# The First AERONET Site in the sub-Sahel

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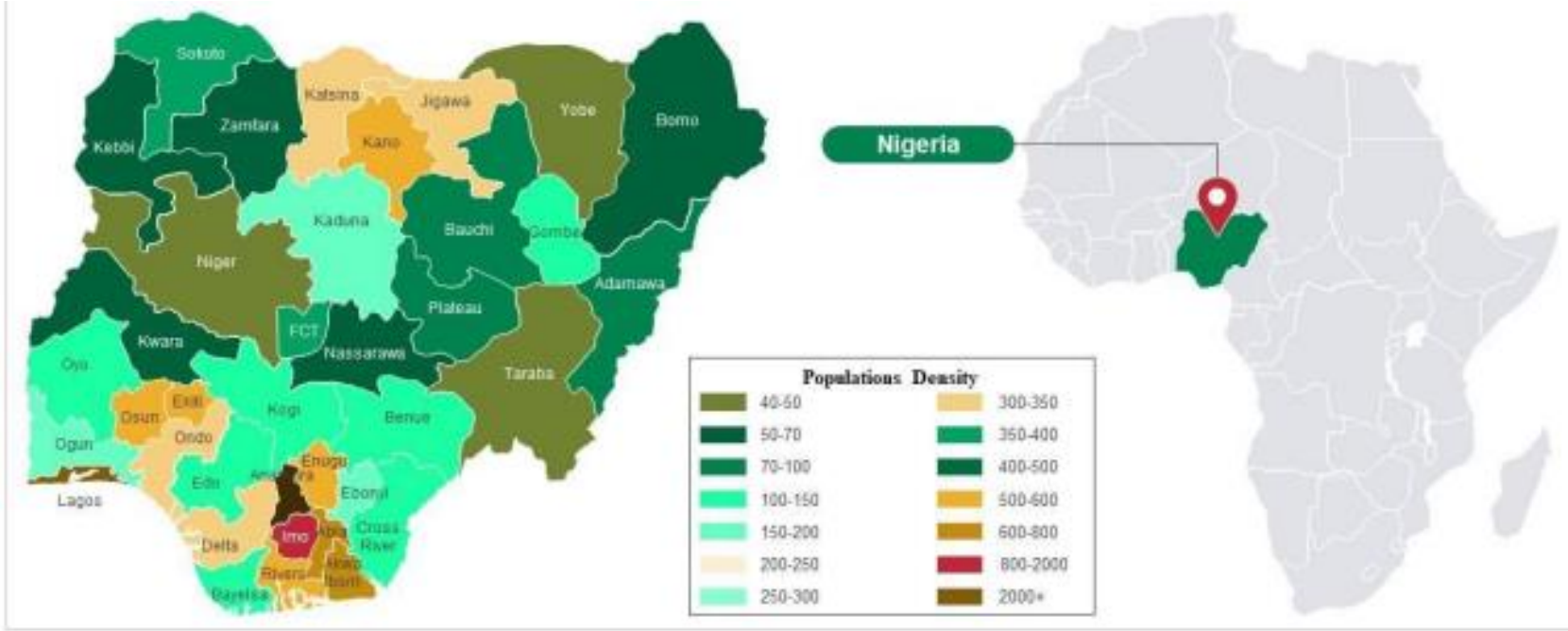
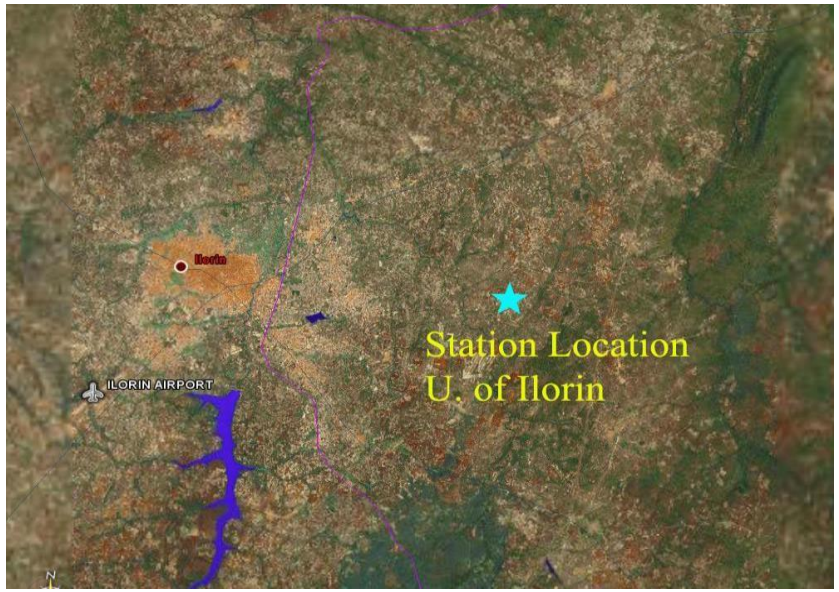



Population: 232,679,478
Growth Rate: 2.10 %
GDP per capita: 2,460
Capital Abuja: 3,840,000



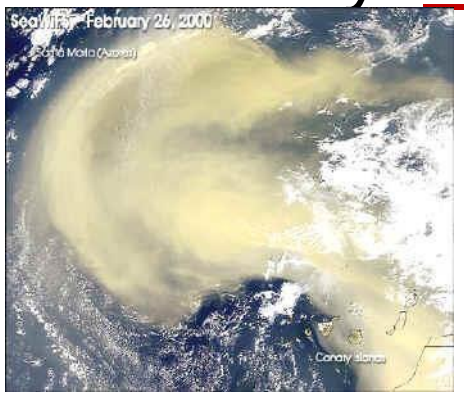

**The Ilorin Station is located on the Campus of the University of Ilorin, Nigeria.**

AERONET Science and Application Exchange 2024
September 17-19, 2024
UMD Alumni Center, 7801 Alumni Dr., College Park, MD 20742

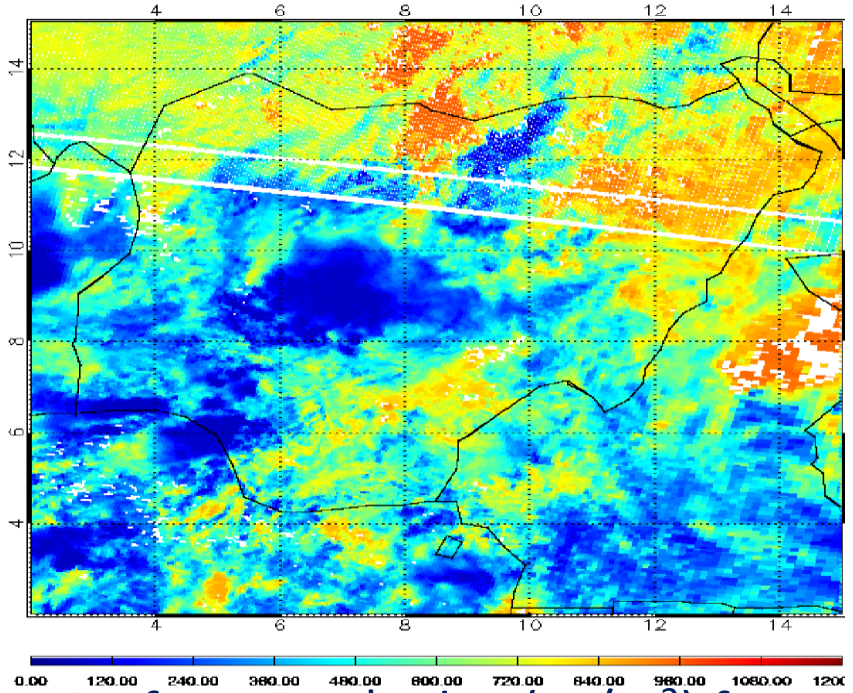
# History of the Ilorin Site

- Established around 1997 under support from the NASA EOS Validation Program to the University of Maryland
- Continues to operate under the AERONET umbrella
- Station Managers: T. O. Aro (First), C. O. Akoshile (Second), I. A. Adimula (Designate)

Objective: Obtain high quality observations of *climate parameters* in a region that is affected by dust outbreaks and biomass burning.




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. Courtesy: SeaWIFS




Surface SW↓ Flux ($W/m^2$) from MODIS TERRA, July 4, 2001 .

# Will Review:

1. Use of data in research by scientific community
2. Use of data in support of major projects in Africa
3. Establishment of collaborative Research Agreements with numerous agencies
4. Training of students
5. Challenges and a wish list.

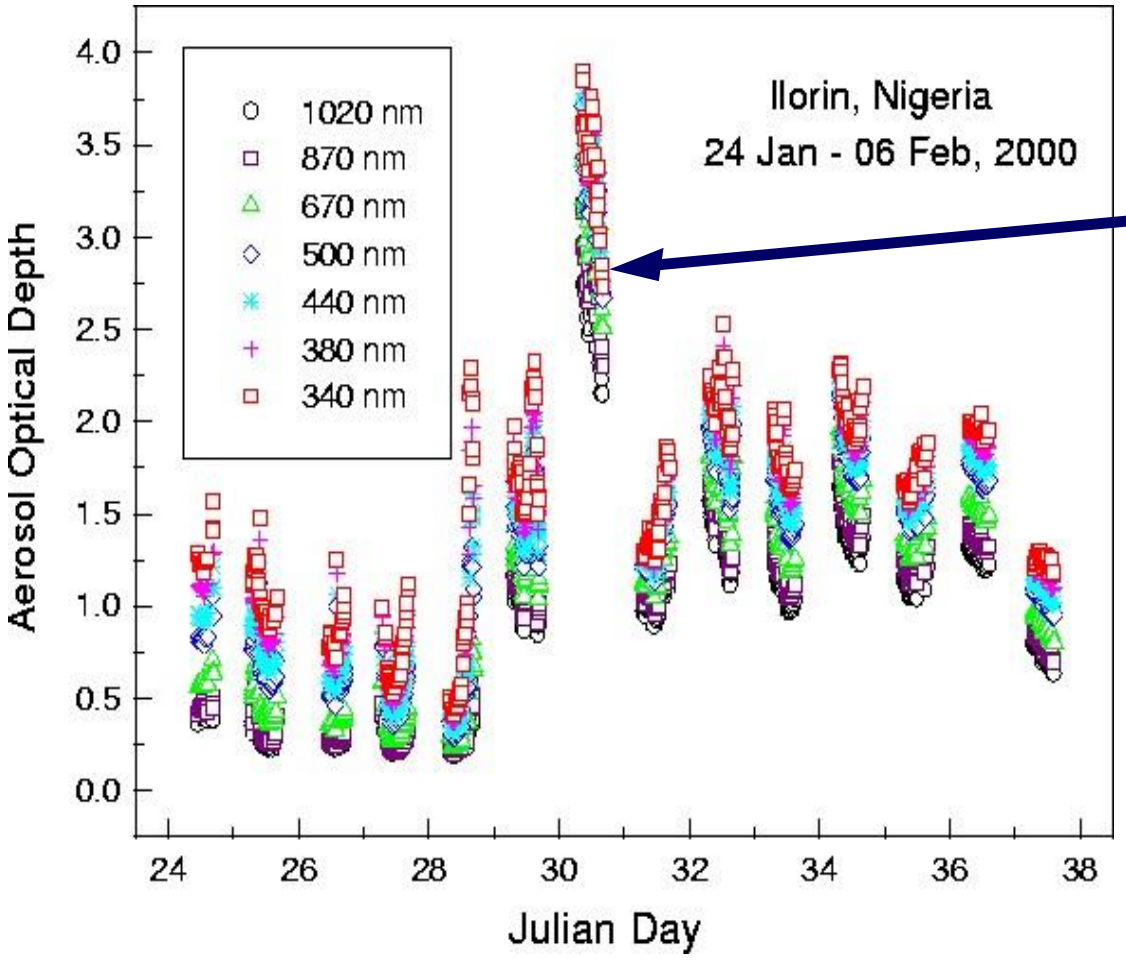

# 1. Use of data in research by community

Scene at Ilorin under clear sky and dust outbreak.

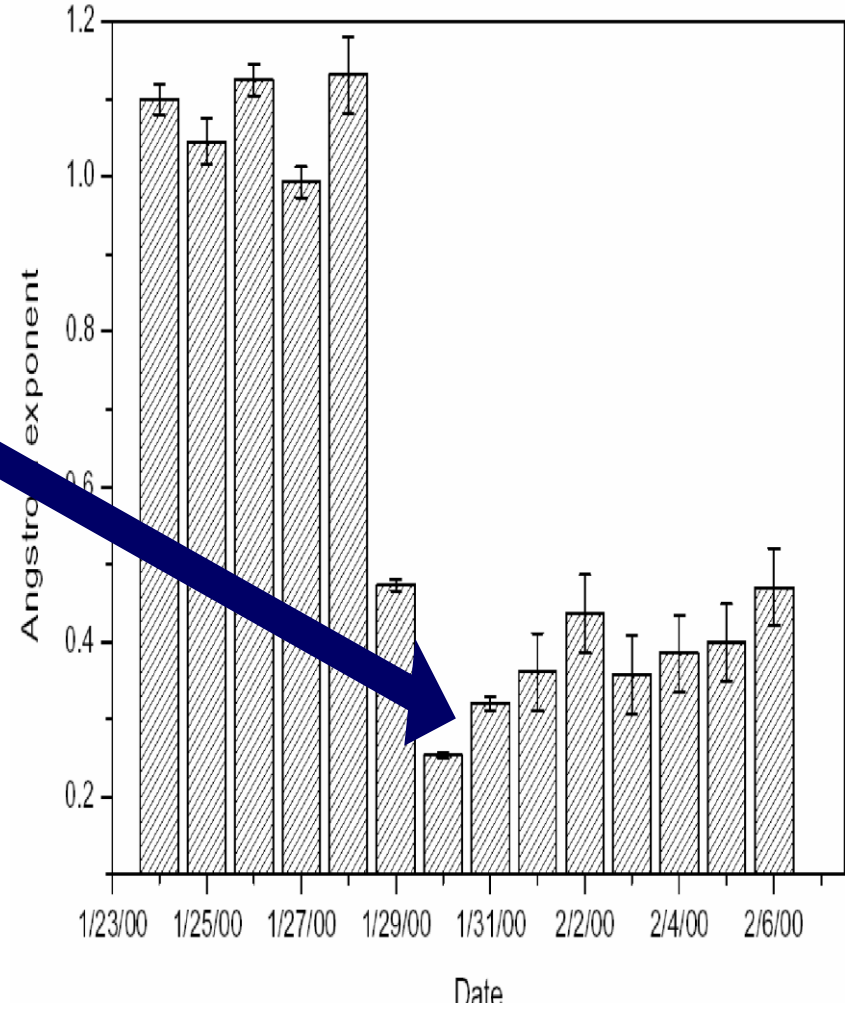
How does a dust outbreak impact aerosol composition?

# 1. Use of data in research by community

## Impact of Saharan dust outbreak on aerosol composition




After dust outbreak drastic **drop** in Angstrom Exponent- Large Particles

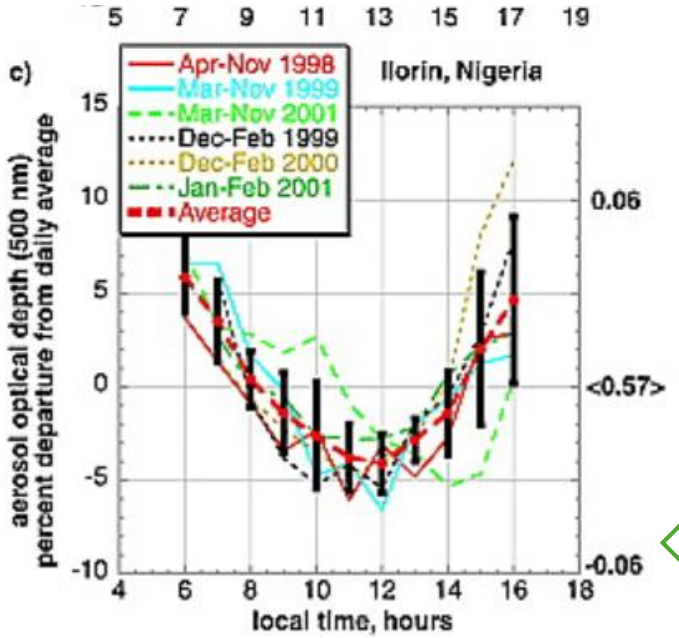



Pinker, R. T., G. Pandithurai, B. N. Holben, O. Dubovik, and T. O. Aro, 2001. A dust outbreak episode in sub-Sahel West Africa. J. Geophys. Res., 106, No. D19, 22,923-22,930.

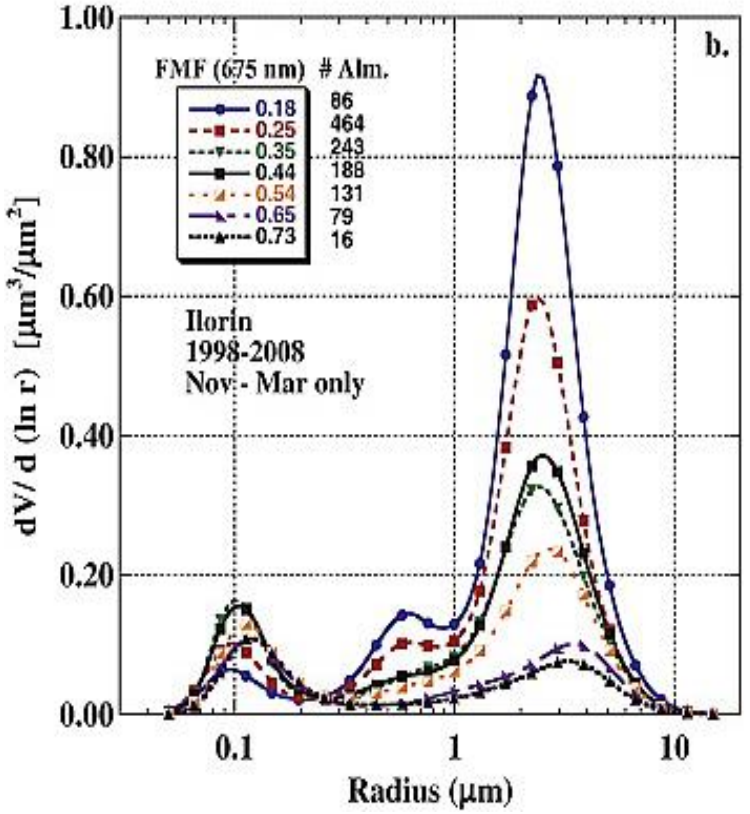
# 1. Use of data in research by community

Eck et al. (2010) studied the mixture of savanna biomass burning aerosols (fine mode) with desert dust from the Sahara and Sahel regions (coarse mode) (among others).

It was found that **the fine mode biomass burning aerosols in West Africa are much more absorbing** than the fine mode aerosols (primarily fossil fuel and biofuels) from industrial




Smirnov et al. (2002)



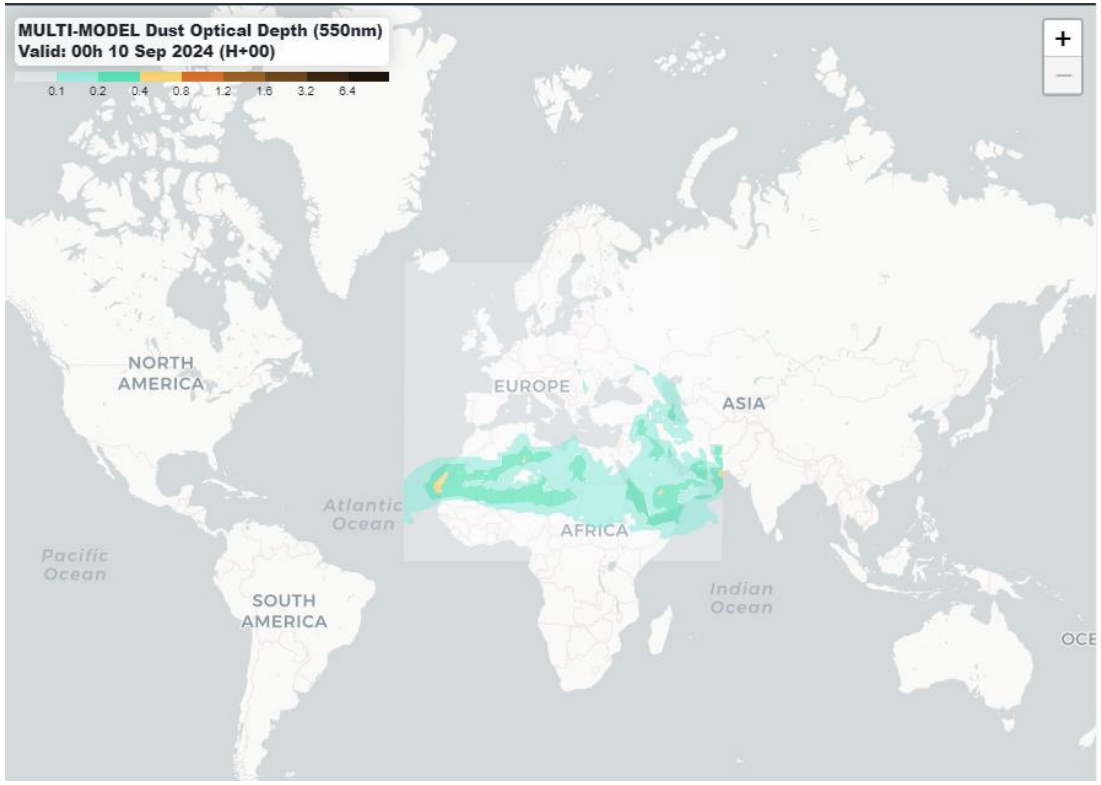

Aerosol volume size distribution at Ilorin.


- Eck, T. F., B. N. Holben, A. Sinyuk, R. T. Pinker, P. Goloub, H. Chen, B. Chatenet, Z. Li, R. P. Singh, S. N. Tripathi, J. S. Reid, D. M. Giles, O. Dubovik, N. T. O'Neill, A. Smirnov, P. Wang, and X. Xia, 2010. Climatological aspects of the optical properties of fine/coarse mode aerosol mixtures. J. Geophys. Res.-Atmos., 115.
- 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.

# 2. Use of data in support of major projects in Africa

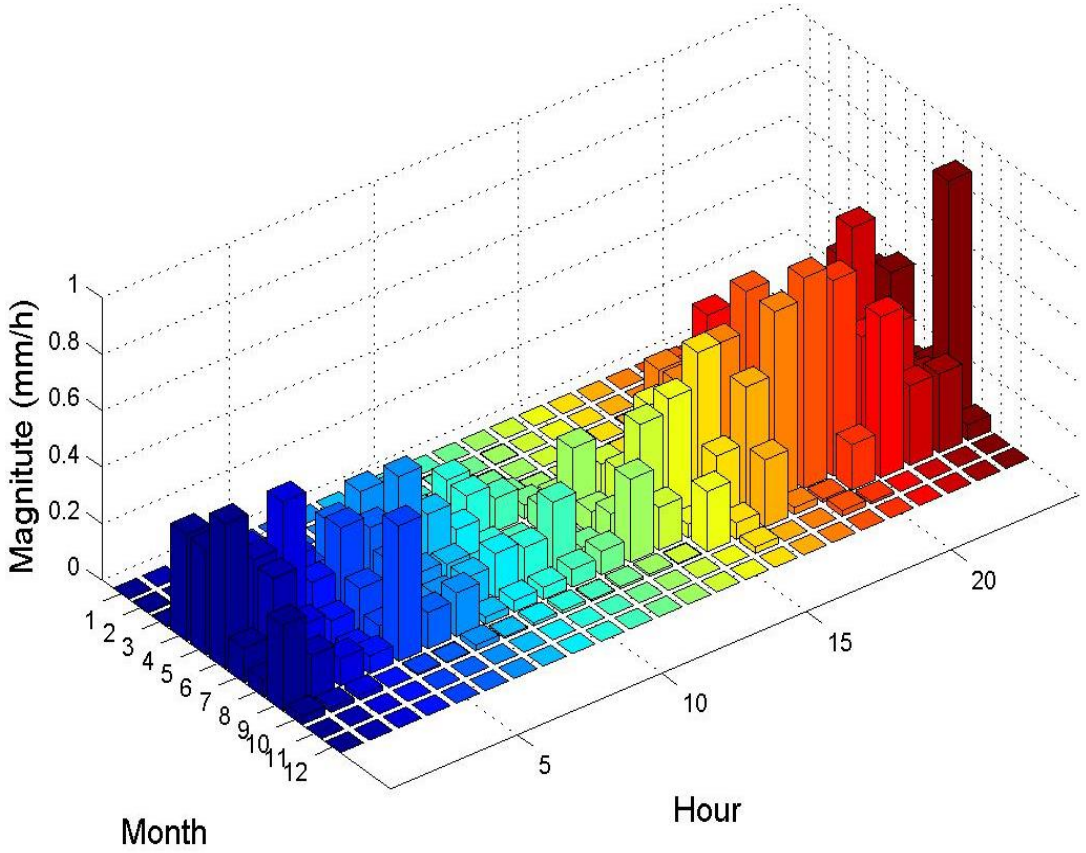
- In 2013, the World Meteorological Organization (WMO) created in Barcelona the first Regional Specialized Meteorological Center on Atmospheric Sand and Dust Forecasts.

- The Dust Regional Center coordinates the research activities and operations of the (WMO) Sand and Dust Storms Warning Advisory and Assessment System (SDS-WAS) in Northern Africa, the Middle East, and Europe and provides access to available dust products.




Ilorin data are used in this product.

# 2. Use of data in support of major projects in Africa

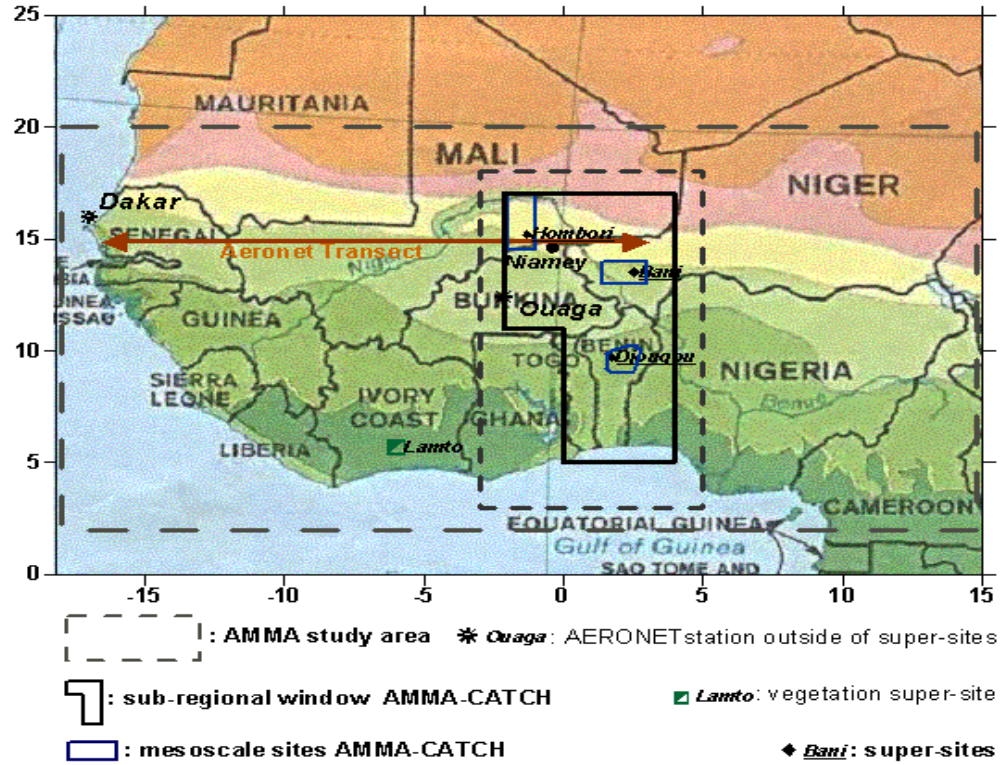



## Ilorin Rainfall Distribution 10/1998-12/2003

Rainy Season between April to October and dry (Harmattan) from November to March.

Pinker, Zao, Akoshile, Janowiak, Arkin, 2006. Geophysical Research Letters, Vol. 33, L07806.

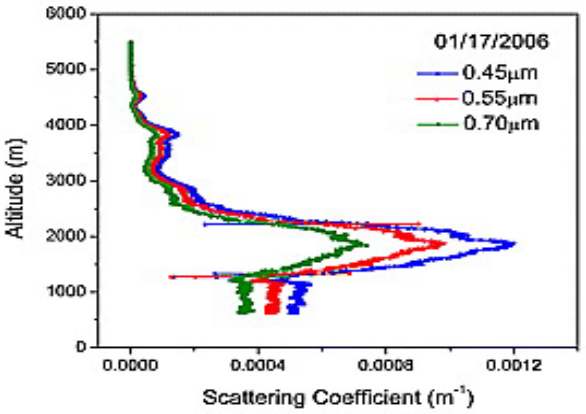
The region designated for the African Monsoon Multidisciplinary Analysis (AMMA) Experiment

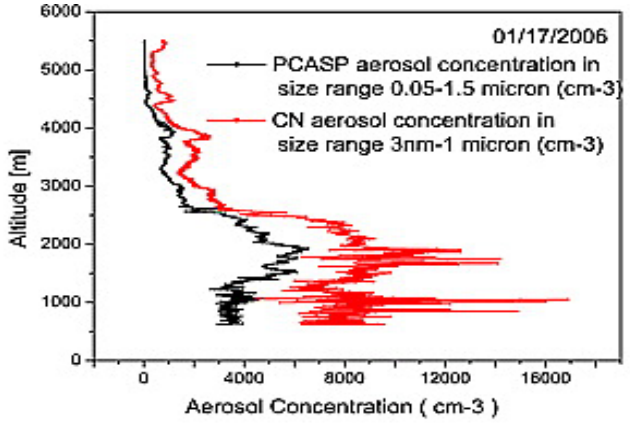


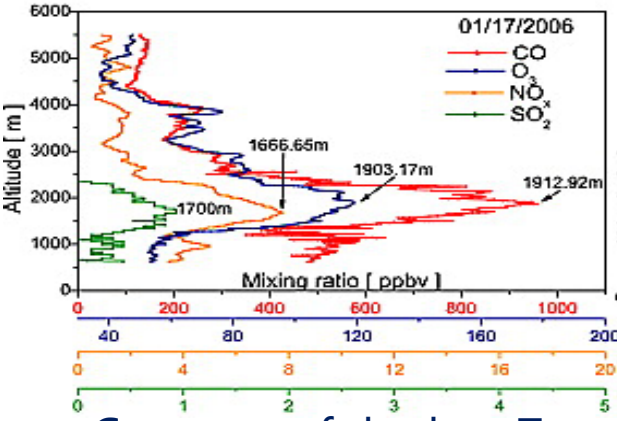

Aerosol Observations at Ilorin were contributed to the AMMA Archive

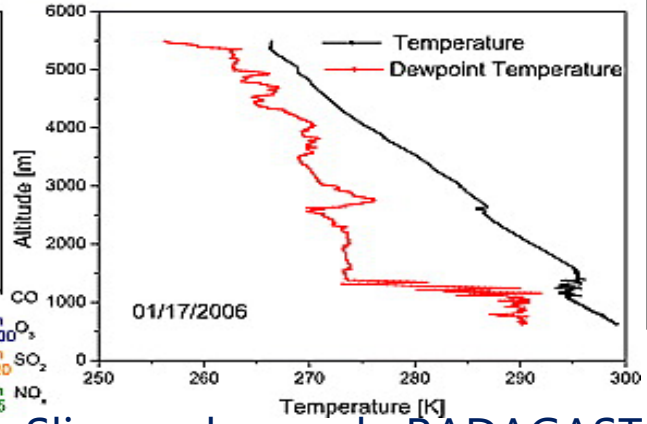
# 2. Use of data over Ilorin from independent experiments

Unique observations of aerosol vertical profiles were made in support of the Radiative Atmospheric Divergence Using ARM Mobile Facility Gerb and Amma Stations (RADAGAST) during a campaign in Niamey, Niger with the participation of the Facility for Airborne Atmospheric Measurement (FAAM) of the U. K. Met Office.




Courtesy of the late Tony Slingo who made RADAGAST happen and extended the Niamey flights over Ilorin.

In the framework of the RADAGAST activity numerous flights were conducted and some extended close to the observing station located at Ilorin, Nigeria.

Using vertical aerosol information improves the estimation of surface radiative fluxes from satellite observations.


Pinker, R. T., H. Liu, S. R. Osborne, C. Akoshile, 2010. Radiative effects of aerosols in sub-Sahel Africa: Dust and biomass burning. JGR-Atmosphere. https://doi.org/10.1029/2009JD013335.

# 3. Establishing Collaborative Research Agreements

- In response to an invitation from the Secretary General of WMO to the Director, Nigerian Meteorological Services (NIMET) a collaborative agreement between University of Ilorin and the Nigerian Meteorological Services has been established.

  Under this agreement, NIMET should be actively involved in supporting the observational activity at the University of Ilorin.

- Memorandum of understanding has been signed with:
  - The University of Maryland
  - The Centre for Atmospheric Research (CAR) of National Space Research and Development Agency (NASRDA).
- The site was adopted by the Surface PARTiculate mAtter Network (SPARTAN) (*Randall Martin*) to conduct research on atmospheric composition, air quality and health. These observations will help to evaluate and enhance satellite-based estimates of ground-level aerosols for global health applications.

# 4. Training of students

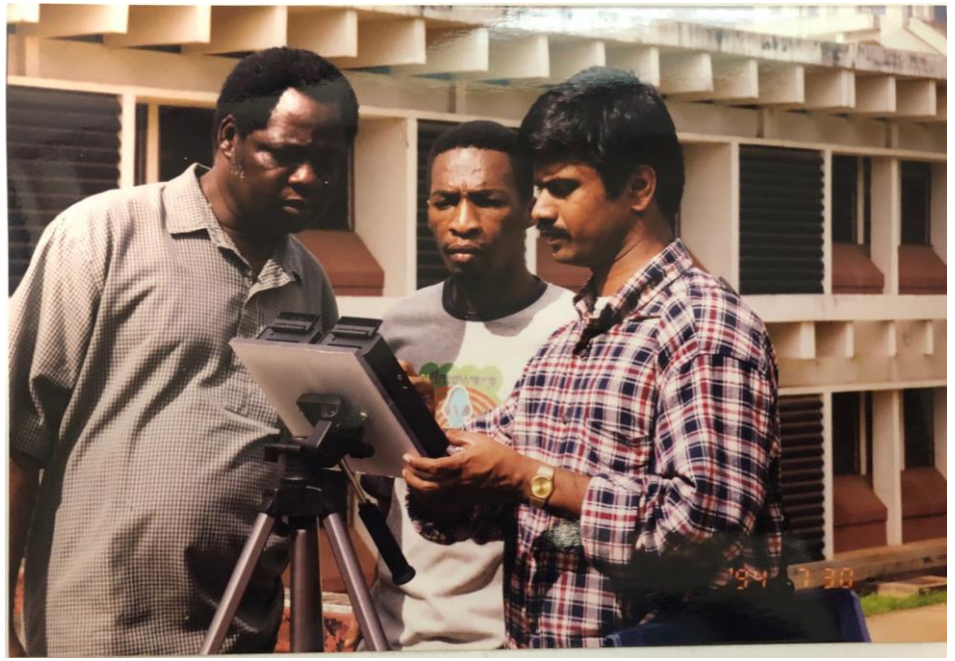
- ❖ University of Ilorin Students have been trained with AERONET data at the MS and Ph. D levels.
- ❖ Sister Universities and the Center Atmospheric Research of Nigeria Space Agency Development Authority (NASRDA) have sent students for training,
- ❖Some graduates have joined the University of Ilorin and others are employed in other academic institutions in Nigeria and contribute to generate awareness on environmental issues in Nigeria.

Selected Research Topics:

- Air Quality and Dust (Health Effects) (Falaiye et al. 2013)
- Agriculture (Aquatic and Plant Bio-diversity) (Babatunde et al. 2009)
- Climate Change (Radiative Fluxes) Iziomon and Aro 1999; Udo and Aro 1999)
- Meteorology (Humidity, Cloud Cover) (Akoshile et al. 2007)
- Aviation (Turbidity and Visibility) (Adimula et al. 2001)

# 5. Challenges

- Electrical Power Supply is unstable; contributes to disruptions in the operation of the station.
- The solar panels that power the CIMEL and Air Sampler show frequent degradation due to environmental conditions.
- Unstable Internet connectivity.
- No steady source of local funding to support operation.
- Need for advanced training of personnel.



# 5. Wish list

- During the EOS Project duration, radiation measurements were also taken. The data are archived at the World Radiation Monitoring Center (WRMC).

- Due to lack of local funding the radiation measurements stopped at the end of the project.

Recommendations:
Re-establishing radiation measurements to augment current information.

Thank you for your attention