Towards Flux Rates from Video Meteor Observations

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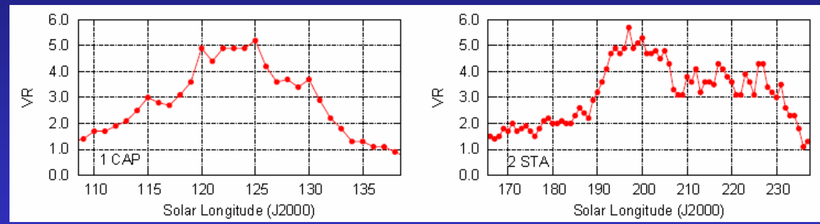
Agenda

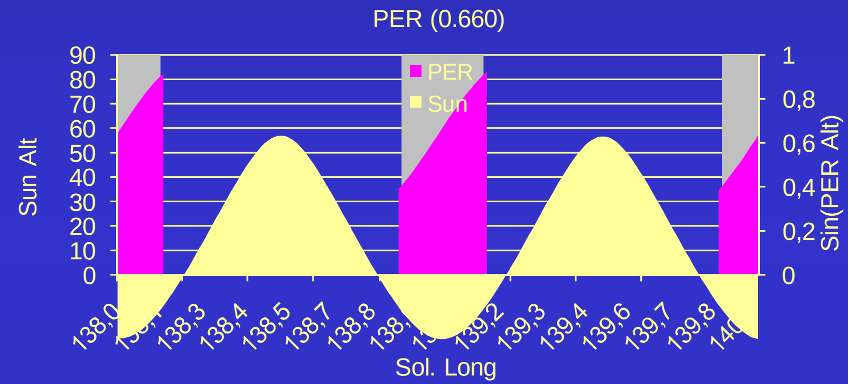
- Motivation
- Limiting Magnitude
- Effective Collection Area
- Conclusion

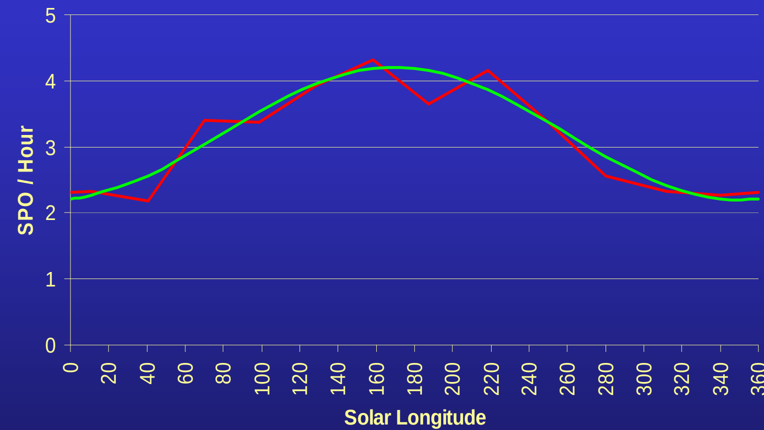
Motivation (I)

- In 2009, we presented detailed activity profiles for all showers detected in the IMO Video Meteor Database
- They were based on positional data only (PosDat)
- Count corrections were based on
  - → The observing geometry: average radiant altitude at the observing site (observability function)
  - → The number of sporadic meteors in the same time interval
  - → The annual sporadic activity curve

→ Works well for large data set, but not for short-term analyses (e.g. single peaks)





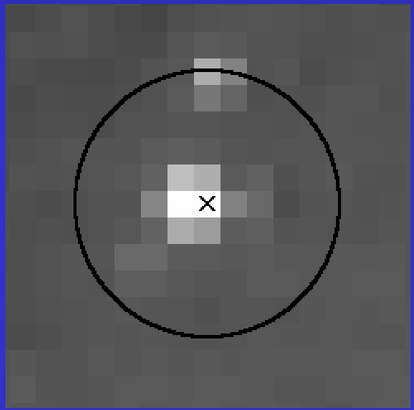


Motivation (II)

- Scaling meteor counts with the sporadic rate has the advantage, that the properties of the video system and observing conditions are all taken into account
  - $\rightarrow$ Size of field of view and obstruction (e.g. clouds)
  - $\rightarrow$ Observing direction
  - $\rightarrow$ Camera sensitivity and limiting magnitude
  - $\rightarrow$ Effective observing time
  - $\rightarrow$ Spectral response, meteor detection efficiency, …
- Of these parameters, only the effective observing time was measured so far
- MetRec was recently improved to obtain also the limiting magnitude and the effective collection area

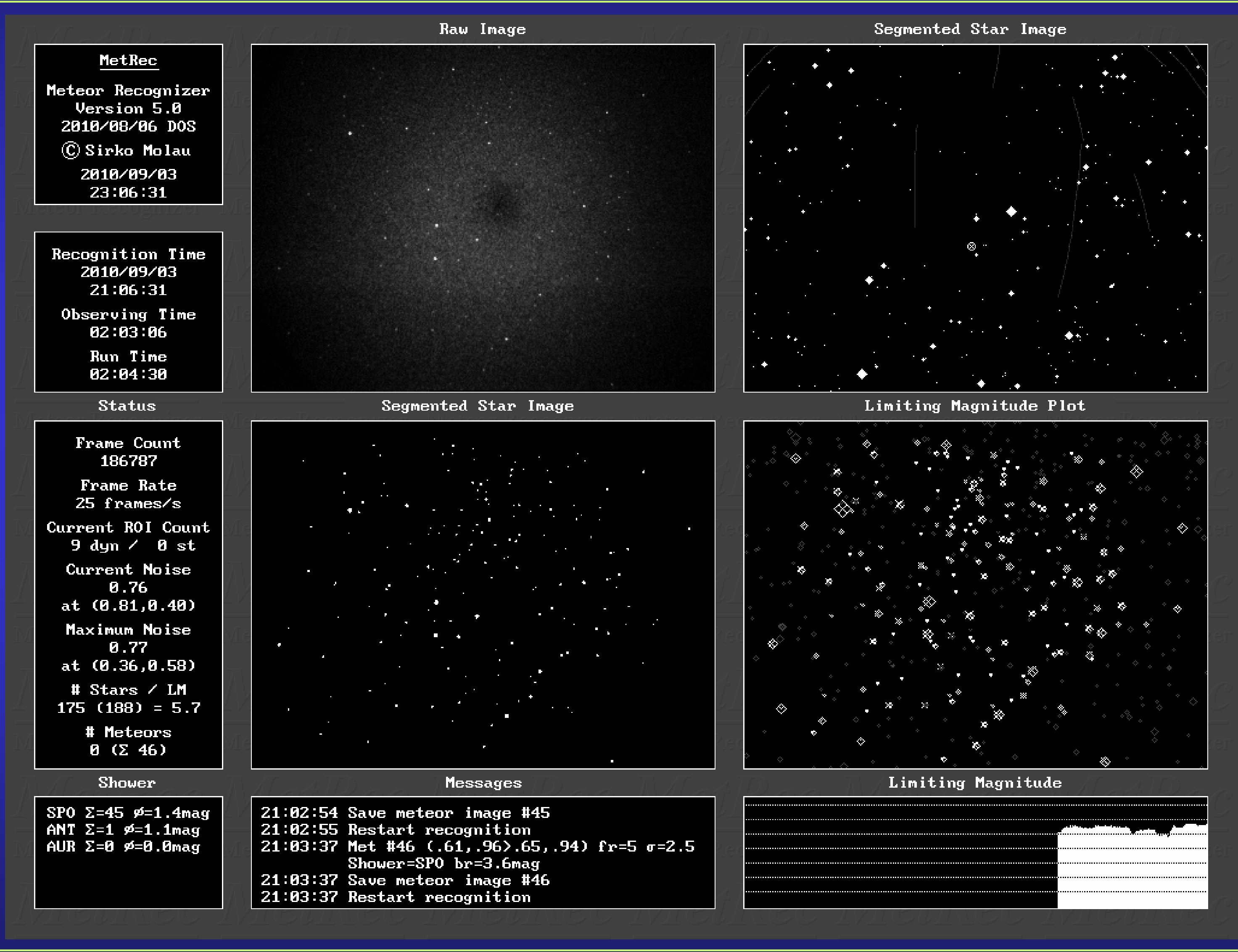
Limiting Magnitude (I)

- A mixture of the *faintest visible star* and the *star counting* method is applied
- Stars in the field of view are continuously segmented from a mean image with a modified high-pass filter
  - → Put all pixels on a circle around the center pixel to a list
  - → Sort that list according to the pixel brightness
  - → Compute the mean brightness of these pixels without the brightest / faintest 25% of pixels
  - → Subtract the mean brightness from the center pixel
  - → Mark the pixel as star, if it exceeds a certain threshold



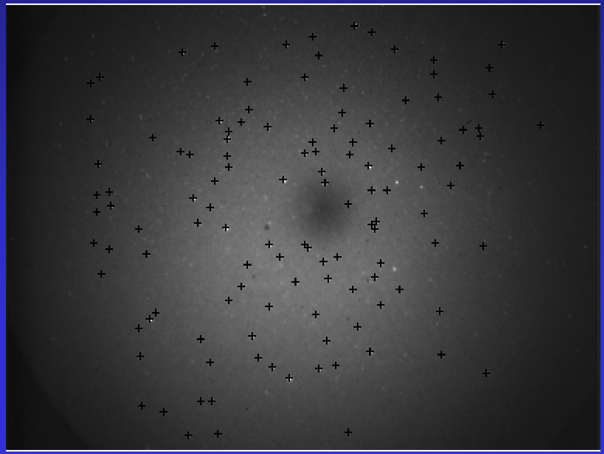
- From the inverse plate constant function and a star map it is computed iteratively, i.e. which stars are expected at what position
- Segmented stars are matched against catalog stars and the identified stars are counted
- The count of identified stars is converted into a limiting magnitude

Limiting Magnitude (II)

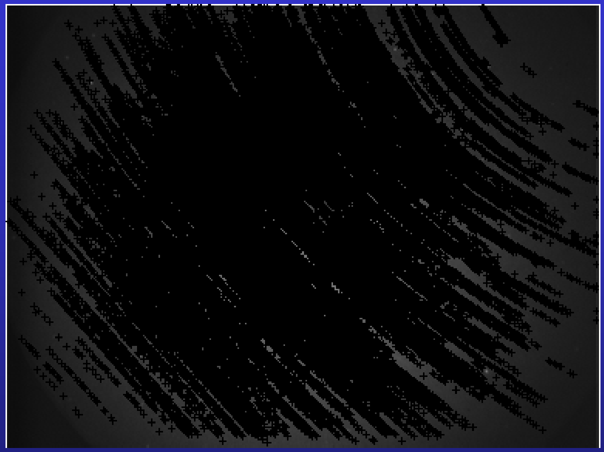


Limiting Magnitude (III)

- The limiting magnitude is computed each minute
- It represents an *average* lm in the field of view (in case of variable sensitivity or obstruction by clouds)
- It's a robust measure (a few stars more or less have little impact on lm)
- With two extra tricks, it works also quite well under difficult conditions (e.g. moonlit clouds):
  - → The number of reference stars on the map depends on the previous lm to reduce chance alignments
  - → When there are n stars detected, one of the n brightest stars must be among them
- Each minute, the positions of dozens or even hundreds of stars are measured, which gives up to 100.000 reference star positions each night
  - → Improved plate constants as by-product



120 manually measured positions



35.000 automatically measured positions

Effective Collection Area (I)

- For each non-masked pixel, the angular extend in square degrees is computed
- This is transformed into square kilometers at the meteor layer (85 km) taking account of the camera orientation

→ The accumulation over all pixels yields the collection area of the camera in square degrees and square kilometers

- For each pixel, the loss in limiting magnitude is calculated
  - → Distance to the meteor layer (conversion to absolute magnitude)
  - → Extinction (currently using "average" conditions)
- The loss in lm is converted into a reduction of the collection area with the correction factor $r^{(-\Delta lm)}$ (assuming an average population index of $r=2.5$)

→ Each minute, the collection area is corrected additionally for the current limited magnitude, and multiplied with the effective observing time in that minute (taking breaks into account)

- Accumulating that figure yields the effective collection area of a camera (corrected for lm=6.5 mag) in a certain night, measured in km^2 x hour

Effective Collection Area (II)

AVIS2

- Image-intensified, 1.4/50 mm lens
- 1,800 square degrees
- 6,100 km^2 @ 85km
- 4,400 km^2 after lm correction

Date: 31.07.2010

Time	#DS	RLM	#RS	#IS	LM	ECA
21:41:00	127	6.7	395	121	5.6	31.6
21:42:00	128	6.6	366	123	5.6	33.0
21:43:00	141	6.6	391	134	5.7	34.3
21:44:00	140	6.7	411	136	5.7	35.5
21:45:00	139	6.7	429	131	5.7	34.0

→ Eff. observing time : 4 h 42 m 15 s

→ Eff. collection area: 8121.8 km^2 x h

MINCAM1

- (old) Mintron , 0.8/12 mm lens
- 1,500 square degrees
- 42,000 km^2 @ 85km
- 5,400 km^2 after lm correction

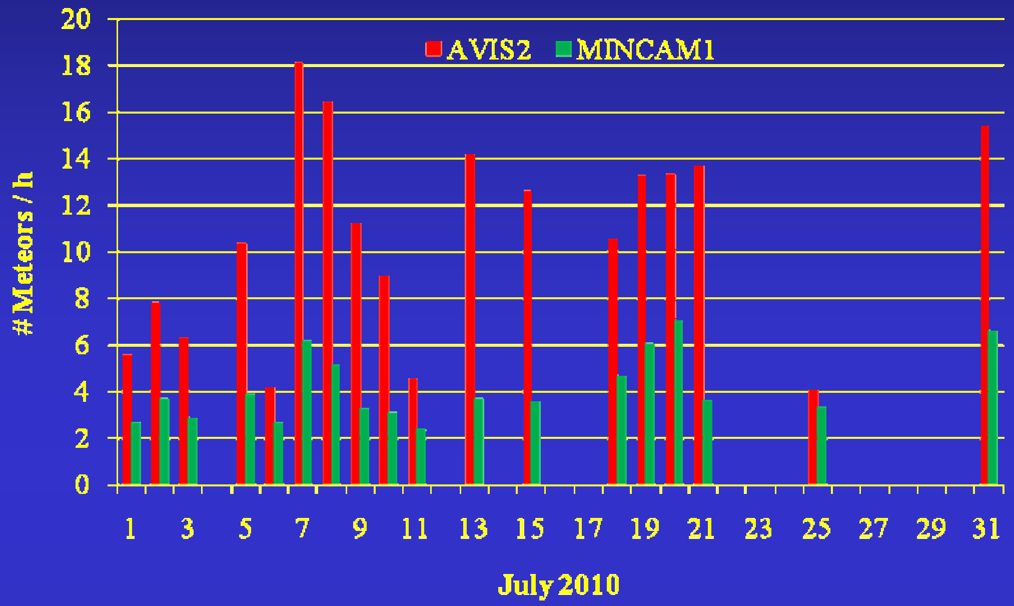
Date: 31.07.2010

Time	#DS	RLM	#RS	#IS	LM	ECA
21:41:00	82	5.9	130	22	4.3	12.1
21:42:00	80	5.3	61	23	4.3	12.2
21:43:00	87	5.3	65	27	4.5	14.7
21:44:00	83	5.5	80	29	4.5	14.3
21:45:00	84	5.5	79	27	4.5	14.6

→ Eff. observing time : 6 h 48 m 50 s

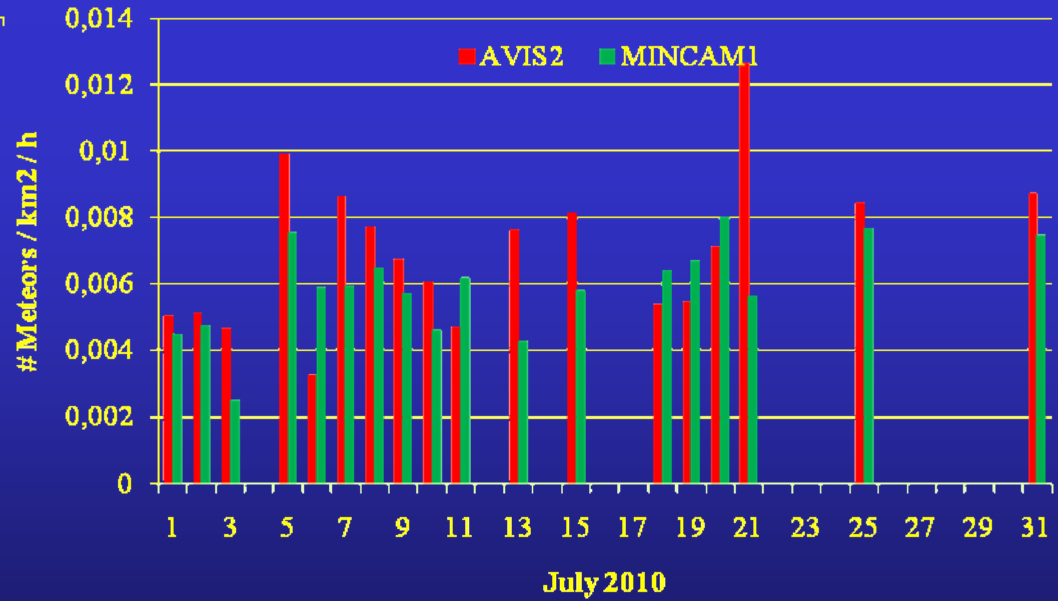
→ Eff. collection area: 6048.1 km^2 x h

Effective Collection Area (III)



Old measure: Meteors / hour

New measure: Meteors / km^2 / h



Conclusion

- Robust measurement of limiting magnitude in real time
- Improved plate constants as by-product (in particular helpful for large fov's)
- Determination of the effective collection area that covers both instrumental (fields of view, sensitivity) and observational (limiting magnitude, cloud obstruction, observing direction, effective observing time) properties
- Better basis to combine data from different cameras
- Biggest limit is a large range in lm, because the population index will differ from 2.5
- Basis for rate/flux measurements independent of sporadic rates

- Special present for IMC 2010: the IMONET Screen Saver

http://www.imonet.org

The End

Thanks for your attention!

Questions?