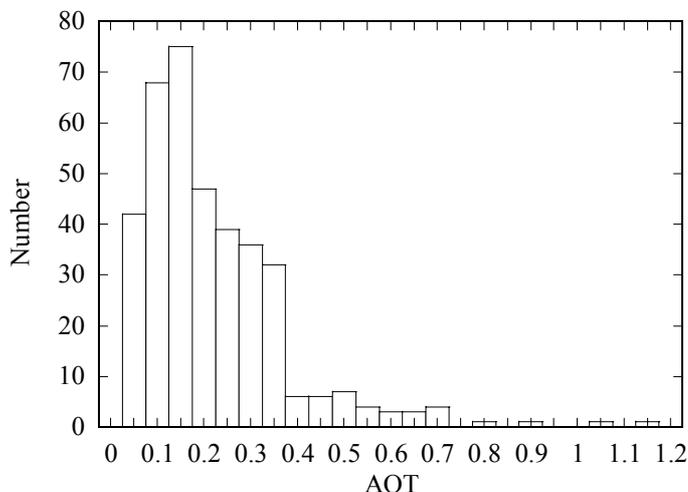


Figure 1: Number distribution of the AOT at 501 nm in De Bilt (20 km from Cabauw), the Netherlands, for the period 1997–2003. The aot values are derived from 376 morning Langley regressions. The mean, median, and standard deviation are 0.22, 0.18, and 0.16, respectively.

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Until 2003, Langley calibrations were performed on site. In order to improve the quality of the sunphotometer's calibration, it was placed at the High Altitude Research Station Jungfraujoch during the period August–November 2003 (Knap and Los, 2004). An example of the excellent Langley calibrations that were obtained is shown in Figure 2. The residuals are almost all within $\pm 0.1\%$ of the instrument signal; this percentage corresponds to the instrument's resolution.

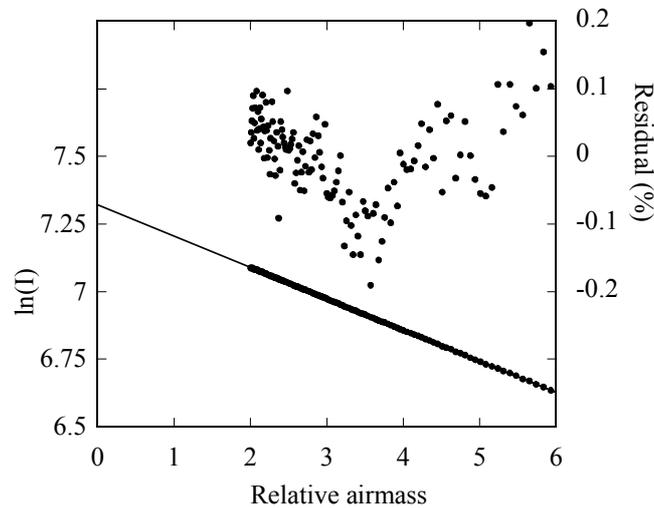


Figure 2: Langley plot derived from direct solar irradiance measurements made at Jungfraujoch on 20 September 2003. The wavelength is 501 nm. The scattered points indicate the differences between the measurements and the fit, relative to the instrument signal.

Figure 3 shows all Langley calibrations for the 501 nm channel that were performed in both the Netherlands and at Jungfraujoch. The figure demonstrates clearly what is generally known: the scatter in the extraterrestrial constants determined at high altitude is substantially smaller than at sea-level and the high-altitude measurements pin down the Langley calibration of the sunphotometer.

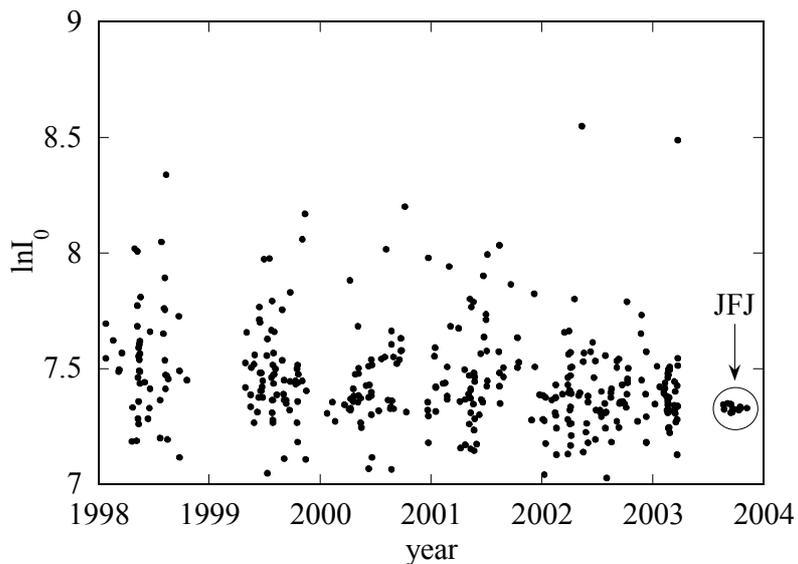


Figure 3: Extraterrestrial constants for the 501 nm channel of the SPUV. All points, except the JFJ (Jungfraujoch) cluster, correspond to measurements made at sea level in the Netherlands (De Bilt).

The second SPUV sunphotometer operated by KNMI is situated at the MDS (Meteorological Service of Suriname) in Paramaribo and is also of the type SPUV (central wavelengths: 366, 494, 670, 815, 1033 nm). The location of the site is in the outskirts of Paramaribo, which is located in the north of Suriname, near the Atlantic coast. Again the products are 1-minute averages of AOT and Ångström coefficient. Clouds are filtered out by the same algorithm that is used for the Cabauw measurements. So far, Langley calibrations have been performed on site and a time series of AOT exists from the end of 2002 until present. An intercalibration using the well-calibrated sunphotometer of Cabauw is considered.

Related instruments

As mentioned before, the Cabauw site is equipped with instruments for research of the atmosphere and its interaction with the land surface. The following instruments or measurements are relevant to aerosol research:

- Basic radiation measurements according to the BSRN standards
- 1064 nm backscatter lidar (operated by National Institute for Public Health and the Environment (RIVM))
- Aerosol in situ instruments (operated by TNO-FEL and Energy research Centre of the Netherlands (ECN))
- Raman lidar (under construction by RIVM)

The Paramaribo site is equipped with radiation instruments similar to those in Cabauw. In the future a Raman lidar will be installed by the Alfred-Wegener-Institut (AWI), initially for a limited period of time.

Summary

KNMI operates two YES SPUV sunphotometers; one in Cabauw, the Netherlands and one in Paramaribo, Suriname. Time series of the standard products, AOT and Ångström coefficient, are available to the community for the periods 1997 – present (De Bilt/Cabauw) and 2002 – present (Paramaribo). The Cabauw sunphotometer has been calibrated at the High Altitude Research Station Jungfraujoch, Switzerland, in the autumn of 2003. It is planned to continue on routine basis our sunphotometer measurements in Cabauw and Paramaribo.

The TNO Physics and Electronic Laboratorium (FEL) has two Cimel sunphotometers connected to the AERONET. In order to study the land-sea transition in aerosol optical properties, one of the instruments is close to Northsea coast (The Hague) and the other in Cabauw (50 km inland).

The Cabauw Experimental Site for Atmospheric Research (CESAR) is equipped with instruments for research of the atmosphere and its interaction with the land surface. Part of the instrumentation is focused on the research of the direct and indirect aerosol effects. Further information can be found on: <http://www.cesar-observatory.nl>.

References

- Harrison and Michalsky. 1994. Objective Algorithms for the Retrieval of Optical Depths from Ground-Based Measurements, *Appl. Opt.* **33**, 5126-5132.
- Knap, W. H., A. Los. 2004. Sunphotometry at the High Altitude Research Station Jungfraujoch. International Foundation HFSJG Activity Report 2003.