Improvement of Star Photometer Validation

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AVI

Aims of STSM

- Better understanding of error propagation within validation process
- Homogenized data set for sun, star and lunar photometer (2004 – 2023)
- Homogenization of validation process for all photometer types

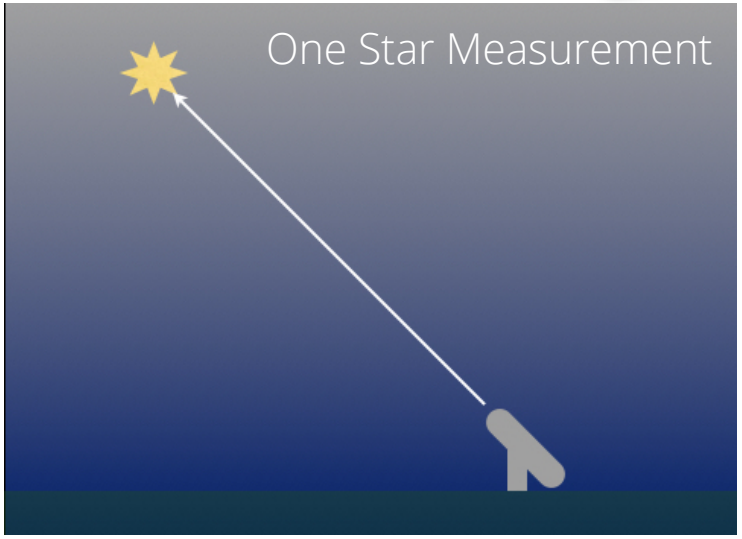
Measurement Site

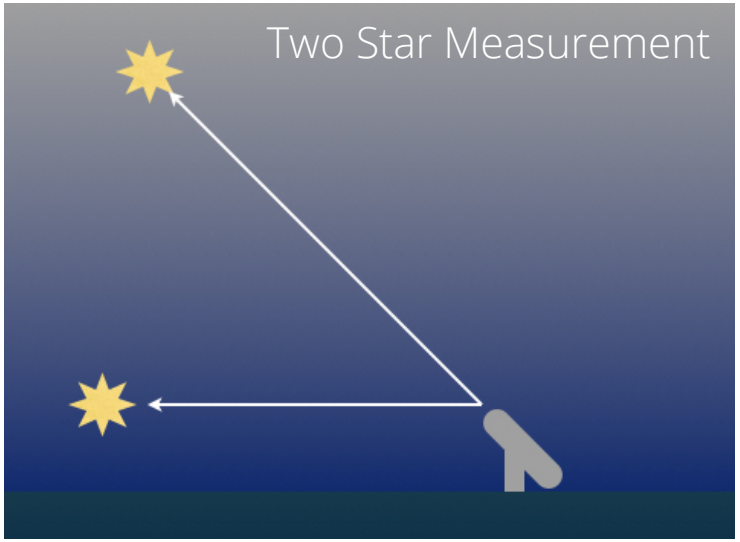
- Measurement site: 78°N
- Sun photometer data not available during winter
- Limitations for moon photometry

  => Star photometer needed

Measurement Principle

Night sky in February in NyA



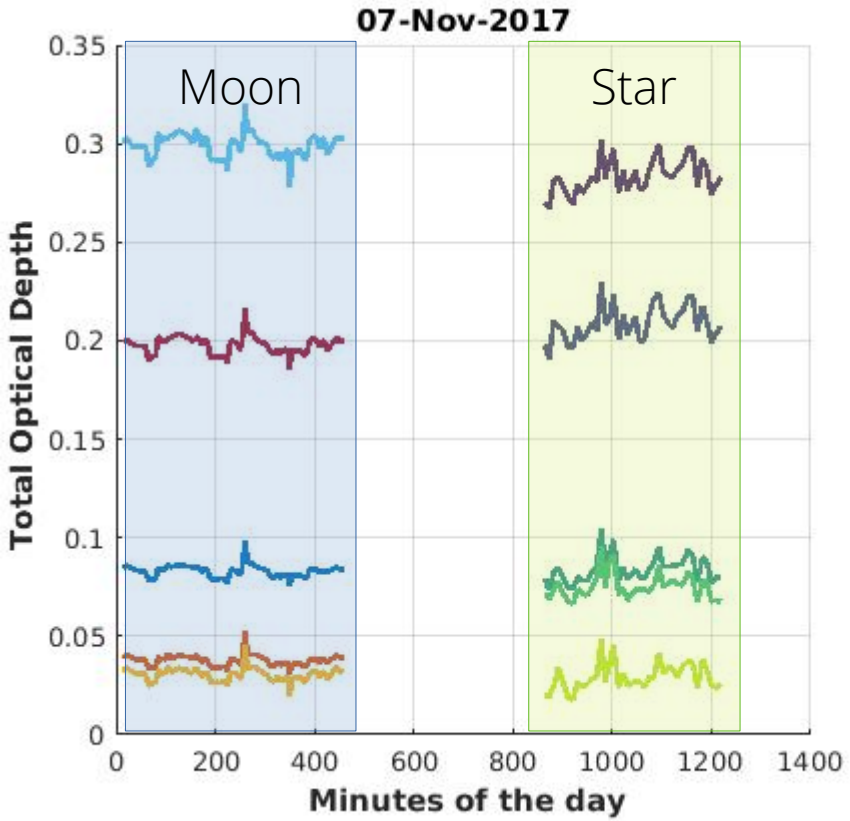


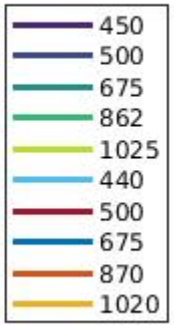
Initial Problems of Star Photometry

- Very long and clear conditions needed every winter for TSM for calibration
- Star photometer program is black box
- Sometimes: AOD < 0

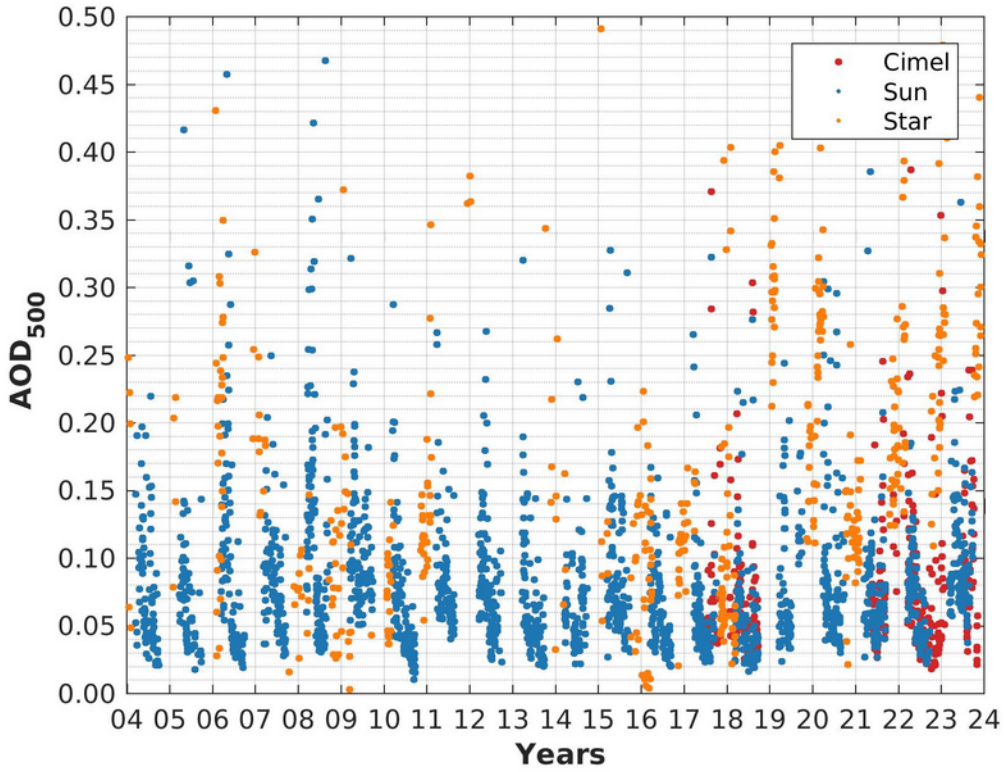
  → understand validation process:
  counts → TOD
- No Langley-Calibration possible
- Comparing star with lunar photometer

Results





→ Generally good agreement to Cimel



Principle of new validation method

1) $I_{meas}(\lambda) = I_0 e^{-AM \cdot \tau}$

with $I_0(\lambda)$ extraterrestrial intensity of star 0, *AM* airmass

2) Calculate extraterrestrial intensity of reference star: $I_0(\lambda)$

3) Apparent magnitude, *mag*:

$$\Delta mag = -2.5 \cdot \log_{10}\left(\frac{I_1}{I_0}\right) \Rightarrow I_1 = I_0 \cdot 10^{-0.4\,(mag_1 - mag_0)}$$

4) Calculation of TOD: $$\tau(\lambda) = \frac{-1}{AM} \cdot \log_{10}\left(\frac{I_{meas}(\lambda)}{I_0(\lambda)}\right)$$

Pros / Cons of new method

Pros

- Validation years later still possible
- Transparent method, no black box
- Independent of OSM / TSM
- Validation parallel to sun photometer
- Calibration values proportional to counts not to stellar magnitudes (SEMIs)
- AOD > 0

Cons

- 1 good calibrated measurement required
- Accuracy depends on measurements of stellar apparent magnitudes

Future Plans

- Publication of homogenized data set for sun and stellar photometer data (2004 – 2023)
- Publication of method in peer-reviewed journal