

WMO CIMO Testbed for Aerosols and Water Vapour Remote Sensing Instruments (Izaña, Tenerife)

Mid-term Summary Report of the activities carried out from January to June 2017

June 28th, 2017

1. Design, development and testing of a new low-cost and robust zenith-looking multi narrow-band radiometer for AOD retrieval.

A look-up table methodology for aerosol optical depth (AOD) retrieval from zenithal sky radiance has been developed and applied to AERONET Cimel sunphotometers from Santa Cruz de Tenerife, Izaña and Tamanrasset (Algeria) validating the results against AERONET AOD. The methodology has been applied to a new low-cost and robust zenith-looking multi narrow-band radiometer developed in collaboration with SIELTEC S.L. company (<http://www.sieltec.com.es/>). Estimated AOD with the new prototypes provided good results when validated against reference AOD from AERONET. These results have been published in Almansa et al., 2017.

Full reference of the paper:

Almansa, A. F., Cuevas, E., Torres, B., Barreto, Á., García, R. D., Cachorro, V. E., de Frutos, Á. M., López, C., and Ramos, R.: A new zenith-looking narrow-band radiometer-based system (ZEN) for dust aerosol optical depth monitoring, *Atmos. Meas. Tech.*, 10, 565-579, doi:10.5194/amt-10-565-2017, 2017.

2. The Izaña Testbed site supporting different field campaigns of radiation/aerosols prototypes

The Izaña Testbed site has been used for different field campaigns of radiation/aerosols prototypes, such as the new Precision Solar Spectroradiometer (PSR), developed at PMOD/World Radiation Centre (WRC, Davos Switzerland), which will replace current filter sunphotometers for long AOD and absolute solar irradiance measurements. This instrument has been absolutely calibrated at Izaña and compared with other reference photometers. Preliminary stellar measurements have also been performed.

A new low-cost sun tracker for Calitoo hand-held sunphotometer from Tenum has been tested at Izaña. New firmware of the Calitoo is being validated at Izaña using AERONET masters as references.

3. The First Lunar Lunar Photometry Campaign and Izaña-2017 Workshop

Between June 1st and 17th, a Lunar Photometric Campaign was host at the Atmospheric Observatory of Izaña. In addition, on June 7th and 8th , a workshop on the same theme was held at the observatory. These events were organized by the Izana Atmospheric Research Center (IARC) and the Atmospheric Optics Group of Valladolid University (GOA-UVa) in the framework of the WMO-CIMO Testbed for Aerosols and Water Vapour Remote Sensing Instruments of the World Meteorological Organization.

The objective of this campaign was to intercompare the instruments and procedures currently being used to determine the aerosol optical thickness at night, which mainly using the moon as a reference. This campaign involves the Izana Atmospheric Research Center, the Atmospheric Optics Group of Valladolid University, the Photons group of the University of Lille, France, the World Radiation Center (PMOD/WRC) in Davos, Switzerland, the Institute of Atmospheric Sciences and Climate of Italy, the French company CIMEL électronique, manufacturer of the CE318T photometers used in the AERONET network, the company SIELTEC Canarias, manufacturer of the SONA All-Sky camera, the German Deutscher Wetterdienst, the Atmospheric Physics Group of the University of Granada and Astrophysics Institute of the Canary Islands. These last two groups participate with instruments that use stars instead of the Moon to determine the aerosol optical thickness. The IARC also has a micro-pulsed Lidar capable of providing aerosol information at night.

4. AERONET-Europe quality assurance linked to the PMOD-WRC international reference

A comprehensive AERONET/WRC-PFR long-term AOD comparison assessment has been performed and final results have been obtained in the first semester of 2017. The main objective of this study is to provide consistent, detailed and accurate information on the degree of agreement between AERONET-Cimel and GAW-PFR observations. For this, a long-term intercomparison Cimel/AERONET - PFR/GAW at Izaña in the period January 2005 - November 2014 (10 years) has been performed in collaboration with PMOD-WRC using 1' minute simultaneous Cimel-PFR AOD data at 500 and 870 nm channels. A total of 15 Cimel sunphotometers and 3 PFR were used during this period. Preliminary results indicate that more than almost 95% of 1-minute AOD differences at 500 and 870 nm (more than 81,000 data in each channel) fell within the AOD 95% uncertainty limits defined by WMO. Statistics of the traceability and possible explanations to non-traceable data have been investigated. This stud sill is in press as an AEMET's Technical

note (Romero-Campos et al.) and as a scientific paper in an international journal is being prepared.

5. Assessment of nocturnal Aerosol Optical Depth at high altitude. Refinement of the Izaña's RObotic Lunar Observatory (ROLO) model outputs

We have studied the evolution of AOD at nighttime in 61 clean and stable nights at Izaña high mountain observatory, according to extinction vertical profiles from a Micropulse lidar installed in a nearby coastal station. We detected a significant bias with moon's phase and zenith angles, especially in longer wavelength channels. Working under the assumption of stable AOD conditions, we have parameterized this residual dependence in nocturnal AOD in terms of moon's phase and zenith angles through an empirical regression model. Our results show AOD at nighttime is significantly corrected, with averaged errors < 0.01 , below the CE318-T photometer precision.

This improvement of Izaña's ROLO outputs permits to obtain more accurate calibrations and AOD observations during the night period. A scientific article explaining the main results has been published in Barreto et al. (2017) in AMT in discussion

The full reference of the paper is:

Barreto, Á., Román, R., Cuevas, E., Berjón, A. J., Almansa, A. F., Toledano, C., González, R., Hernández, Y., Blarel, L., Goloub, P., and Yela, M.: Assessment of nocturnal Aerosol Optical Depth from lunar photometry at Izaña high mountain Observatory, Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-423, 2017.