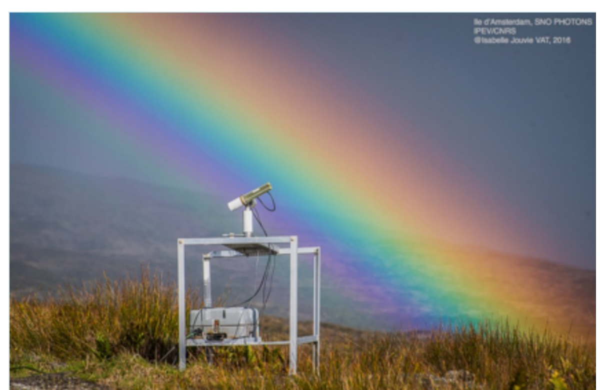
Status and Plans for the Sun-Lunar Photometer

Jiri Blazek

Institute of Physics of the Czech Academy of Sciences

June 21st 2016

CCF F2F Meeting Barcelona



This picture has been taken by! Isabelle Jouvie, IPEV CNRS, at the Amsterdam Island AERONET site, (Indian Ocean), May 2016.

Current Status

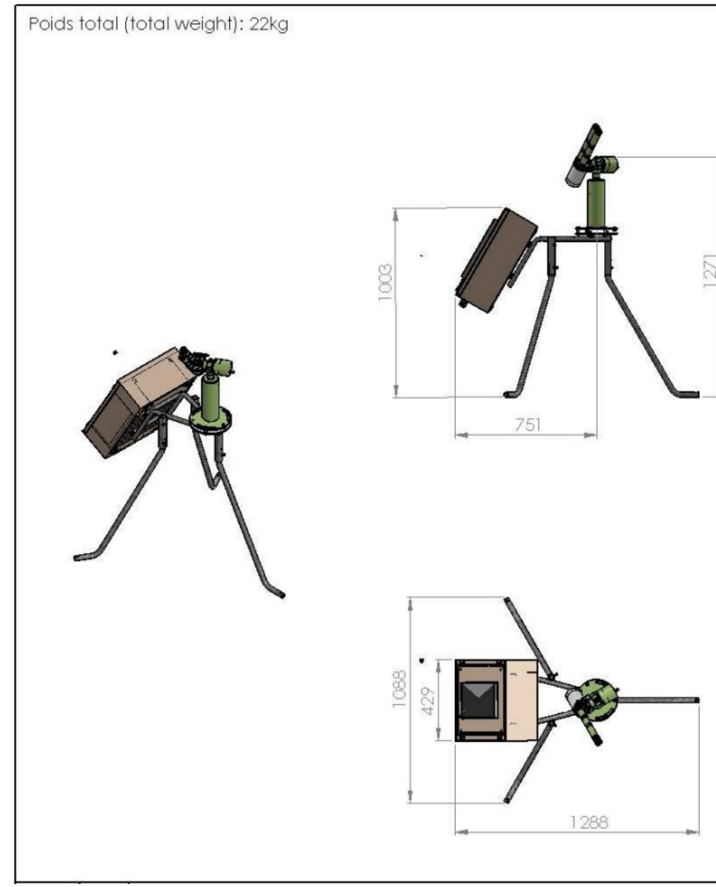
- Cimel CE318-T Photometer deployed and functional at Armazones
  - Data retrieved by Dusan Mandat
  - No data analysis yet
- IoP CAS seeks funding for a second one to be installed at La Palma
  - Negligible chance in 2016
  - ~30% chance in 2017
  - ~50%+ in 2018+
  - some other institute may have resources? our proposal can be withdrawn at anytime
- New PhD student in Prague to focus on data analysis – Jakub Jurysek
  - Starts in July

Photometers

- Measure optical depth (integral value)
- Passive
- Formerly only a day cycle
- Data analysis mainly via AErosol RObotic NETwork (AERONET), a global monitoring network
  - Three levels of data quality:
    - Level 1.0 (unscreened)
    - Level 1.5 (cloud-screened)
    - Level 2.0 (cloud-screened and quality-assured)

Cimel CE318-T

- New generation of Lunar Photometer(s)
- Able to perform Sun / Sky / Lunar measurements
- Measures triplets to asses stability of conditions
- Needs > 50% of Moon illumination
- Built-in control unit – data acquisition + storage, communication
- Built-in battery, solar panel
- GPS synchronization
- Robust



Cimel CE318-T

- Communications:
  - Automatic real-time transfer through RS-232 to a local PC with PhotoGetData software
  - via the Data Collection System though meteorological satellites (optional)
  - Manual collection through USB
  - Real-time transfer by GPRS
- Data processing:
  - Obtains: Aerosol Optical Depth (AOD), Angstrom coefficient, precipitable water vapor
  - Via the AErosol RObotic NETwork (AERONET)
    - Calibration may be possible at no cost using the ACTRIS infrastructure (http://actris2.nilu.no)
  - Through the provided DIAAMS software (??)

Specification	value
Irradiance precision	< 0.1%
Field of view	1.3°
Minimal scaterring angle from the sun	2°
Spectral range	340 to 1640 nm
Optical filter drift	< 1% / year
Automated mount	Azimuth and zenith motors
Sky angular scanning	Whole sky : Azimuth: 0 – 360° Zenith: 0 – 180°
Mechanical precision spot	0.003°
Solar tracking precision	0.01°
Power consumption	< 2W
Interferential filter bandwidth	< 30 nm
Total weight without support	25 kg
Power supply	Autonomous through solar panel
Mode	Sun, Sky, Lunar
memory	32 GB on SD card
Solar and moon scanning	4 quadrant sensor
Temperature	-30 to 70° C
humidity	0 to 100 %
RS232 (up to 100 m cable)	9600 baud/s
Numeric count dynamic	0 to 2 097 152

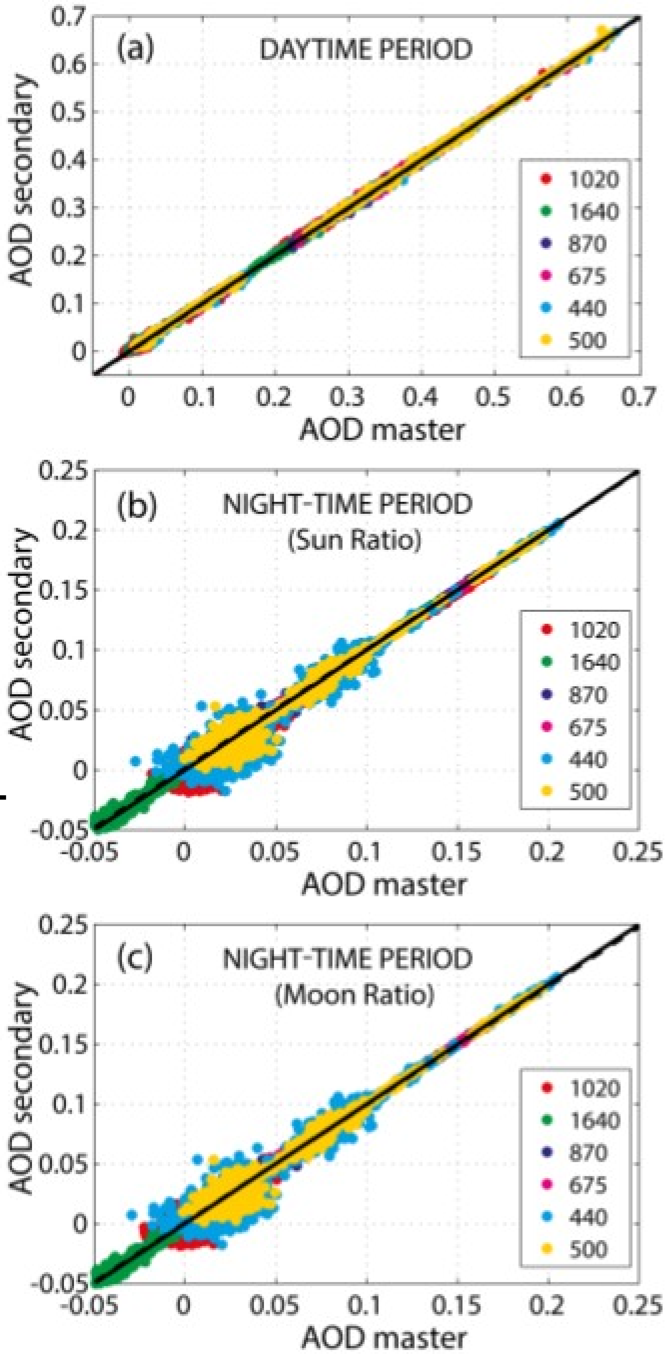
Filters : 340-380-440-500-675-870-936-1020-1640 nm.

From Barreto et al., 2016

Calibration transference from
a master to secondary instrument:

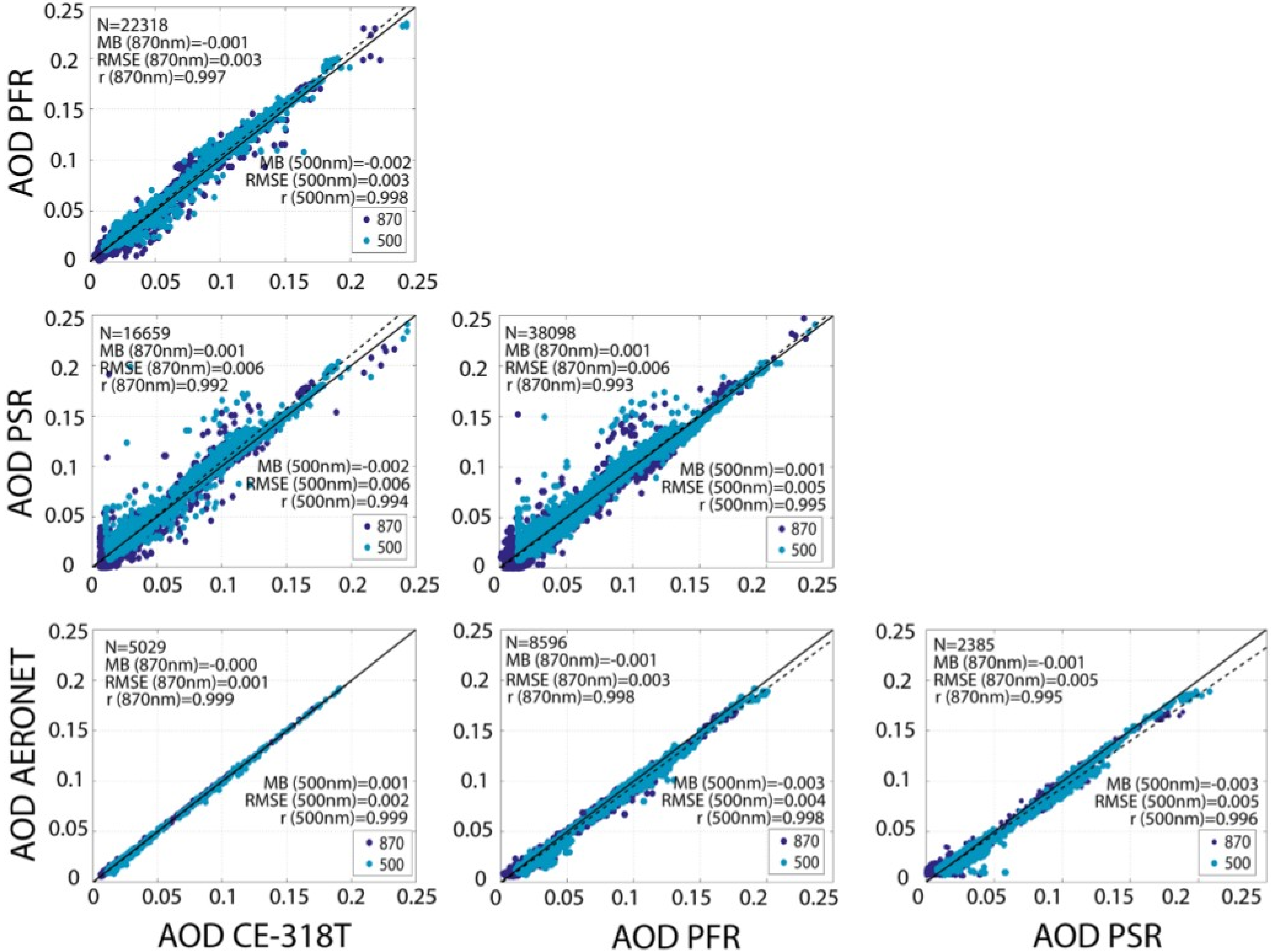
Reference (master) instruments
daytime uncertainty ~ 0.005
secondary inst. ~ 0.015

Secondary inst. night-time uncertainty ~ 0.021



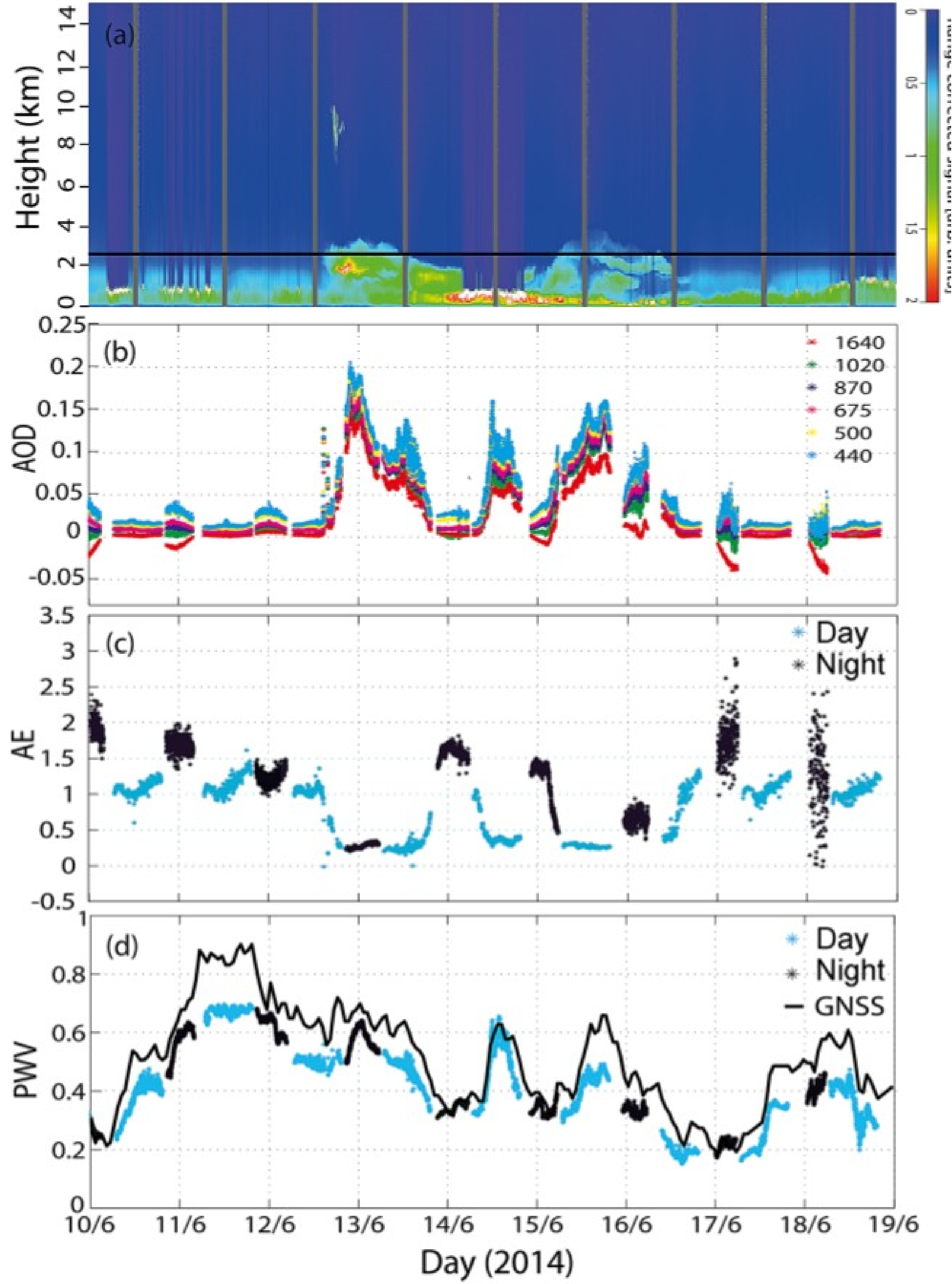
From Barreto et al., 2016

Precision Filter Radiometer
Precision Spectro-radiometer



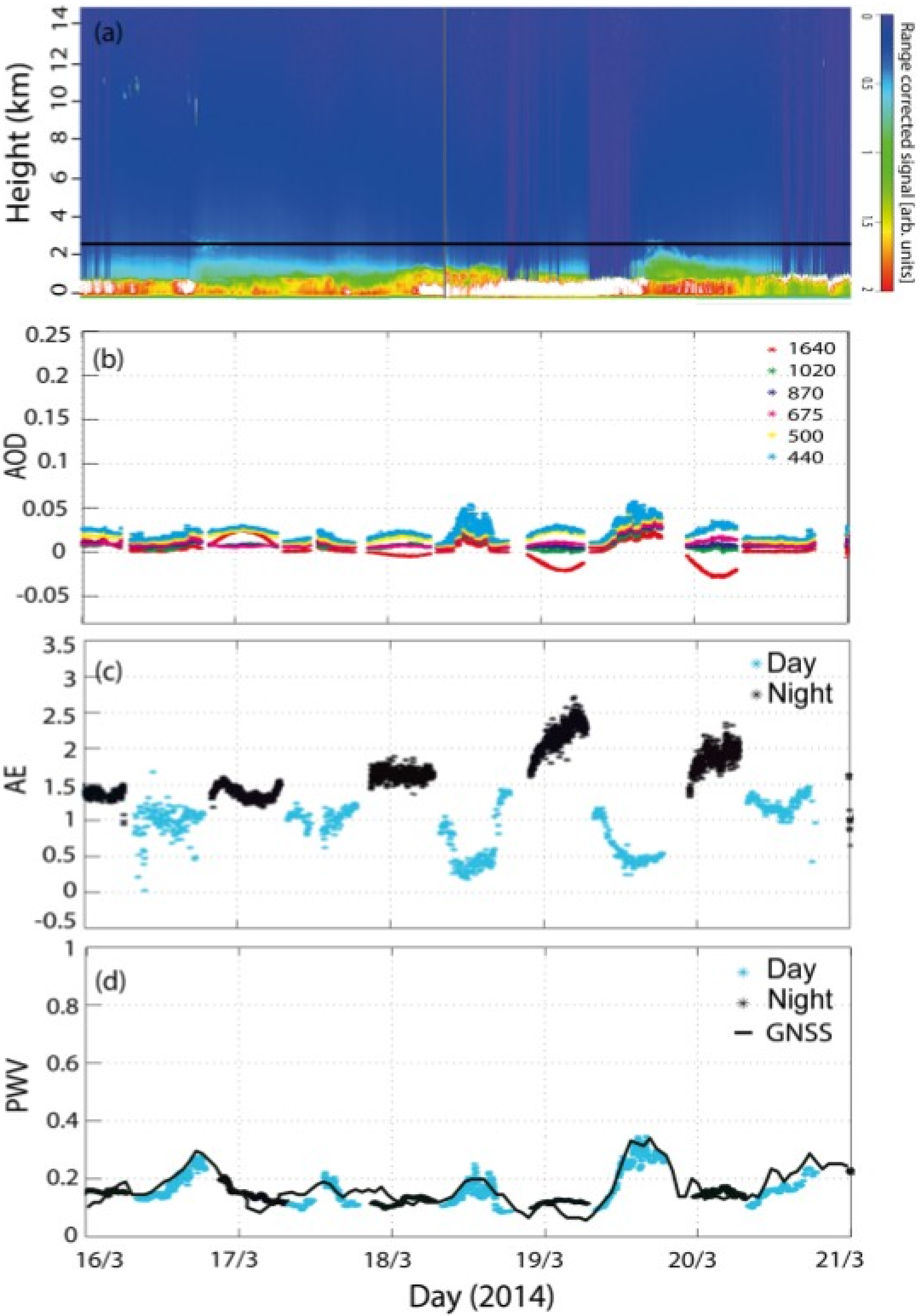
From Barreto et al., 2016

Izaña site,
June 2014, Saharan Air Layer intrusion

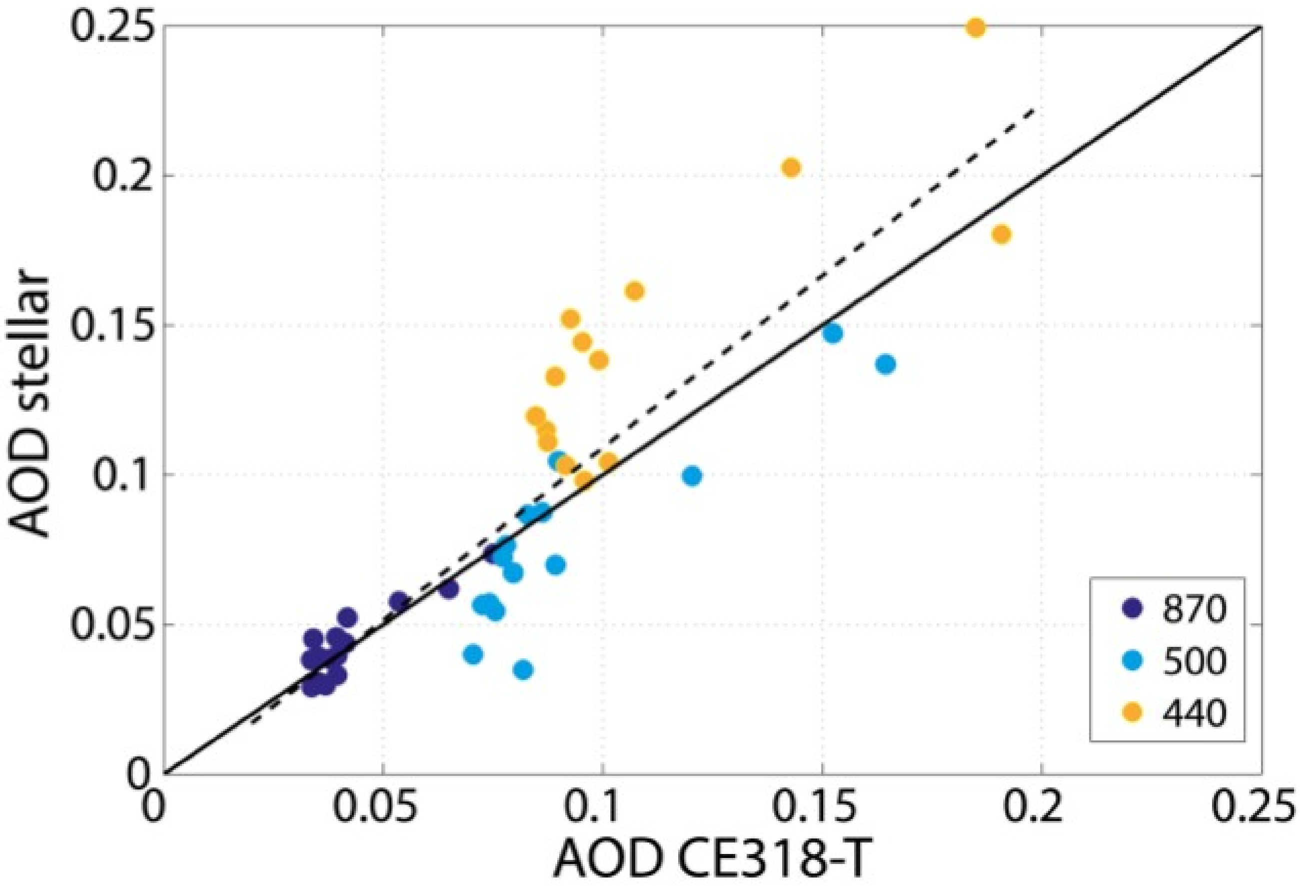


From Barreto et al., 2016

Izaña site,
March 2014, "Pristine" conditions



Comparison with a stellar photometer



- Cross-calibration still needed
- Synergistic Lidar – Photometer measurements may be possible (already some literature...)

Backup

Zero airmass: $$V^{i}_{0,\lambda} = I_{0,\lambda} \cdot \kappa^{i}_{\lambda},$$

$$\mathrm{AOD}_{\lambda} = \frac{\ln(\kappa_{\lambda}) - \ln(\frac{V_{\lambda}}{I_{0,\lambda}}) - m_{\mathrm{atm}}(\theta) \cdot \tau_{\mathrm{atm},\lambda}}{m_{\mathrm{a}}(\theta)}.$$

$$\ln(\mathrm{AOD}(\lambda_j)) = \ln(\beta) - \mathrm{AE} \cdot \ln(\lambda_j).$$