The ATOM all-sky camera

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H.E.S.S.

Overview

Device description

The Automated Telescope for Optical Monitoring

The sky monitor: a rain warning system

Using the sky monitor as "watchdog"

Weather characterisation

Quantifying weather

Partial cloudiness

Looking for aerosols

Linking Cherenkov and sky monitor data

Looking at higher air mass

**Device description**

Introducing the sky monitor

The Automated Telescope for Optical Monitoring

- optical 75 cm telescope
- monitors VHE sources in optical wavelengths
- synchronises with H.E.S.S. observations (when feasible)
- can cover more sources in one night than Cherenkov telescopes
- regularily detects flaring activity in VHE sources
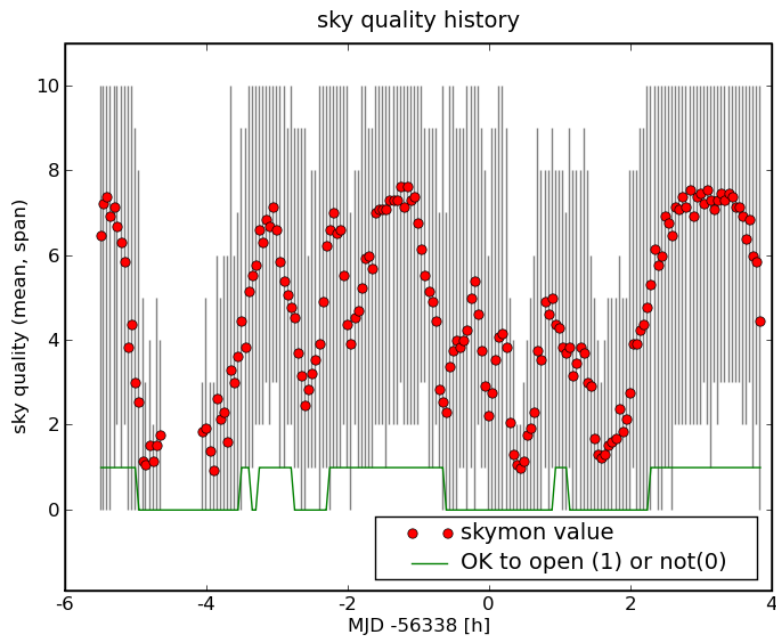
The Automated Telescopes for Optical Monitoring
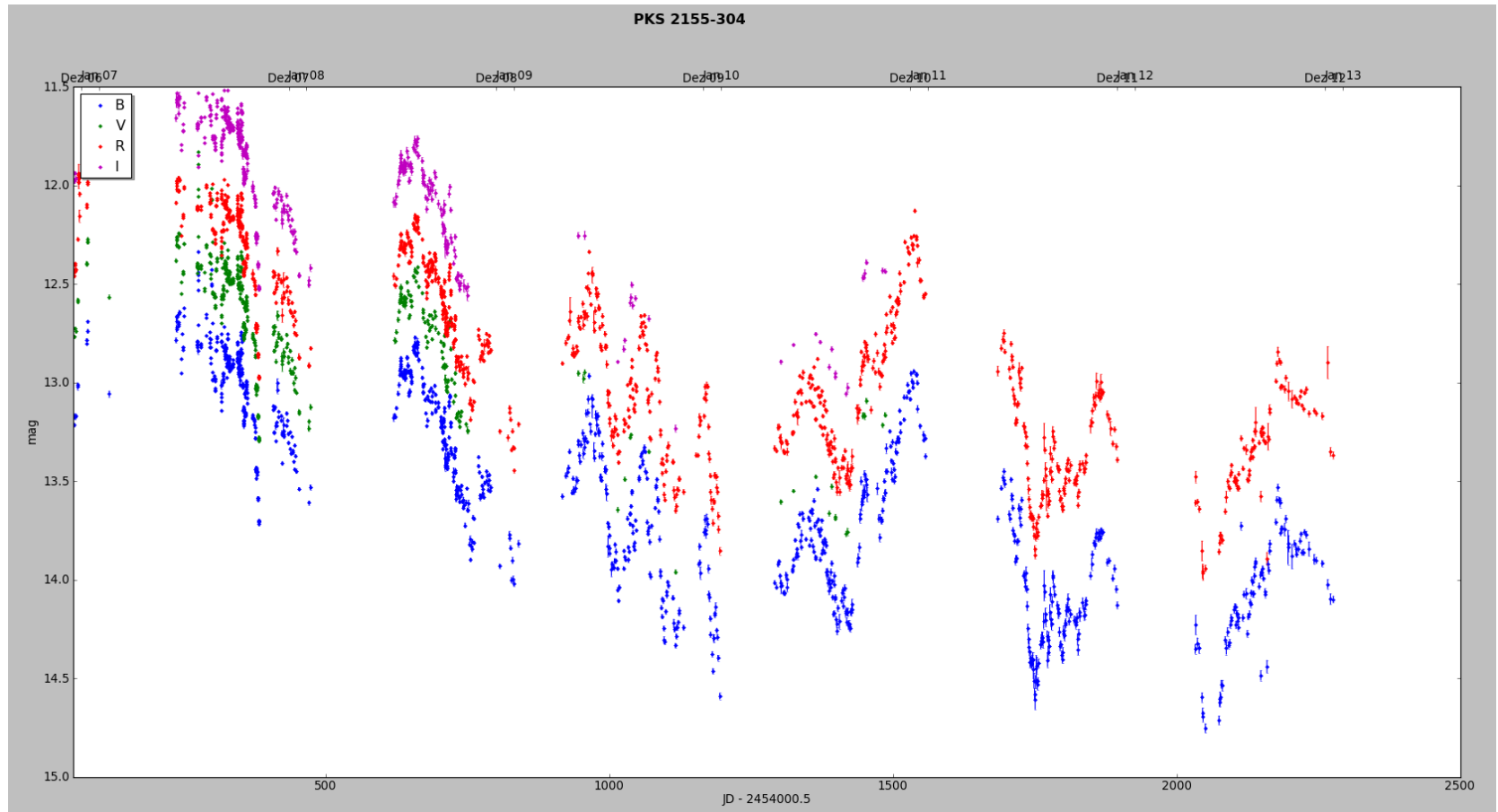
Characteristics of ATOM

- 8' field-of-view
- up to magnitude 20 in 300 seconds in R-band
- works fully automated, without human oversight
- auto-scheduling
- automated data analysis pipeline
- robotic observation
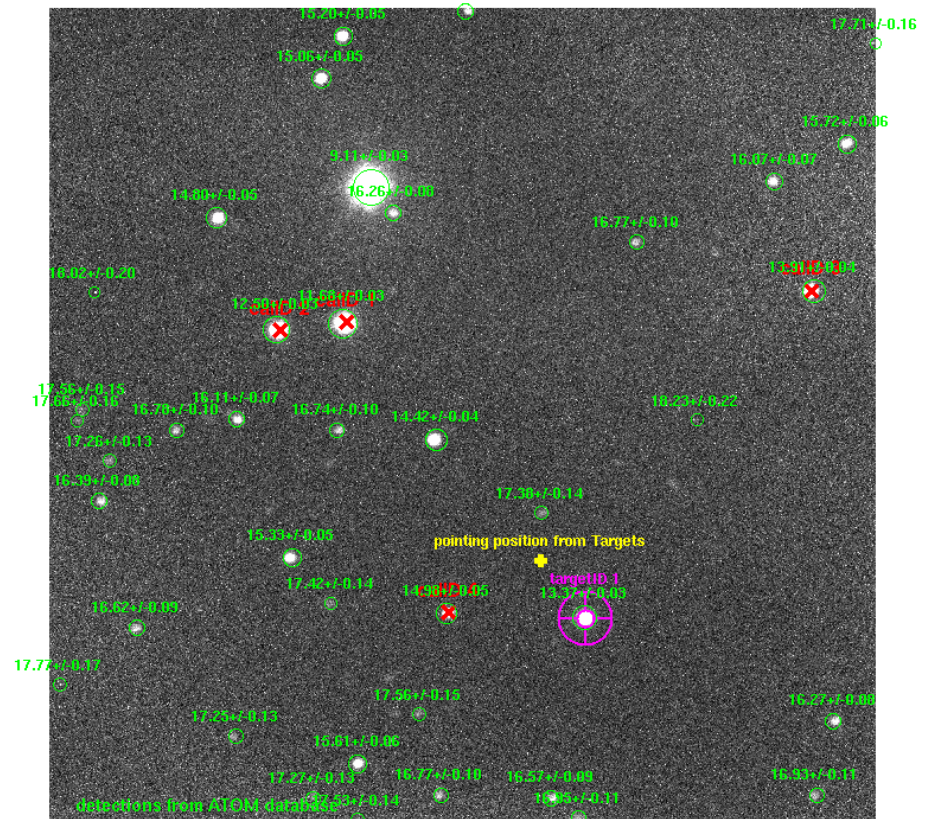
Sky monitor as rain warning system

- Lack of human controller necessitates automatic protection against rain.
- Simple rain sensor would react too late.
- Observation of clouds can predict danger of rainfall.
- Installed the sky monitor in 2008.

Device design

- designed and built by Hamburg Observatory (led by H. Hagen)
- low resolution $640 \times 480\,\mathrm{px}$ camera behind fisheye lens, covered by protective lid
- takes all-sky frame every three minutes

# Working principle of the sky monitor

- data pipeline follows the following procedure
  - extract positions of all visible stars up to 5th magnitude
  - compare with astrometric night sky model
  - if stars are missing in the actual image, assume clouds
  - assign values from 0 to 10 depending on brightness of hidden stars
- "side-products" of pipeline includes background images, photometric analysis, ...
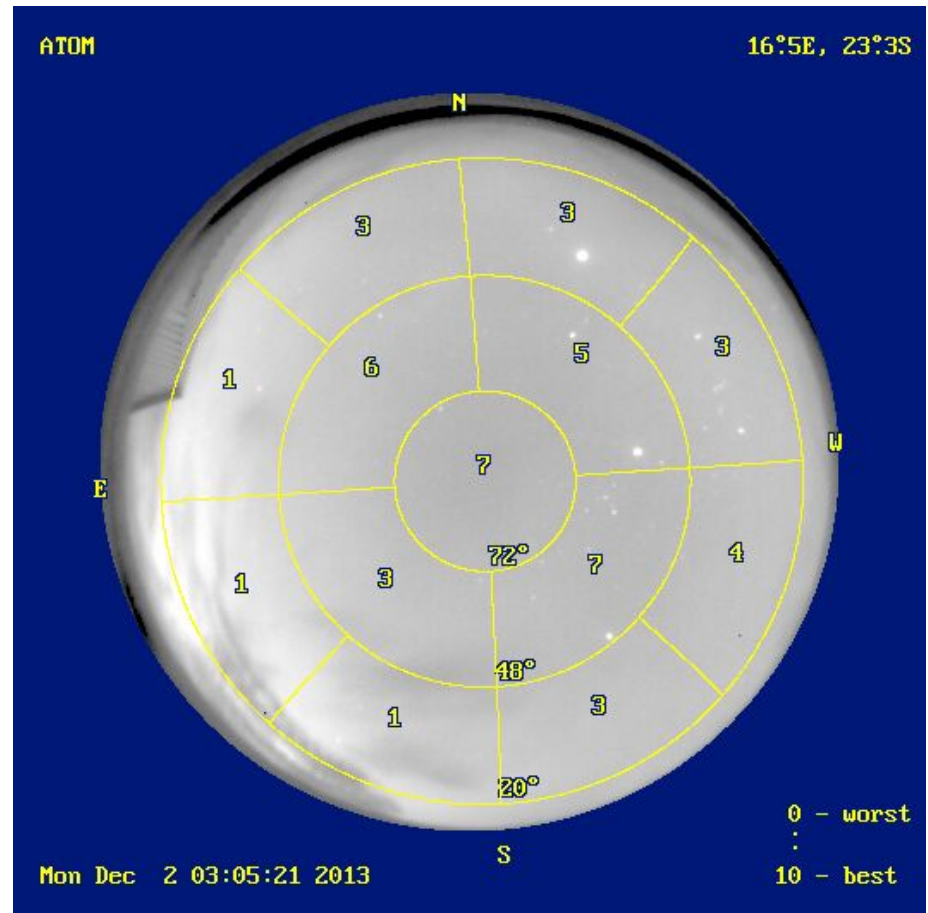
Sky monitors currently in use
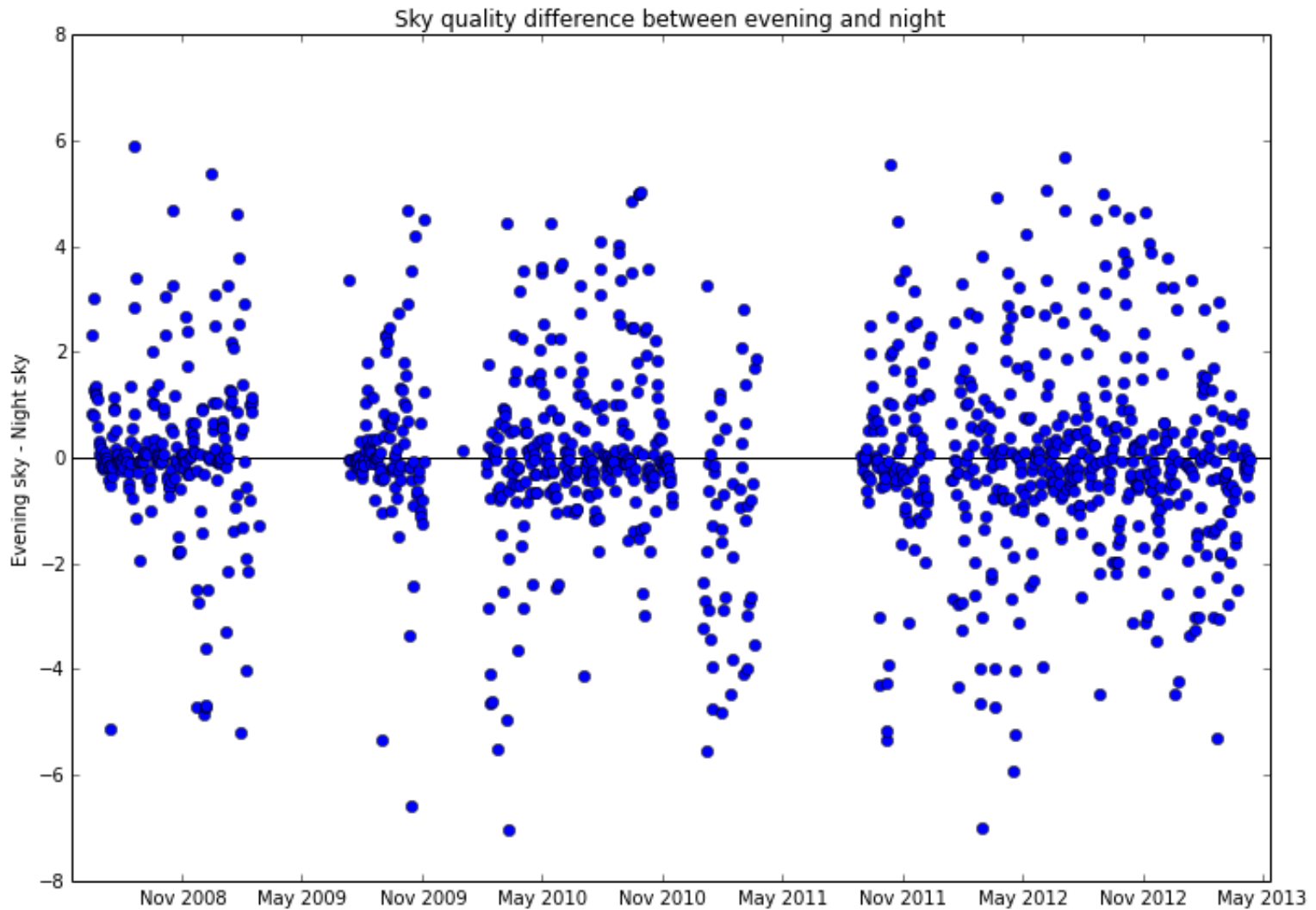

Stationary Göllschau model
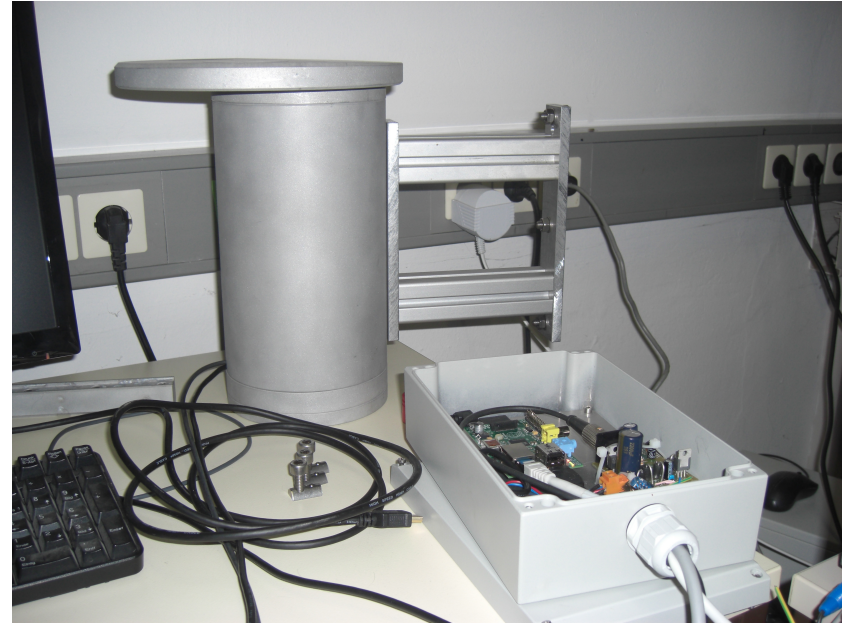
Mobile Aar model

Benefits of the device design

- (almost) maintenance-free
- performance consistent over long and short time
- possibility to dynamically add additional optical components in front of lens, e.g. daytime or colour filters

Difference between evening and night

Sky quality difference between evening and night

If we didn't have the sky monitor ...
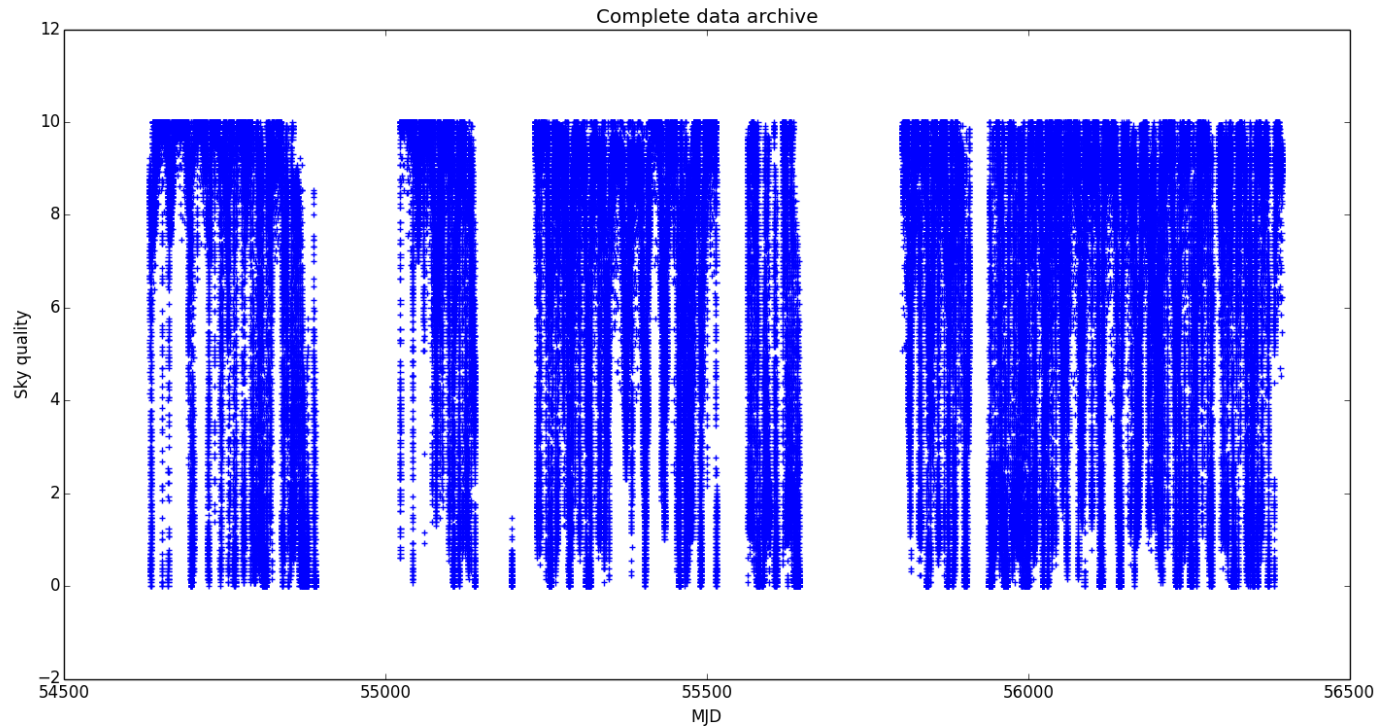

Difference in weather between evening and whole night

Weather characterisation

Sky monitor data archive

Complete data archive

Data binned to nights

Site quality per night without moon, using mean quality threshold >= 8.
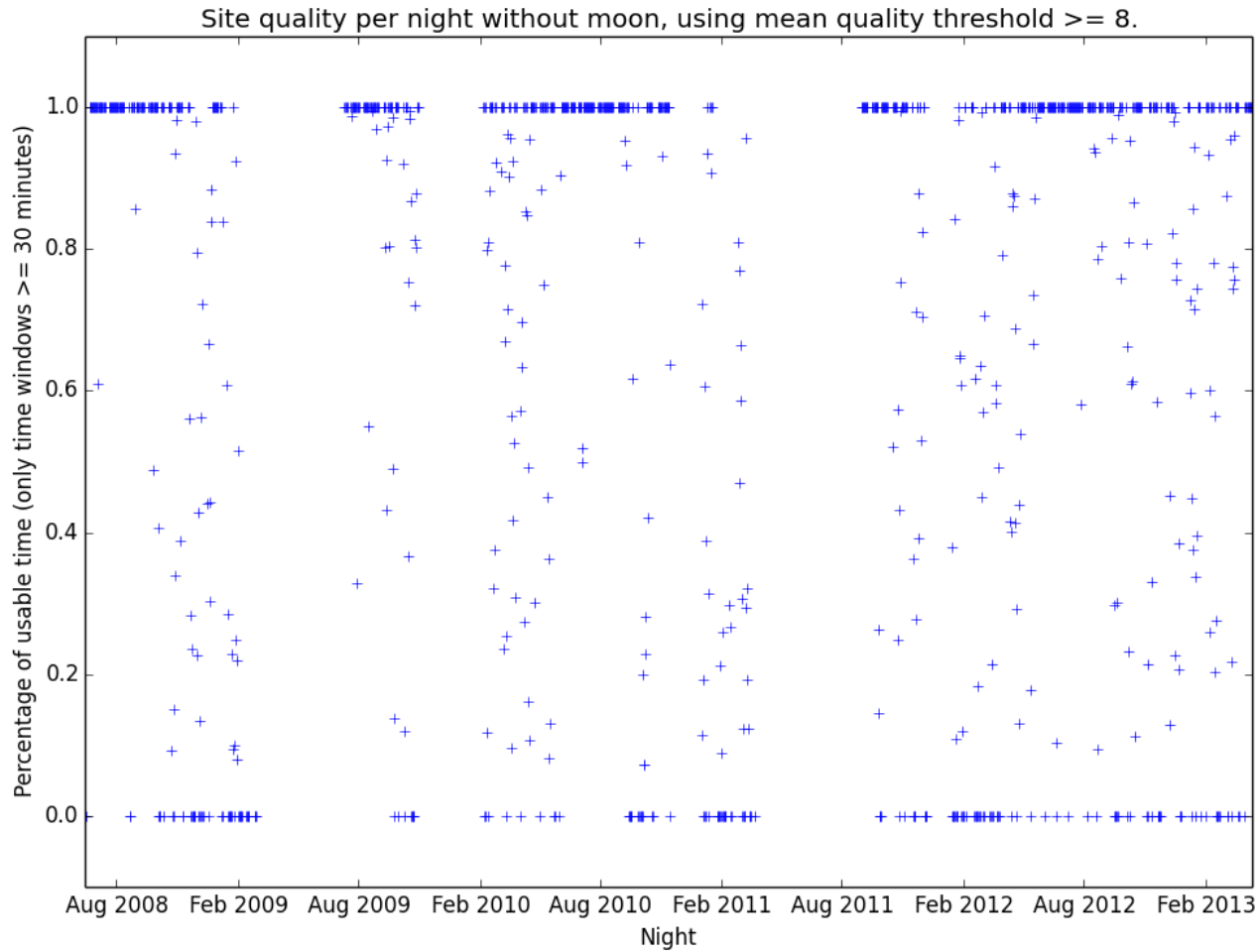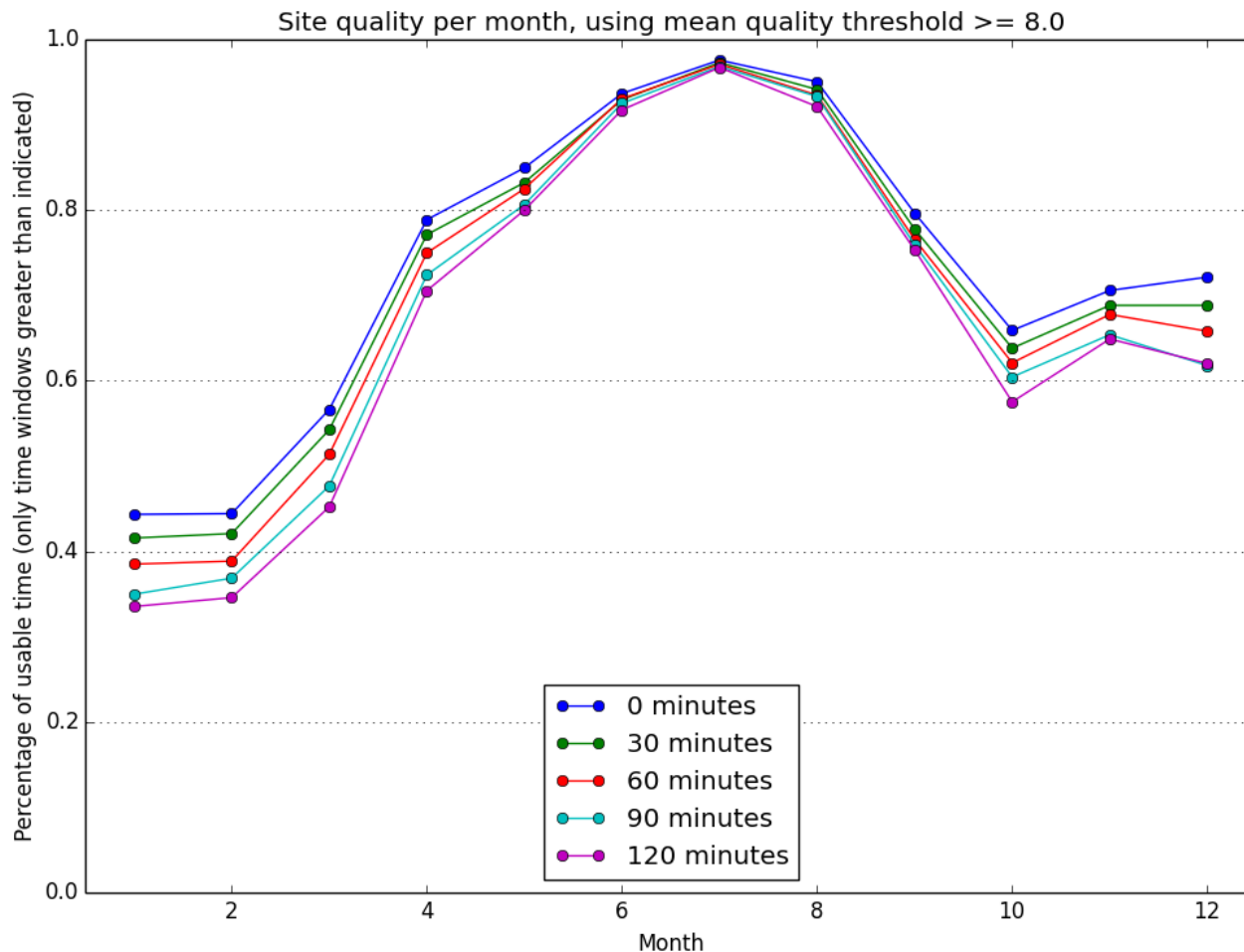
Summer and winter characteristics
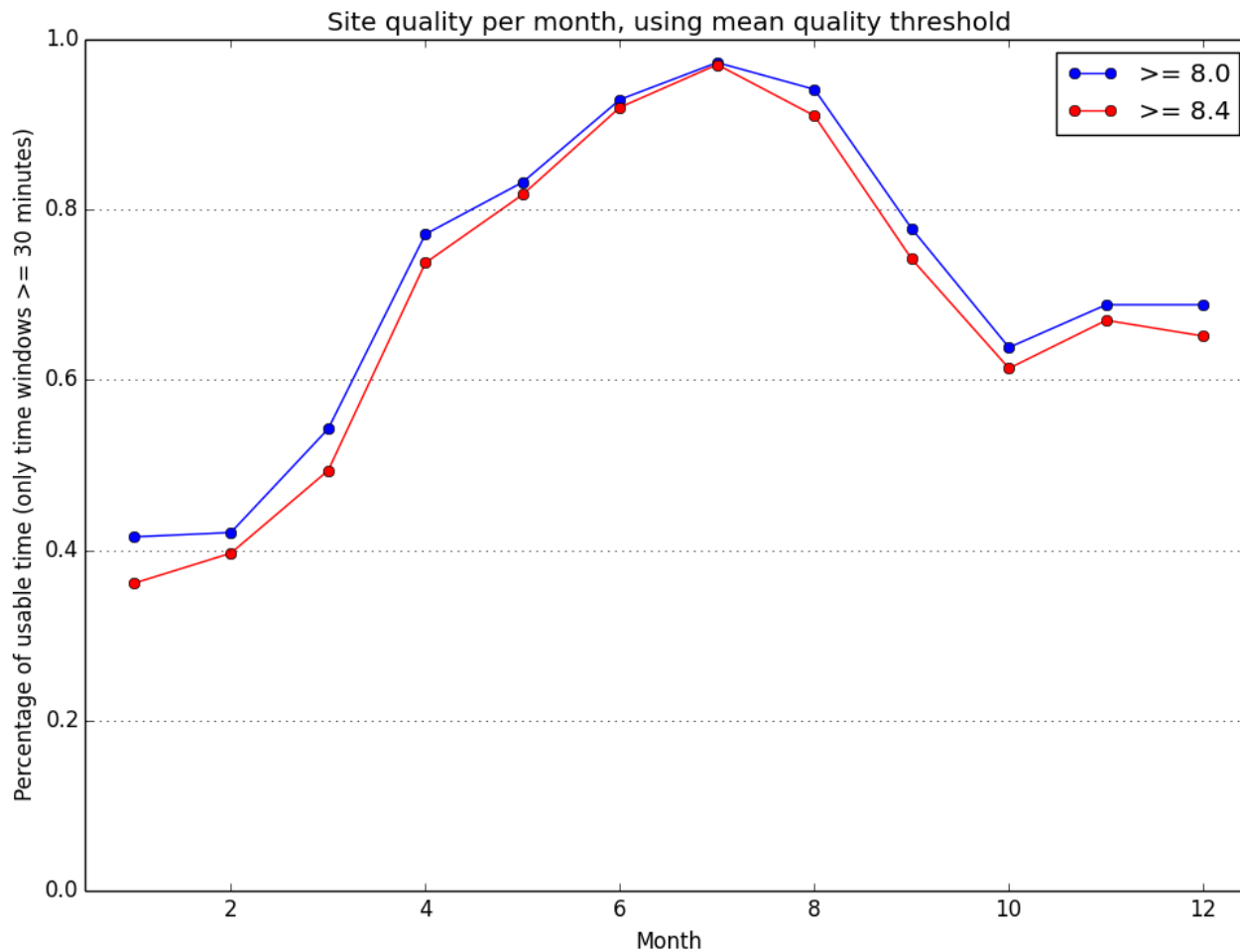
Comparing different minimum time windows

Site quality per month, using mean quality threshold >= 8.0

Legend:
- 0 minutes
- 30 minutes
- 60 minutes
- 90 minutes
- 120 minutes

y-axis: Percentage of usable time (only time windows greater than indicated)
x-axis: Month

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Using smart scheduling

Distribution of partial cloudiness
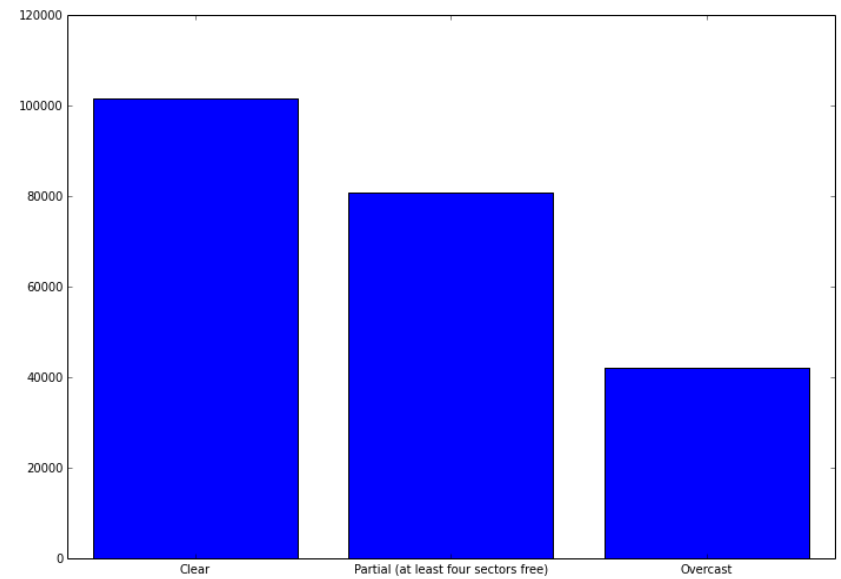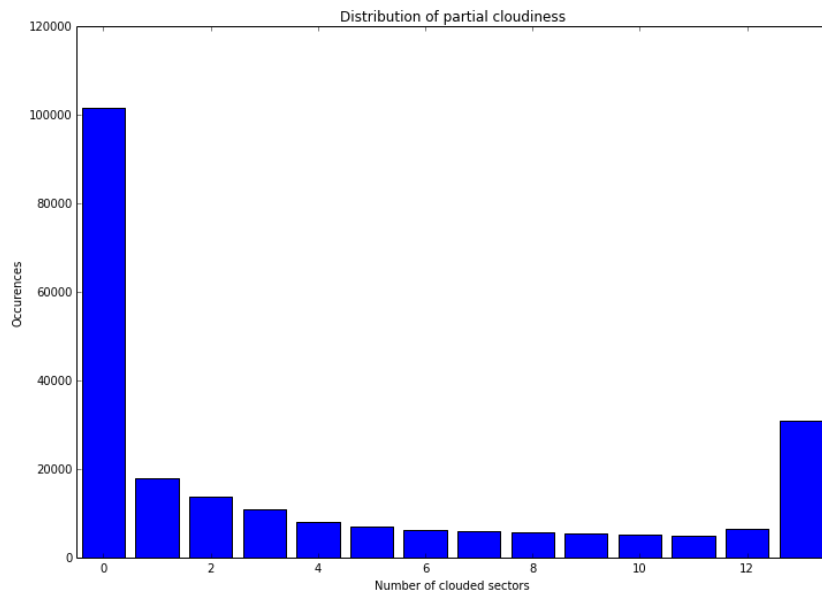
Looking for aerosols

Biomass burning effect at H.E.S.S.

Transparency coefficient vs. time
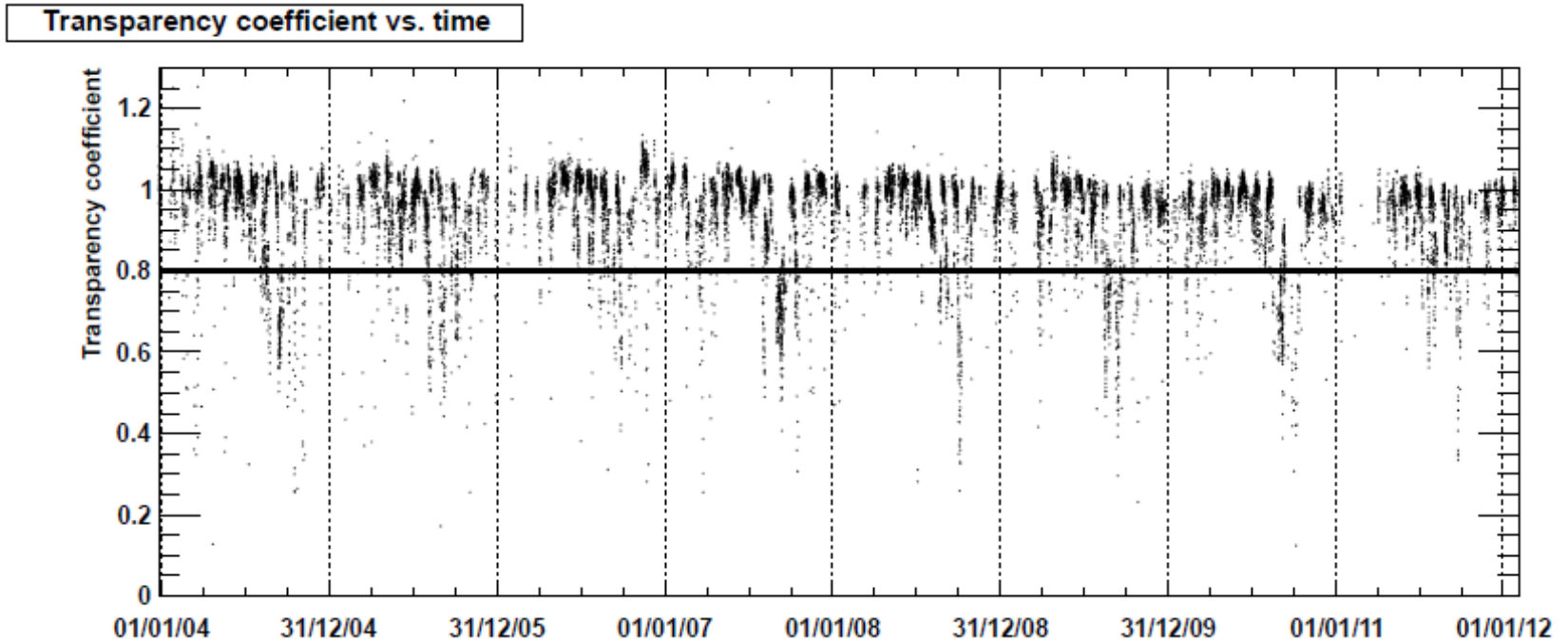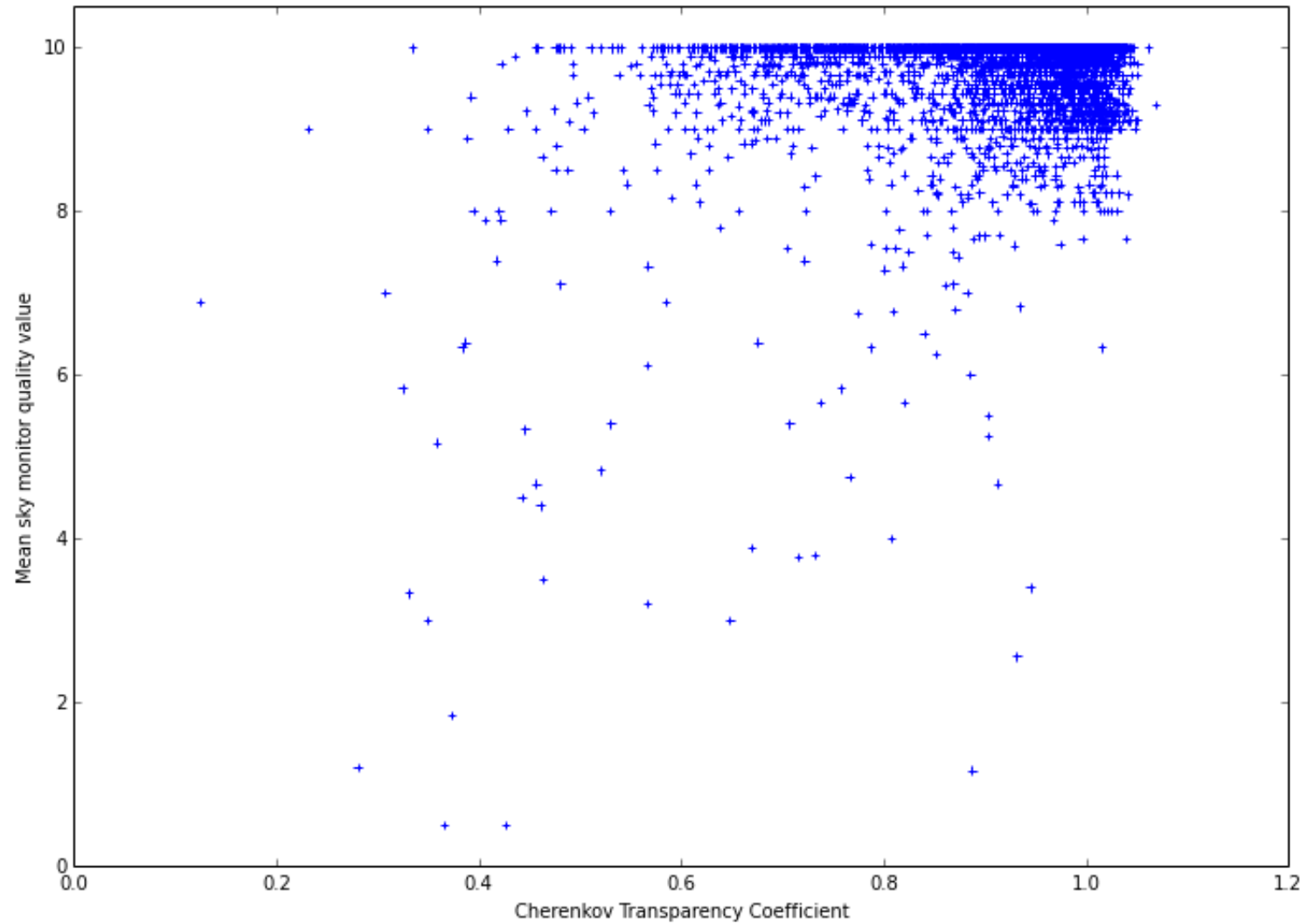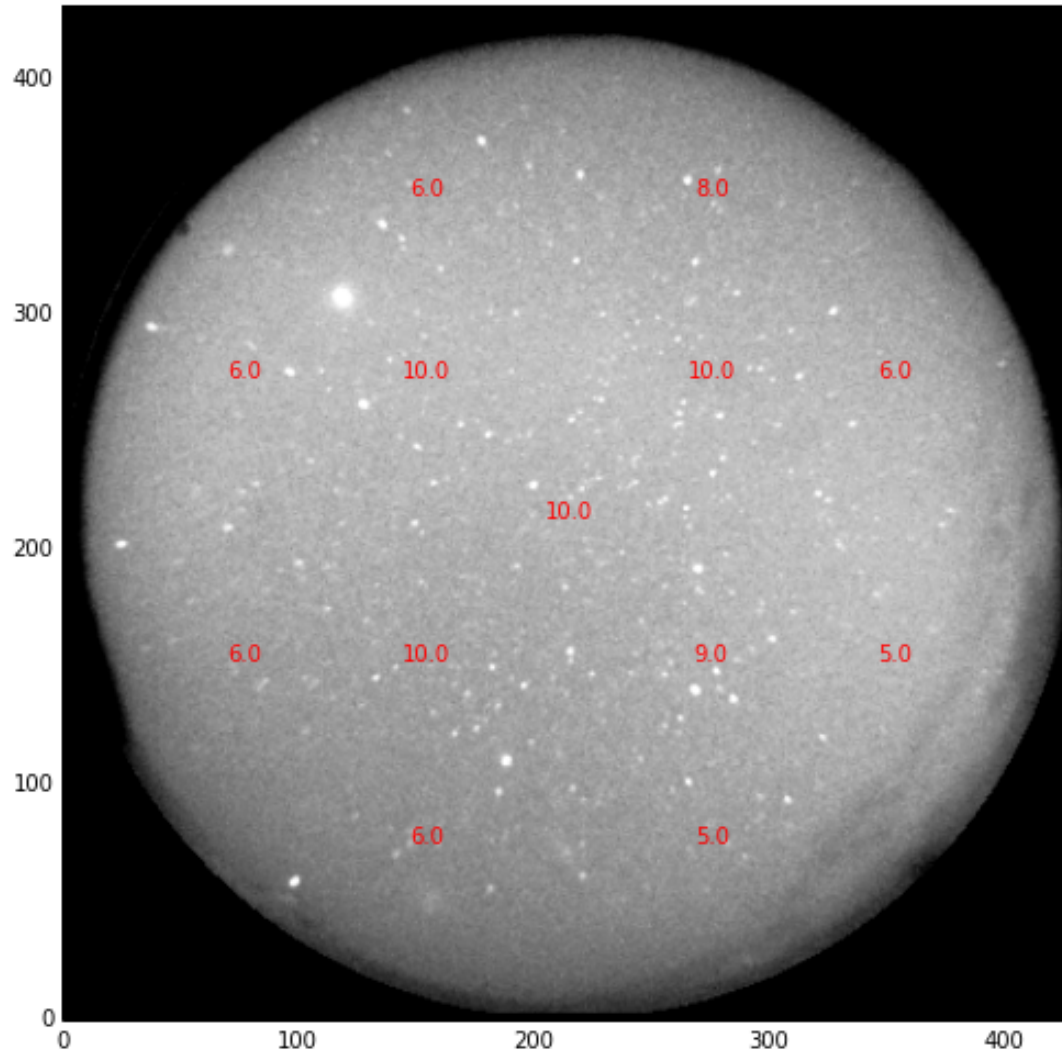
Every year, during September and October, bushfires produce a large scale aerosol layer covering the H.E.S.S. site at Göllschau.
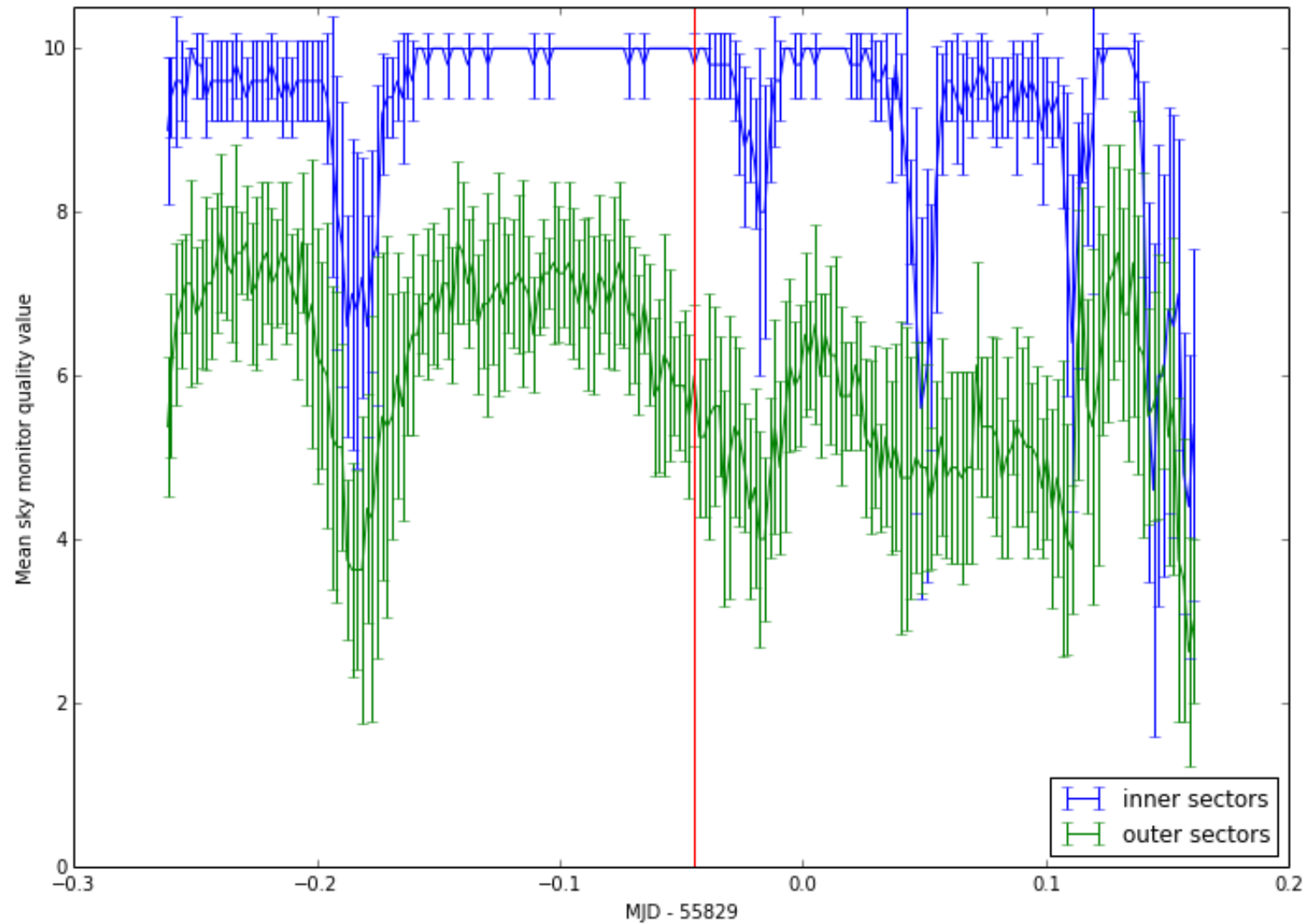
Aerosols and the sky monitor

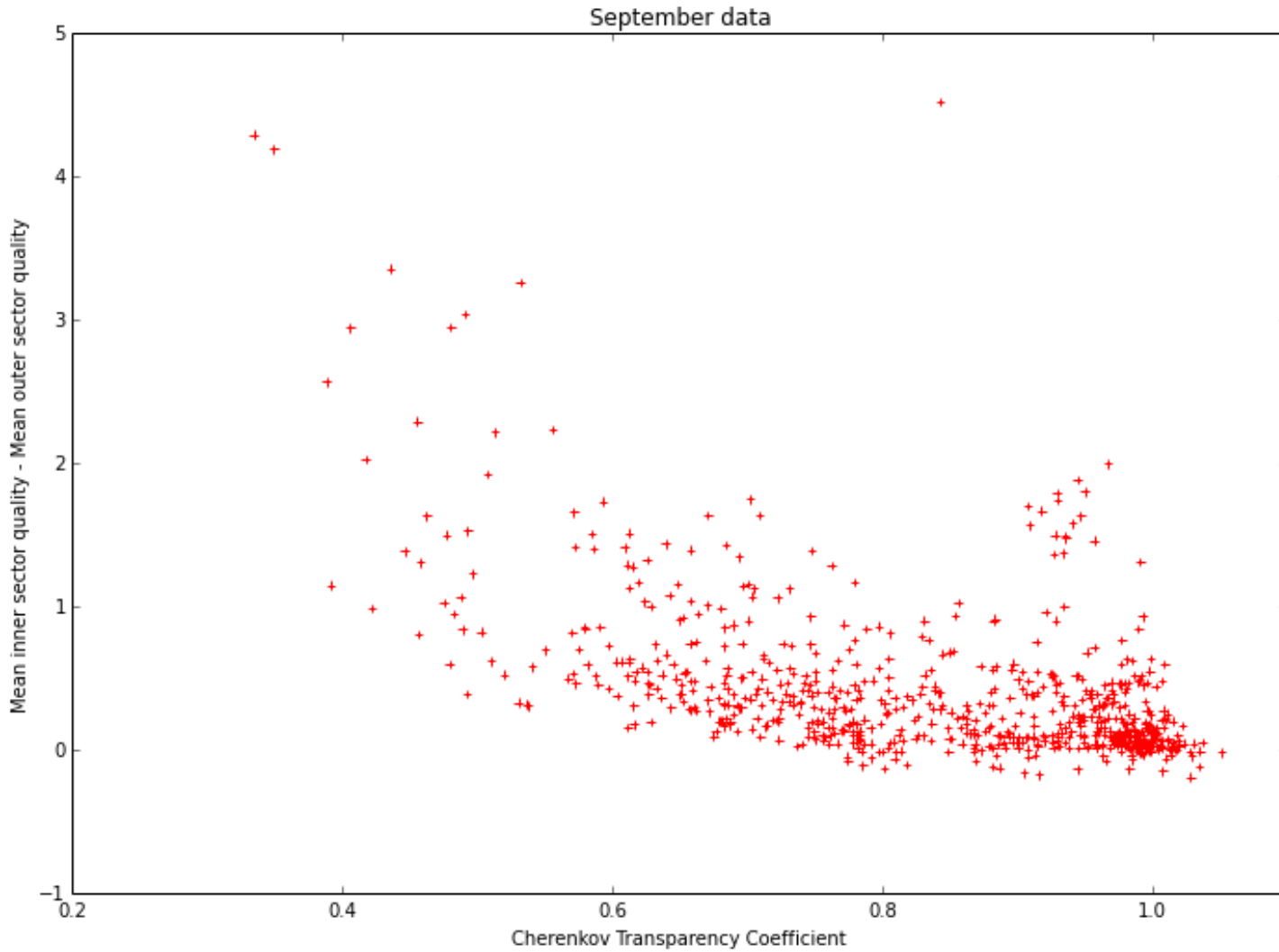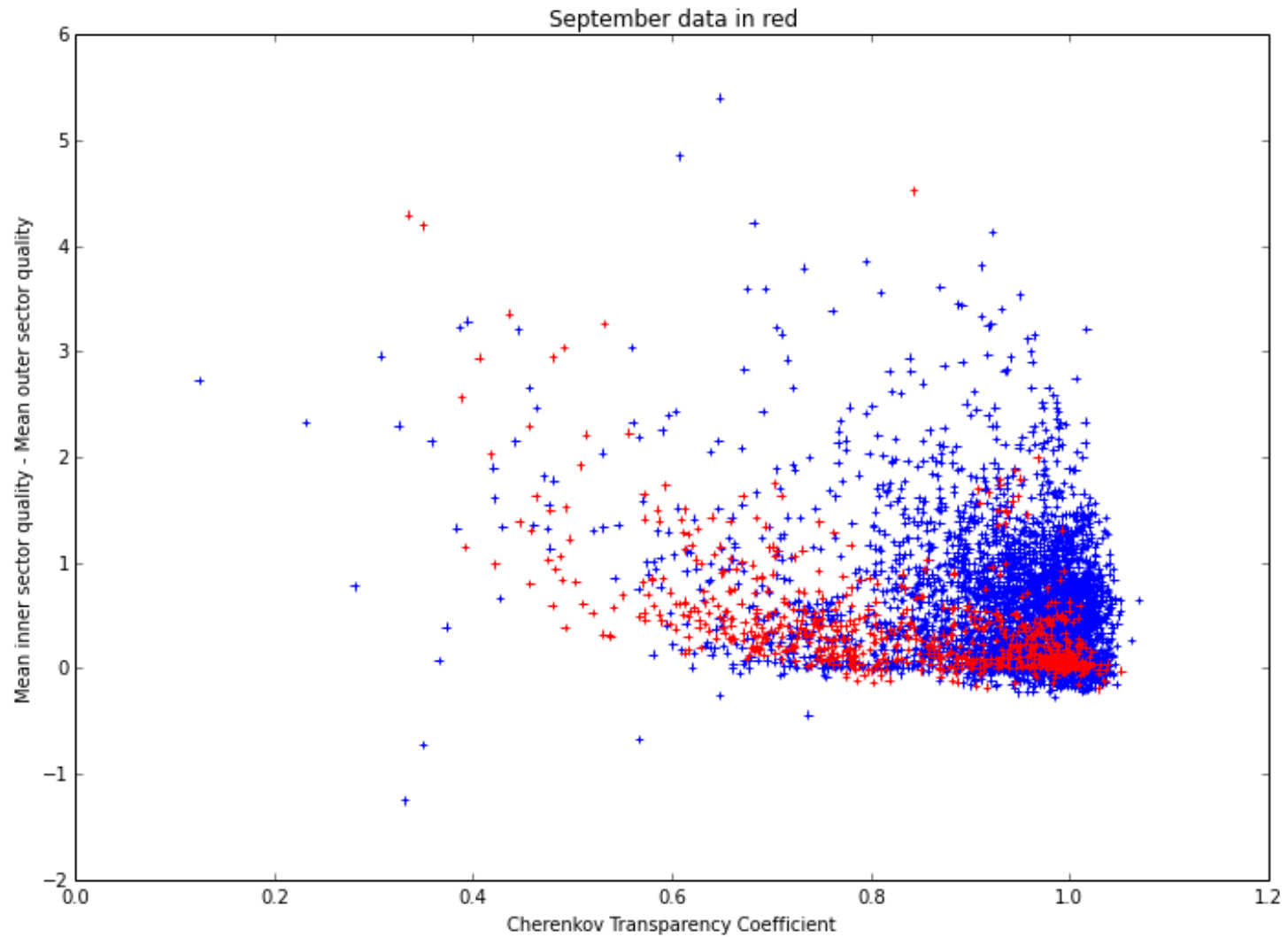# Air mass effect during aerosol coverage

Higher and lower elevations during aerosol night

Comparing with Cherenkov transparency

But life's never easy ...

September data in red

Where to go now?

- Ability of sky monitor to differentiate between aerosols and other types of intransparent layers not straightforward.
- Cloud monitor can probably be used to detect homogenous aerosol layers if accepting false positives.
- Still, we are not finished yet.
- However, colour seems like a more certain way to go.

Extending capabilities

by T. Herbst, MPIA

Summary

- Sky monitor is an excellent tool for its original purpose.
- Sky monitor also offer unique insights with respect to weather monitoring and prediction of optical observation quality of a site.
- Linking sky monitor data with Cherenkov observations is not straightforward.
- But further developments – technical and analytical – may overcome these limitations.

All-sky cameras are very capable tools, but have to be used with caution. Nevertheless, they can offer a lot for Cherenkov astronomy and therefore should receive further attention.

Until next time!