Chinese SONG and new Site for future astronomy in China

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National Astronomical Observatories, CAS

Tenerife, Oct 2018

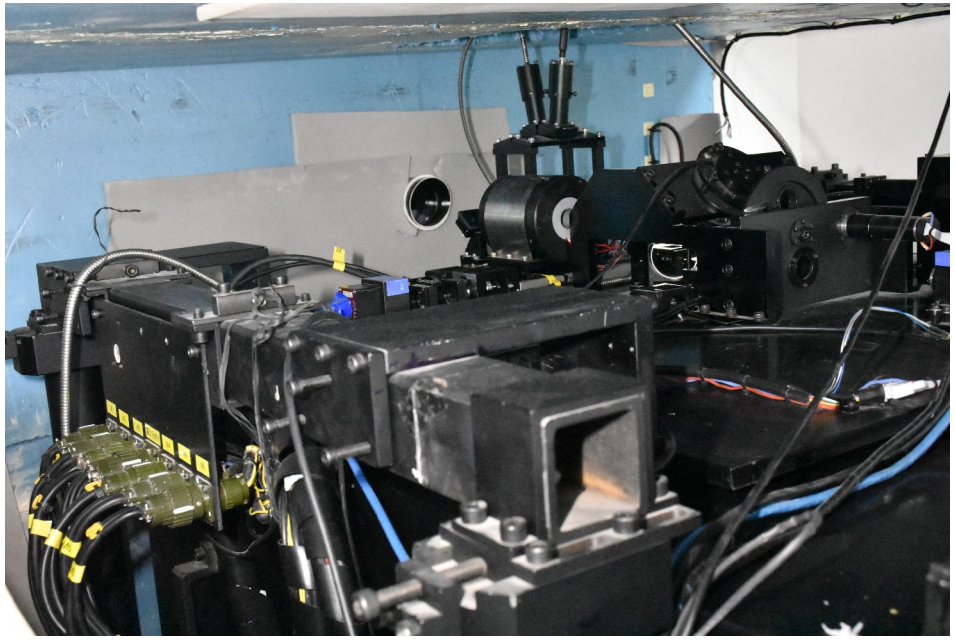
Contents

- Chinese SONG: Done and to be done
  - Brief report for 2013-1018
  - Issues with the system
- SONG and existing sites in the west
- Current site: protection vs fast development
- The need for new sites: Chinese mega-science plans
- Site qualification at LENGHU.

Current SONG @Delingha

- Shutted done spring 2018 for a major maintenance after about 132hr ‘manned’ observations mainly in 2017
  - Removing secondary unit, recoating and replace the support (hexapod -> linear focusing only)
  - Re-cabling the system (which has been a mess even for regular operations)
  - Realigning all the optics
  - Sorting out solar fiber feed
  - Maintenance of the spectrograph (the best part of the system)
- Still working on most of above tasks

Secondary support

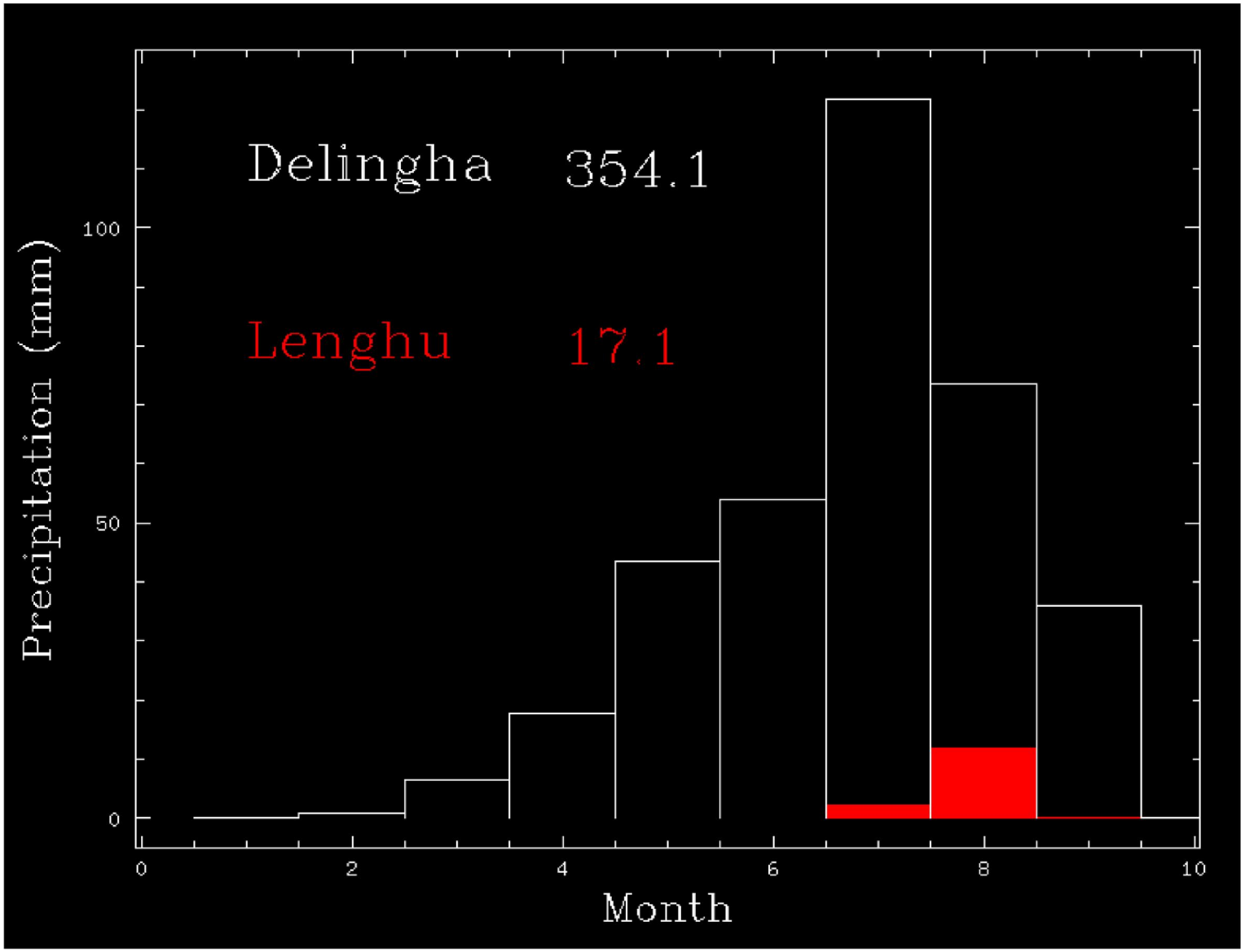


Delingha site quality keep decaying since 2014

- The city is brightening up exponentially at night (local development and touristic activities
- Direct light pollution reaching the Zenith at the site (shooting entertainment laser beams)
- Agricultural activities reaches 10 meter away from our facility
- Abnormal climate change, rain like in Yangzi area

- But these are not the reason for relocating SONG

Precipitation: DLH vs LH

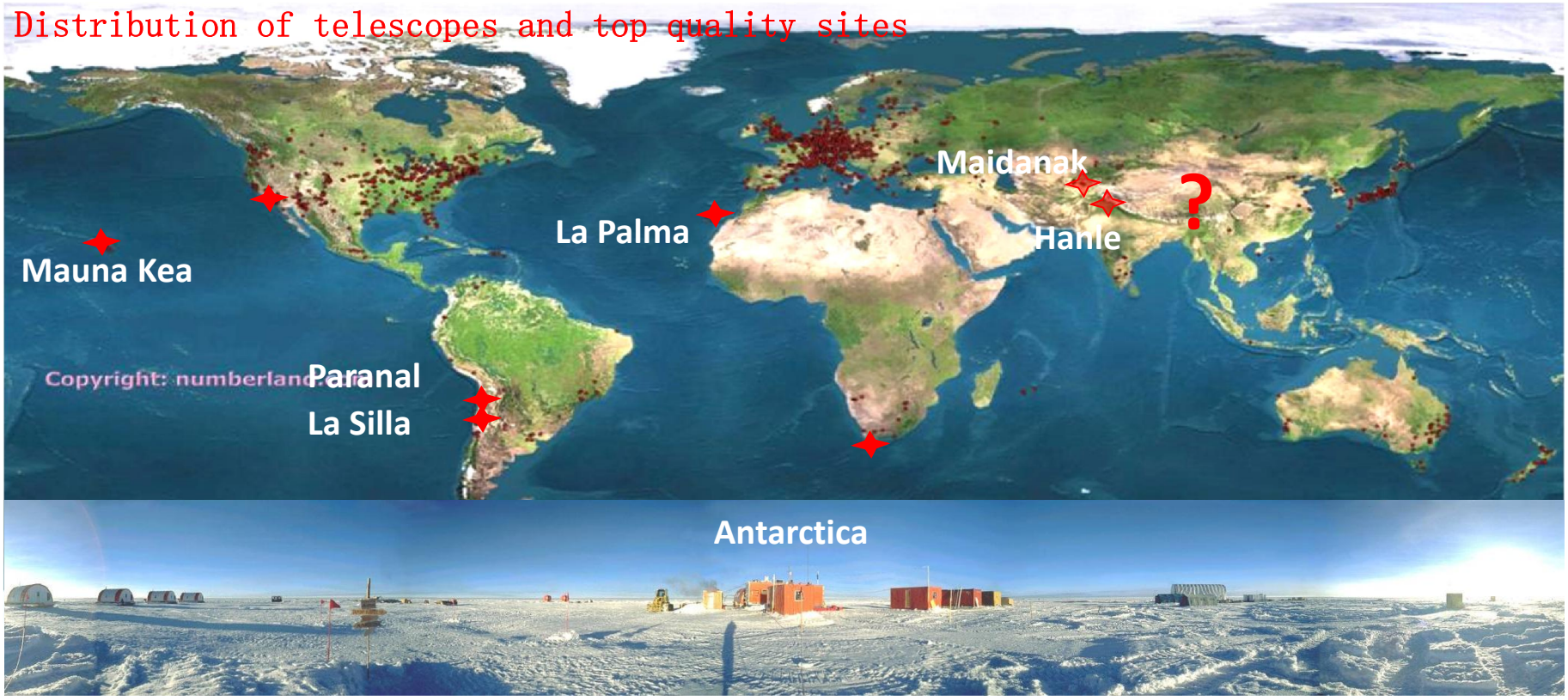


New site, opportunity for SONG

- 12 meter LOT project
- 6.5 meter, side project of Tianqin, a G-wave detection mega-science project by Sunyisian‘ University
- Local government at Lenghu is promoting development plan:
  - using Starry sky and spectacular landscape as the main attractions
  - Night sky protection will be enforced at the whole district (by a law - to be approved)
  - Providing funding for site survey and relocating SONG!

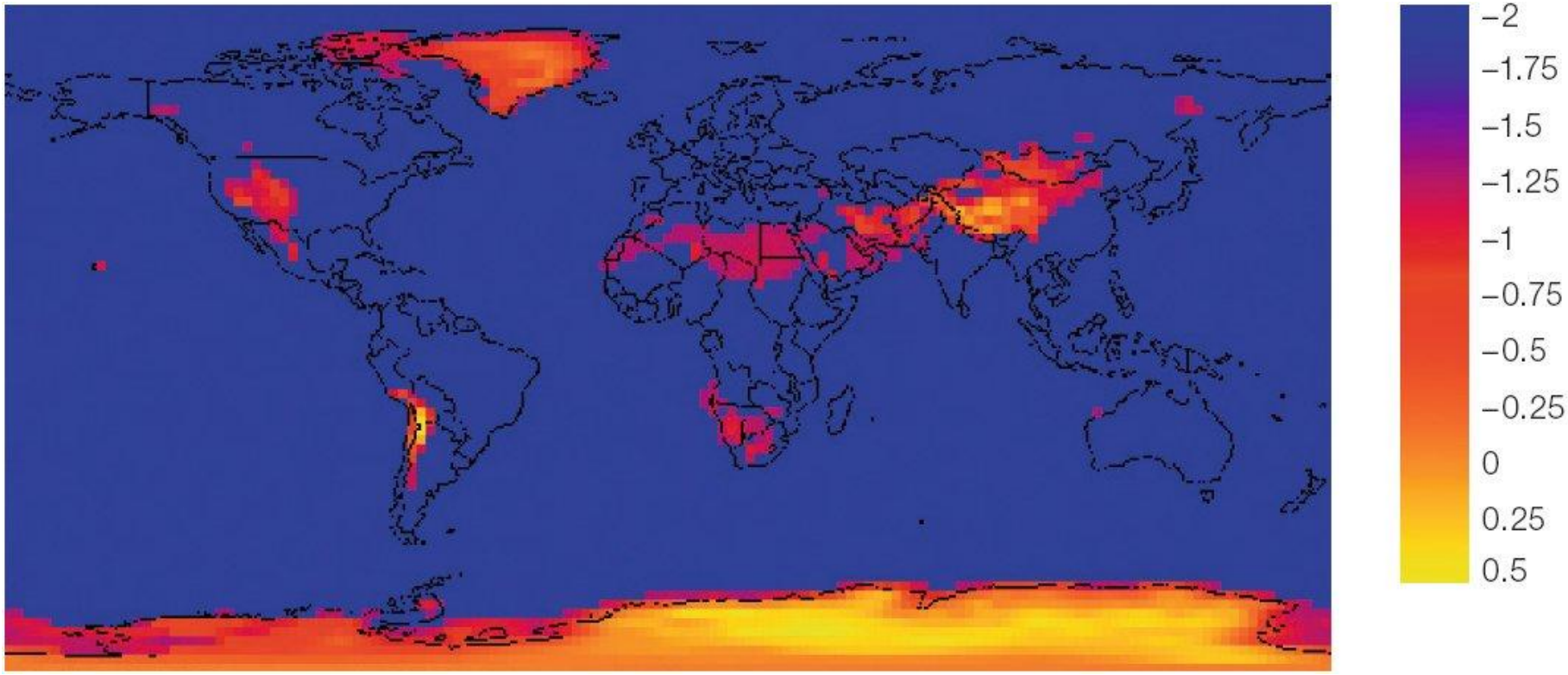
Site resource world wide

Low cloud coverage, low atmospheric turbulence, low extinction



Global satellite view

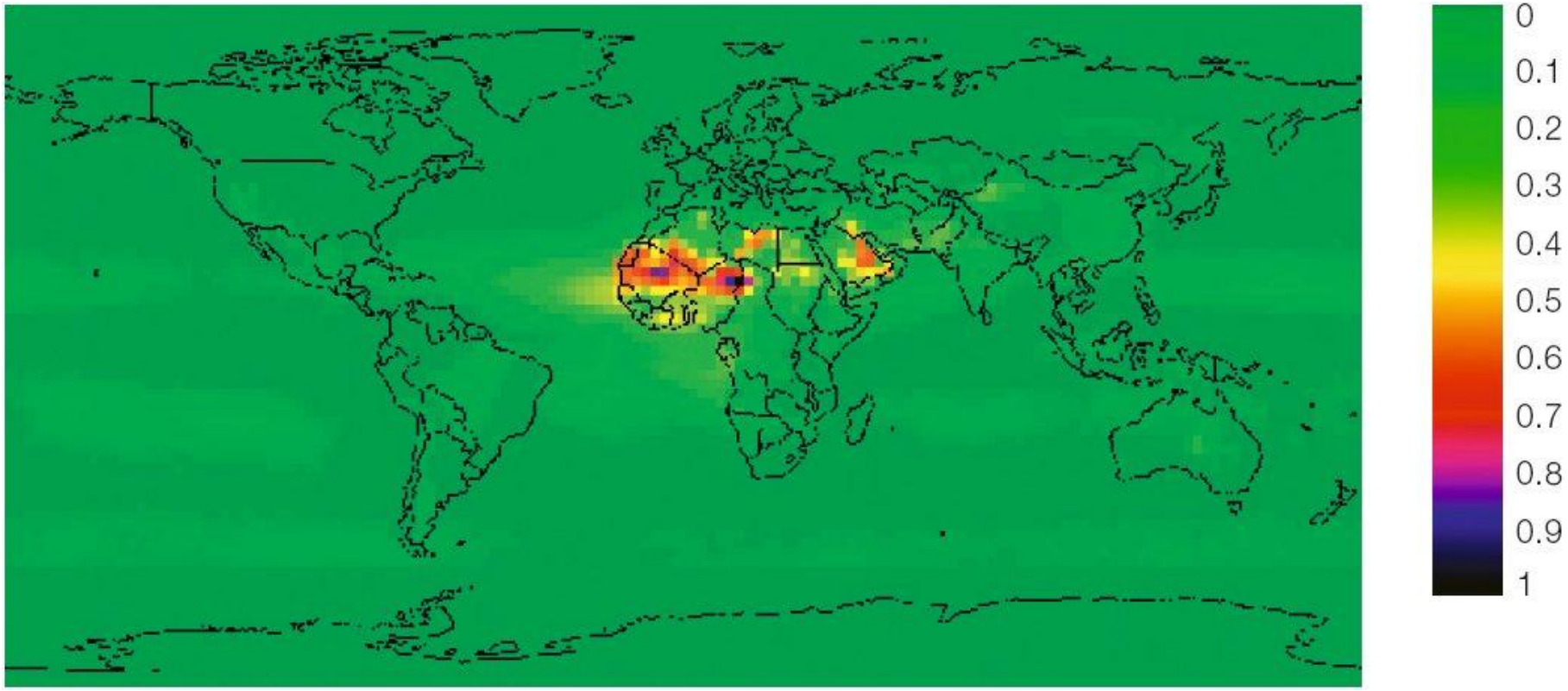
Marc Sarazin et al. 2006
FriOWL: A Site Selection Tool for the E-ELT Project



Overlay distinguishing areas providing high summits and low cloudiness as well as low PWV, 2.5 degree square pixels.

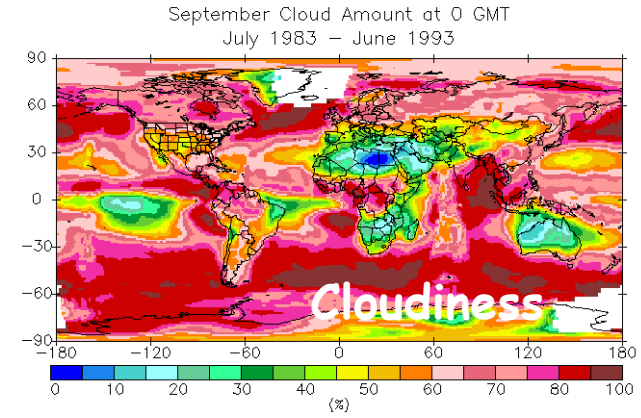
Sand problem

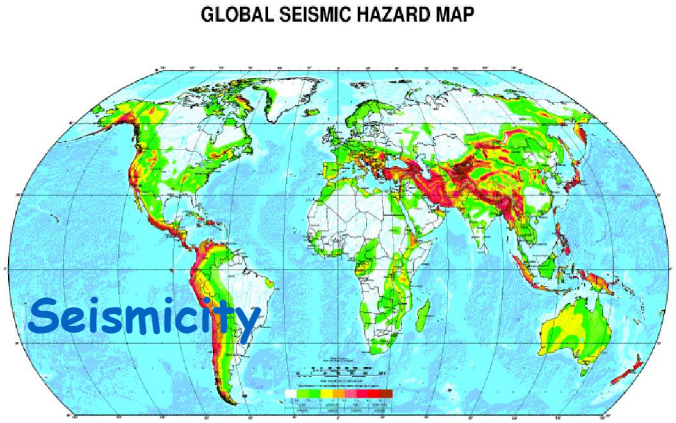
Marc Sarazin et al. 2006
FriOWL: A Site Selection Tool for the E-ELT Project

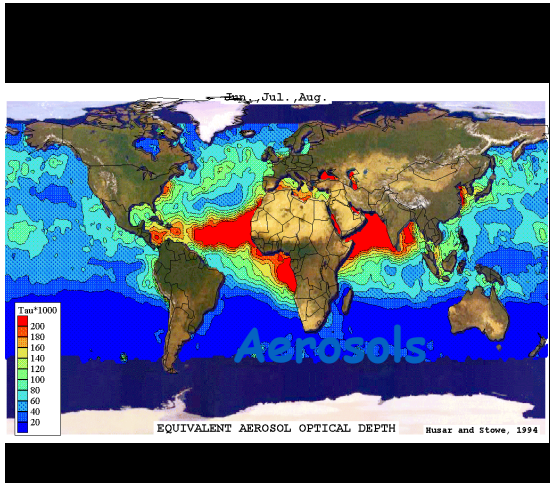


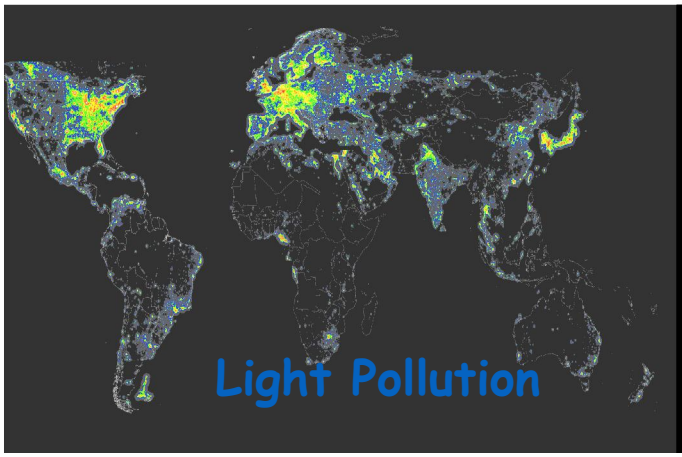
Mean aerosol index as measured by TOMS UV satellite for the period 1980-2002.

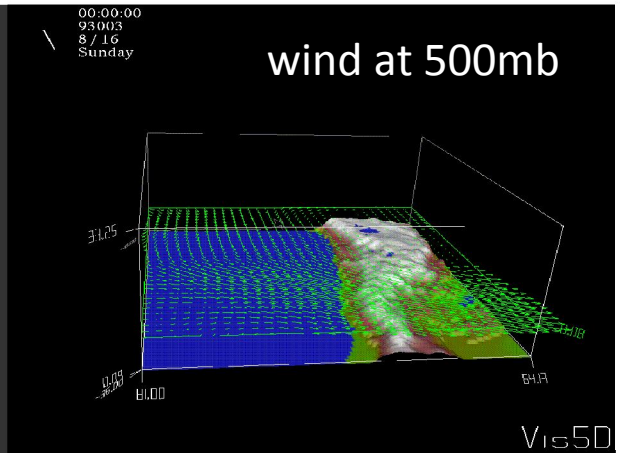
Geographical Information Systems (GIS)

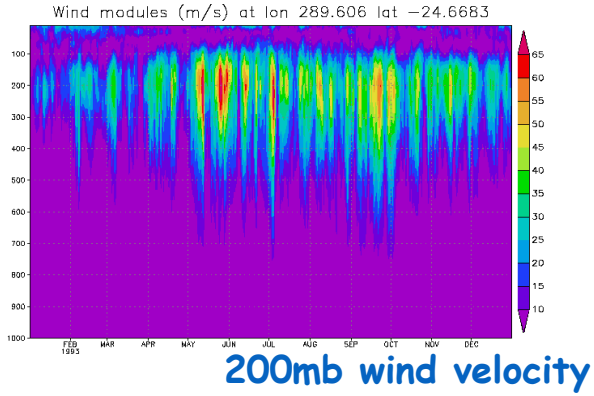






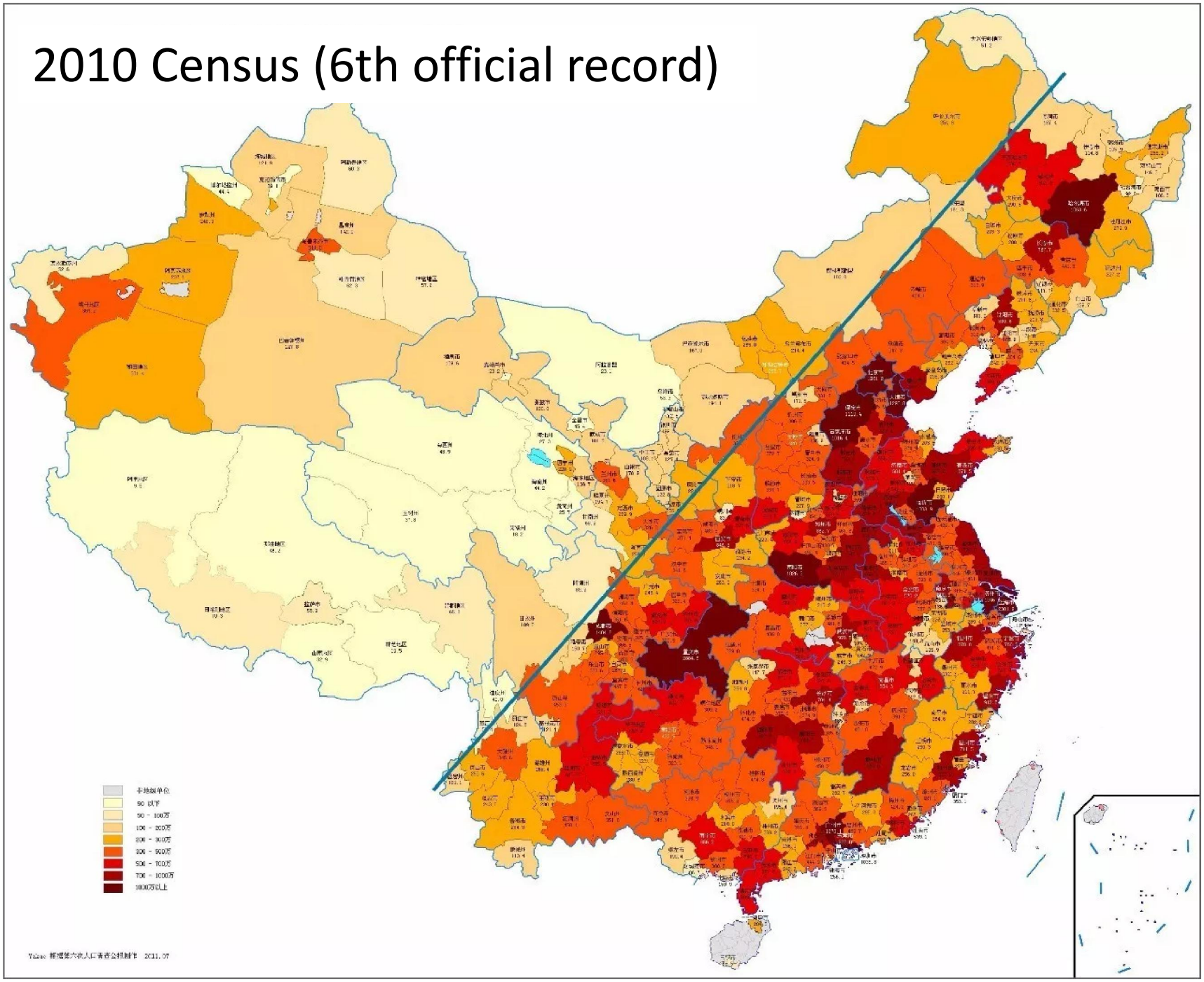


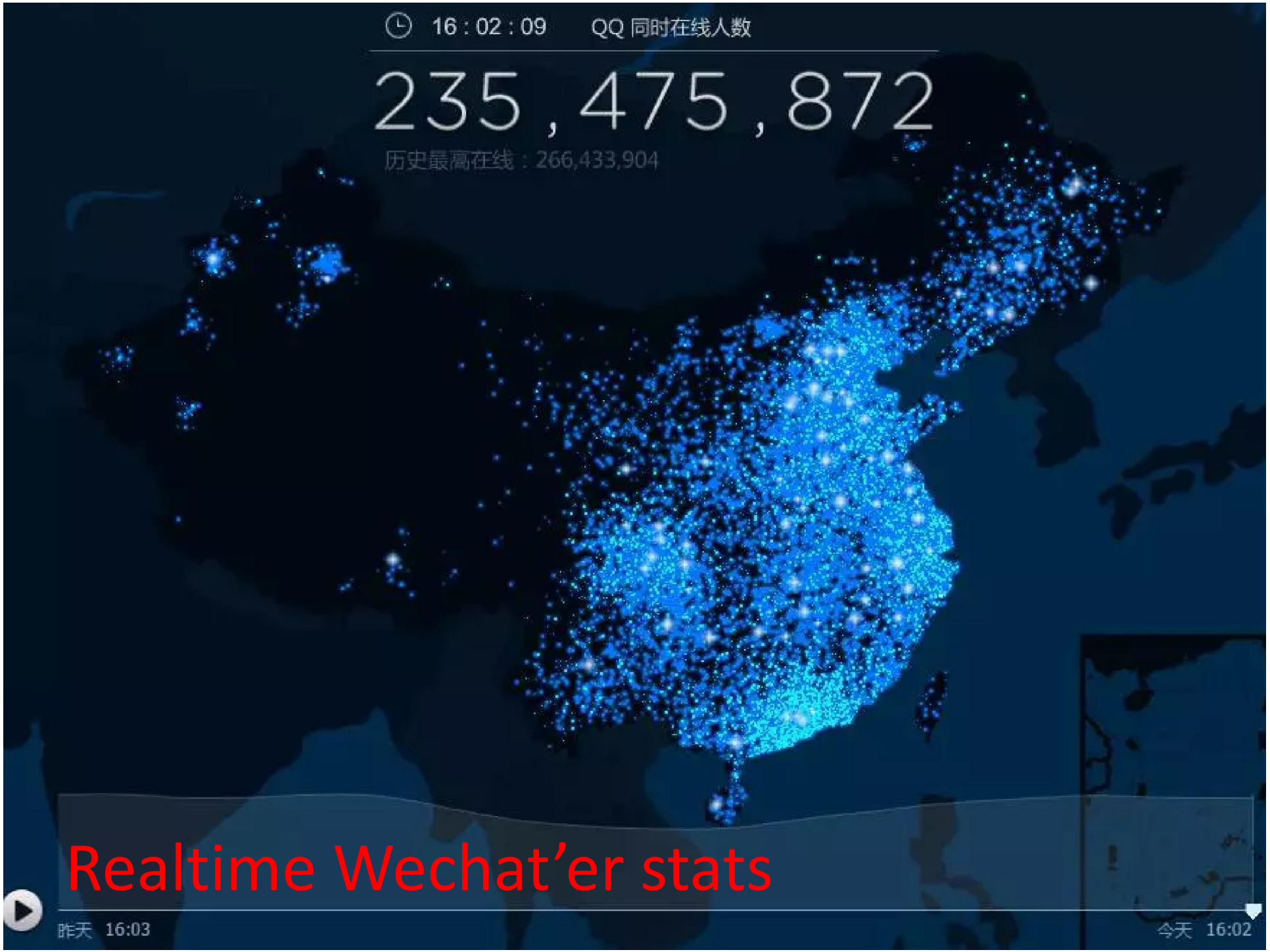




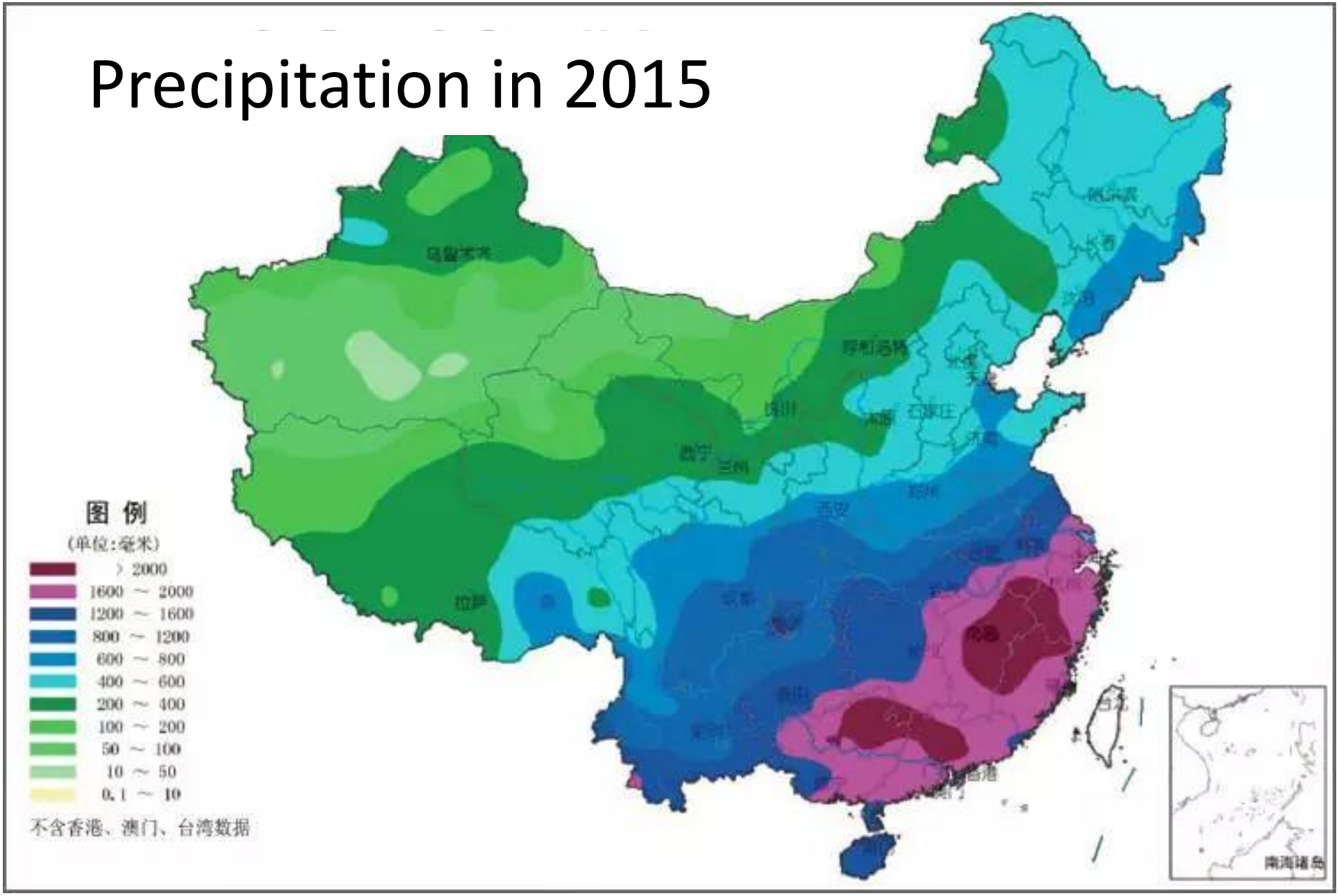
Why going on to the plateau?

2010 Census (6th official record)



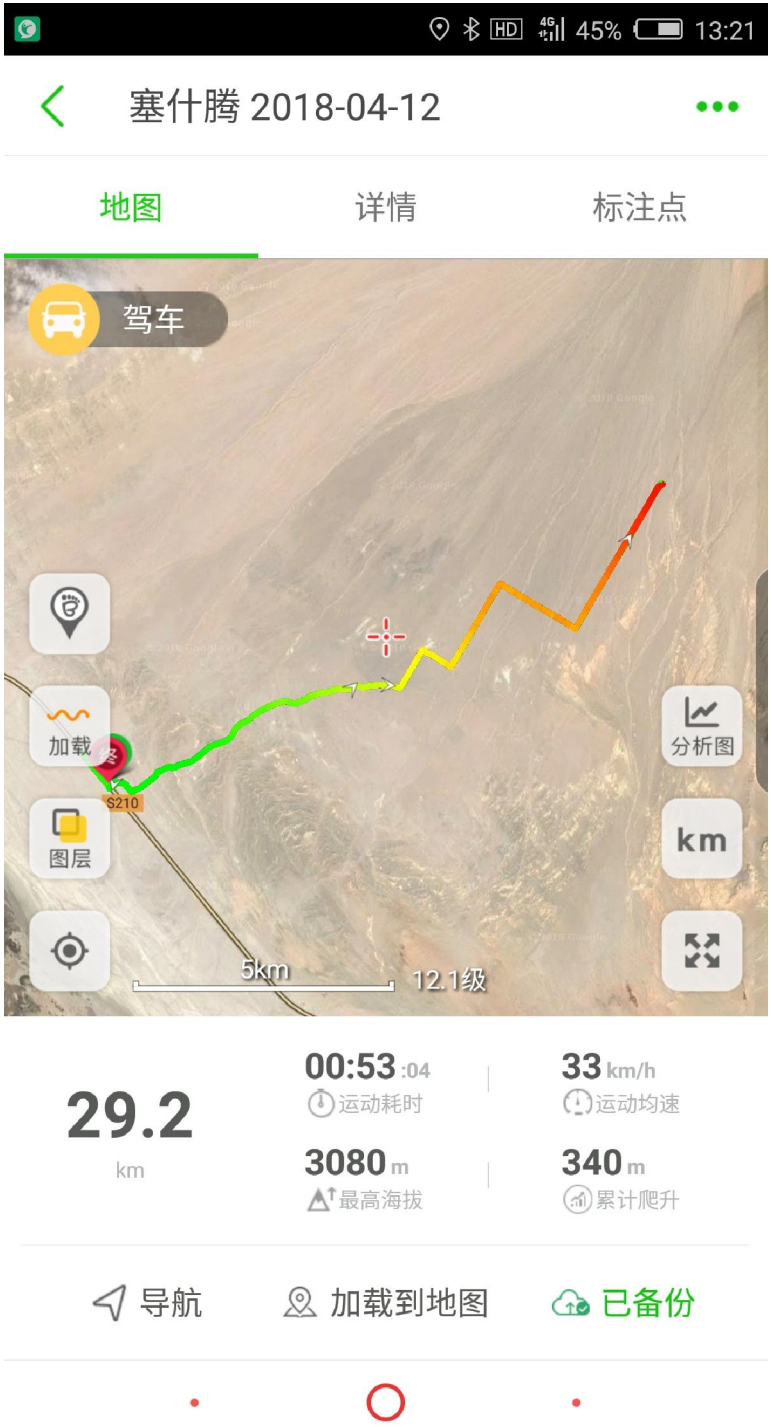

16 : 02 : 09
QQ 同时在线人数
235,475,872
历史最高在线：266,433,904
Realtime Wechat’er stats
昨天 16:03
今天 16:02

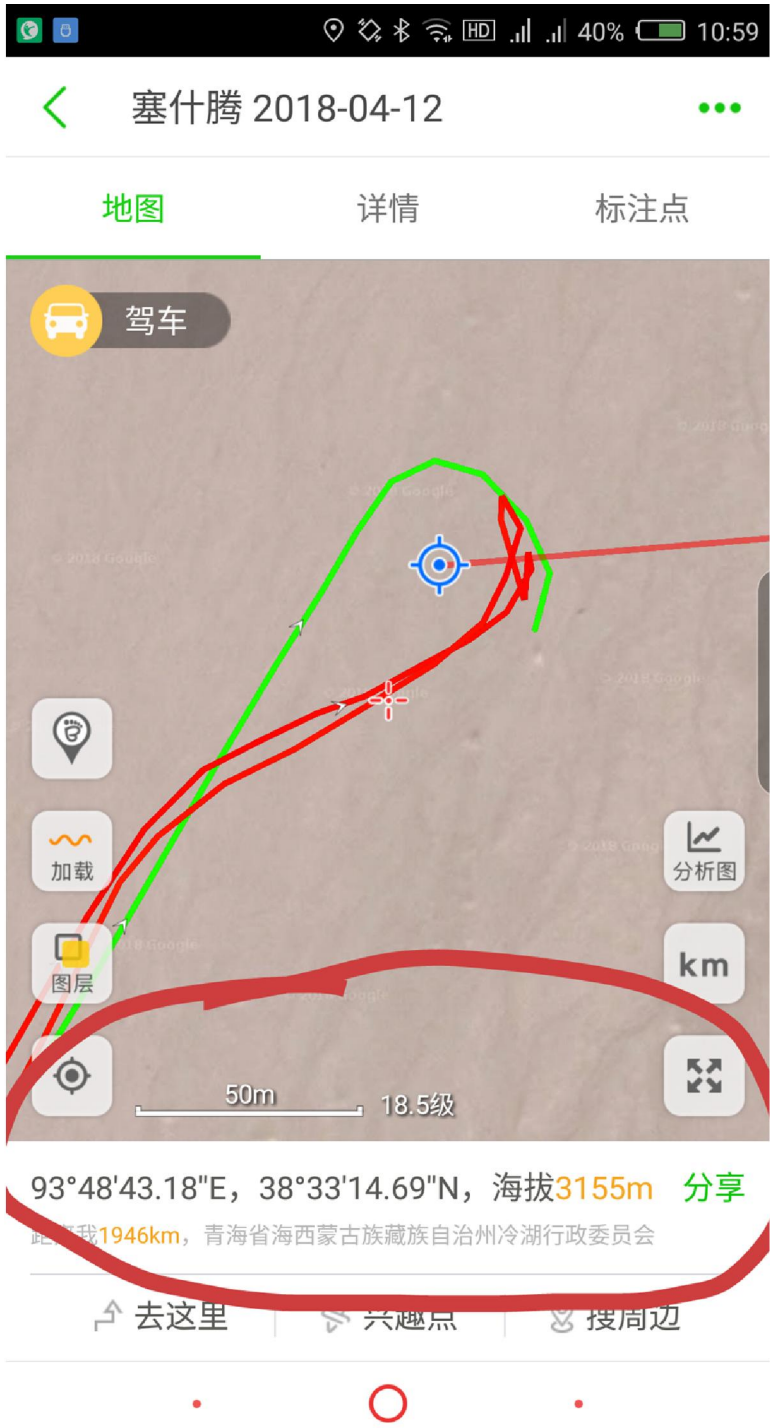
Precipitation in 2015



Candidate sites for the Chinese node
Muztaga
Lenghu
Ali
哈萨克斯坦
蒙古
乌鲁木齐
比什凯克
阿拉木图
塔拉兹
奇姆肯特
塔什干
吉尔吉斯斯坦
奥什
苦盏
塔吉克斯坦
新疆维吾尔自治区
甘肃
西宁
兰州
青海
巴格兰
Gilgit
Skardu
喀布尔
贾拉拉巴德
查谟和克什米尔
加德兹
霍斯特
拉瓦尔品第
Jammu
喜马偕尔邦
拉合尔
木尔坦
奎达
Quetta
旁遮普
巴基斯坦
北安查尔邦
哈里亚纳
Dipayal
巴哈瓦尔布尔
Bahawalpur
新德里
New Delhi
北方邦
尼泊尔
加德满都
Kathmandu
锡拉
Madar
锡金邦
不丹
Moranhat Town
Tuli
那加兰
阿萨姆
梅加拉亚邦
拉贾斯坦邦
斋浦尔
Jaipur
巴利
Pali
瓜廖尔专区
Gwalior
坎普尔
Kanpur
戈勒克布尔
Gorakhpur
比哈尔
瓦拉纳西
Varanasi
科塔
Kota
卡拉奇
Karachi
海得拉巴
Hyderabad
拉萨
西藏自治区
四川
成都
昆明
曼尼普尔
200 公里
200 英里
©2011 Google - Imagery ©2011 TerraMetrics, 地图数据 ©2011 Europa Technologies, Geocentre Consulting, Goo

G314
Rangkul
Murghab
Мургоб
G314
G314
G314
Qarabolaq
Qala-e
Mafushad
Wakhan
Corridor
Nature Refuge
پارک ملی
دره واخان
Baza'i Gonbad
Sarhad
سرحد بروغیل
Map
3D
Google
Imagery ©2018 Landsat / Copernicus, Map data ©2018 Google
Spain
Terms
Send feedback
20 km


45% 13:21
塞什腾 2018-04-12
地图
详情
标注点
驾车
加载
图层
分析图
km
S210
5km
12.1级
29.2
km
00:53:04
运动耗时
33 km/h
运动均速
3080 m
最高海拔
340 m
累计爬升
导航
加载到地图
已备份


40% 10:59
塞什腾 2018-04-12
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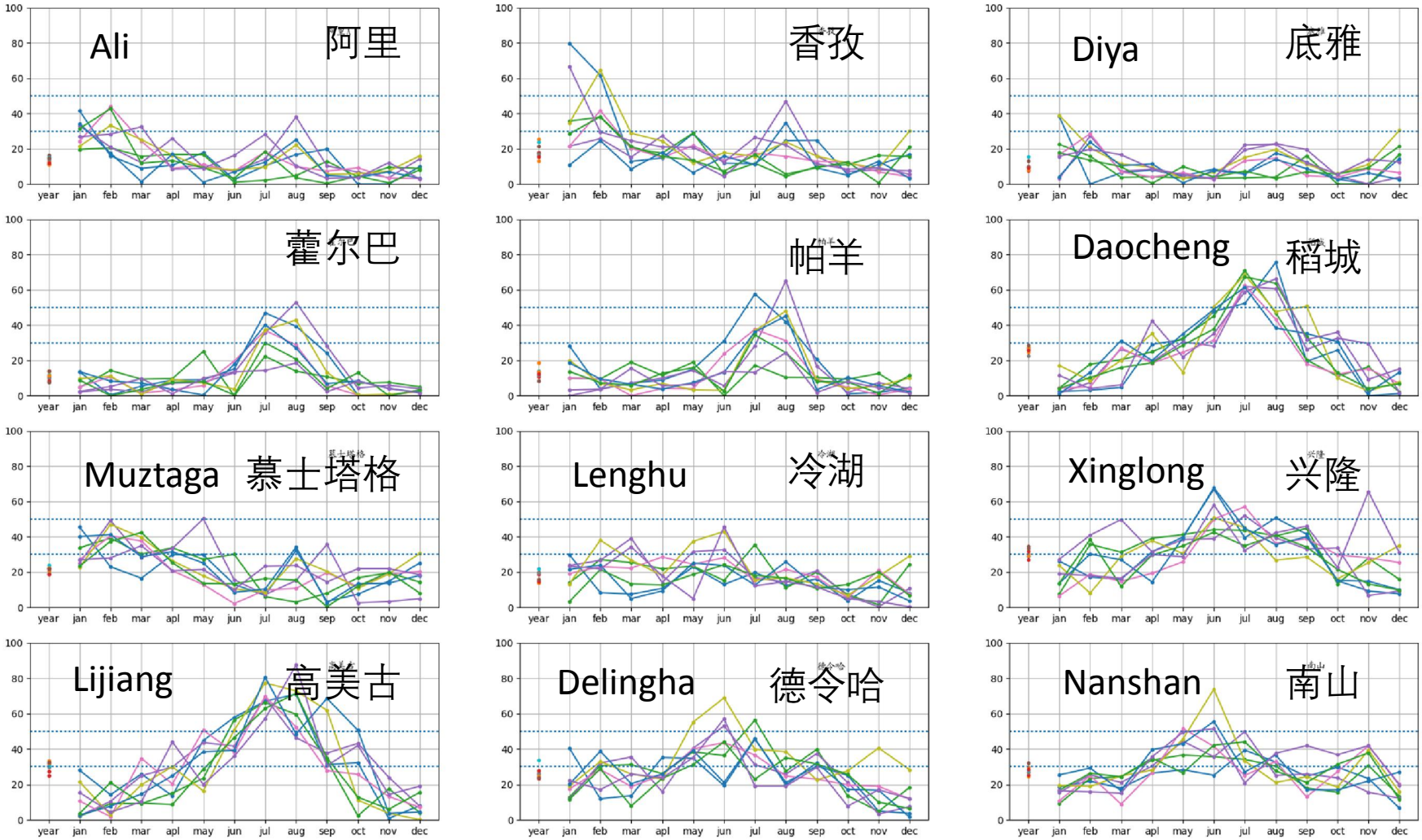
详情
标注点
驾车
加载
图层
分析图
km
50m
18.5级
93°48'43.18"E，38°33'14.69"N，海拔3155m
分享
1946km，青海省海西蒙古族藏族自治州冷湖行政委员会
去这里

N38.655411
E93.871729
Alt 4100
Untitled Placemark
Image © 2017 DigitalGlobe
Image © 2017 CNES / Airbus
©2010 Google
8.91 km

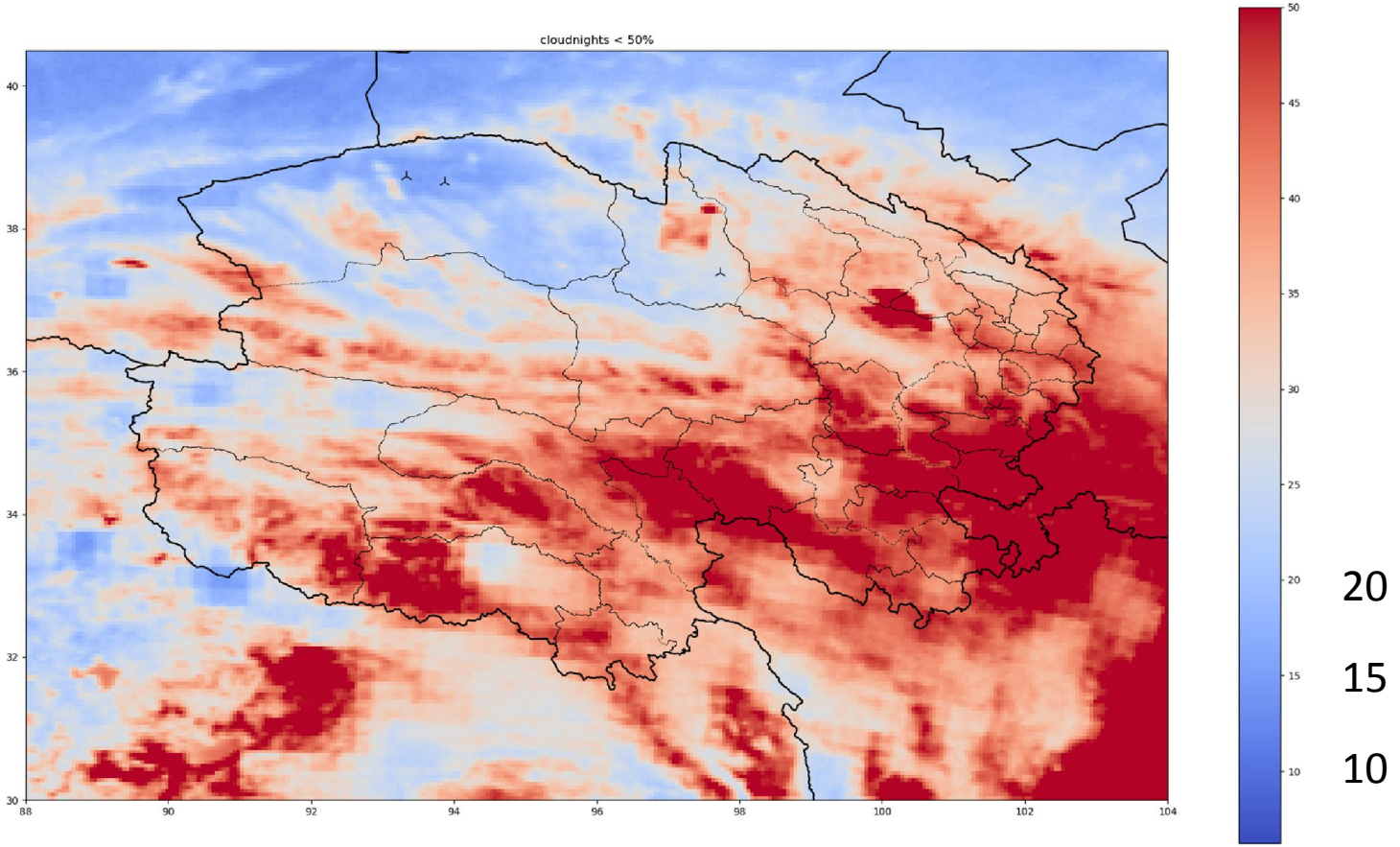
国内各台址（含候选）云量比较

感谢国家天文台赵永恒



气象卫星云量统计（2008-2016）

感谢国家天文台赵永恒



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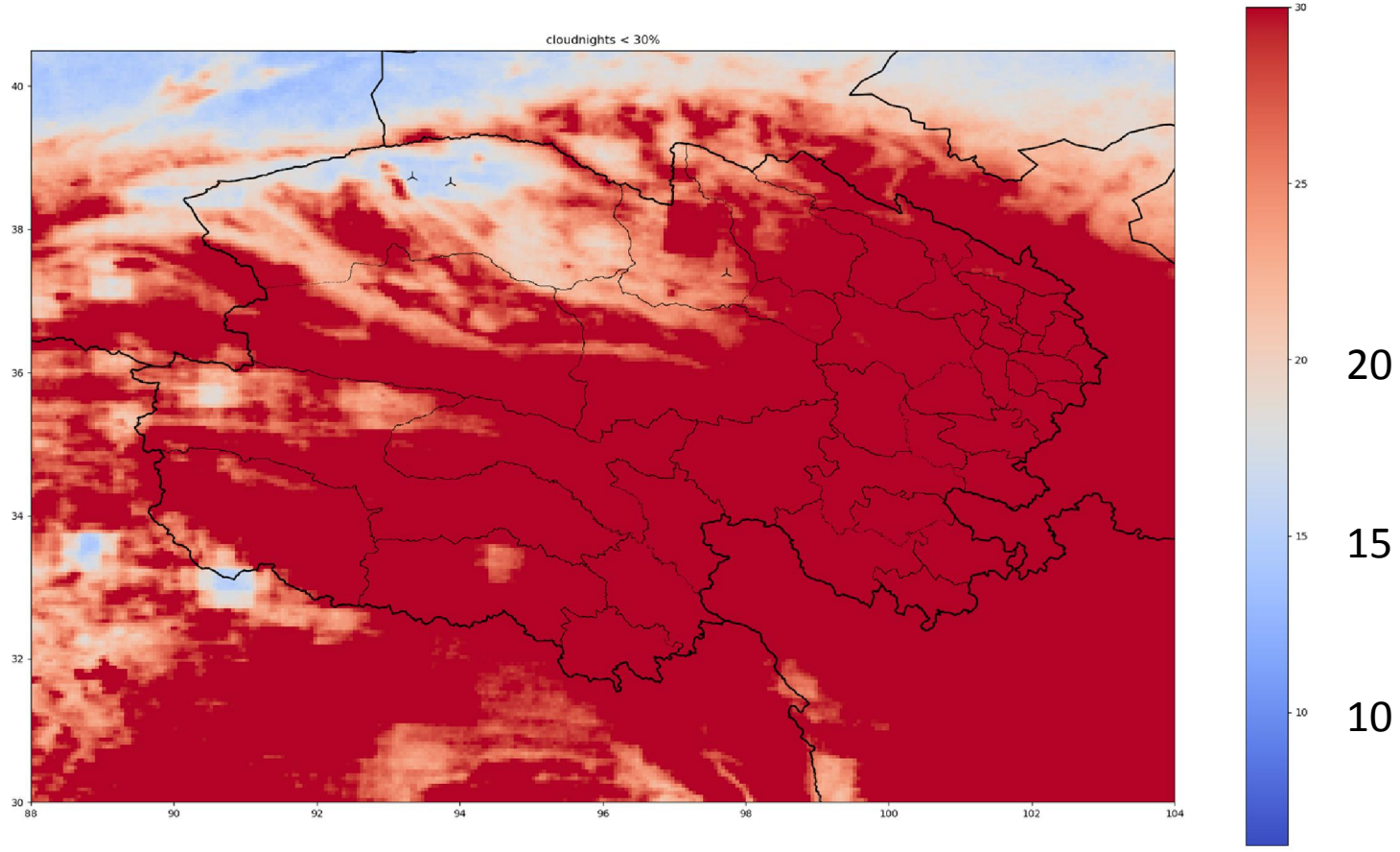
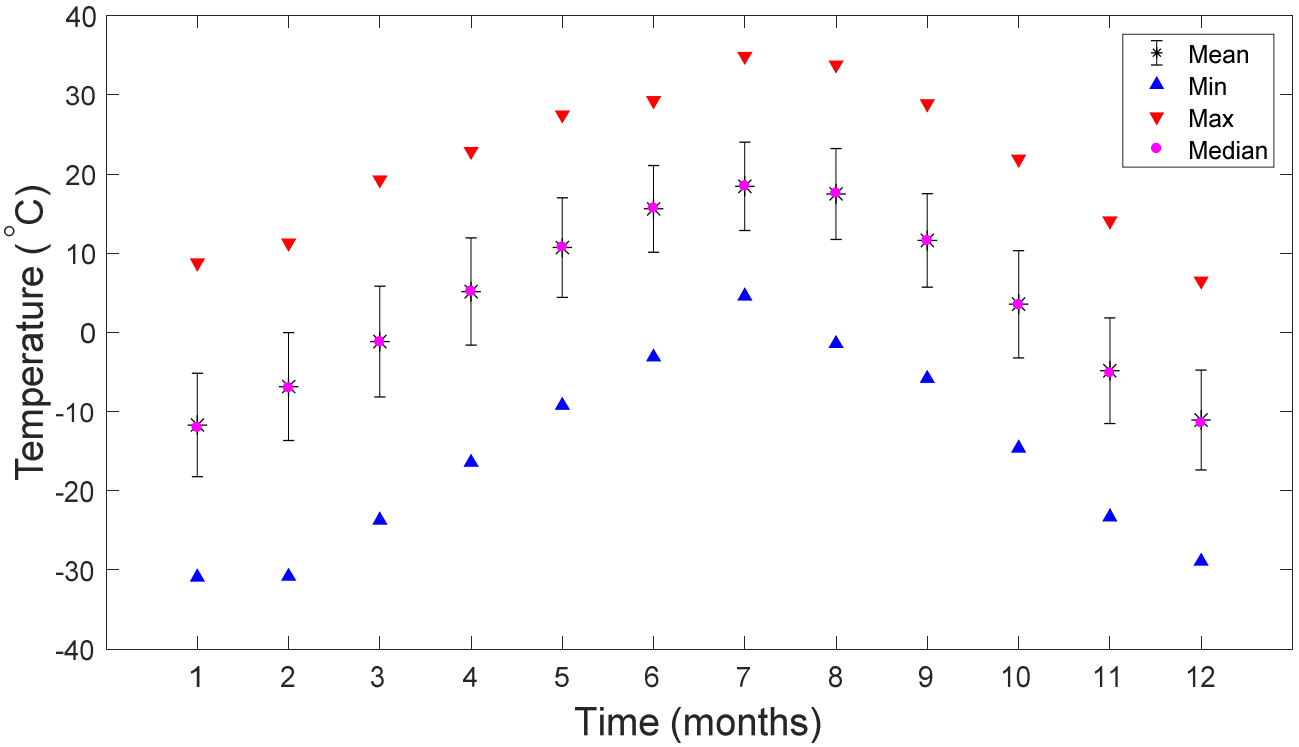


10 year meteorological data

- 3 local weather station LH、DFS、MHH
- Each has temperature,humidity,wind speed and direction
- Statistical analysis
- Wind rose, 10min average

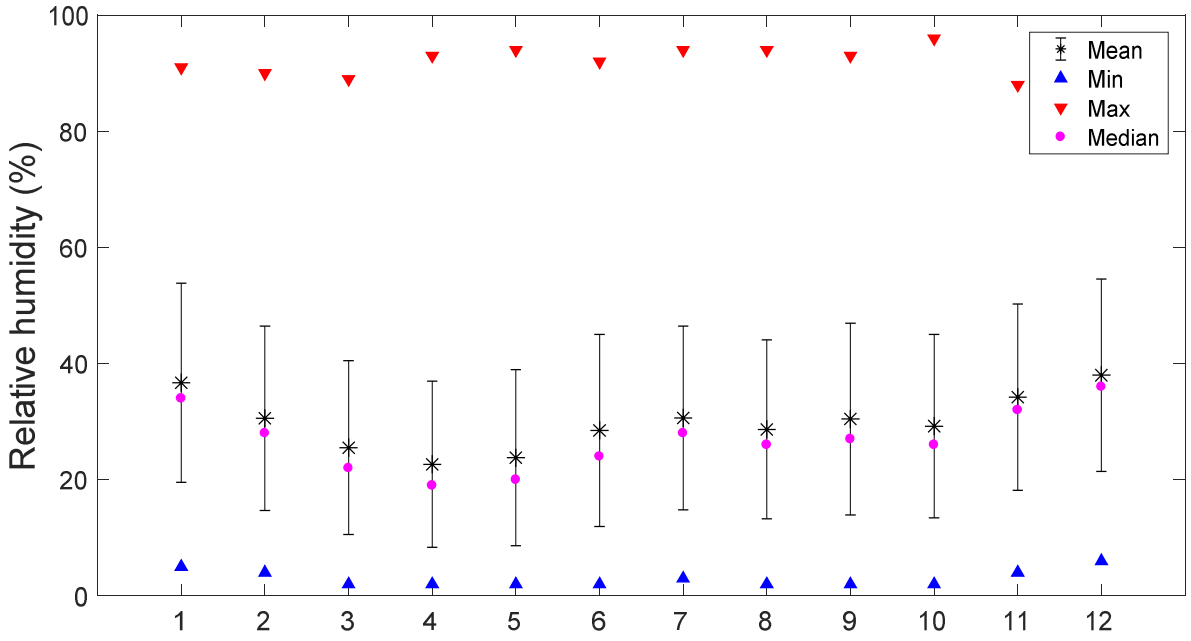
感谢冷湖气象站樊万珍!

WS @Lenghu: temperature



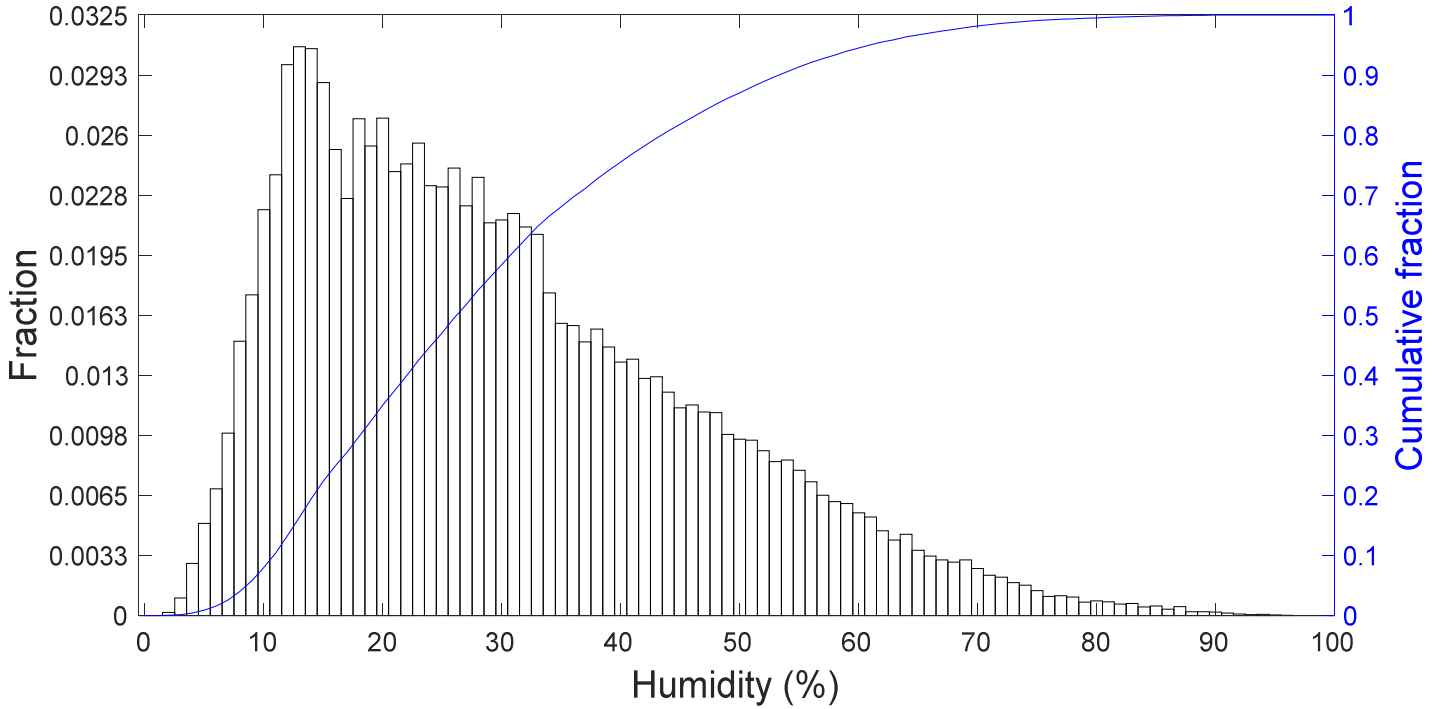
LH: Max = 34.9 min = -30.9 median = 4.9 mean = 4.1

WS @Lenghu: Relative Humidity



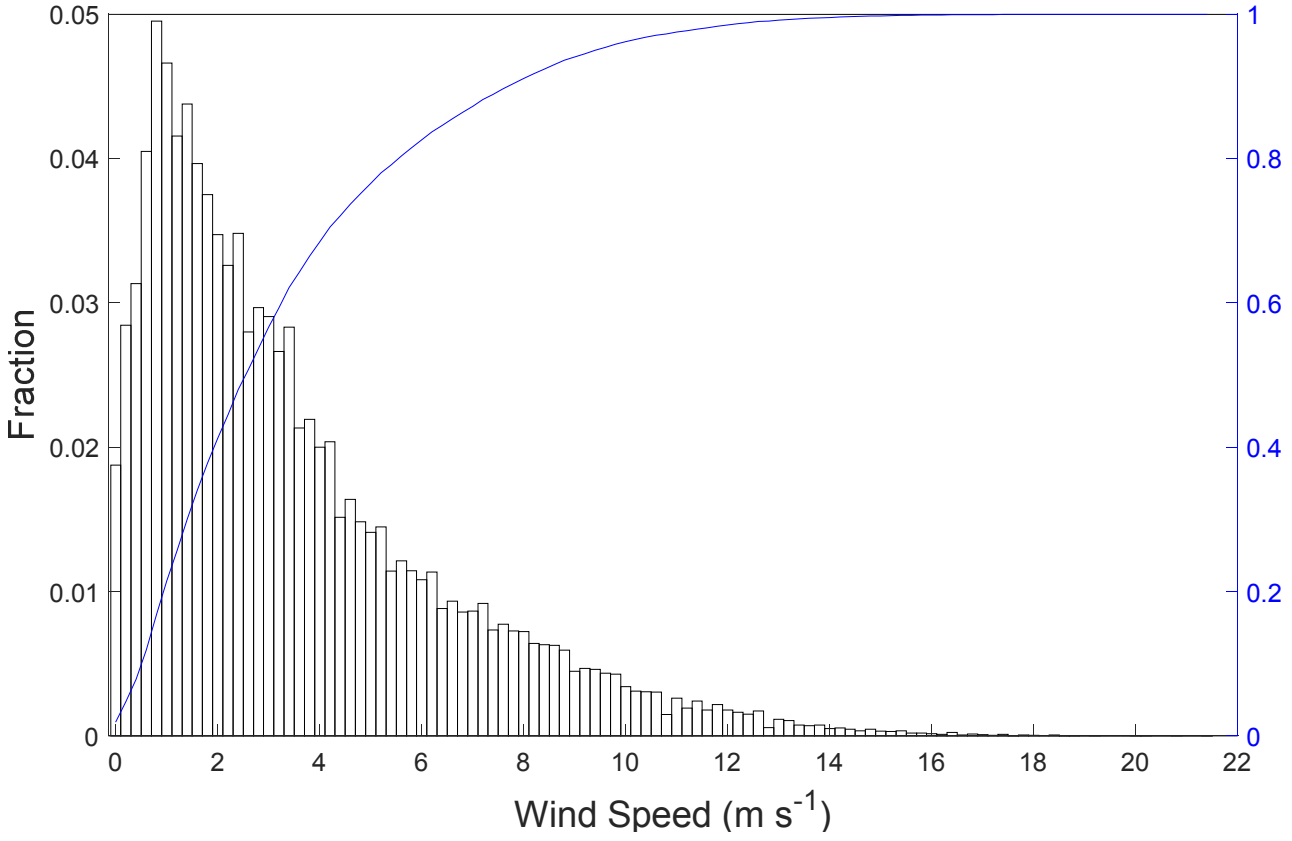
LH: Max = 96 min = 2 median = 27 mean = 29

WS @Lenghu: Humidity distribution



LH: median = 27

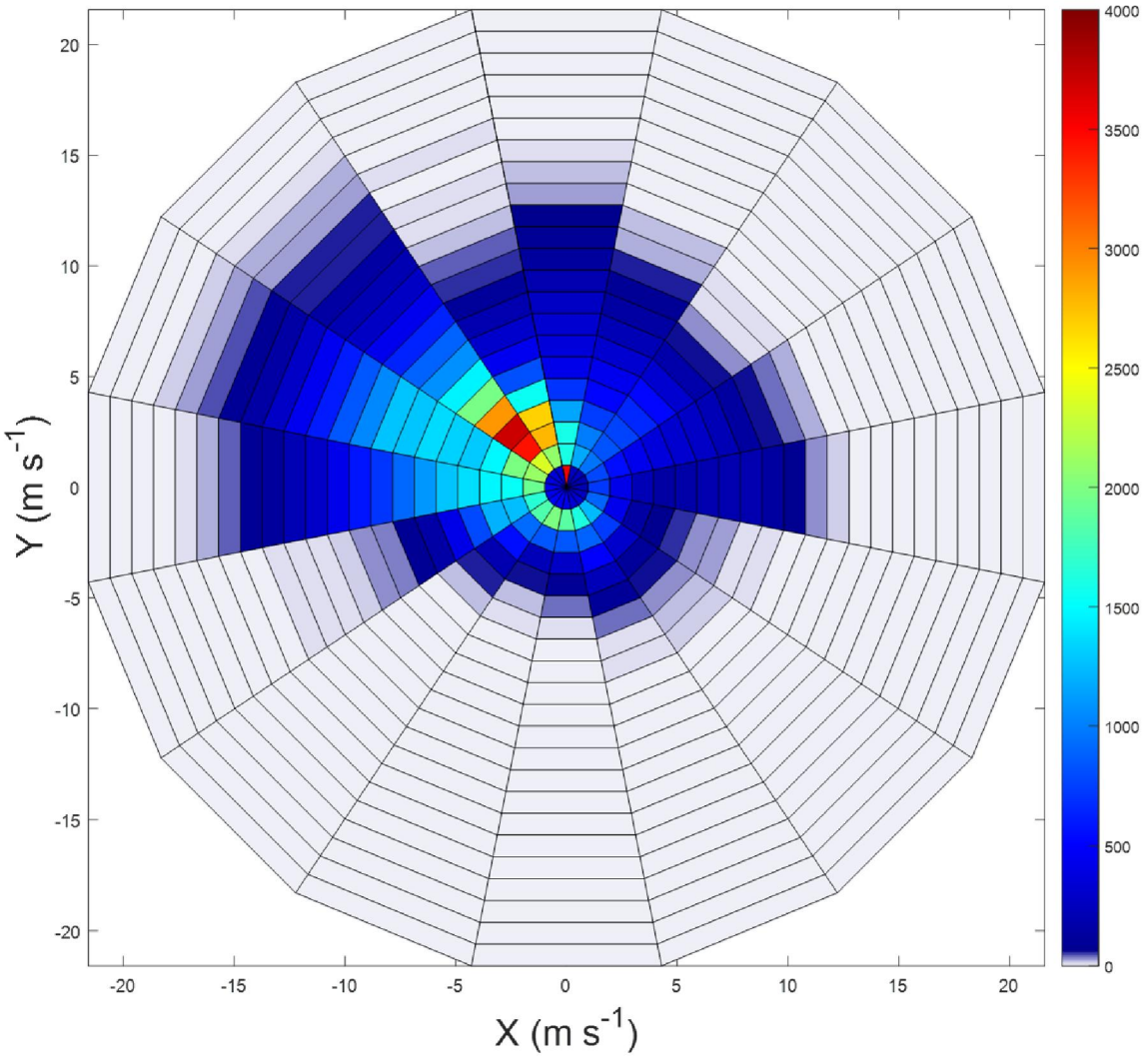
WS @Lenghu: Wind speed



LH: median = 2.7 max = 21.4

WS @Lenghu: Wind Rose

LH



Following Delingha (SONG site), to be done:

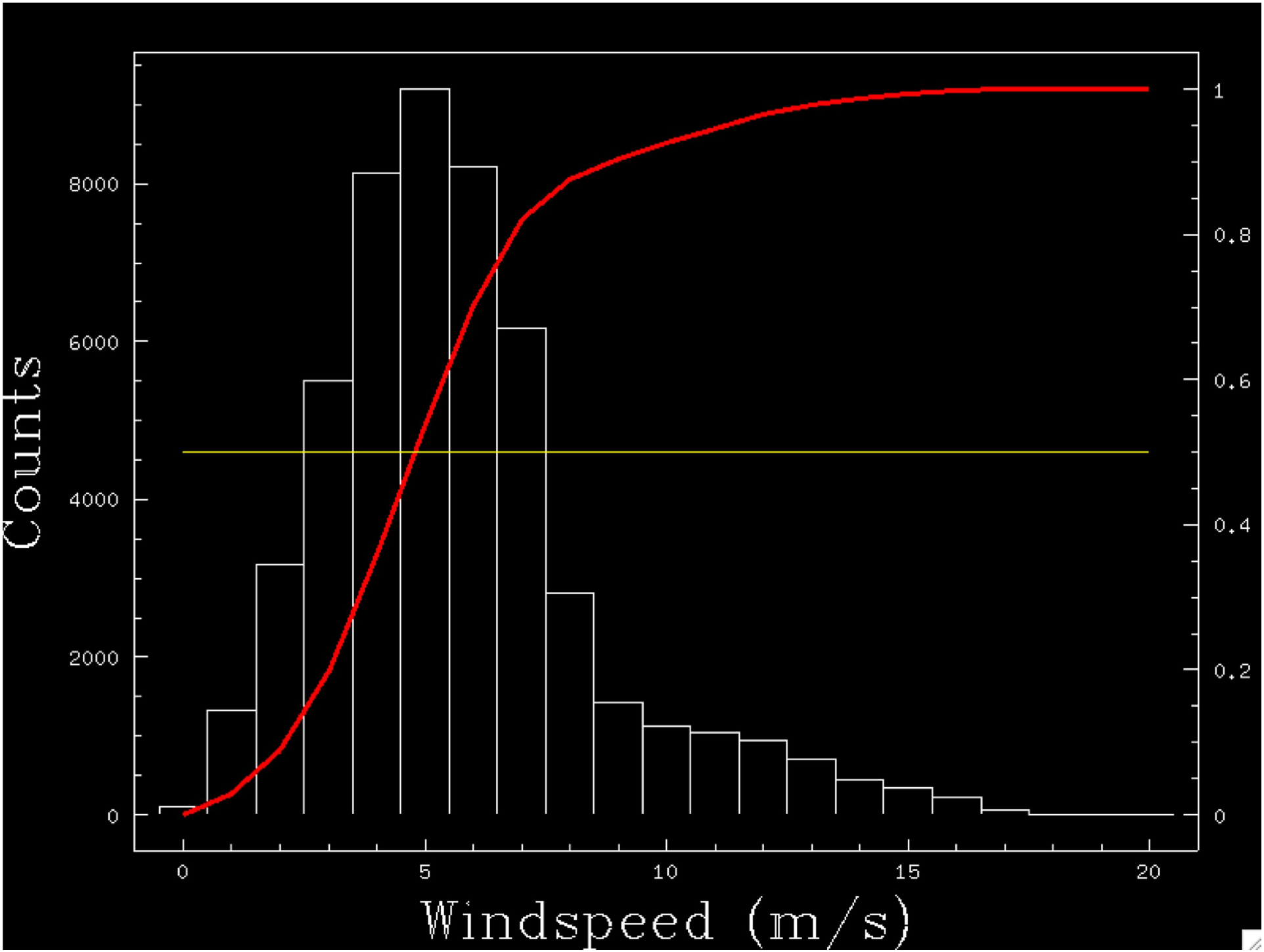
- ~~Historic weather record~~
- ~~Weather data from stations~~
- **Sky background stats**
- **Av. Annual Cloudiness (observing time assessment)**
- **Seeing (making sense only at the actual site)**
- **Higher standard for Large T.!**

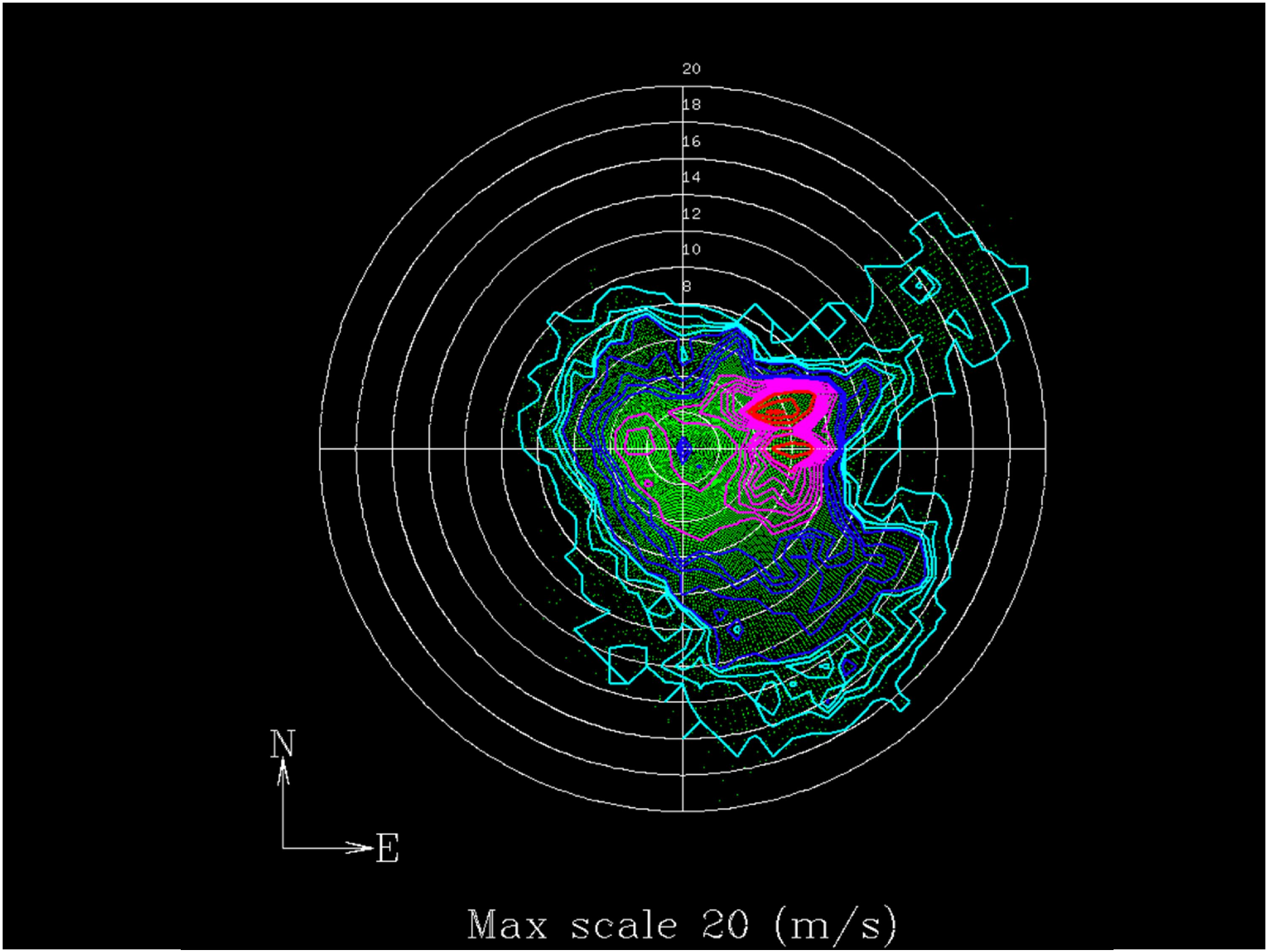
Site qualification measures

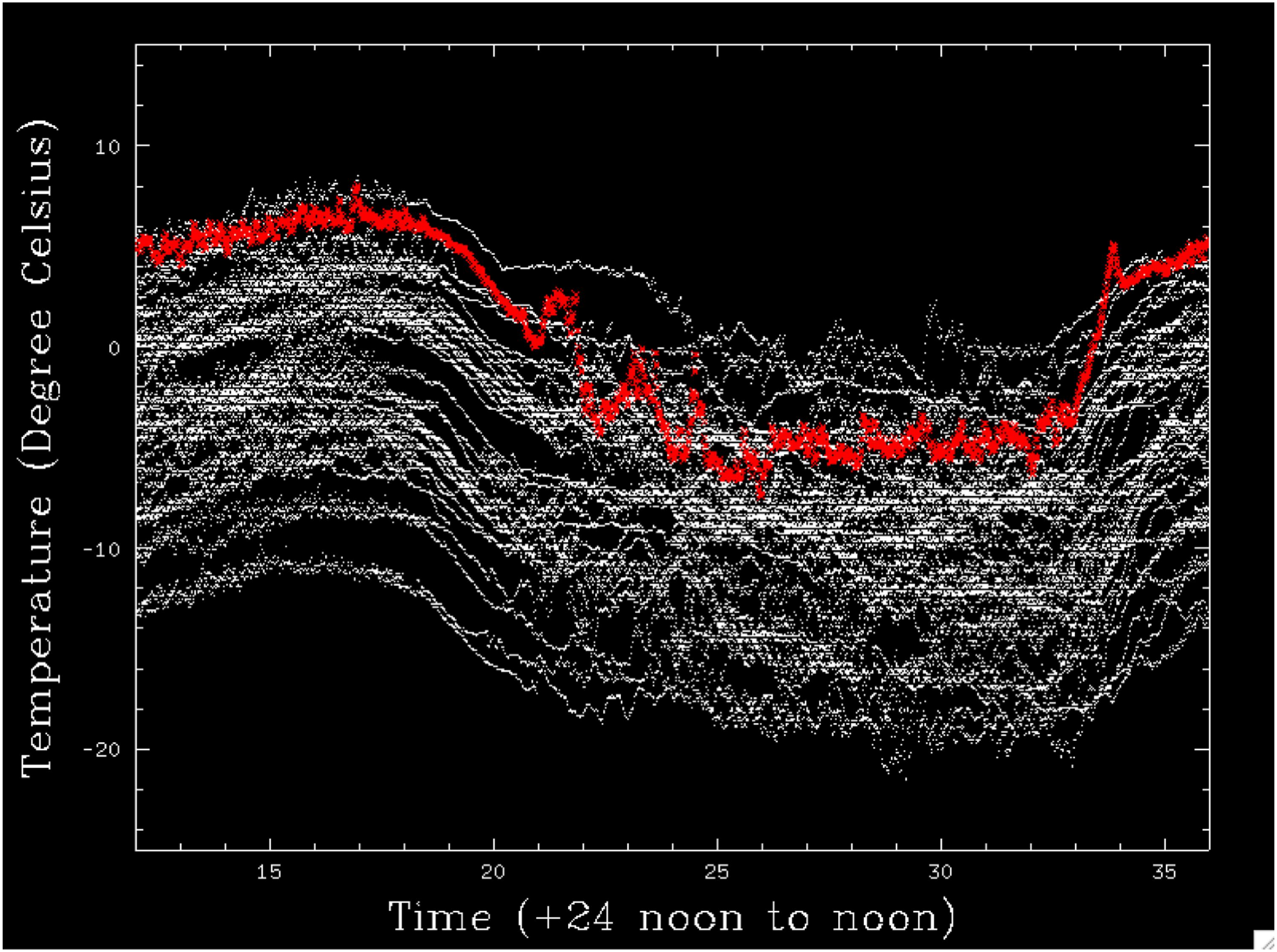
- Power: Solar panels + inverter 3KW X2, good for all instruments including DIMM, regular running start Feb.
- All sky cam: regular operation only after Mar.
- Sky brightness （SQM）
- Weather station (Wind speed and direction, pressure, temperature, humidity)
- Other instruments: Mass-DIMM, SNIDAR

Zodiacal light at Sun set

First human footprint at the site

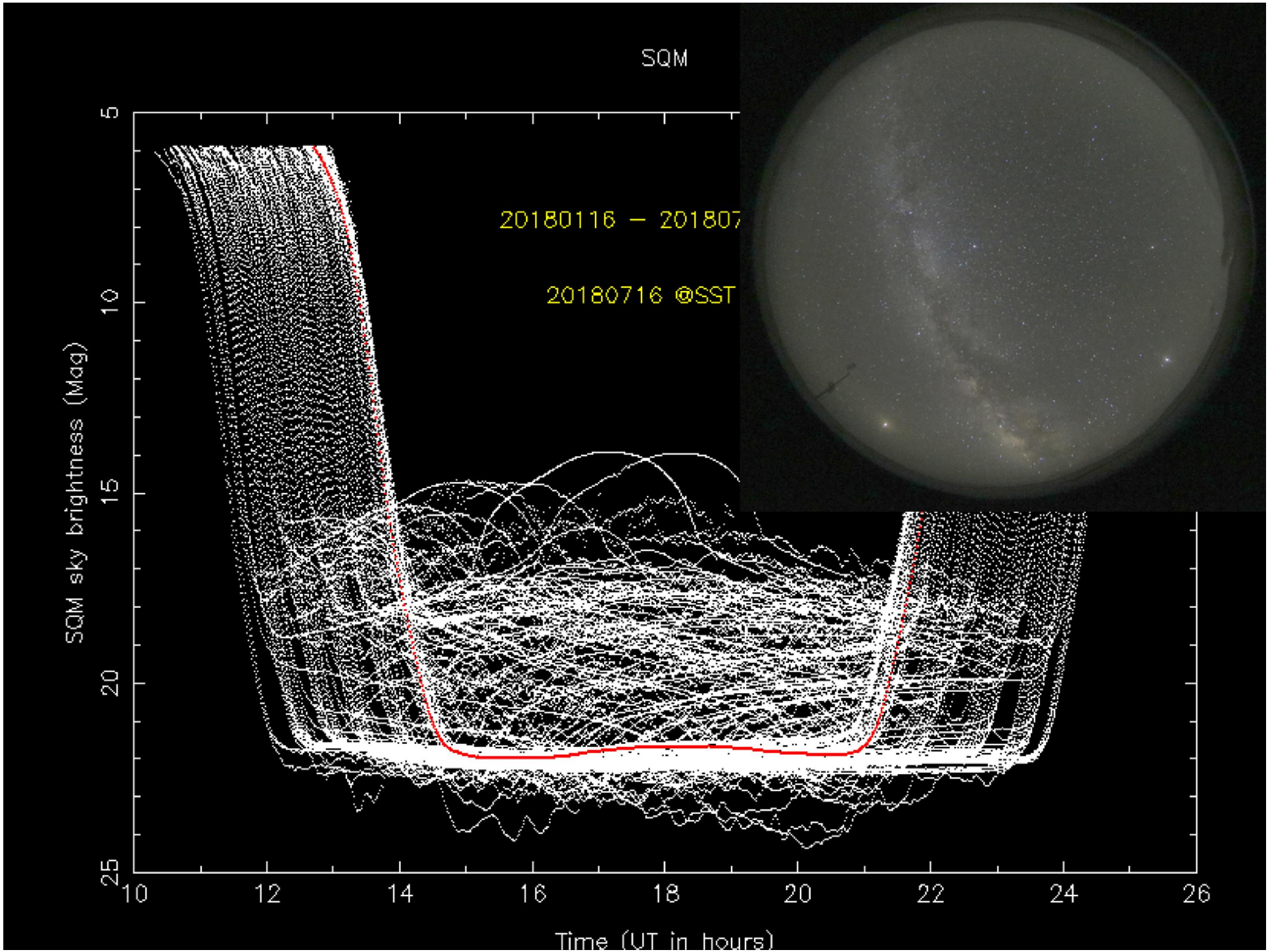

Counts
8000
6000
4000
2000
0
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
Windspeed (m/s)

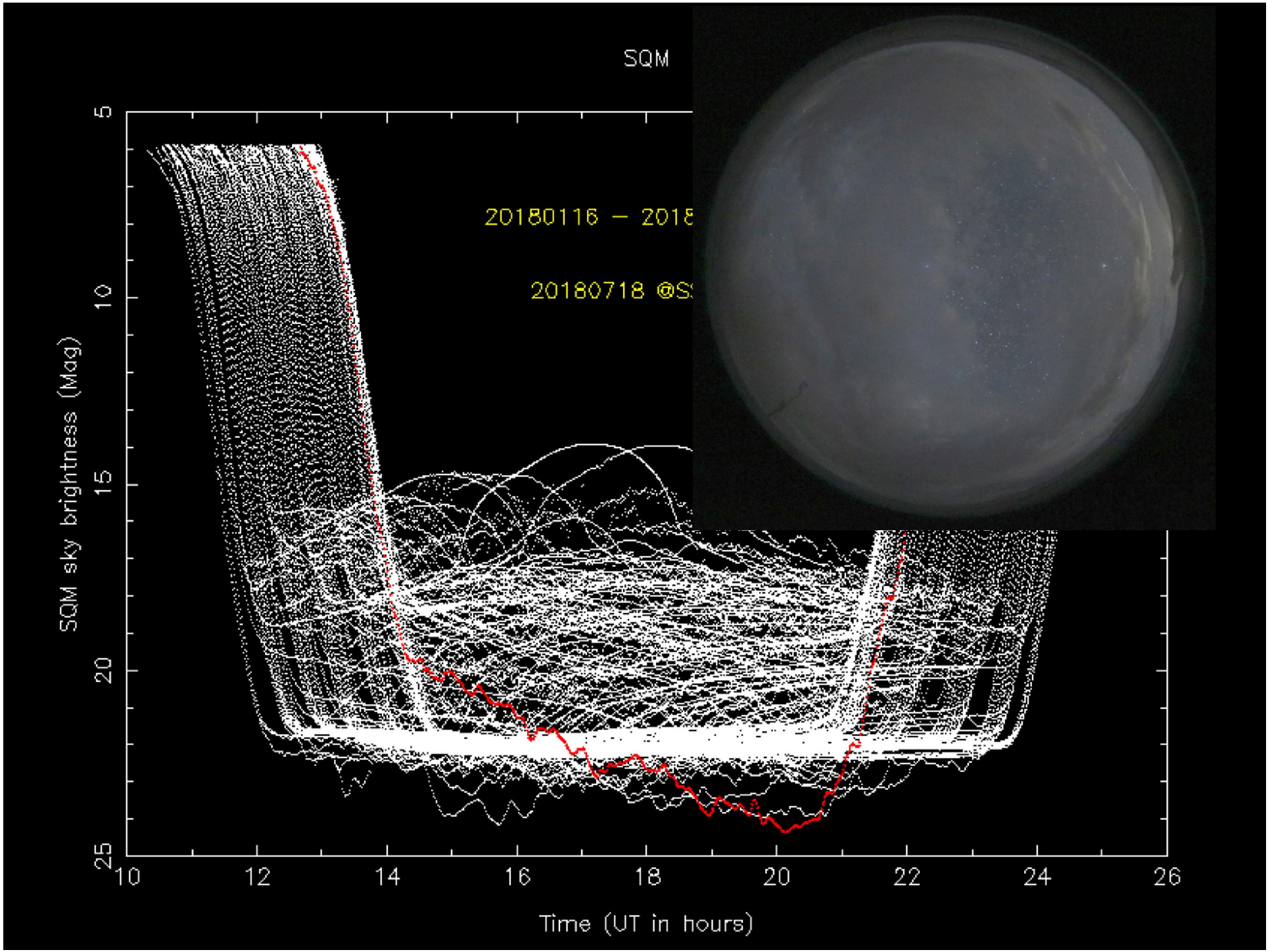

20
18
16
14
12
10
8
N
E
Max scale 20 (m/s)


Temperature (Degree Celsius)
10
0
-10
-20
15
20
25
30
35
Time (+24 noon to noon)

Sky quality assessment by SQM

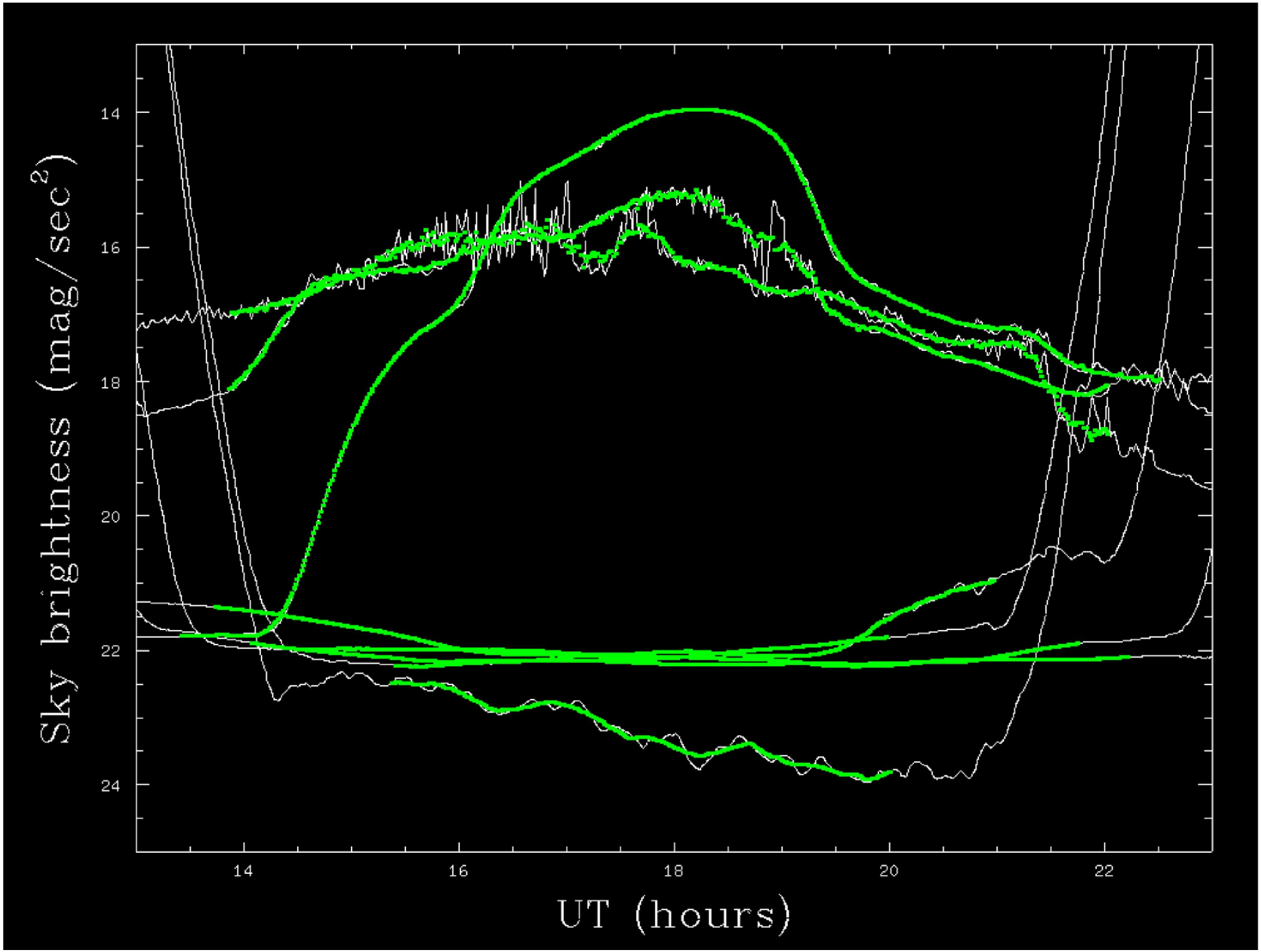
- SQM facts:
  - Wide band (~B+V),wide sampling angle (15°/30°) , output mag/seqdeg (well calibrated), accr.0.01m
  - Industrial product (identical/stable/durable/ data recording)
- Sky brightness is very sensitive to cloud passage!
- Time series data is good for night quality analysis, basics available from Unihedron’s homepage

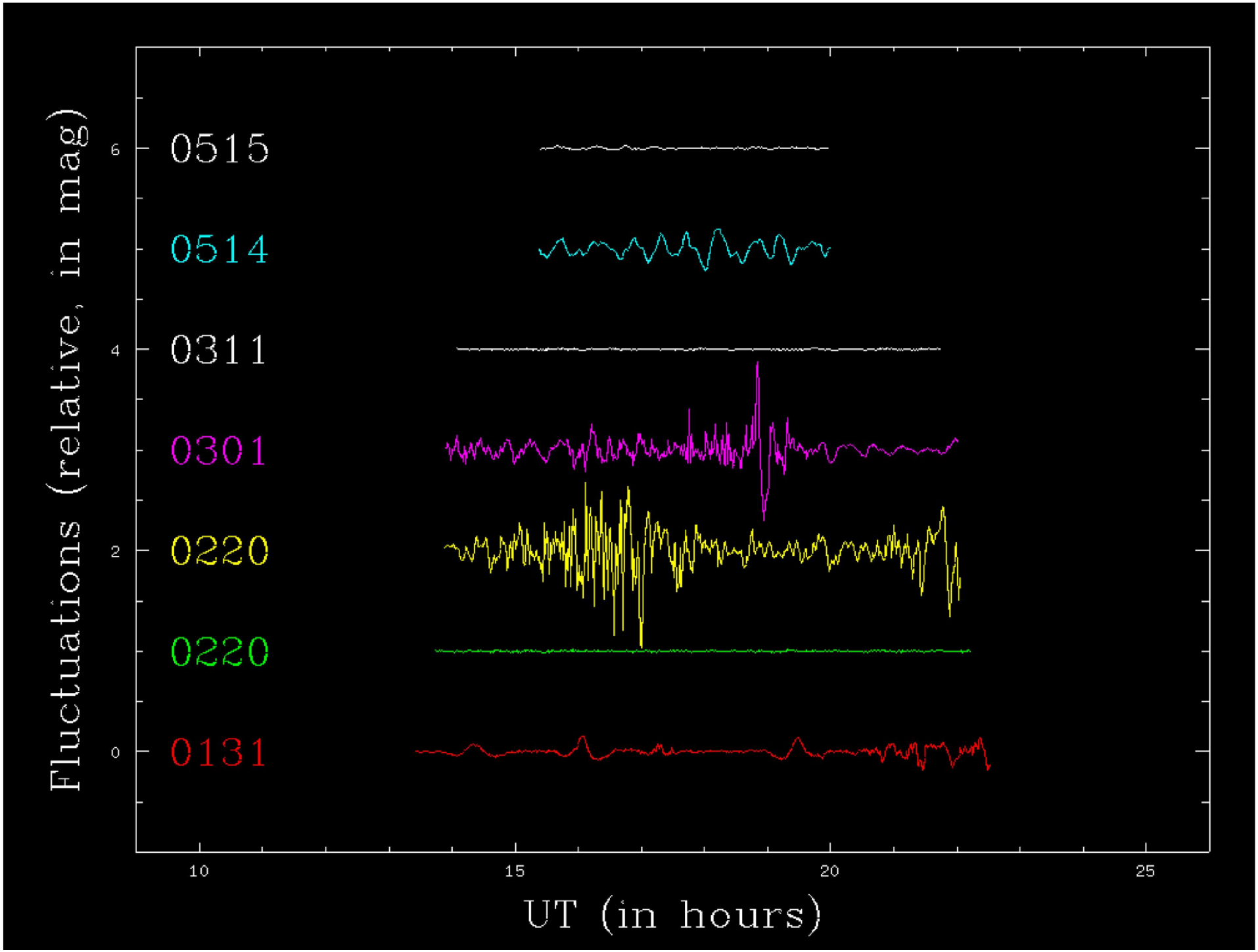

SQM
20180116 – 201807
20180716 @SST
SQM sky brightness (Mag)
5
10
15
20
25
10
12
14
16
18
20
22
24
26
Time (UT in hours)

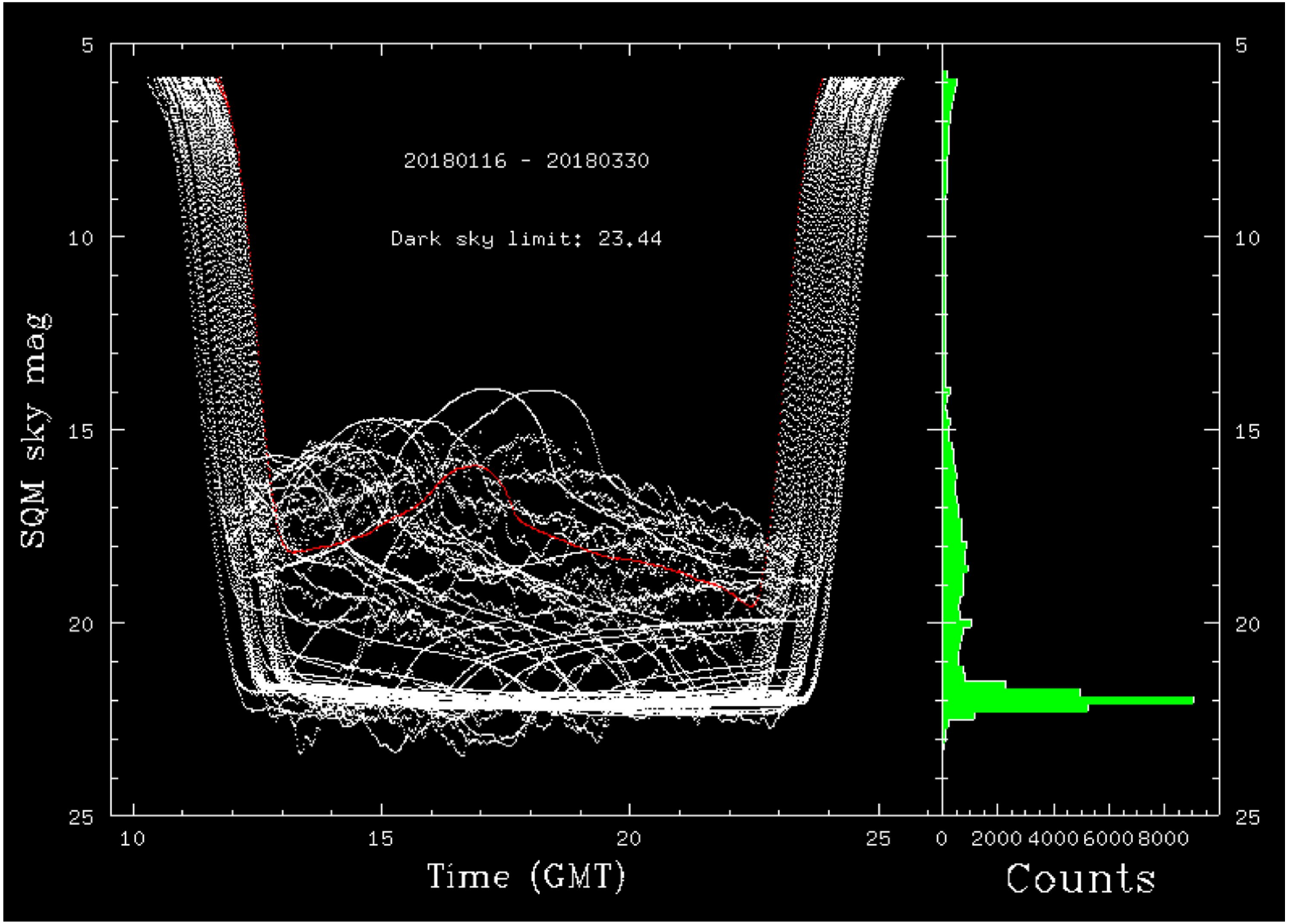

SQM
20180116 – 2018
20180718 @S
SQM sky brightness (Mag)
5
10
15
20
25
10
12
14
16
18
20
22
24
26
Time (UT in hours)

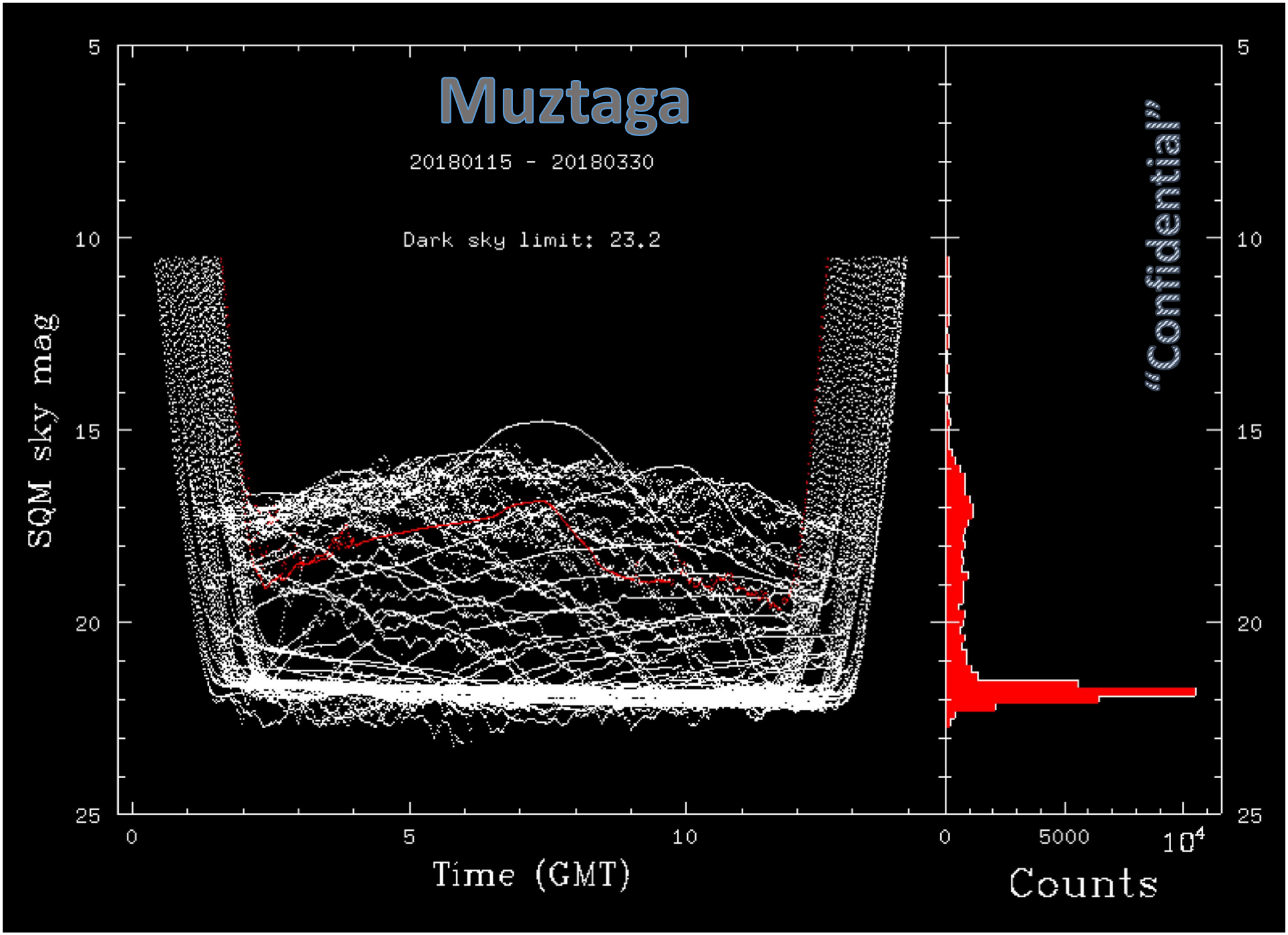
Sky quality assessment by SQM

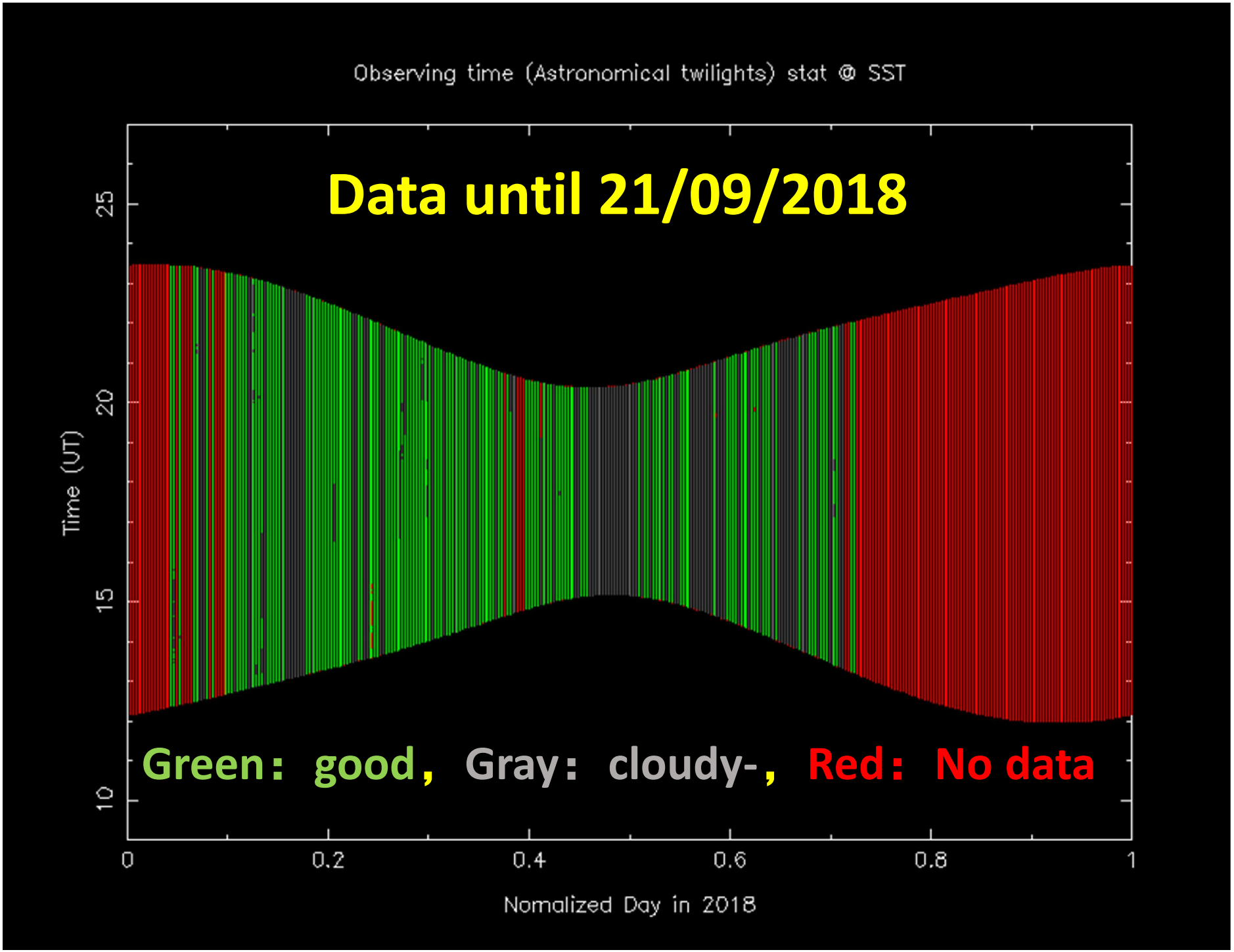
- Slope $\frac{\delta M_{SQM}}{\delta \mathrm{t}}$ at each data points
- Smoothing (average) with a 15min window (SQM sampling rate 1/min), corresponding to median characteristic timescale of cloud passage
- Reconstruct smoothed data using an smoothed slope in a window of 15min or smaller
- Calculate the residual at each data points (between twilights), giving a quality index


Sky brightness (mag/sec^2)
14
16
18
20
22
24
14
16
18
20
22
UT (hours)


Fluctuations (relative, in mag)
0515
0514
0311
0301
0220
0220
0131
6
4
2
0
10
15
20
25
UT (in hours)

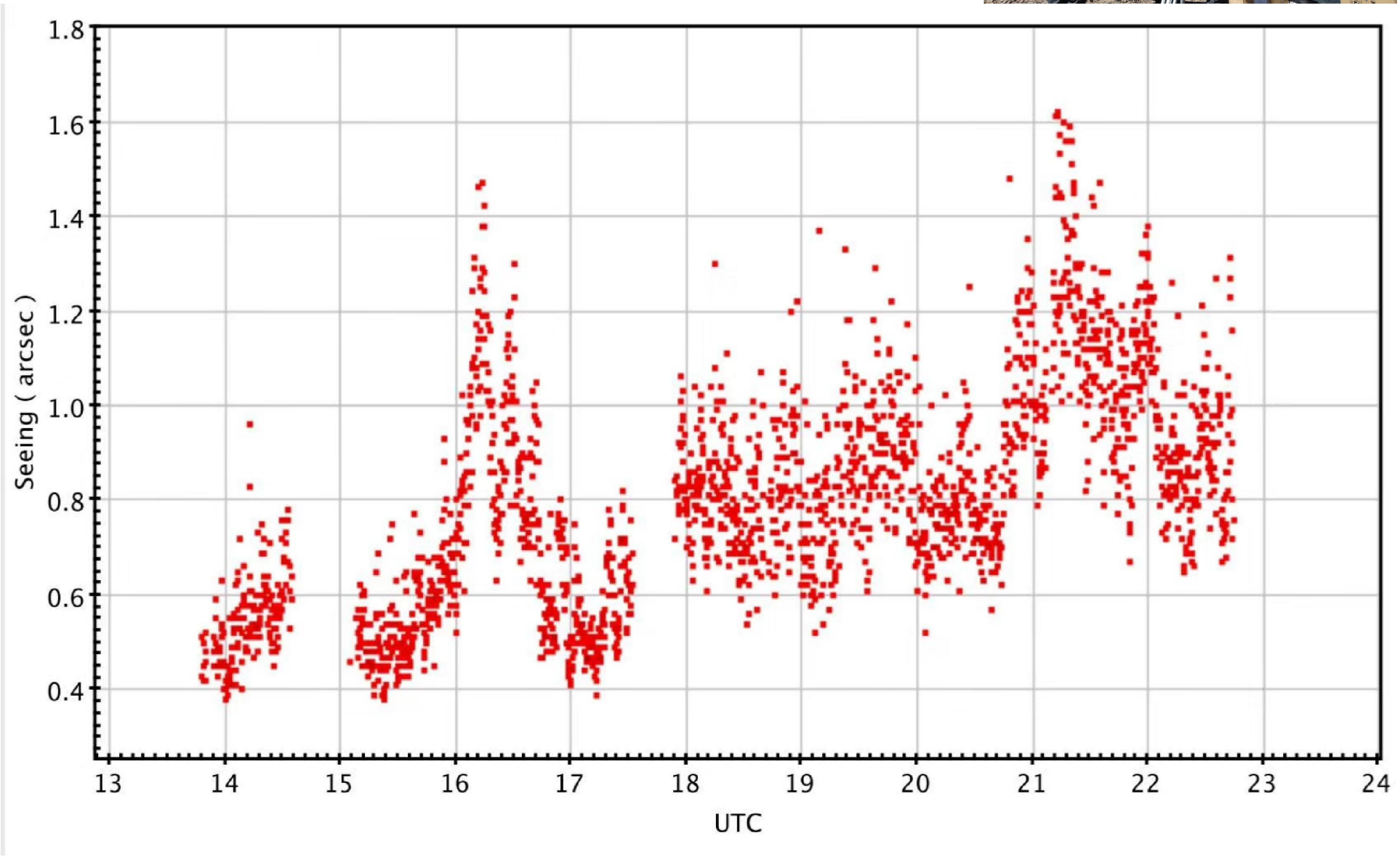

20180116 - 20180330
Dark sky limit: 23.44
SQM sky mag
Time (GMT)
Counts
5
10
15
20
25
0
2000
4000
6000
8000


Muztaga
20180115 - 20180330
Dark sky limit: 23.2
SQM sky mag
Time (GMT)
Counts
10^4
"Confidential"
5
10
15
20
25
0
5
10
0
5000

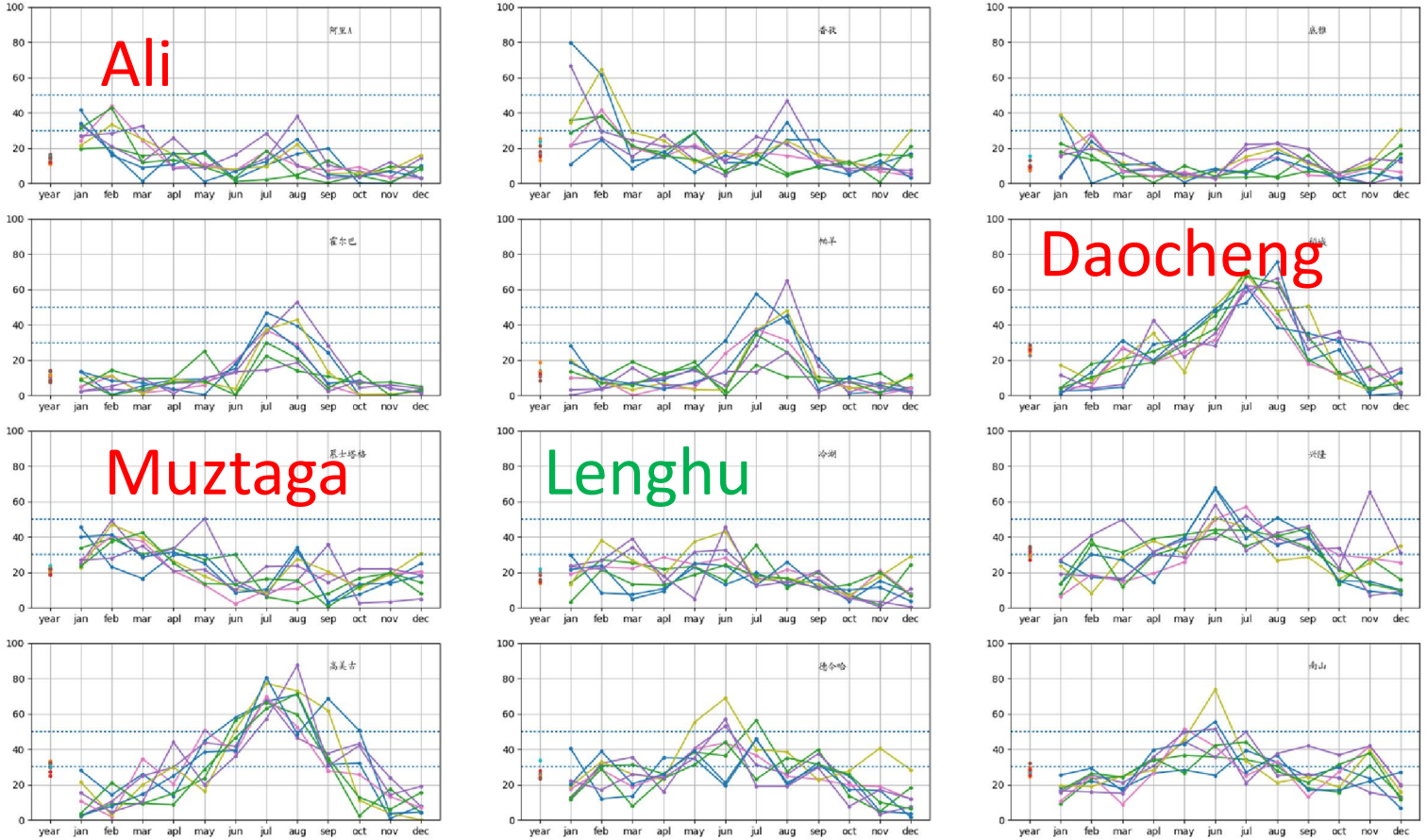

Observing time (Astronomical twilights) stat @ SST
Data until 21/09/2018
Time (UT)
25
20
15
10
0
0.2
0.4
0.6
0.8
1
Nomalized Day in 2018
Green: good, Gray: cloudy-, Red: No data

Seeing at submit C SST

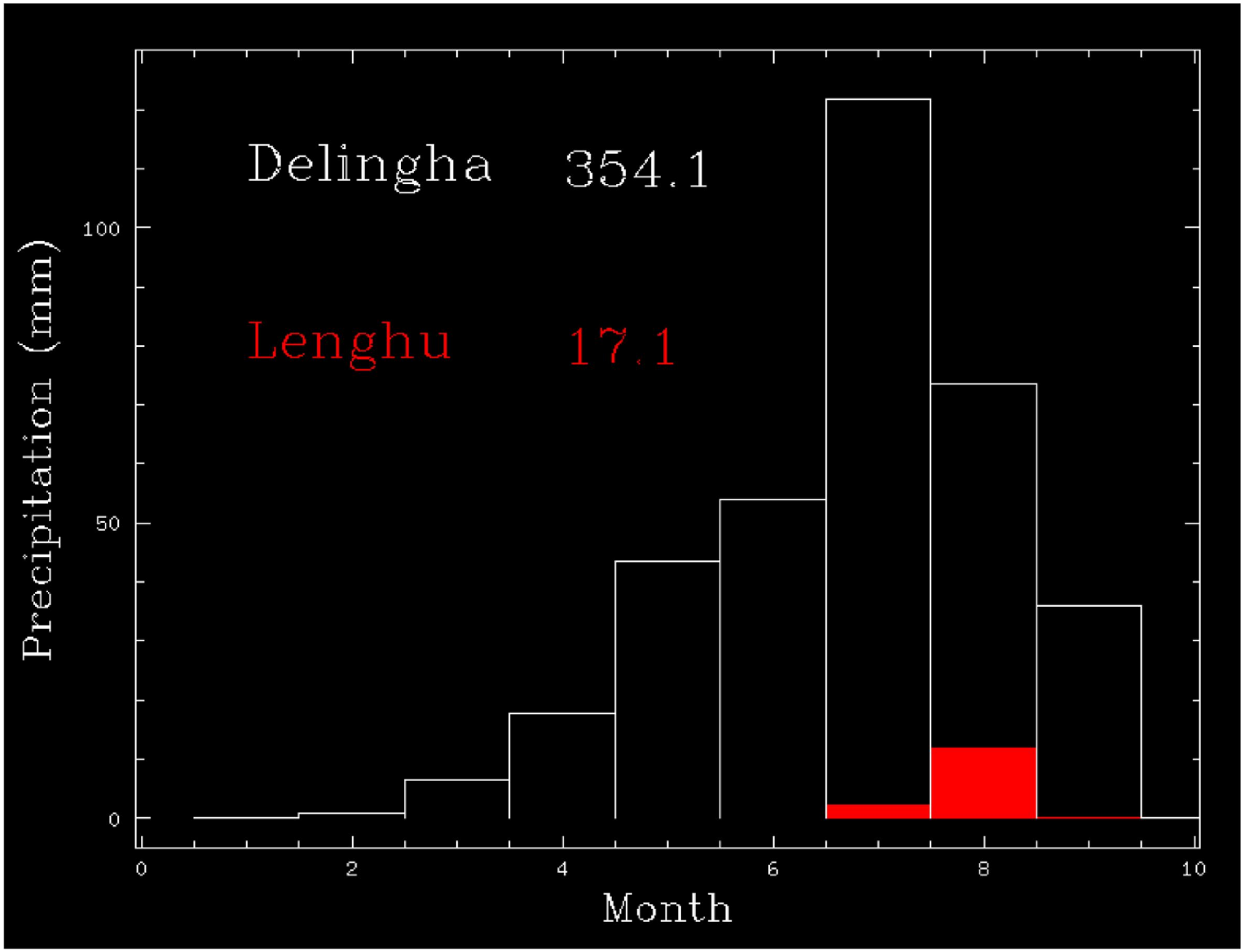
on 20180922



New sites proposed for future plans

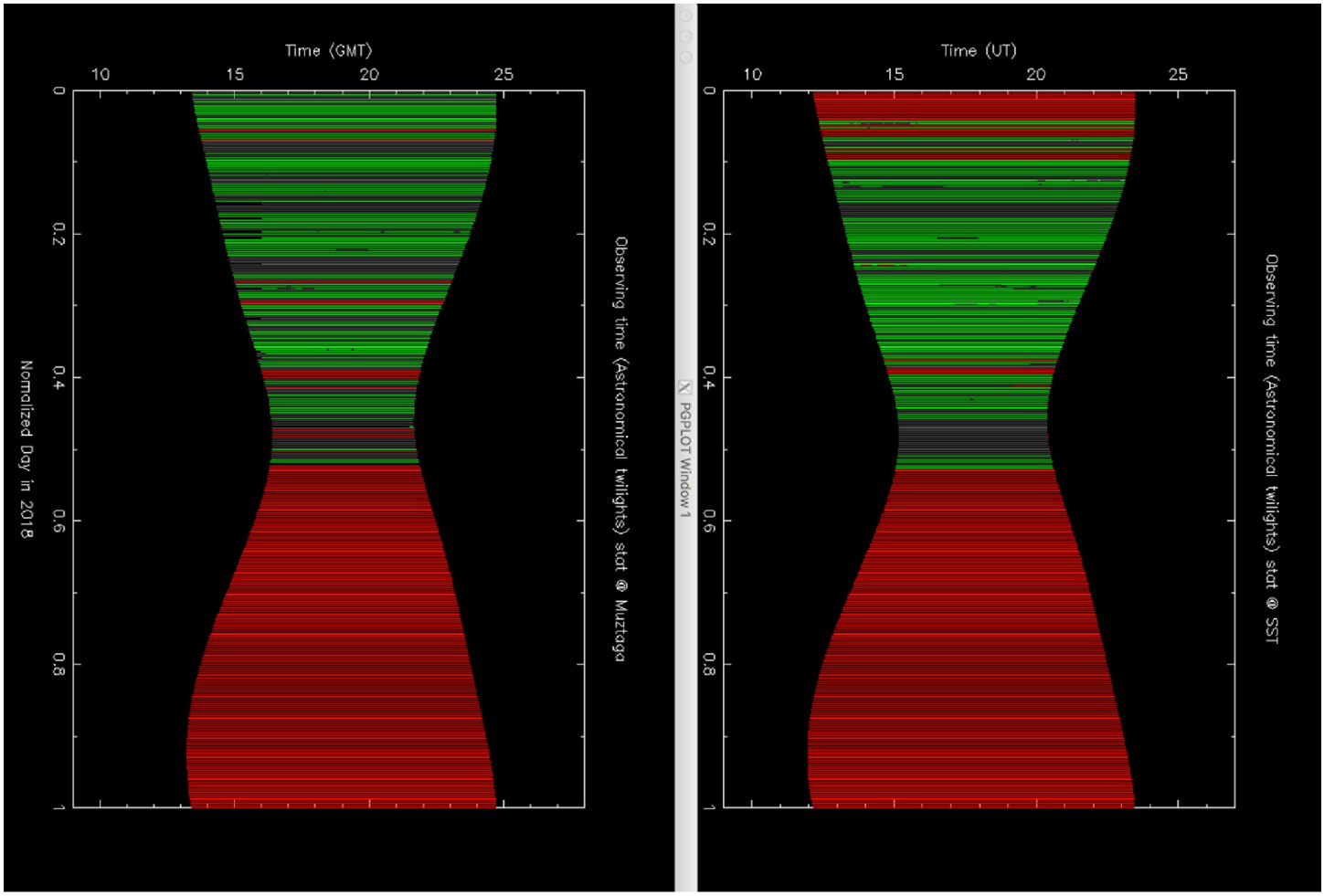


Precipitation: DLH vs LH



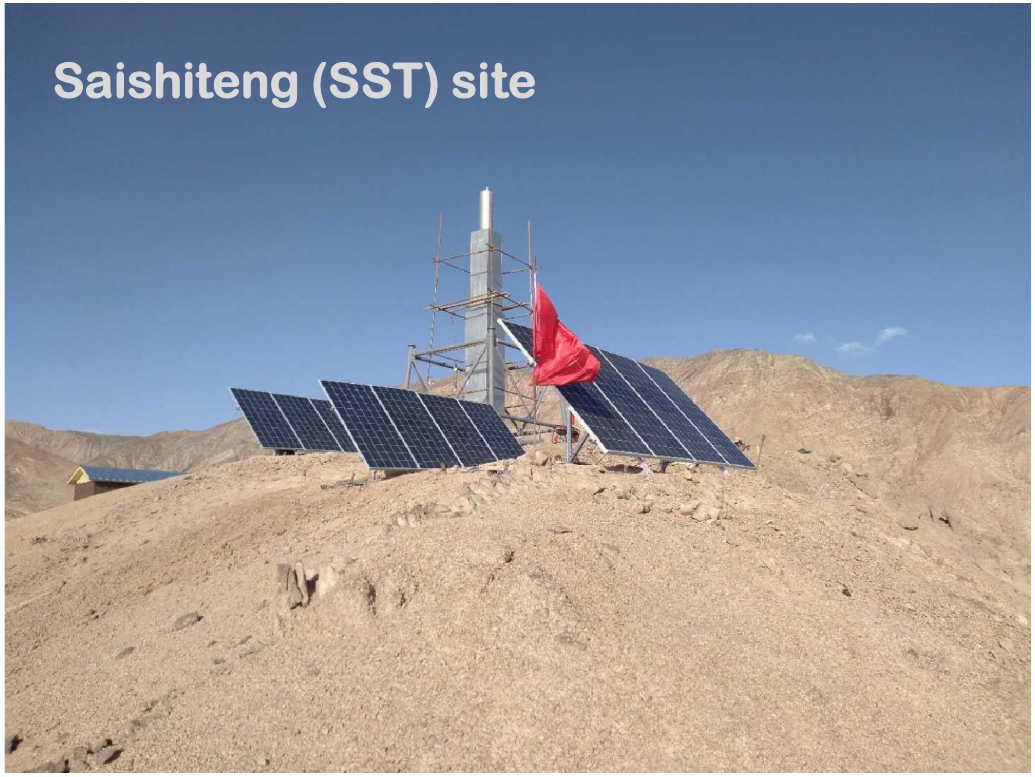
Lenghu (upper) vs Muztaga (lower)

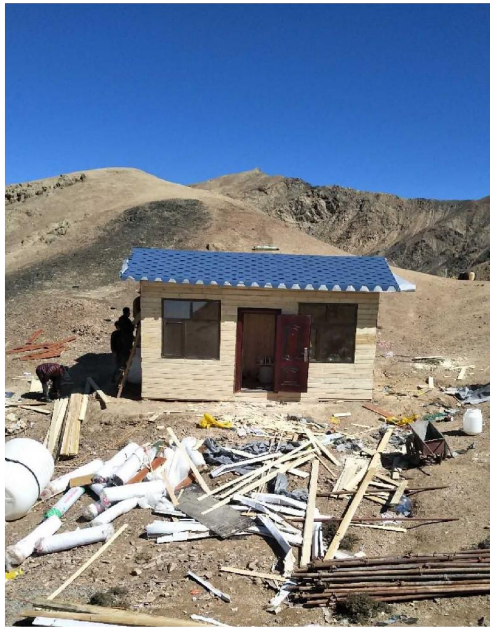
Sky quality stat.



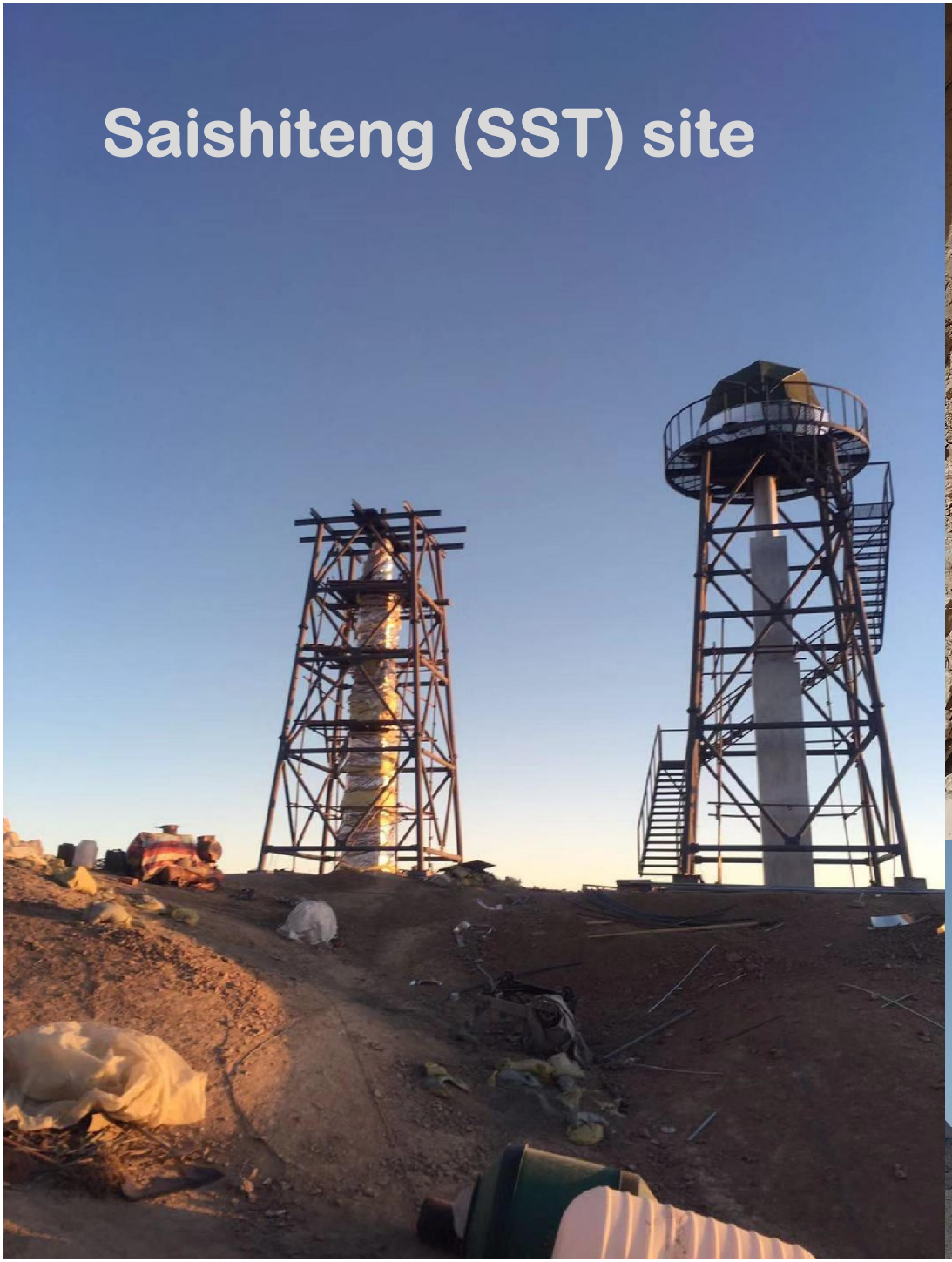
阿里站星空（腾讯项目供图）

2018 03 23 19:40:19
阿里星空和狮泉河镇的灯光
阿里站星空（腾讯项目供图）


Saishiteng (SST) site



Saishiteng (SST) site



SONG (China)

- Will be (again) in test mode soon, in Delingha
- Need at least a year for construction
- Need a summer season for relocating and another year for alignment, test