AERONET: From GIMMS to DRAGONs with 2020 vision

Laying the big egg

Goddard fertilization

People, Evolution & the future

Monterey, Oct 2022

AERONET: Twenty-nine Years of Observations and Research
The Twisted path: Lucky, Old and Fun

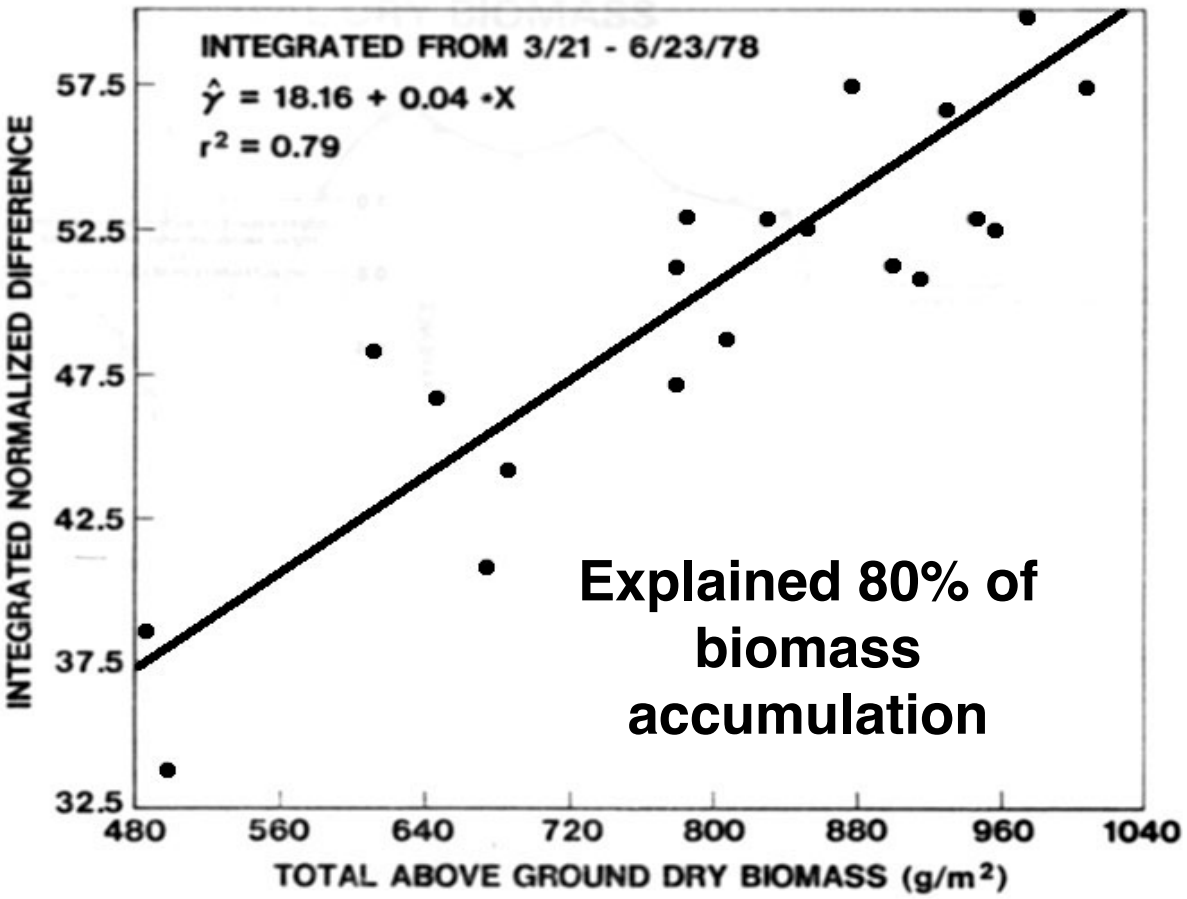
The AERONET program is a federation of ground-based remote sensing aerosol networks established by NASA and LOA-PHOTONS (CNRS) and has been expanded by collaborators from international agencies, institutes, universities, individual scientists and partners.

AERONET provides a long-term, continuous public database of aerosol optical, microphysical, and radiative properties for aerosol research and characterization, validation of satellite measurements, and synergism with other databases.

- 15,983 citations
- Sat. & model Val., assimilation
- NRT aerosol characterization
- ~500 sites
- Over 90 countries and territories
- http://aeronet.gsfc.nasa.gov

The Beginning-GIMMS Tucker/Justice/Holben (‘75 to ‘82)

Integrated NDVI vs. total dry biomass



Tucker, Holben, Elgin, & McMurtrey RSE 1981

NO
SMOKING
IN AREA
94 3 17

Jump to Senegal 1981 using NOAA AVHRR for GPP

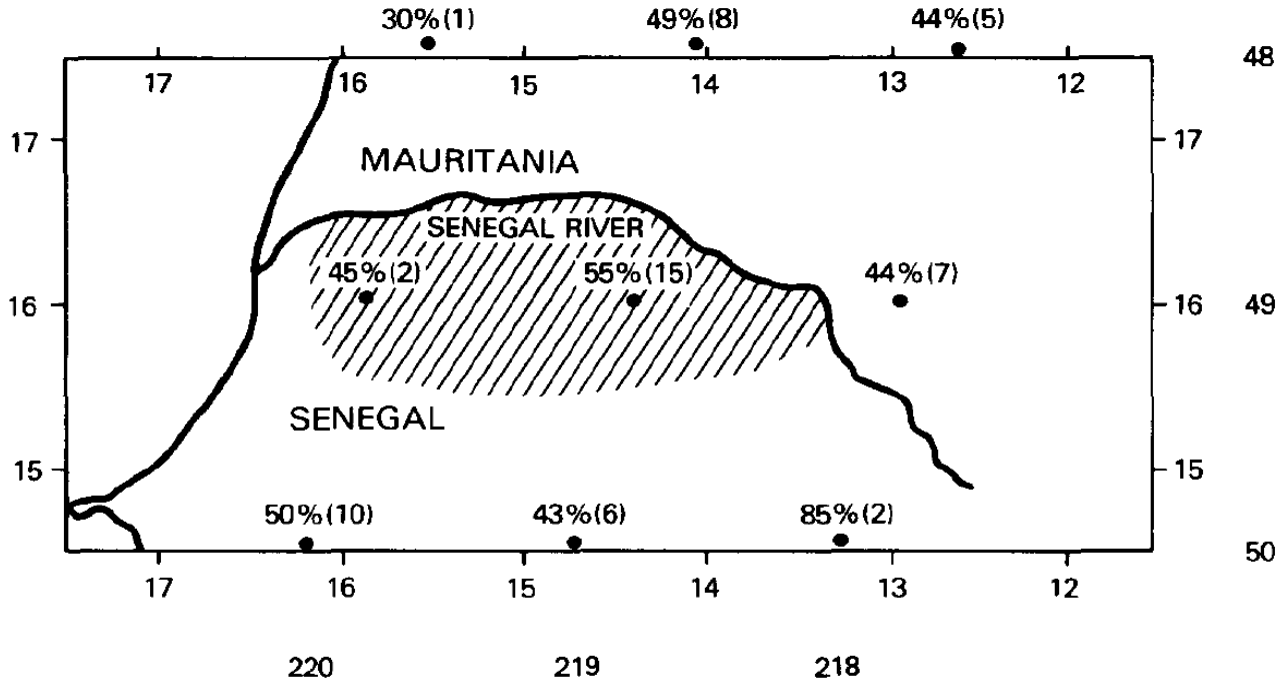
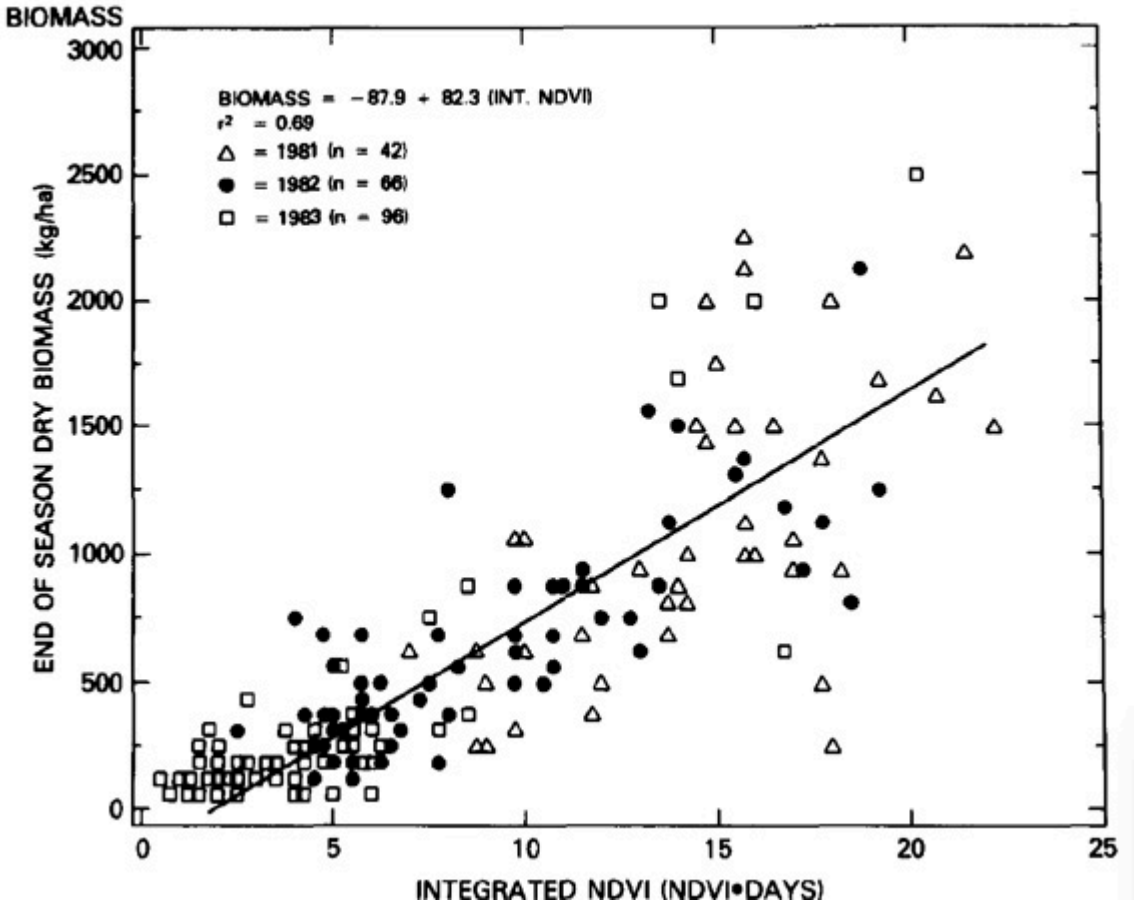


FIGURE 2. A summary of the available Landsat MSS data from Senegal and adjacent portions of Mali and Mauritania which were acquired during the rainy season period of 15 July to 15 October from 1972 to 1983. The total number of scenes is given over this 12-year period and the average cloud cover appears in parenthesis, for each path and row. The Ferlo area is indicated by the stippled are.

Senegal 1981-1983 Integrated NDVI & end of season total dry matter accumulation or GPP



∫ NDVI vs. ∫ dry herbaceous biomass @ 1 km² Ferlo Region, Senegal 1981-1983

NASA-FAO/UNEP

REMOTE SENSING OF ENVIRONMENT 17:233–249 (1985)

Satellite Remote Sensing of Total Herbaceous Biomass Production in the Senegalese Sahel: 1980–1984

C. J. TUCKER

Laboratory for Terrestrial Physics / Code 623, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771

C. L. VANPRAET, M. J. SHARMAN, and G. VAN ITTERSUM

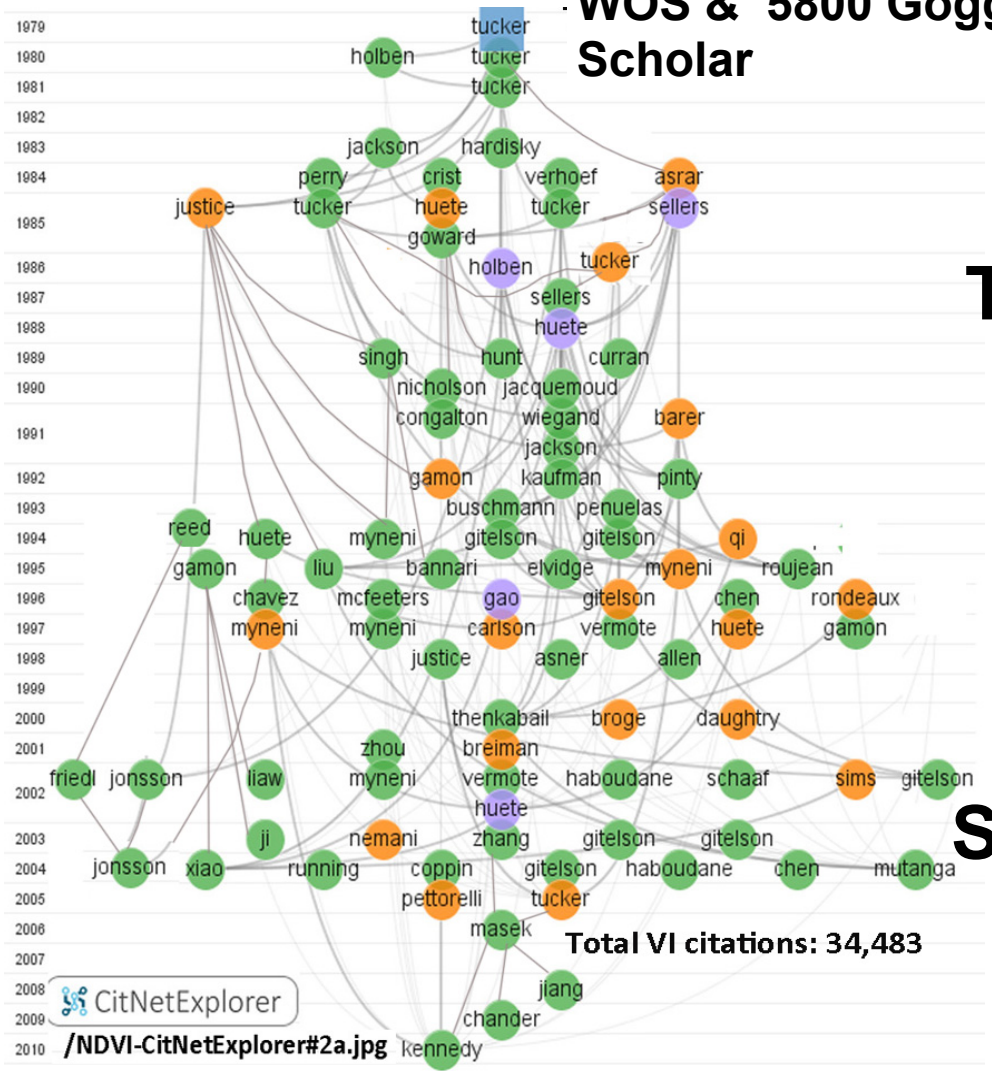
Pastoral Ecosystems Project, FAO / UNEP, P.O. Box 154, Dakar, Senegal

Sahel '84

SAHEL

Traffic along
BR 364

RONDONIA



CitNetExplorer

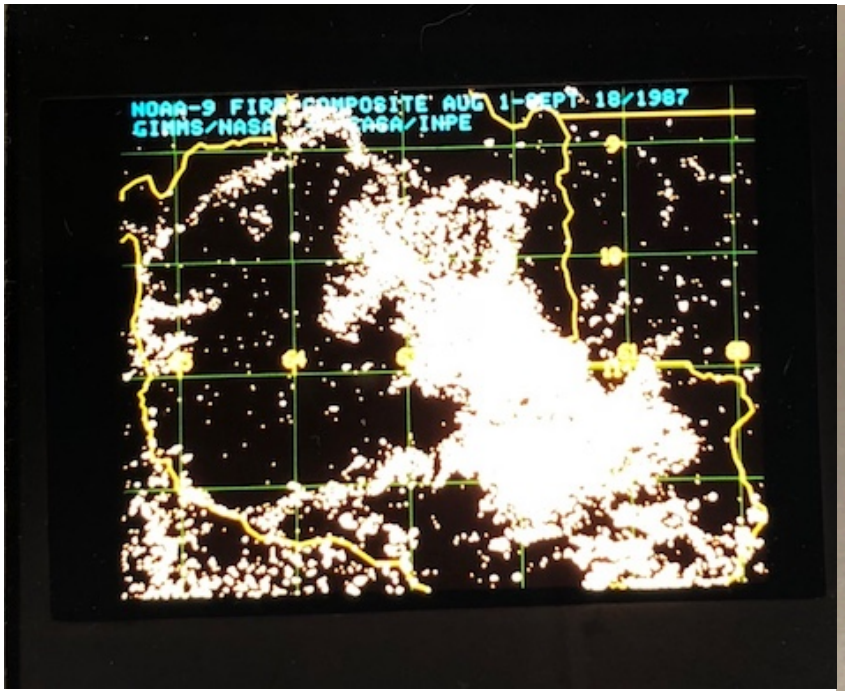
1985:
Justice et al Phenology
Tucker et al. Senegal GPP

Tucker & Townshend LULCC
Sellers linking land & atmosphere

Sets table for MODIS & Off to the races!

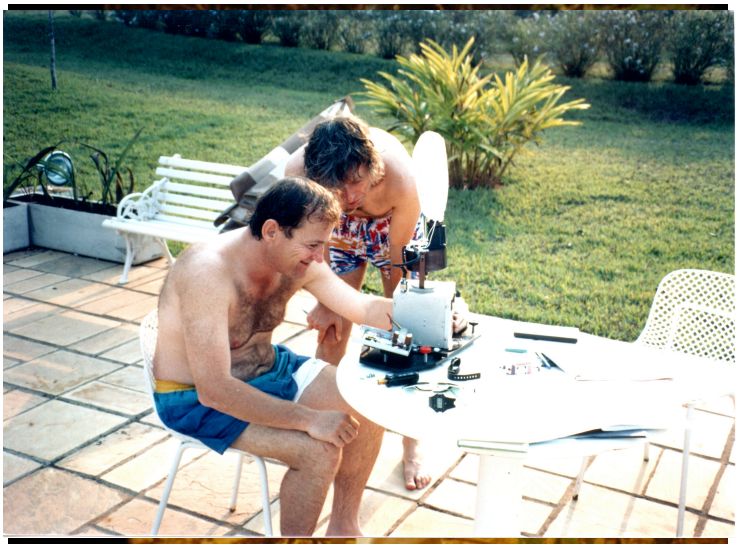
1988 fertile fields of GSFC

- Alberto Setzer 1988, smoke in Amazon
- Kaufman, BRDF and parties
- Didier Tanre arrived, visiting scientist
- Terry Nakajima arrived, visiting scientist
- Brent Holben: 3 toddlers
- No money for aerosols or instruments, NASA HQ



Alberto's
Big Fly
About

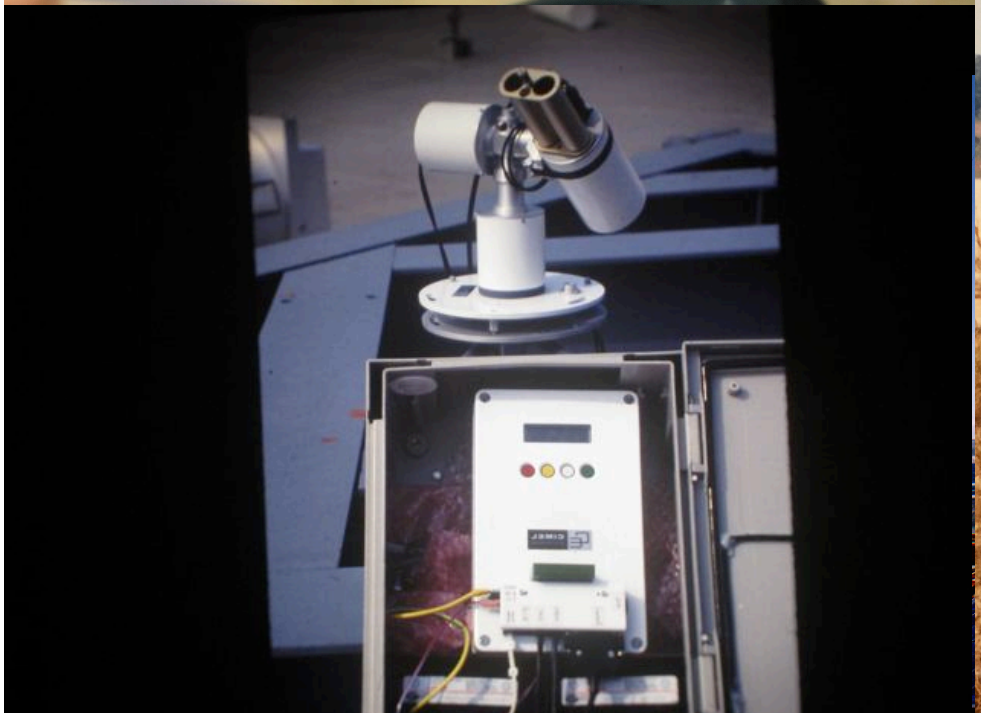
Tanre/Nakajima/ Kaufman/Holben/Smoke



1988 - 1991

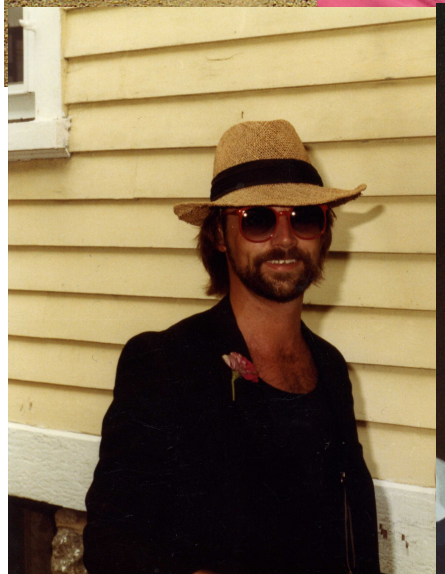
Mother
Diane

POMMERY



TOYOTA

Early Hero's of AERONET



EOS MODIS Validation/atmospheric correction (1995)-King: Kaufman, Justice, Esaias

$ $ $

People and Campaigns and Instruments

- Nadir Abuhassen-Engineer
- Alexander Smirnov-Sun Photometry
- Oleg Dubovik-RT Inversion
- Boreas-Markham
- LBA-Schafer
- TARFOX, INDOEX, Zibbie, Safari, BASE-B
- 100 instruments by 1998

Holben et al., 1998

- Imposed Network Standardization
  - Instrumentation
  - Calibration
  - Measurements
  - Processing
  - Distribution
- Near real time Acquisition-transparency of data (the good and bad)
- Federated with global partners
- AOT➔Size Distribution, ref Index
- Citations: 7394

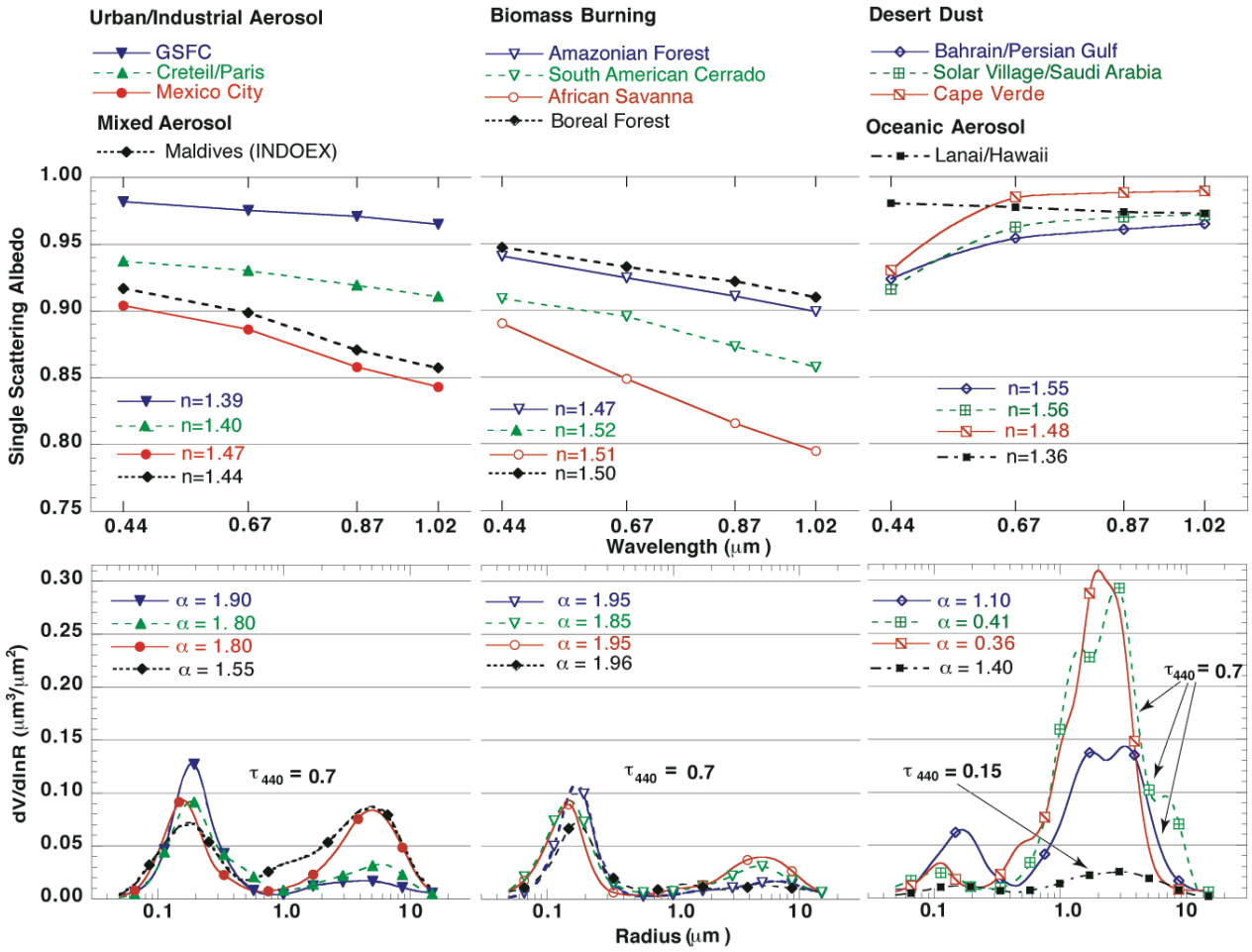
Comrade Hero's of AERONET

Mature at last!

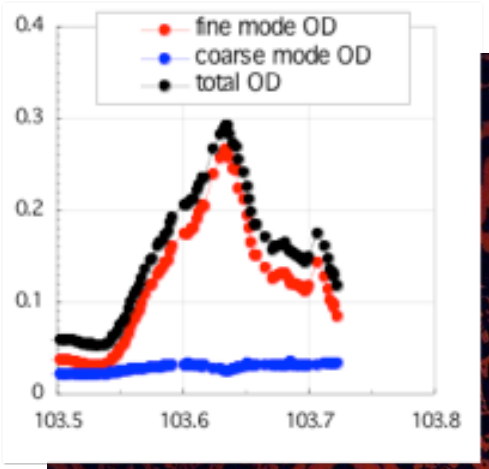
2533 citations

NET Milestones: Dubovik & King Dubovik et al., 2002

1812 citations

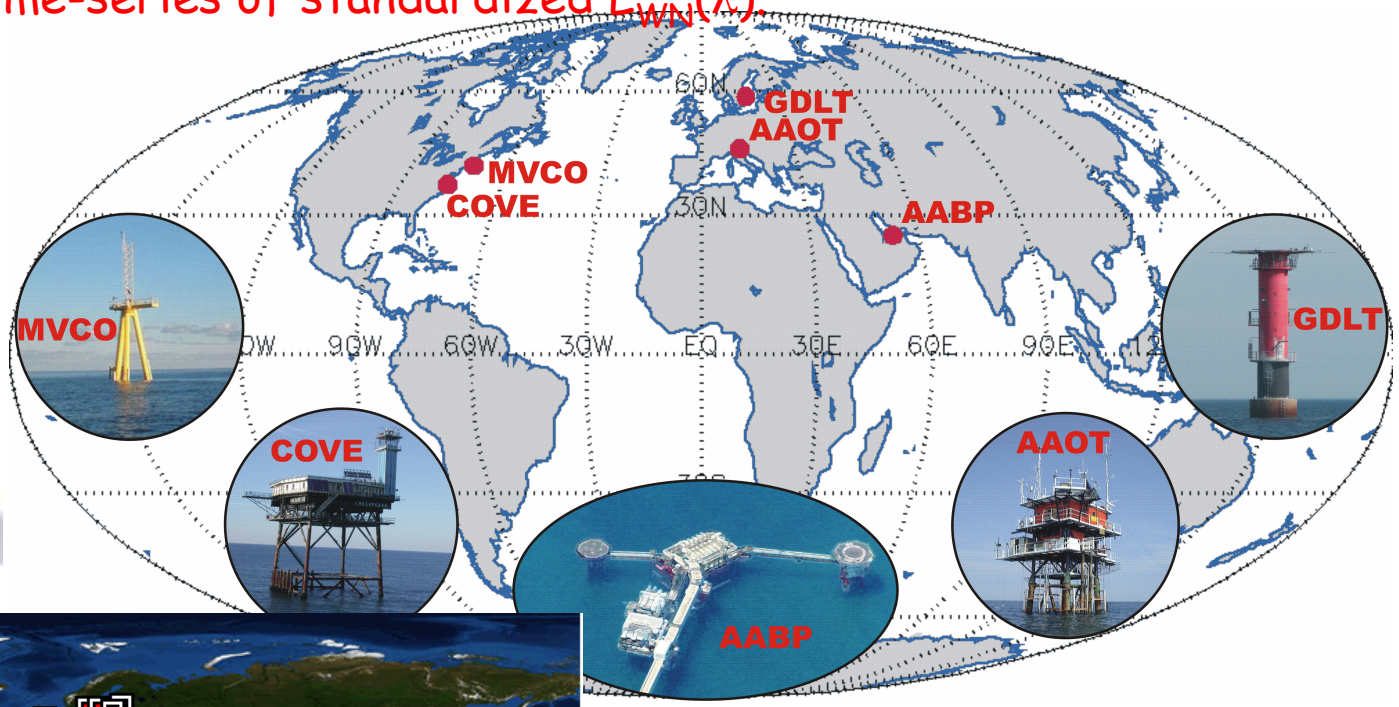


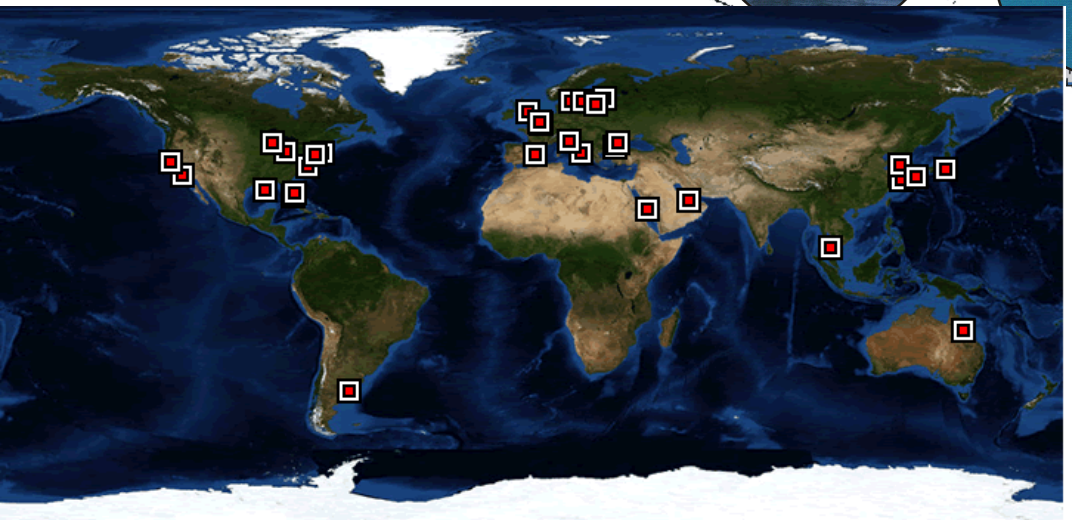
Norm, Sasha & Tom. San Fran AGU, 2012. Discussions of SDA



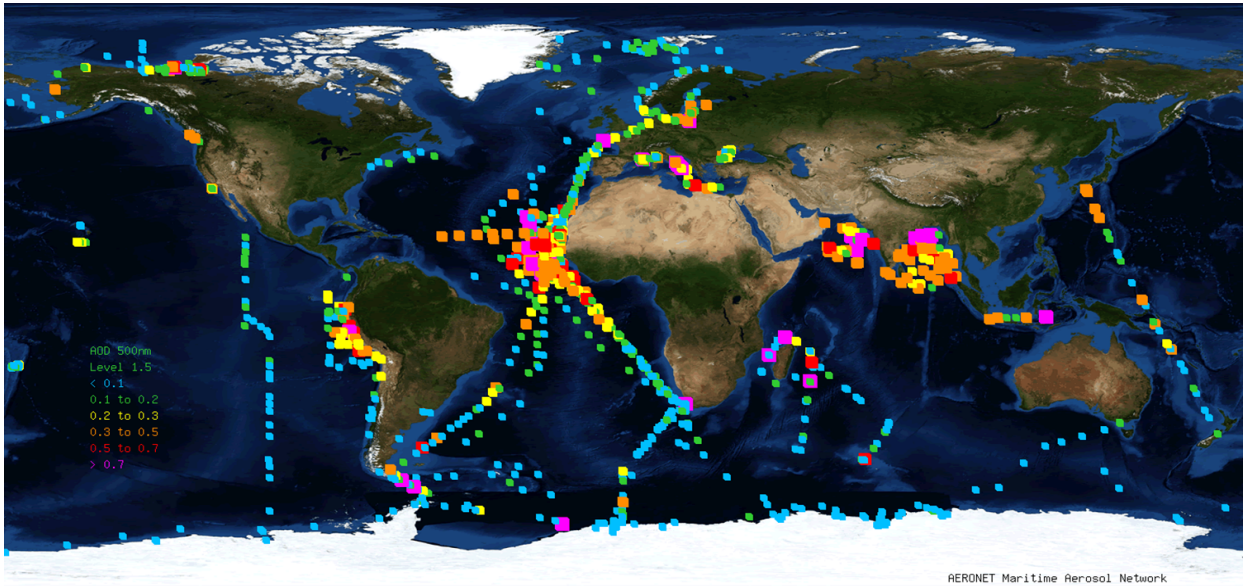
G. Zibordi/JRC & S. Hooker/GSFC

AERONET – Ocean Color (AERONET-OC): an integrated network, part of the Aerosol Robotic Network (AERONET), supporting ocean color validation with highly consistent time-series of standardized $L_{WN}(\lambda)$.

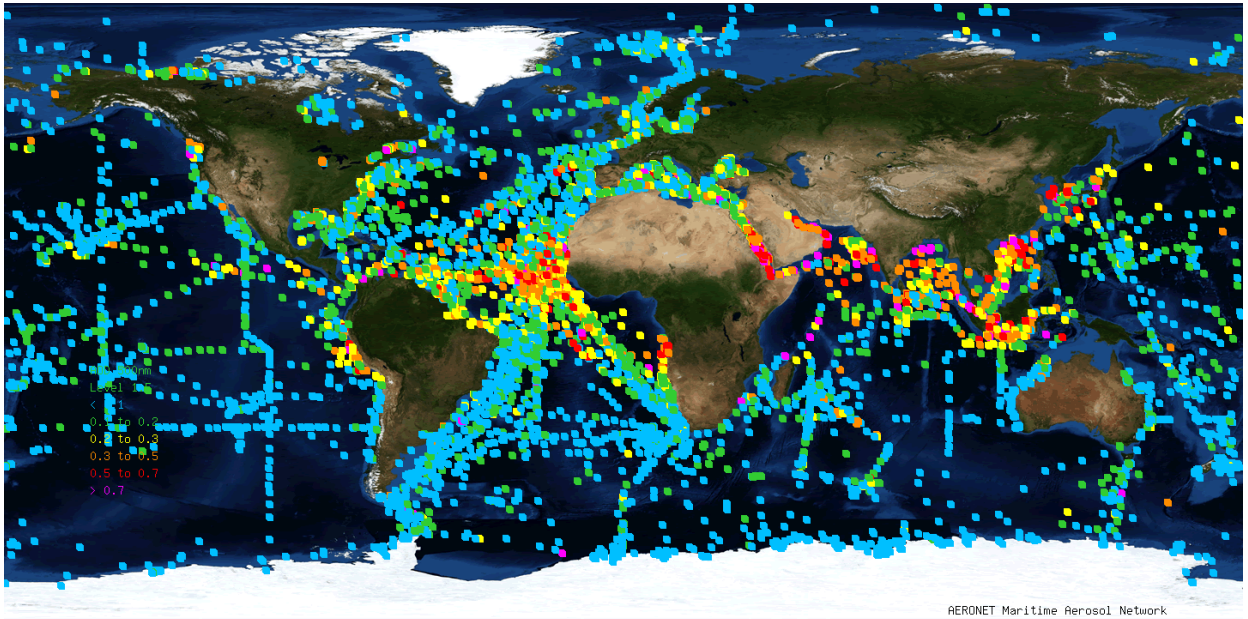




2009

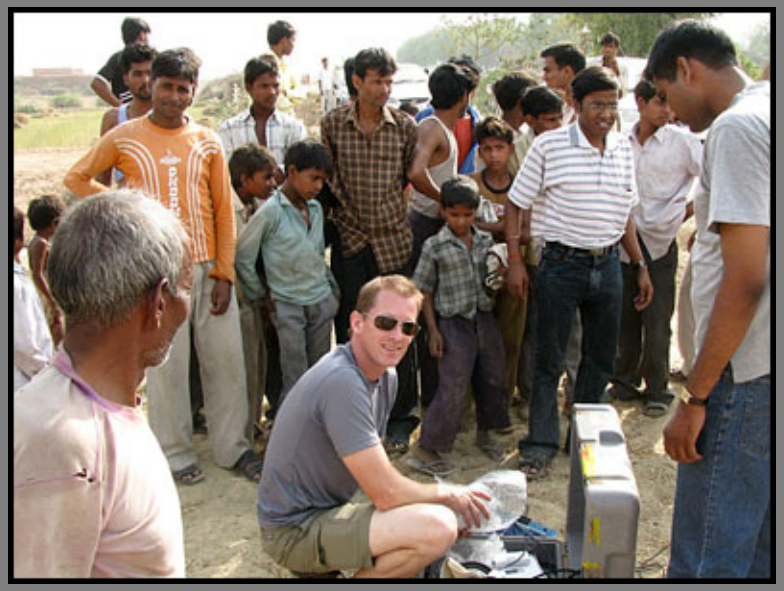


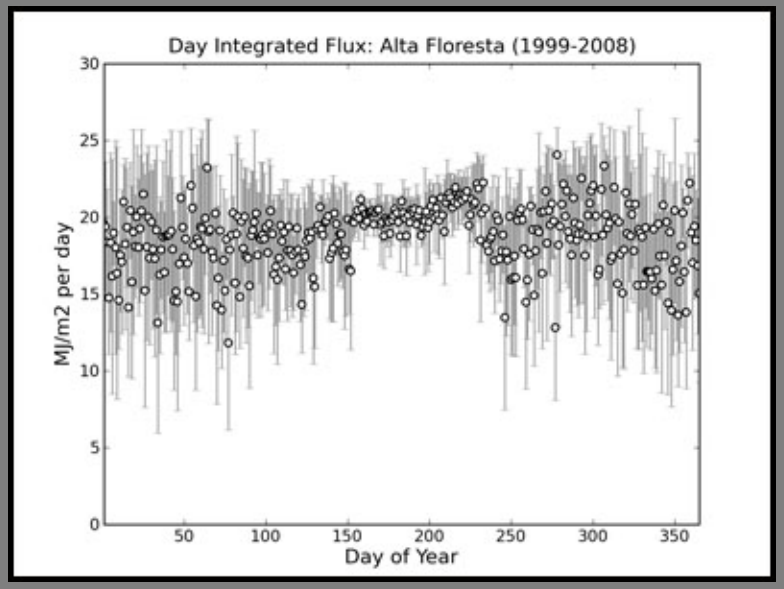
2022

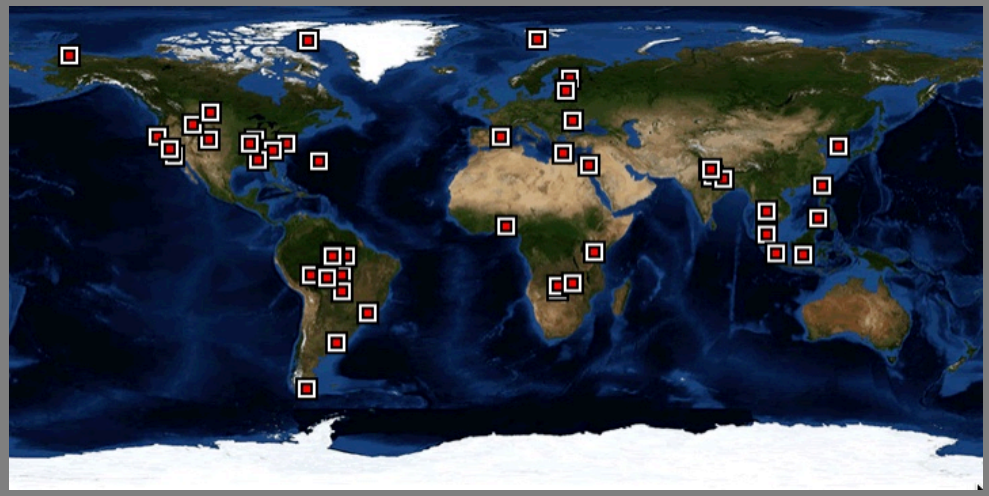


Cruise tracks and daily averages of aerosol optical depth at 500 nm (squares are colored with respect to AOD values, i.e. blue – AOD<0.10, green – 0.1≤AOD<0.2, yellow – 0.2≤AOD<0.3, orange – 0.3≤AOD<0.5, red – 0.5≤AOD<0.7, purple – AOD≥0.7).

SolRad-NET-Joel Schafer 1992-present





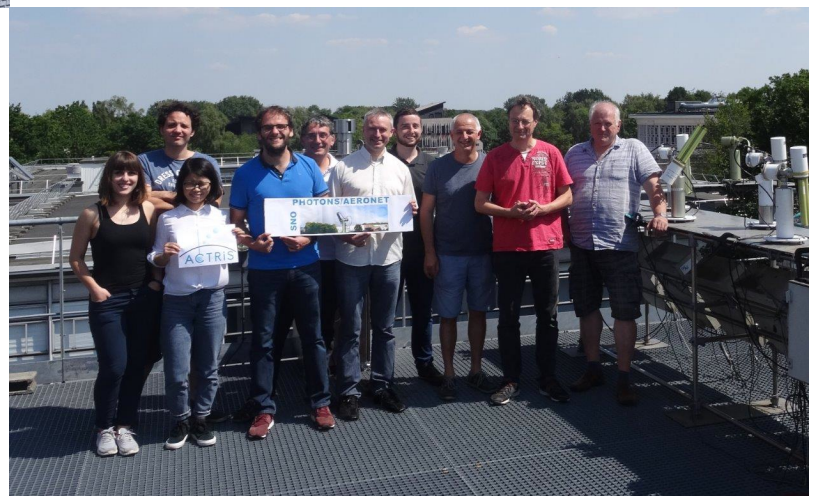


PHOTONS ACTRIS Team

Philippe Goloub, lead

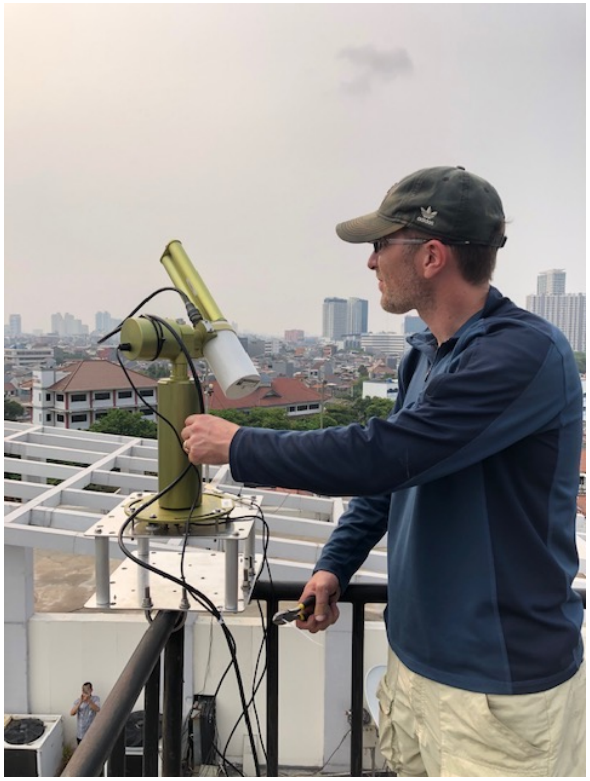
Calibration
Research
Lidar, ship and airborne
sun photometry

Rima Team (not shown)
Carlos Toledano, lead
Calibration,
Research



Version 3

David Giles **https://aeronet.gsfc.nasa.gov**



- Data Display
- Download Tool
- Download All Sites
- Climatology Tables
- Web Services
- Synergy Tool

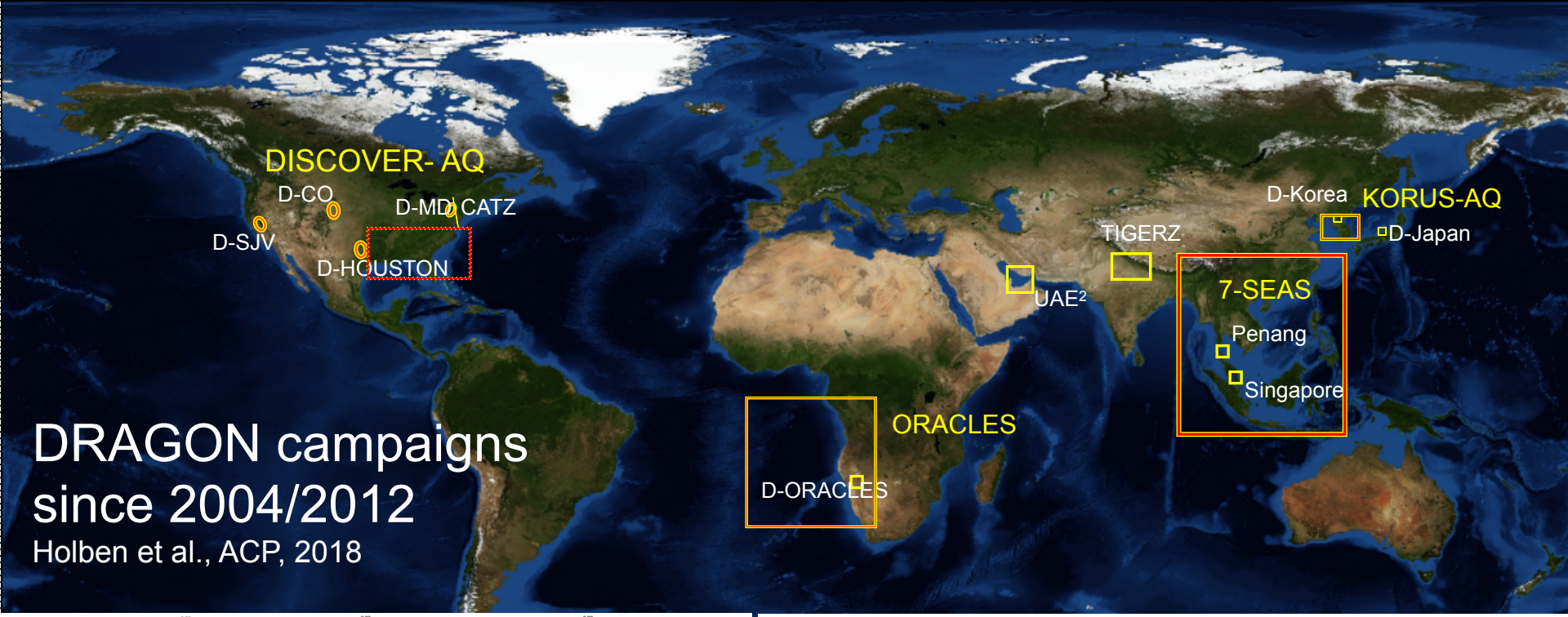
Giles, D. M., Sinyuk, A., Sorokin, M. S., Schafer, J. S., Smirnov, A., Slutsker, I., Eck, T. F., Holben, B. N., Lewis, J., Campbell, J., Welton, E. J., Korkin, S., and Lyapustin, A.: Advancements in the Aerosol Robotic Network (AERONET) Version 3 Database – Automated Near Real-Time Quality Control Algorithm with Improved Cloud Screening for Sun Photometer Aerosol Optical Depth (AOD) Measurements, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2018-272, in review, 2018.

What has happened since V3?

- Sept 2018-–Level 2 hybrid scan inversions
- Feb 2019—Level 2 inversion uncertainty estimates
- Feb 2019—Lunar AOD (Provisional)
- Covid
- August 2022 Holben retires
- Nov 22—The new vision
- Dec 2023—Version 4

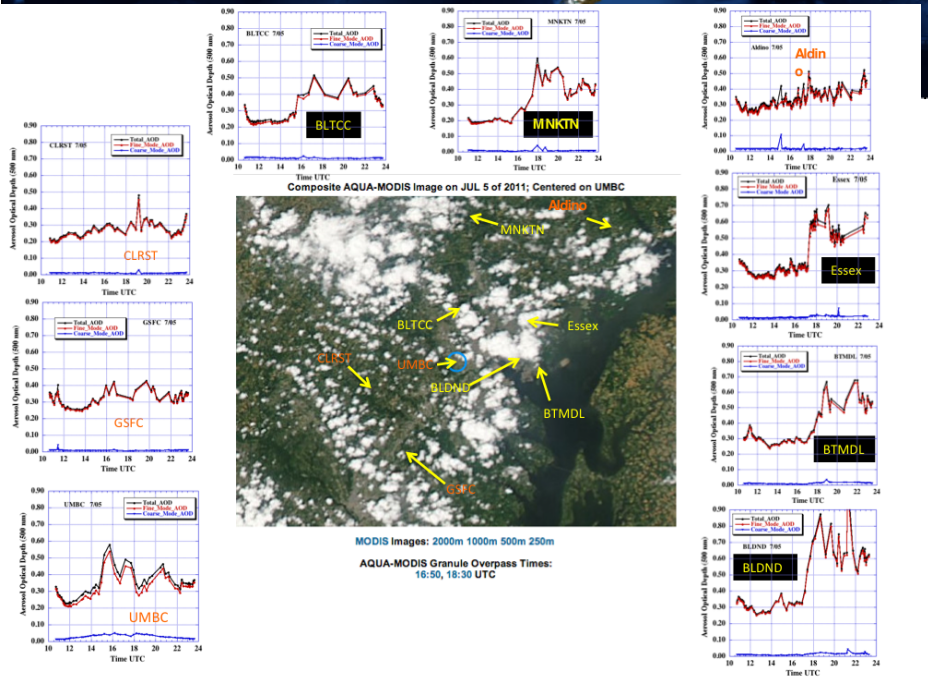
What lies ahead?

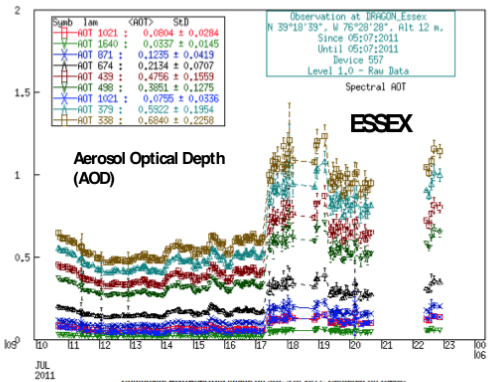
- 7-channel inversions
  - Brown Carbon/UV absorption
- Hybrid/almucantar polar inversions
- Vicarious/intercomparison calibration
- Improvements in Lunar (Inst, models, QA)
- Solar spectrum, BRDF
- New international Cal facilities
- DRAGON field campaigns
- Politics

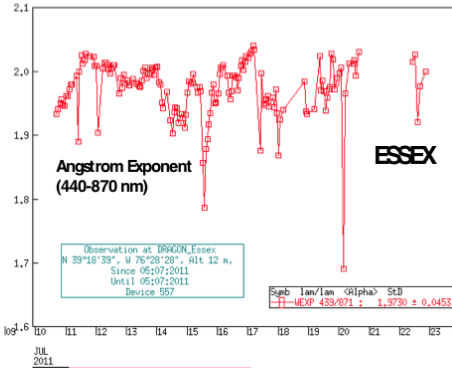


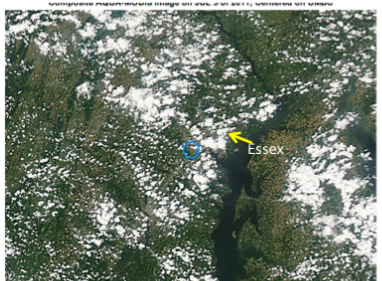
DRAGON campaigns since 2004/2012

Holben et al., ACP, 2018







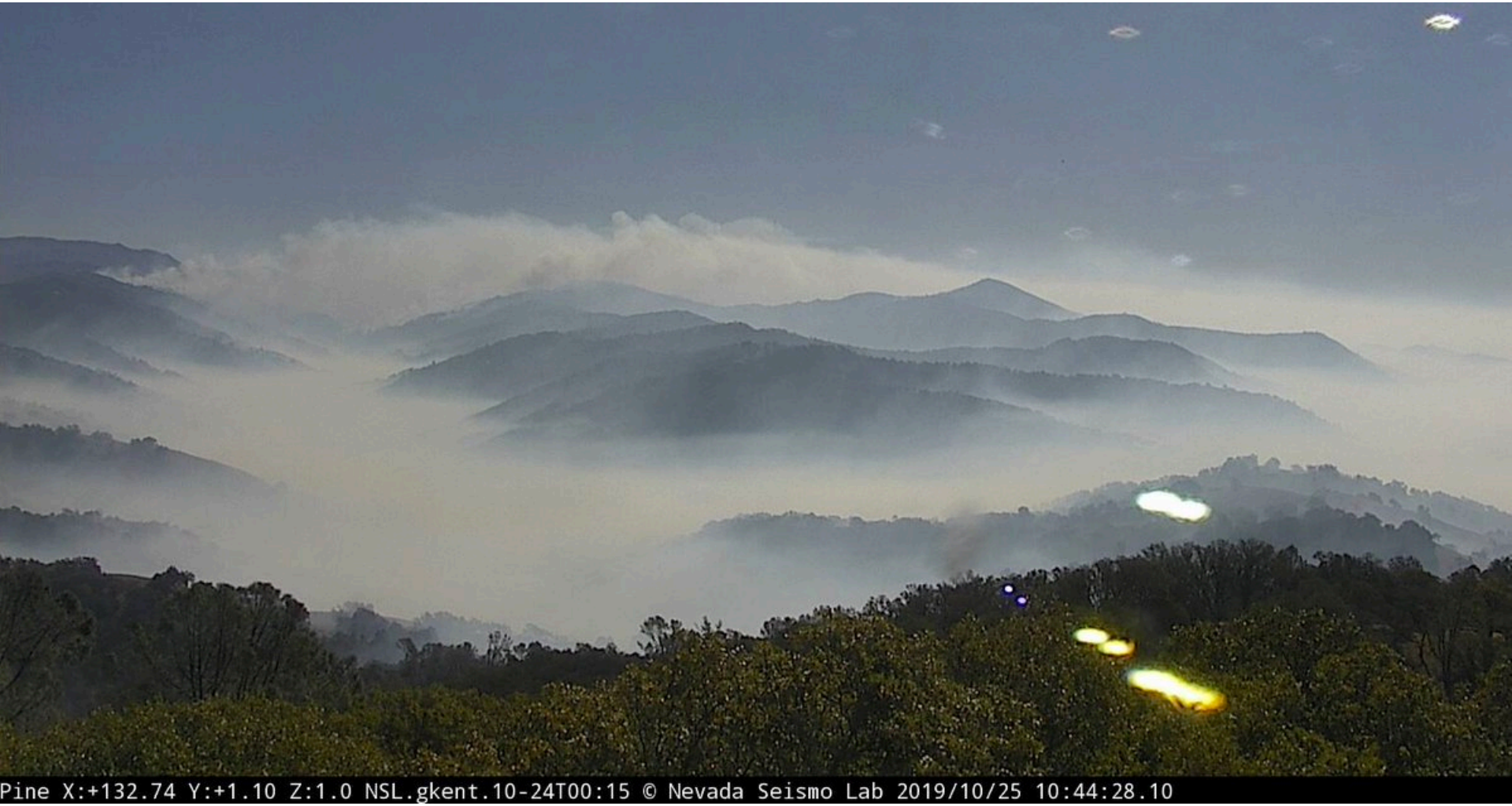


Large jump in AOD (~0.3 at 440 nm) at the DRAGON Essex site occurred just after solar noon on July 5. However, the Angstrom exponent (440-870 nm) remains very high (>1.9) suggesting possible new particle formation in the cloud environment since a particularly dense cluster of clouds is seen in the vicinity of the Essex site. Also note the larger variance of AOD (1 min intervals) in the afternoon versus morning indicating relatively

Looking Ahead: Sustaining AERONET and meeting the growing needs of the aerosol community

- Sustain AERONET's longstanding measurement network
- Support NASA's new missions in the coming years
- Co-Leadership: Two Civil Servant Scientists
  - Contribute to the day-to-day network operations
  - Engage in science and strategic efforts that keep AERONET at the forefront of major science, field campaign, and satellite mission efforts
- CS Co-lead: Elena Lind (Virginia Tech); instrumentation and methods
  - Engage Cimel Electronique
  - Support calibration efforts at NASA and across the network
  - Guide future development of instrumentation and algorithms
  - Deliver new science, new partnerships, and new funding

Looking Ahead: cont.

- CS Co-lead Pawan Gupta (NASA Marshall Space Flight Center); Research and applications expert on atmospheric aerosols, including satellite and ground-based Air Quality measurements
  - Provide new linkages to help support, sustain, and grow AERONET
  - Engage international teams that support AERONET, maintain relationships, and solidify new partnerships for the network
  - Communicate science and deliver training to enhance the use and development of AERONET data for science and applications

Merci from California