“GOAC: Contributing to TEMPO”

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Brief History:

1988 - 1997

Soviet LD-2 Stratospheric Lidar Installed & operated at Camagüey, Cuba

Bull. Amer. Meteor. http://dx.doi.org/10.1175/BAMS-D-11-00149.1

Describes history of GOAC (CLS-Camagüey Lidar Station).

GOAC Philosophy:

- Full cycle research
- Measurement-QC
- Interpretation
- Application for Atmospheric Research
Welcome to the Optic's Atmospheric Group of Camagüey

The Atmospheric Optics Group of Camagüey (GOAC from its Spanish name) has its origins in the research group initially formed to study stratospheric aerosols, the Camagüey Lidar Station (CLS), from which took its original name. The natural development of the group is part of the working strategy designed in the early 90’s of last century. That strategy was oriented to the assimilation of knowledge and know-how for conducting research on solar radiative transfer processes in the physical geographical conditions of our country and region. Its execution has enabled the group to continue the research on solar radiation transfer processes while it is beginning to provide scientific and technical services of high added value.

The general goal GOAC is:

"The study of radiative transfer processes in the atmosphere to the conditions of our country."

It consists of two specific goals:

- To characterize, through instrumental observations, the factors involved in the processes of radiative transfer in the atmosphere in the conditions of our country. (Aerosols, clouds, etc.) Water Vapor too!!
- To characterize the processes involving the above factors using instrumental observations and numerical simulation.

Part of the Camagüey Meteorological Center
Belongs to the INSMET (Cuban Meteorological Institute)
Sun photometer operated jointly by GOAC & GOA-UVA (Universidad Valladolid, España) contributing from 2008 to AERONET (NASA).
GPS for Water Vapor Measurements:

May 2014: A team of atmospheric and geodetic scientists from UNAVCO and the University Corporation for Atmospheric Research (UCAR) sent and helped set up a global positioning system (GPS) receiver to measure atmospheric water vapor at the Grupo de Óptica Atmosférica de Camagüey (GOAC) at the Camagüey Meteorological Center in Camagüey, Cuba.

Obtaining permission from both sides to send a highly sensitive instrument from the United States to Cuba was not easy.
Solar Radiation Data Rescue at Camagüey, Cuba
by Juan Carlos Antuña, Aramis Fonte, René Estevan, Boris Barja, Roberto Acea, and Juan Carlos Antuña Jr.

Although global-scale digitized climate information is abundant, in some countries a considerable amount of information remains in paper records. These valuable records are at risk of being lost forever. Several ongoing efforts are preserving data at risk of deterioration by digitizing them into computer-compatible form for easy access. In a 2004 bulletin article, Page et al. described the following main challenges in such data rescue projects: decaying paper records, missing data (because of damage by improper storage, natural disasters, station operations suspensions, etc.), lack of funds, and the use of obsolete technologies. Although that particular article addressed the situation in Southeast Asia and the South Pacific, the challenges are common to the entire world.

Here we describe the ongoing project for rescuing the solar radiation measurements dataset collected at Camagüey, Cuba. The data have been collected over a period of more than 30 years. Like many of the current meteorological and climatic records in Cuba, these data are only stored on paper, which inhibits various applications. For instance, the need to update procedures for information analysis was one of the barriers to the development of solar energy applications identified by the Cuban report to the Solar and Wind Resource Assessment.

Because of the lack of funding for computer equipment, we have developed a low-cost data rescue design. It is based mainly on using old, out-of-service PCs and involves key-entering software in FORTRAN running under MS-DOS, though the use of state-of-the-art PCs is also possible. Engaging the complete research cycle is fundamental to Cuban science philosophy, and thus to the Camagüey Lidar Station team, so we have also gone further than just rescuing the original observations. The project also has involved developing the software for processing the observations, controlling quality, and improving the original manual processing.

### Table 1. Instruments used at Camagüey Meteorological Center for solar radiation measurements.

<table>
<thead>
<tr>
<th>Instrument models</th>
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<tbody>
<tr>
<td>Actinometer M-3</td>
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<tr>
<td>Pyranometer M-80-M, M-115-M</td>
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<tr>
<td>Balanometer M-10-M</td>
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<td>Galvanometer GSA-1MA, GSA-1MB</td>
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Usually, meteorological data rescue projects in less developed countries have been led and supported by international organizations and/or institutions from developed countries. The main reason for this is the lack of funding in the less-developed countries and sometimes a lack of local “know how.” In this case, we demonstrate an alternative approach with very few material resources, optimizing both the local technical expertise and scarce material resources.

We believe such low-cost projects in less-developed countries can complement the internationally supported data rescue projects that use state-of-the-art technology.

### SOLAR RADIATION MEASUREMENTS.

Measurements at Camagüey Meteorological Station (21.4°N, 77.9°W, 122 m ASL) began in 1966. The manually operated Yantsevsky actinometric instrumentation was provided by the Hydrometeorological Service of the former Soviet Union. Sensors from this station type operate based on the thermoelastic principle. Similar instruments (see Table 1) have collected valuable broadband solar radiation datasets in other

First publication ever by Cuban scientists in BAMS.
Solar Radiation Diagnostic Service

Evolution:

Data Rescue

Rescued:
Camagüey: 1970 - 2014
Jovellanos: 2010 - 2014
La Fe: 2012 - 2014
Topes Collantes: 2011 - 2014
Casablanca: ---
GOAC Online Services:

Solar Radiation Diagnostic Service for Cuba

http://www.goac.cu/actino/

Broadband Optical Depth Service for Cuba (Aerosol & aerosol+cloud)

http://www.goac.cu/seoc/

Real time Meteorological Information for Camagüey (From GPS Met/Station)

Muchas Gracias.