Non-night-sky events

Dr SO Chu-wing

The University of Hong Kong

Factors affected raw NSB data

- Sunlight / twilight
- Unphysical NSB readings
  - e.g., $<=10$ mag, $>= 23$ mag
- Aging / light attenuation of optics
  - SQM-LE's filter
  - Window of housing
- Non-routine lighting events
  - Stargazing events / private observations
  - Others: e.g., Earth Hour, holidays
- Natural phenomena
  - Moonlight
  - Scattered city light from clouds

Non-night-sky events

- The above factors that polluted the NSB light curves were known as "**non-night-sky**" events
  - Factors that do not truly reflect the **general** night sky (light pollution) conditions
- "Non-night-sky" events
  - Have to be removed before conducting data analysis
  - Human events:
    - Keep good record of their occurrences for each observing location
  - Natural phenomena:
    - Check their occurrences from astronomical almanac, weather data, etc
- Details will be discussed in "Introduction to data analysis" session.

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Sunlight / twilight

- Sunlight saturates the sensor of SQM-LE
  - Can be easily avoided by <u>removing data taken before sunset or after sunrise.</u>
  - Get the sunset and sunrise timings from official meteorological agency of your country or region, or

    http://www.timeanddate.com/worldclock/sunrise.html

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Sunlight / twilight

- Sunrise and sunset calculator:

http://www.timeanddate.com/worldclock/sunrise.html

🔴 Tokyo, Japan — Sunrise, sunset and daylength, December 2014

Current Time:	25 Dec 2014, 18:46:06	
Sun Direction:	← 258.91° W	
Sun Altitude:	-26.10°	
Sun Distance:	147.142 million km	
Next Equinox:	21 Mar 2015 07:44 (Vernal)	
Sunrise Today:	06:49	↘ 119° Southeast
Sunset Today:	16:33	↙ 241° Southwest

Daylight
06:49 – 16:33
9 hours, 44 minutes

City or country...   Search   Time/General Weather Time Zone DST Changes Sun & Moon

Sun & Moon Today   Sunrise & Sunset   Moonrise & Moonset   Moon Phases

December 2014 — Sun in Tokyo

Month: December   Year: 2014   Go

2014	Sunrise	Sunset	Daylength		Astro. Twilight		Naut. Twilight		Civil Twilight		Solar noon	
	Sunrise	Sunset	Length	Diff.	Start	End	Start	End	Start	End	Time	Mil. km
Dec												
1	06:32 ↘ (116°)	16:28 ↙ (243°)	9:55:59	−1:05	05:02	17:58	05:32	17:27	06:04	16:56	11:30 (32.6°)	147.521
2	06:33 ↘ (117°)	16:28 ↙ (243°)	9:54:56	−1:02	05:02	17:58	05:33	17:27	06:05	16:56	11:30 (32.4°)	147.496
3	06:34 ↘ (117°)	16:28 ↙ (243°)	9:53:56	−1:00	05:03	17:58	05:34	17:27	06:06	16:56	11:31 (32.3°)	147.472

Sunlight / twilight

- Twilight
  - Can be avoided by <u>excluding data taken outside the astronomical dark period.</u>
    - Astronomical dusk / dawn
      - Sun reaches 18+ degrees below the horizon
    - Astronomical dark period
      - The time between astronomical dusk and dawn.
    - Sunlight is also avoided by excluding data taken outside astronomical dark period
  - Timing of astronomical dark period can change significantly over the year, especially in locations with high latitude.
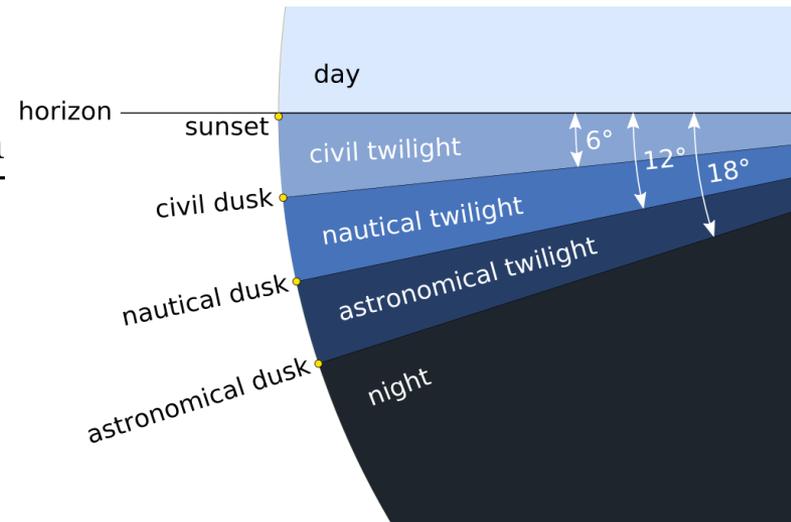
Sunlight / twilight

- Get the timings from official meteorological agency of your country or region, or
http://www.timeanddate.com/worldclock/sunrise.html
- Sunrise and sunset calculator:
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Sun & Moon Today   Sunrise & Sunset   Moonrise & Moonset   Moon Phases

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Unphysical NSB readings

- Can be easily avoided by <u>excluding data with NSB <= 10 or NSB >= 23 during data extraction.</u>
  - Or define your own limits based on the actual situation
- Details will be discussed in "Introduction to data analysis" session.

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Aging / light attenuation of optics

- The aging of SQM-LE's filter is assumed to be absent for recent models.

- The light attenuation of glass window can be adjusted by offsetting raw NSB data by -0.11 mag arcsec^{-2}.

  - The size and the evolution of the offset need further studies.

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Non-routine lighting events

- Database table *non_night_sky_events* records the occurrence of non-night-sky events, including non-routine lighting events

- **All SQM-LE users are invited to maintain a good record of non-night-sky events related to their location(s).**

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Non-routine lighting events

1. Click table "*non_night_sky_events*"
2. Click "*New item*"
3. Provide the following information for each events
4. Click "*Save*"

Select data **Show structure** Alter table New item

Column	Type	Comment
id	mediumint(9) *Auto Increment*	
site	varchar(10) *NULL*	
start_date_time	datetime *NULL*	local time
end_date_time	datetime *NULL*	local time
category	int(10) unsigned *NULL*	
detail	text	
remark	text	
reading_affected	enum('yes','no')	

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Non-routine lighting events

- Each type of non-night-sky event has a category ID with two digits

- Non-night-sky events are categorized into 9 main categories (1st digit):

category	event
10-19	installation
20-29	network
30-39	power
40-49	mounting
50-50	maintenance

category	event
60-69	activity
70-79	astronomy
80-89	weather
90-99	others

- ID x9 in each main category is reserved for "other"

- Categorization are listed in the database table *non_night_sky_events_category* which will be updated from time to time

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Non-routine lighting events

- The field "*reading_affected*" only has two values: *yes*, *no*

- If you believe that the NSB readings were affected by the non-night-sky event, click "*yes*". For examples:
  - In a public event, the external lighting on the rooftop where the SQM-LE is installed were turned-on. The sky readings were affected by this event.

- If you believe that the NSB readings were NOT affected by the non-night-sky event, click, click "*no*". For examples:
  - During a private observation, no external lighting was turned-on. The sky readings were not affected by this event.
  - The mounting of SQM-LE was disassembled temporary for maintenance works in daytime. The sky readings at night were not affected by this event.

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Non-routine lighting events

- **<u>All SQM-LE users are invited to maintain a good record of non-night-sky events related to their location(s).</u>**

- For example, suppose there was a public stargrazing event conducted on the NAOJ rooftop where the SQM-LE is installed from 8pm to 10pm last night. External lighting were switched on.

  - site = *AOJ*

  - start_date_time = *2015-01-07 19:30:00* (including preparation time)

  - end_date_time = *2015-01-07 22:30:00* (including time on tidying up)

  - category = *61*

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Non-routine lighting events

- Detail = A *public stargrazing event hosted by Mr ABC…External lighting were turned-on sometime*

- Remark = *same rooftop as SQM-LE installation*

- reading_affected = *yes*

id	Auto Increment	
site	▼	AOJ
start_date_time	▼	2015-01-07 19:30:00
end_date_time	▼	2015-01-07 22:30:00
category	▼	61
detail		A public stargrazing event hosted by Mr ABC…External lighting were turned-on sometime
remark		same rooftop as SQM-LE installation
reading_affected		○ *empty* ● *yes* ○ *no*

Save   Save and insert next

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Non-routine lighting events

- Points to note:
  - If you are unsure whether a particular event is "non-night-sky", please also record it and make some remarks.
  - Please provide details on each event as much as possible.
  - If no category fit, input x9, e.g. 49 for "other" event related to mounting.
  - Please make a record as soon as you know it
    - Accept future events
    - Accept daytime events
  - Please check "non-night-sky" events input by others if you are analyzing light curves of that particular locations.
  - <u>Exclude data taken during certain non-night-sky events before analysis.</u>

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Moonlight

- Unless for moonlight-NSB analysis, the effect of moonlight can be easily avoided by <u>excluding data taken when the Moon is above the horizon</u> (or above certain lunar brightness).

- Get the moonset and moonrise timings from official meteorological agency of your country or region, or

  http://www.timeanddate.com/worldclock/moonrise.html

- If you need more data on the Moon…

  - e.g., Alcyone Ephemeris software (not freeware): http://www.alcyone.de/

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Moonlight

- Moonrise and moonset calculator

http://www.timeanddate.com/worldclock/moonrise.html

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Lunar eclipse

- Unless for moonlight-NSB analysis, the effect of lunar eclipse can be easily avoided by <u>excluding data taken during lunar eclipses.</u>

- Get the eclipse timings from official meteorological agency of your country or region, or

<u>http://www.timeanddate.com/eclipse/</u>

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Scattered city light from clouds

- The effect of scattered city light from clouds can be easily avoided by <u>excluding data taken when the sky is cloudy.</u>
- Alternatives:
  - Averaging a huge amount of data covering multiple sky conditions
  - Analyzing "flat" light curves
- Cloud amount can be estimated by manual observation, cloud sensor, or ceilometer.
- Get the cloud amount data from official meteorological agency of your country or region, if any.
- An alternative is to install an all sky camera near the NSB observing station
  - e.g., The Moonglow Technologies All Sky Cam: http://www.moonglowtech.com/products/AllSkyCam/

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To be studied…

- Other natural phenomena (**you are invited to study their effects on NSB and share your ideas / findings among us!**)
  - Rain
  - Snow
  - Lightning
  - Aurora
  - Bird and its dropping
  - Insect
  - …
- Program bugs

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