

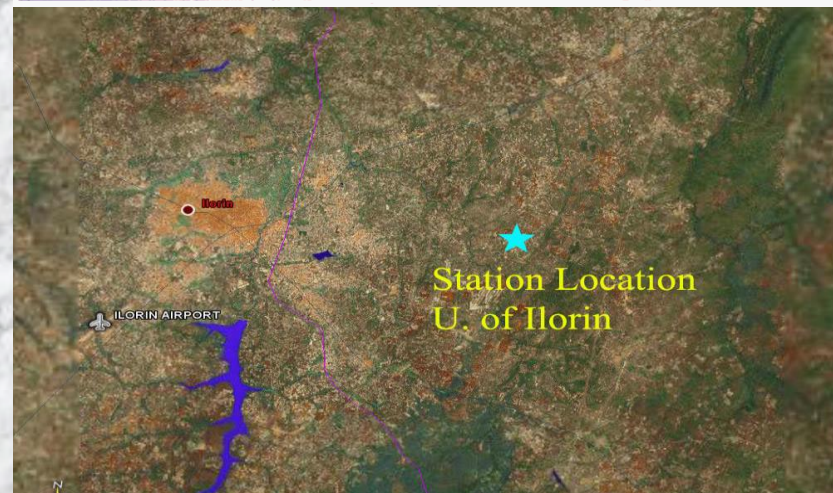
A BSRN Station in a Developing Country: Need, Challenge, Effort and Progress

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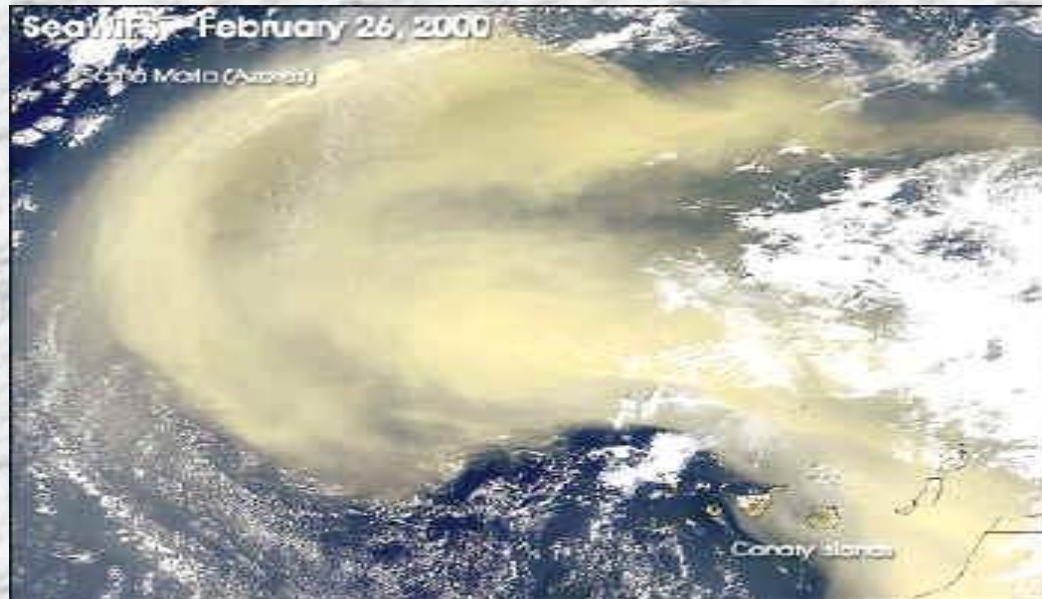
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14th BSRN Workshop
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Canberra, Australia

Motivation for Observations

- Need for high quality observations of climate parameters in regions that are **affected by biomass burning** and **dust outbreaks**. Observations are needed for accurately estimating effects of such events on **surface radiative fluxes**.
- The Ilorin site has a long history of monitoring geophysical parameters required for understanding climate change and for providing basic information for a wide range of environmental applications.



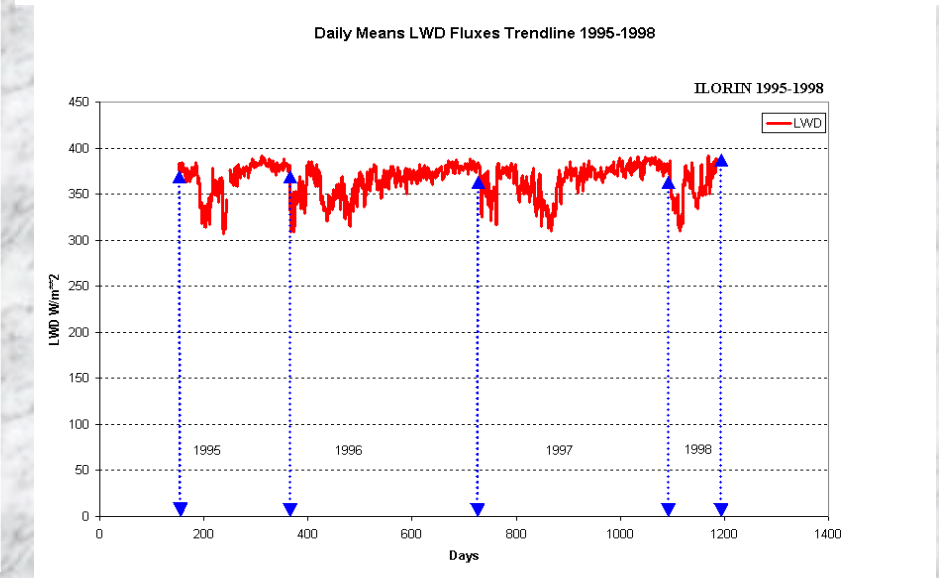
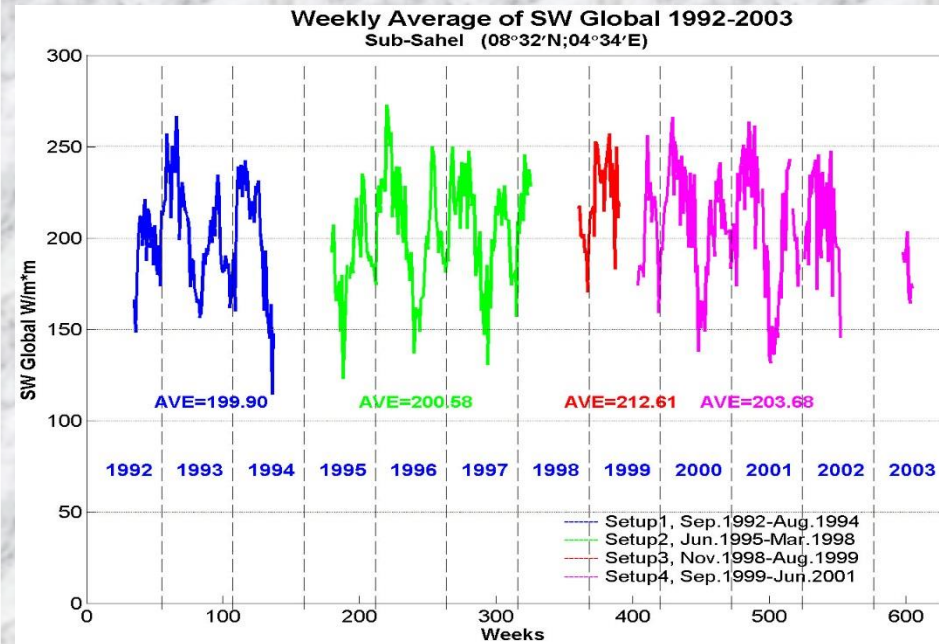
A massive sandstorm off the northwest African desert blankets hundreds of thousands of square miles of the eastern Atlantic Ocean with a dense cloud of Saharan sand.

Image Courtesy: SeaWiFS project: image acquired February 26, 2000

Station History

Year	Measurements
1992	Total global, PAR, LW down
1997	Direct and diffuse SW, Air temperature, Relative Humidity, Wetness, Pressure
1998	Sunphotometer Cimel, Solar tracker, Rain gauge, Microtops: water vapor, aerosols, ozone
1999-2006	Addition of wind speed and direction
1999-2005	Periodic visits by UMD personnel for recalibration, and maintenance
1997-present	Continuing Measurements
2014-present	Sunphotometer Cimel Air quality

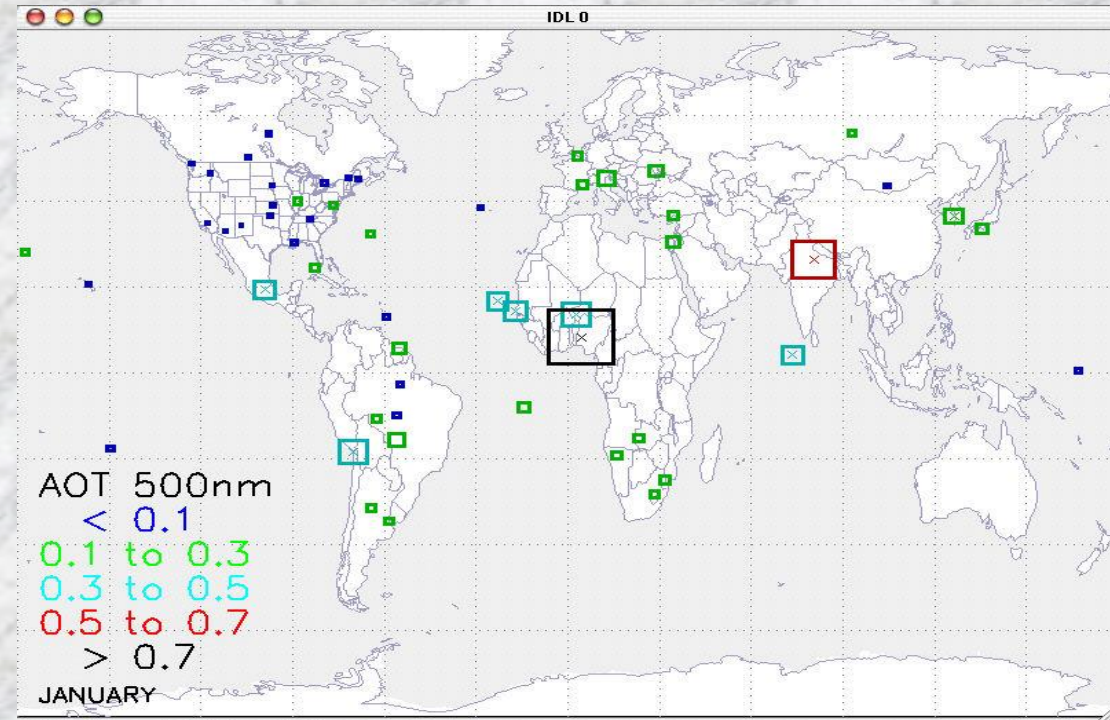
Sample Results of SW and LW Radiative Fluxes at Ilorin



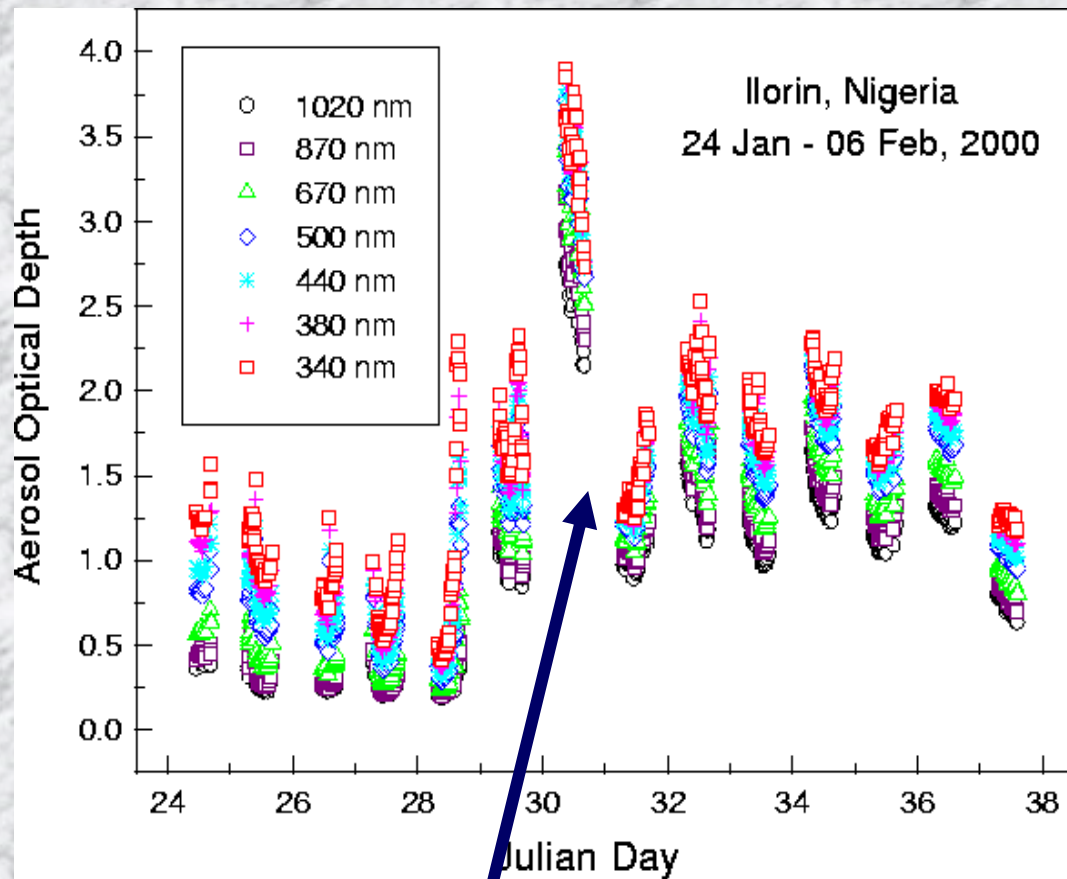
Aerosol Measurements Ilorin has highest aerosol optical depth measured at AERONET Sites

Part of AERONET-Aerosol Robotic NETwork, a ground-based observational and research-enabling program designed to characterize the properties of aerosols in a vertically integrated column with sufficient accuracy to validate satellite-based aerosol retrievals from EOS satellite platforms.

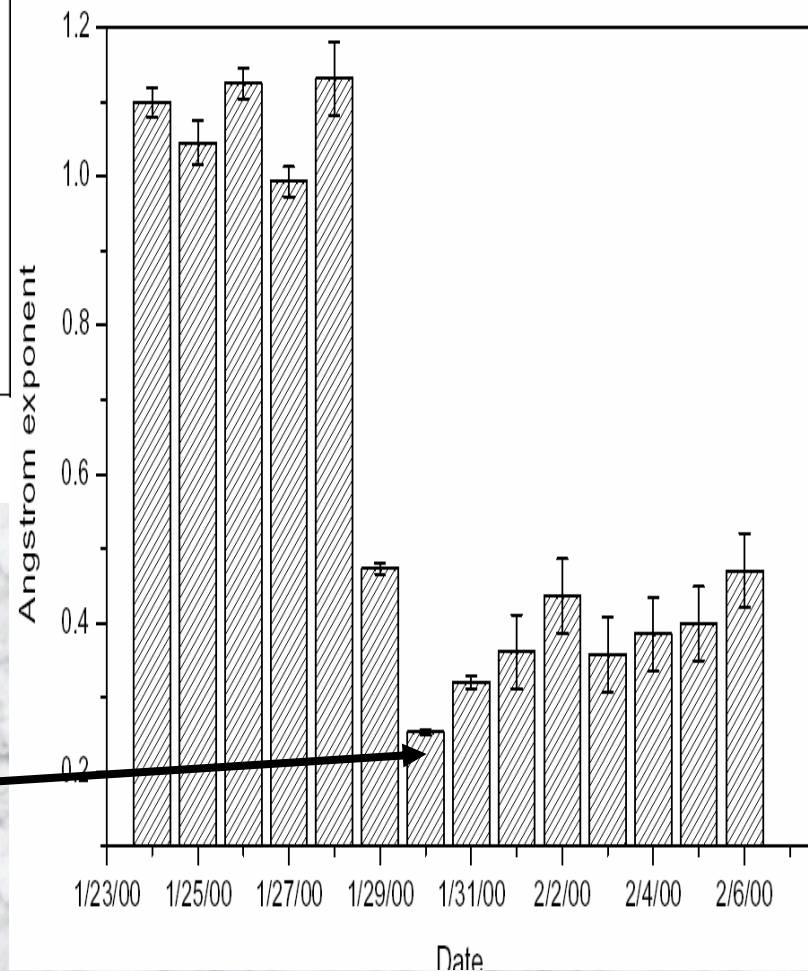
All instruments are calibrated to a NASA Goddard reference radiometer. AERONET stations continuously transmit data to Goddard Space Flight Center via satellite links, the AERONET program provides processing in real time to the all instruments in the AERONET federation.



Color coded distribution of measured AOT (blue < 0.1, green 0.1 to 0.3, light blue 0.3 to 0.5, red 0.5 to 0.7 and black >0.7).



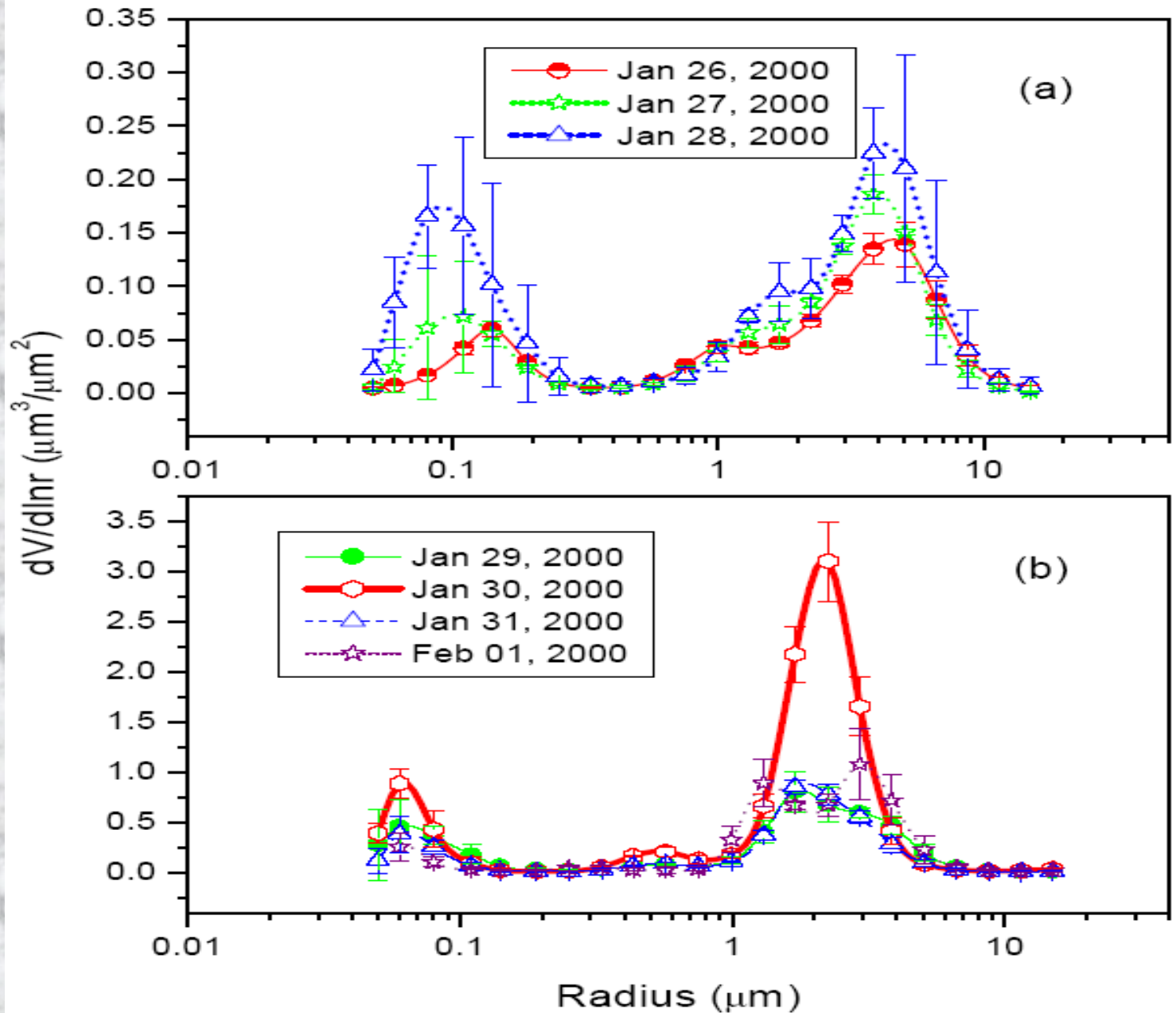
After dust outbreak,
drastic drop in
Angstrom Exponent-
large particles



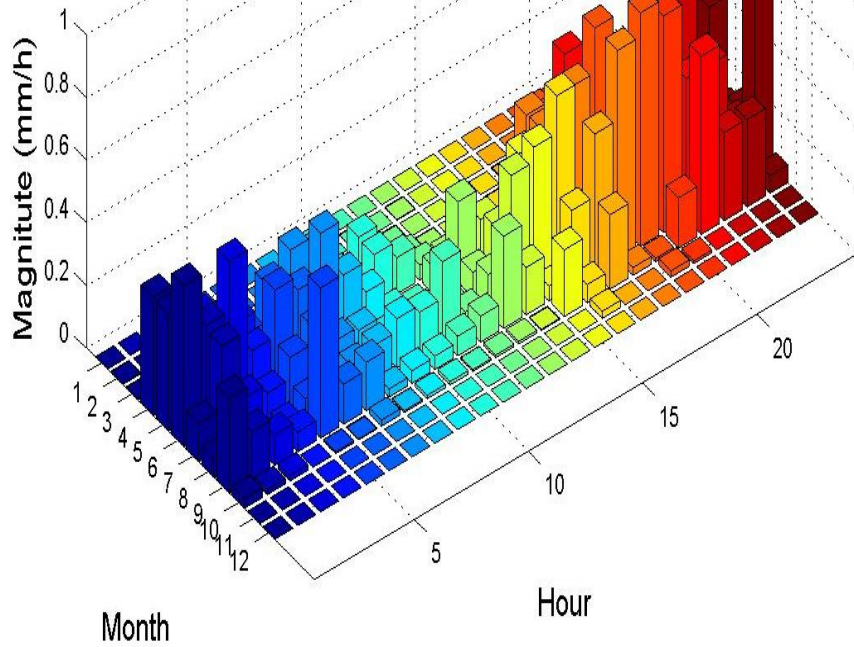
Size distribution before dust outbreak

Size distribution after dust outbreak

Order of magnitude increase

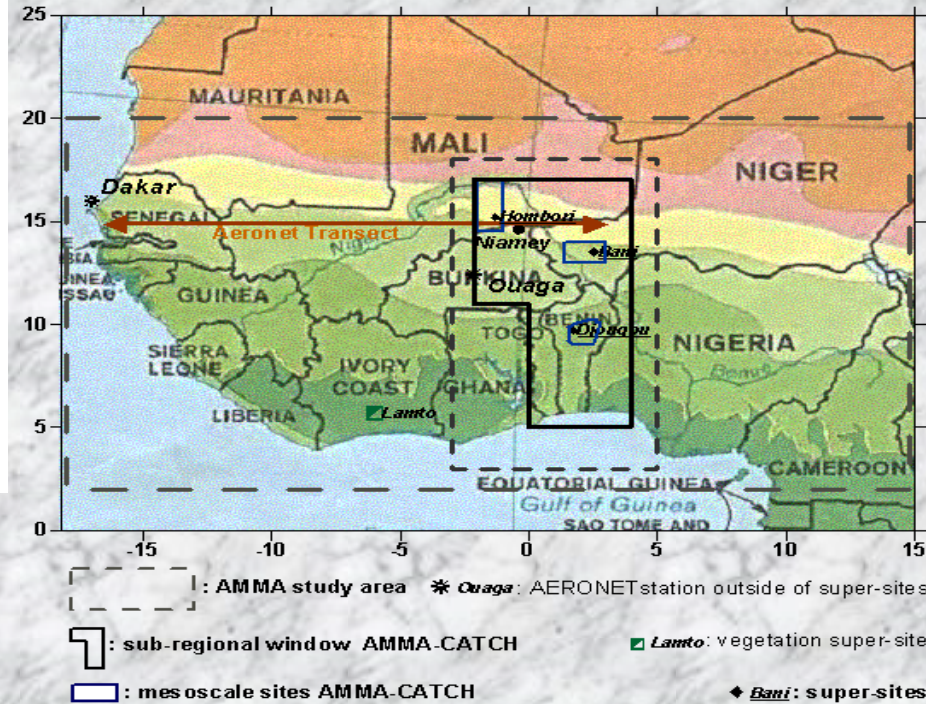


The region designated for the African Monsoon Multidisciplinary Analysis (AMMA) Experiment



Average rainfall at a certain hour of a certain month during 10/1998-Dec 2003

Pinker, Zao, Akoshile, Janowiak, Arkin, 2006. Geophysical Research Letters, Vol. 33, L07806, doi:10.1029/2005GL025192



Aerosol Observations at Ilorin are contributed to the AMMA Archive

Challenges

- ❖ Electrical Power Supply - provided by “Power Holding Company of Nigeria” is unstable; contributes to failures of measuring instruments.
- ❖ No remuneration for staff that maintains station. No steady source of local funding to ensure continuity of operation.
- ❖ Need for advanced training of local personnel
- ❖ Unstable Internet Connectivity

Effort and Progress

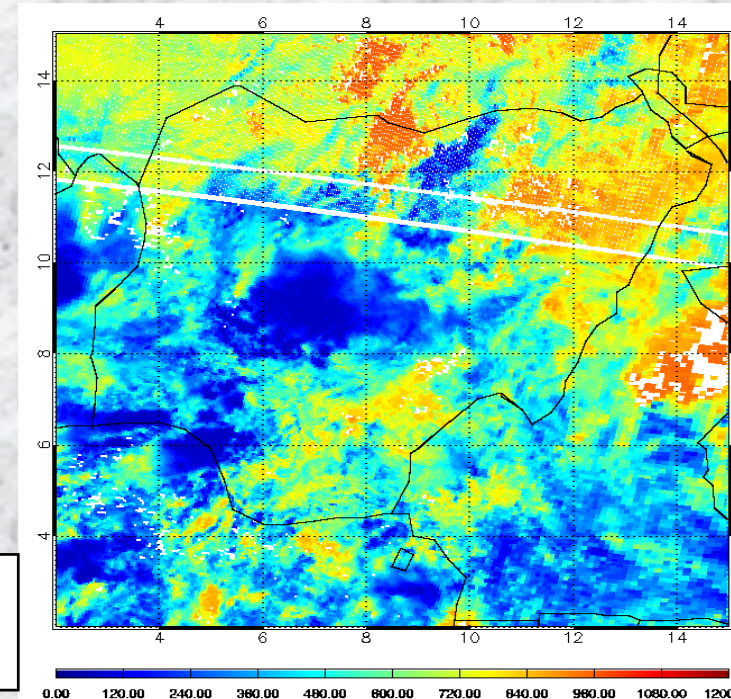
- ❖ The University of Ilorin is in agreement with the Power Holding Company for priority power supply.
- ❖ The University has purchased several heavy duty diesel powered generators to help during power disruptions.
- ❖ Solar panels added to charge the Cimel sunphotometer and Air Sampler.
- ❖ Data transmission is now via Internet.
- ❖ Training: Students are being trained at B. Sc., M. Sc. and Ph.D. levels using data from the Ilorin site; some have joined the University of Ilorin and others are employed in other academic institutions in Nigeria.



Collaborative Agreements in Place

- In response to an invitation from the Secretary General of WMO, Geneva, Switzerland, to the Director, Nigerian Meteorological Services and with the strong support of the Vice Chancellor of the University of Ilorin, a collaborative agreement between University of Ilorin and the Nigerian Meteorological Services has been established.
Under this agreement, the Nigerian Meteorological Service *should* be actively involved in supporting the observational activity at the University of Ilorin. It is hoped that such collaboration will be of mutual benefit and help the Ilorin station reach a BSRN status.
- About 2 years ago, the site was adopted by the SPARTAN network (Randall Martin, Department of Physics and Atmospheric Science, Dalhousie University) to conduct research in the area of atmospheric composition, relevant to climate change, air quality and health, and is, in conjunction with developing a global network to evaluate and enhance satellite-based estimates of ground-level aerosol for global health applications known as Surface PARTiculate mAtter Network (SPARTAN). A memorandum of agreement has been signed.
- ❖ Memorandum of understanding has been signed with the Centre for Atmospheric Research (CAR) of National Space Research and Development Agency (NASRDA); limited assistance is provided.

Surface $SW\downarrow$ Flux (W/m^2) from MODIS
TERRA, July 4, 2001 using the UMD scheme.



Additional Scientific Activity at Ilorin

A Magnetic Data Acquisition System (MAGDAS) was installed in the Physics Department of the University of Ilorin in August 2006 by the Space Environment Research Centre (SERC) of Kyushu University, Japan, under the framework of the International Heliophysical Year (IHY).

The University is well suited for magnetic measurement because of nearness to the magnetic equator. Since August 2006, good quality ground based magnetic field measurements are available for space research.

An IPS 42 Ionosonde equipped with a Digital Binary Decoder (DBD) installed in conjunction with the Abdulsalam International Centre for Theoretical Physics (ICTP), Trieste, Italy for ionospheric measurements; in place since 2001 and continuing.

Staff at Physics Department, University of Ilorin

Atmospheric and Solar Radiation Measurements, ionospheric studies and magnetic field studies are conducted with the help of experienced technicians who have managed the radiation observation at the station. They include:

C. O. Akoshile (*Station Manager*), I. A. Adimula, J. O. Adeniyi, A. A. Wiloughby, O. A. Falaiye, T. B. Ajibola, T. Adewole, O. Okunlola and O. Oloruntoba.

Selected uses of Ilorin data: Barcelona Dust Forecast Center

In May 2013, the Sixty-fifth Session of the WMO Executive Council (EC-65) designates the consortium formed by the Spanish State Meteorological Agency (AEMET) and the Barcelona Supercomputing Center (BSC-CNS) to create in Barcelona the first Regional Specialized Meteorological Center with activity specialization on Atmospheric Sand and Dust Forecast (RSMC-ASDF): doc EC-65-d04-3(1). The Center shall operationally generate and distribute predictions for Northern Africa (north of equator), Middle East and Europe.

<http://dust.aemet.es/about-us/barcelona-dust-forecast-center>

Ilorin, Nigeria is one of the evaluation sites.

Selected publications that used data from Ilorin Site

1. Pinker, R. T., Idemudia, G., and Aro, T. O., 1994. Characteristic Aerosol Optical Depths During the Harmattan Season on Sahara Africa. *Geophys. Res. Lett.*, 21, (8), 685-688.
2. Holben, B. N., D. Tanre, A. Smirnov, T. F. Eck, I. Slutsker, N. Abuhassen, W. W. Newcomb, J. Schafer, B. Chatenet, F. Lavenue, Y. J. Kaufman, J. Vande Castle, A. Setzer, B. Markham, D. Clark, R. Frouin, R. Halthore, A. Karnieli, N. T. O'Neill, C. Pietras, R. T. Pinker, K. Voss, G. Zibordi, 2001. An emerging ground-based aerosol climatology: Aerosol Optical Depth from AERONET. *J. Geophys. Res.*, Vol. 106, No. D11, 12,067-12,097.
3. Smirnov, A., B. N. Holben, T. F. Eck, I. Slutsker, B. Chatenet and R. T. Pinker, 2002. Diurnal variability of aerosol optical depth observed at AERONET sites. *Geophys. Res. Lett.*, 29 (23), 2115, doi:10.1029/2002GL016305.
4. Nwofor O. K., Chineke T. C., Pinker R. T., 2007. Seasonal characteristics of spectral aerosol optical properties at a sub-Saharan site. *Atmospheric Research*, 85, 38-51.
5. Pinker, R. T., Liu, H, Osborne, S. R., and C. Akoshile, 2010. Radiative effects of aerosols in sub-Sahel Africa: Dust and biomass burning, *J. Geophys. Res.-Atmos.*, 115, Article Number: D15205.

[See attached list of manuscripts that used Ilorin data \(over 50\).](#)