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Development of an open source package for the processing of sun-sky photometric data in the European Skyrad Users network (ESR)

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The European SkyRad users network (ESR) is a joint initiative from the Institute of Atmospheric and Climate Sciences (ISAC) at the National Research Council (CNR) in Italy, the Group of Solar Radiation (GRSV) at the University of Valencia (UV) in Spain, and the Plymouth Marine Laboratory (PML) in the United Kingdom. It was started as a Protocol of Agreement between the three institutions, in 2003. The main objective was to collaborate on the improvement of some technical aspects of the Skyrad.pack algorithm. Currently the network is addressed at European research groups that are users of sun – sky photometers and mainly focus their research on the study of atmospheric aerosols and their application to remote sensing or climatological studies.

There exist well known international networks such as AERONET (Aerosol Robotic Network) or SKYNET (SKYrad NETwork, in Asia) but they have some characteristics that actually prevent many European research groups to get involved with them. These limitations mean that a number of European groups are working independently, with no coordination. The resultant databases are not made public or the employed methodology is not homogeneous. In turn, it means that a great amount of data is being lost for critical regional studies in Europe.

One of these limitations is related to the supported instrumentation. International networks usually adopt a given model of sun photometer as a standard. The ESR is a multi instrumental network using both Prede POM and Cimel CE318 sun – sky photometers.

Another limitation is related to the calibration. In the case of AERONET, a centralized and stringent calibration protocol is adopted. This protocol is designed in order to offer a well tracked and quality assured calibration and data elaboration; it is in fact the key stone for the homogeneity of the network results. But centralization raises other problems. The instruments must be periodically sent every 6 – 12 months to United States or France; therefore, 1) the instrument absence generates considerable data gaps, 2) it is also a chance for equipment damage during the transport, and 3) the proprietary group must cope with the economical cost of these international insured deliveries. Moreover, the protocol constrains the network capability to handle a large amount of instruments. In fact, AERONET is very reluctant at the moment to accept new sites in Europe. ESR has developed an improved version of the Langley plot technique (SKYIL) that allows the users to perform a continuous in situ calibration. Previous results show that the obtained uncertainties in the calibration factors (1.0 – 2.5%) are very similar to the uncertainty values for field instruments in AERONET (1.0 – 2.0%).

A third difference that could make ESR more appealing to some European research groups is related to the algorithms itself. The core inversion code (Skyrad.pack), the calibration codes and all the automatization scripts are free open source codes that can be further customized by the users. Therefore, an advanced user could easily access and modify the algorithms for new improvements.

As a conclusion, the ESR users network has been conceived as a flexible network and collaborative platform for European groups whose main research is focused on atmospheric aerosols characterization and model development. The package we have developed for the network is an open source product that is available for public use, both for Cimel CE318 and Prede POM instruments.