Keep it Deep!

Günther Wuchterl
Kuffner-Sternwarte, Wien
Thüringer Landessternwarte, Tautenburg
IDA Austria
CEDIC, Linz, AEC, 20. März 2011, 9:00-9:40

… today at the news-stand

Save the night!
The world always becomes brighter but body and soul need darkness.

The “spots”(*) are the tools!

- Dark sky parks
- Starlight Reserves / Oasis
- European network of dark sky parks (officially established)
- ...

How it work?

Do we like it?

(*) Surfinary: a “spot” is a place where the sea may produce waves but as well leaves the Surfer frustrated by dead-flat water. Sometimes exceptional condition produce legends that are so unique that the are referred to by weekdays, e.g. “big wednesay”, that occupies the rank of the battle of Waterloo in surf-history.

Grossmugl Starlight Oasis – July 31st

Bild: Daniel Korbel, Kuffner-Sternwarte

Bild: Daniel Korbel, Kuffner-Sternwarte

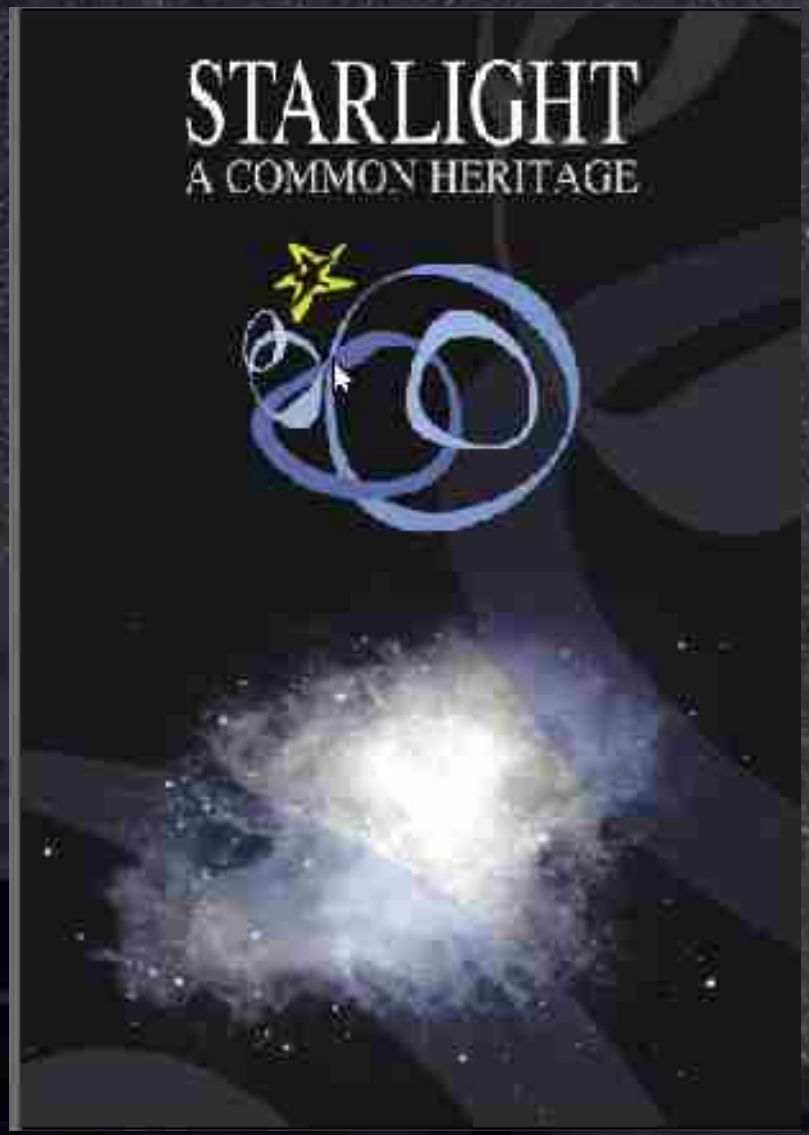
Bild: Daniel Korbel, Kuffner-Sternwarte


It helps to talk
Jena, Saturday, April 4th, 2009, 21h – 24h

Bild: Christian Hogner, Thüringer Landessternwarte Tautenburg

Bild: Christian Hogner, Thüringer Landessternwarte Tautenburg

Starlight Initiative



- UNESCO, WTO, IAU, IUCN, ...
- Deklaration of La Palma, 2007
- Right for starlight
- Starlight Reserve 2009 (Oasis/Reserve)
- 2010:UNESCO World Heritage committee opens programme for the night-sky

Nightsky and World Heritage

- Brasilia session adopted ”Thematic Study – Astronomy and World Heritage” UNESCO/IAU/ICOMOS
- http://www.astronomicalheritage.org/
- Astronomical contribution to the all important *Universal Outstanding Value* for the World Heritage Programme evaluated
- Nominations: national UNESCO comm.
- Starlight Reserves, Oasis, Skies of WHC-sites

Motto

Starlight for the millions


Which sky as a park?

Often conflicting goals

- Perfect skies
- Perfect access for many people
- Perfect tourist infrastructure

- Starlight reserves where the people are
- Mountains helpful:
  - Height
  - Natural shielding

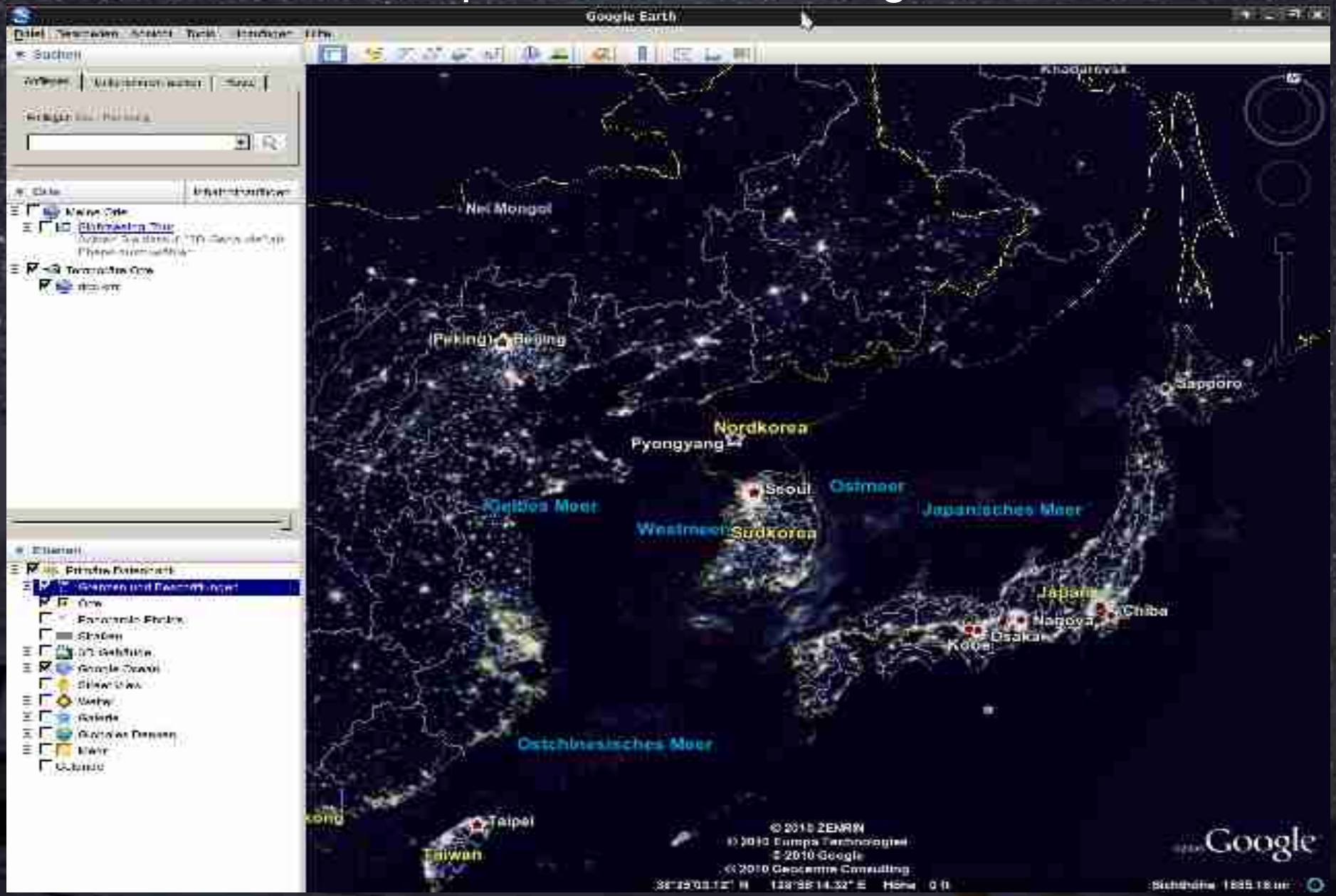

Deep Skies near you

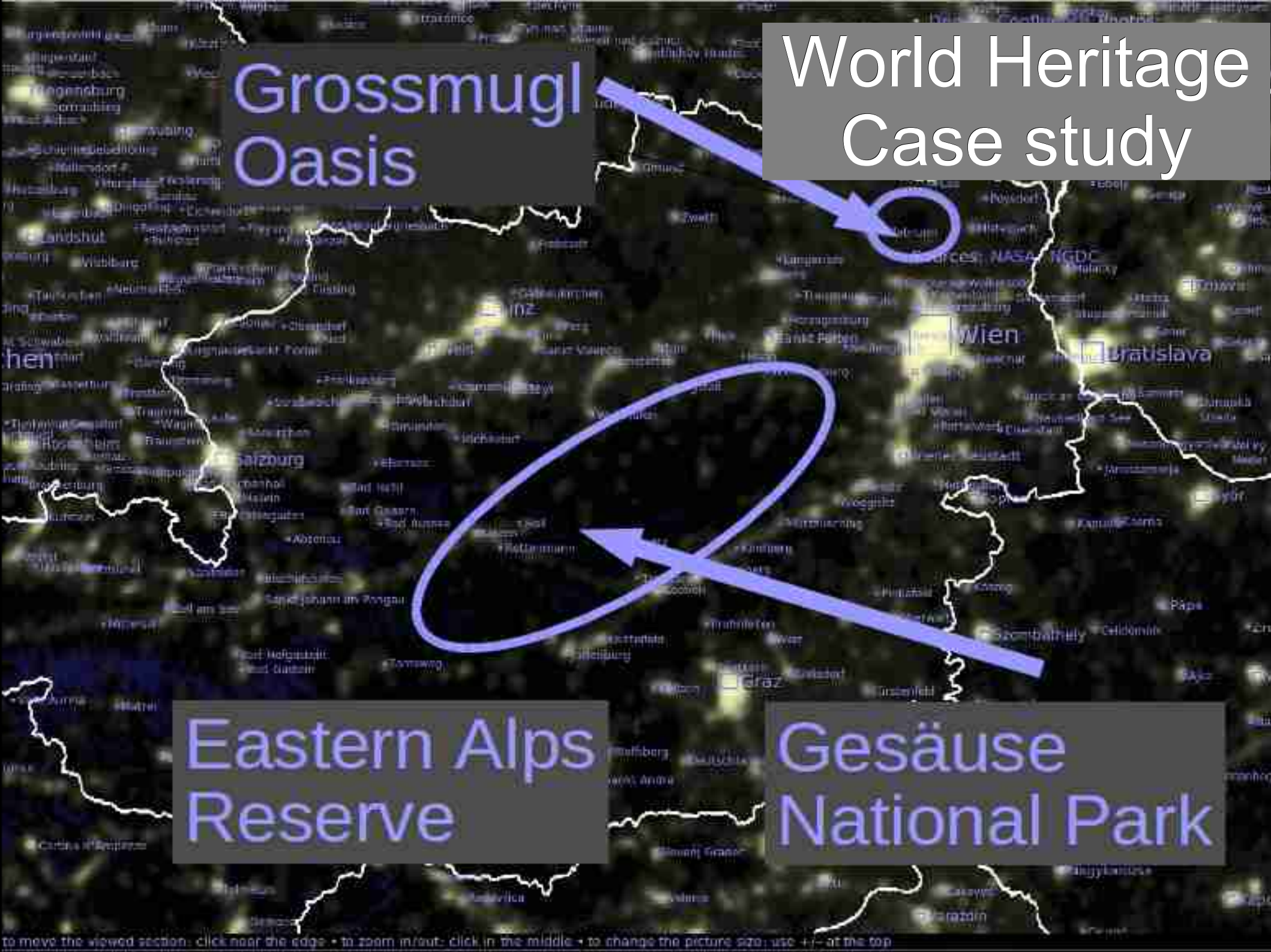
2009 DMPS + A. Trawöger
http://light.datenscheibe.org/

http://light.datenscheibe.org/

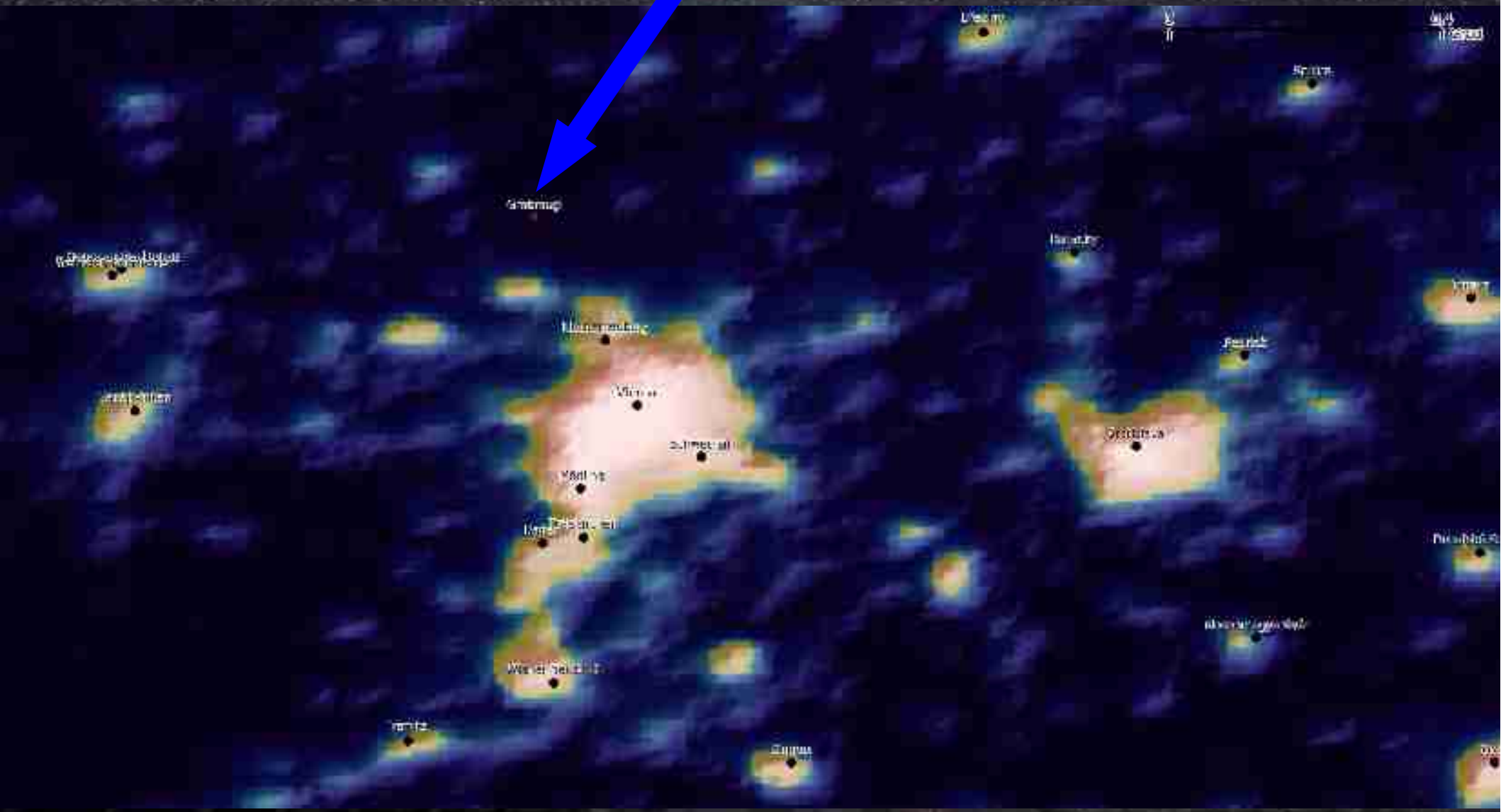
Google-Earth Overlays

http://datenscheibe.org




World Heritage
Case study
Grossmugl
Oasis
Eastern Alps
Reserve
Gesäuse
National Park
Wien
Bratislava
Salzburg
Graz
to move the viewed section: click near the edge • to zoom in/out: click in the middle • to change the picture size: use + / - at the top

Vienna + Großmugl Starlight Oasis



DMSP 2009 stable lights - 2.5D

Satellites as guides?
Does the sky from above
look like the sky from below?

Which sky as a park?

Quantification and Comparison

Quantification? - Watt Quantity?

- Logarithmic light ratios to known stars: magnitudes per area – magnitudes - which magnitudes?
- Illumination for humans - Lux
- Energy stream of light – Watt/m²

Watt Purpose?

- Magnitudes → astronomy
- Illumination → lighting for humans
- Energy flux → energy / CO2 / environment

Light is already monitored by atmospheric physics, solar-energy harvesting and meteorology:
total radiation (global radiation) –
“all light hitting the ground”

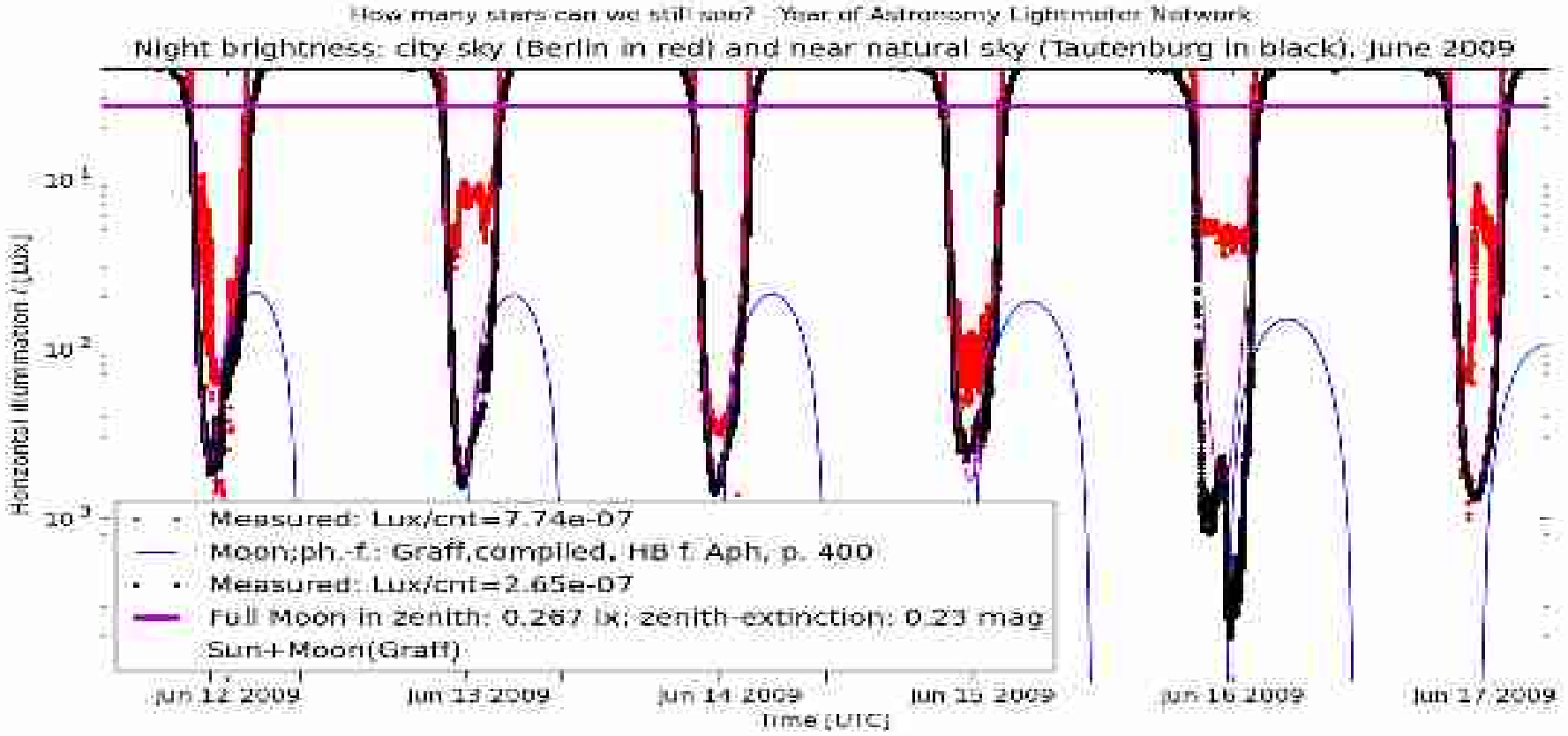
→ Do it at night and keep the Watt/m² – but how?

Run a solar cell at night

- Concept: solar cell collects energy
- The more light the more energy
- Light to the sky is unwanted “uplight”
- What is reflected down makes the sky and the environment brighter
- Anything above natural is pollution

Can we measure it?

IYA-Lightmeter: simple, continuous sky-monitoring



Why a Lightmeter?

- Measure a known thing, but at night!
- **Snapshot vs. Monitor --- light-weather vs. light climate**
- **Quantify night brightness as environmental factor**
- **Building an network fast ---> low cost (100 €) + existing technology (PC + Windows/Linux/Mac system)**
- **Easy to use long-term continuous monitor**
- **Long term comparability**
- **All weather (night pollution is much worse with clouds rain/snow)**
- **Short term variations give high-end sky quality**
- **Cloud detection and classification**

Lightmeter 2011

- Mark 2.3l: August 2010
  - amorphous Si solar cell
  - USB-connection (up to 100m with Ethernet ext)
  - daylight part non-linear (from full moon)
  - 1 Hz
  - Linearity < 0.1µW/m² - 0.01 W/m² (1 Lux)
  - PC as data logger
  - detection limit a few 10 nW/m² (single stars)

Lightmeter Mark 2.4 pro: less latency, linear to 10 Lux, lower noise amplifier, windows supp

Skies – from deep to shallow

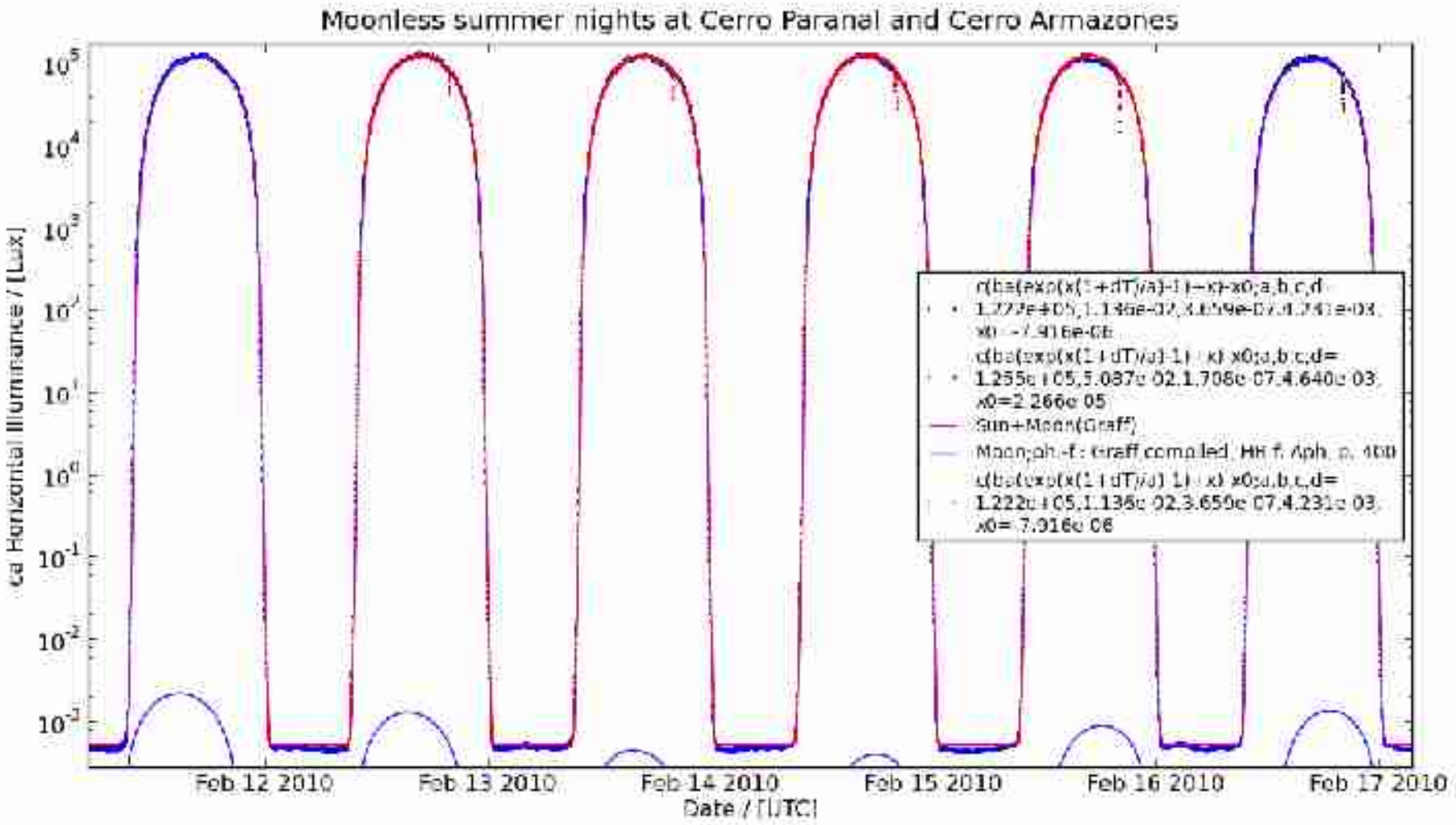
Results from the
International Year of Astronomy
Lightmeter Network

http://lightmeter.astronomy2009.at

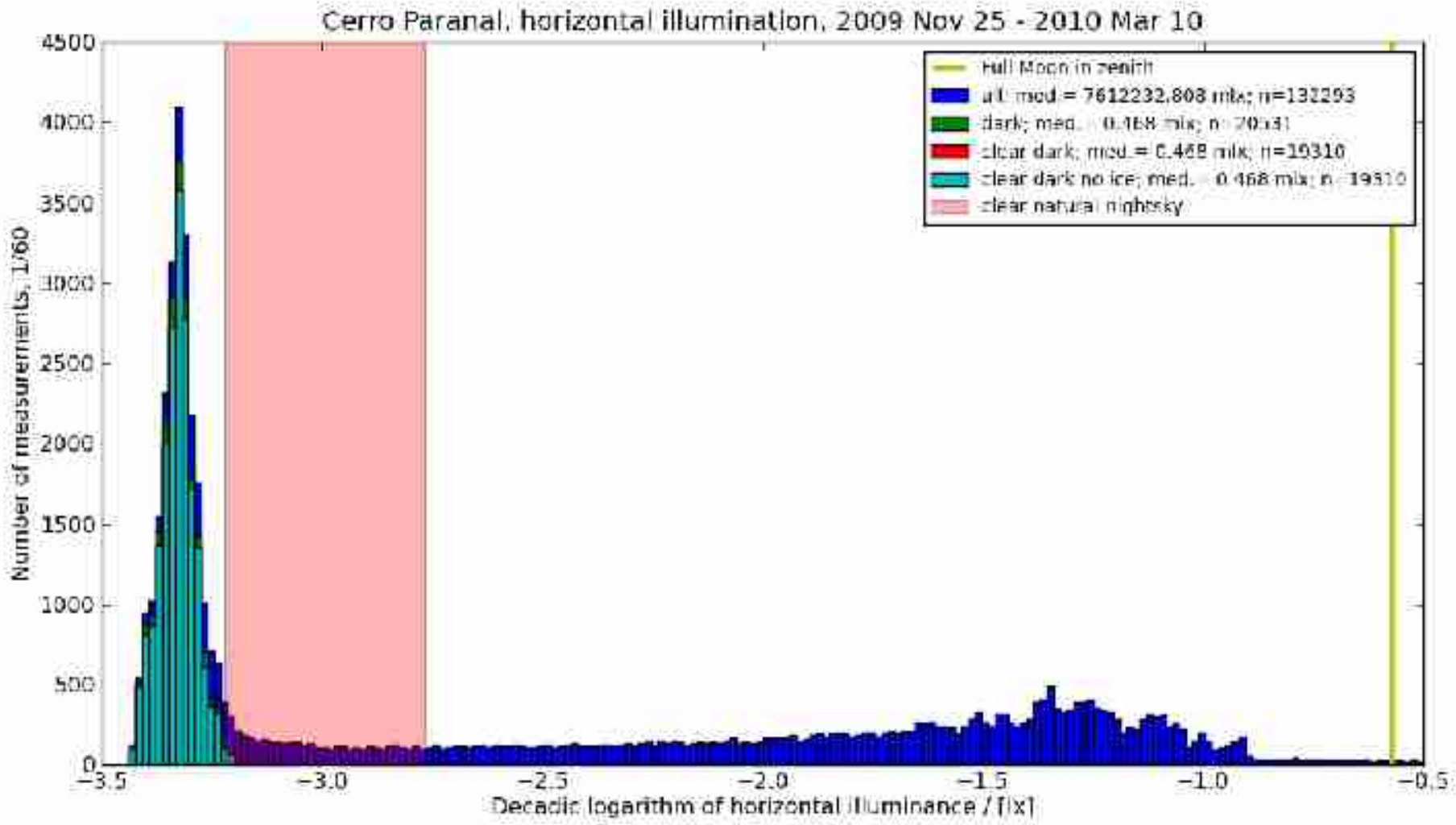
One of ~150: Teide Observatory

Near ESO-VLT at Paranal

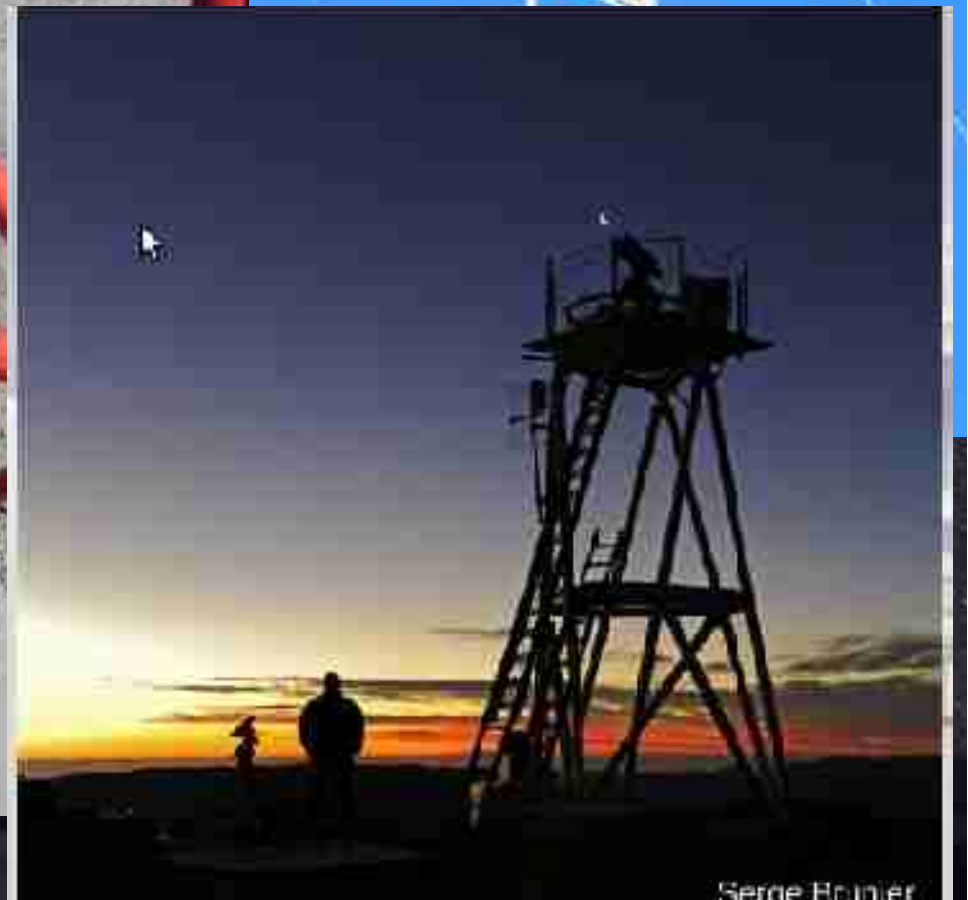
Atacama summer nights Feb 2009



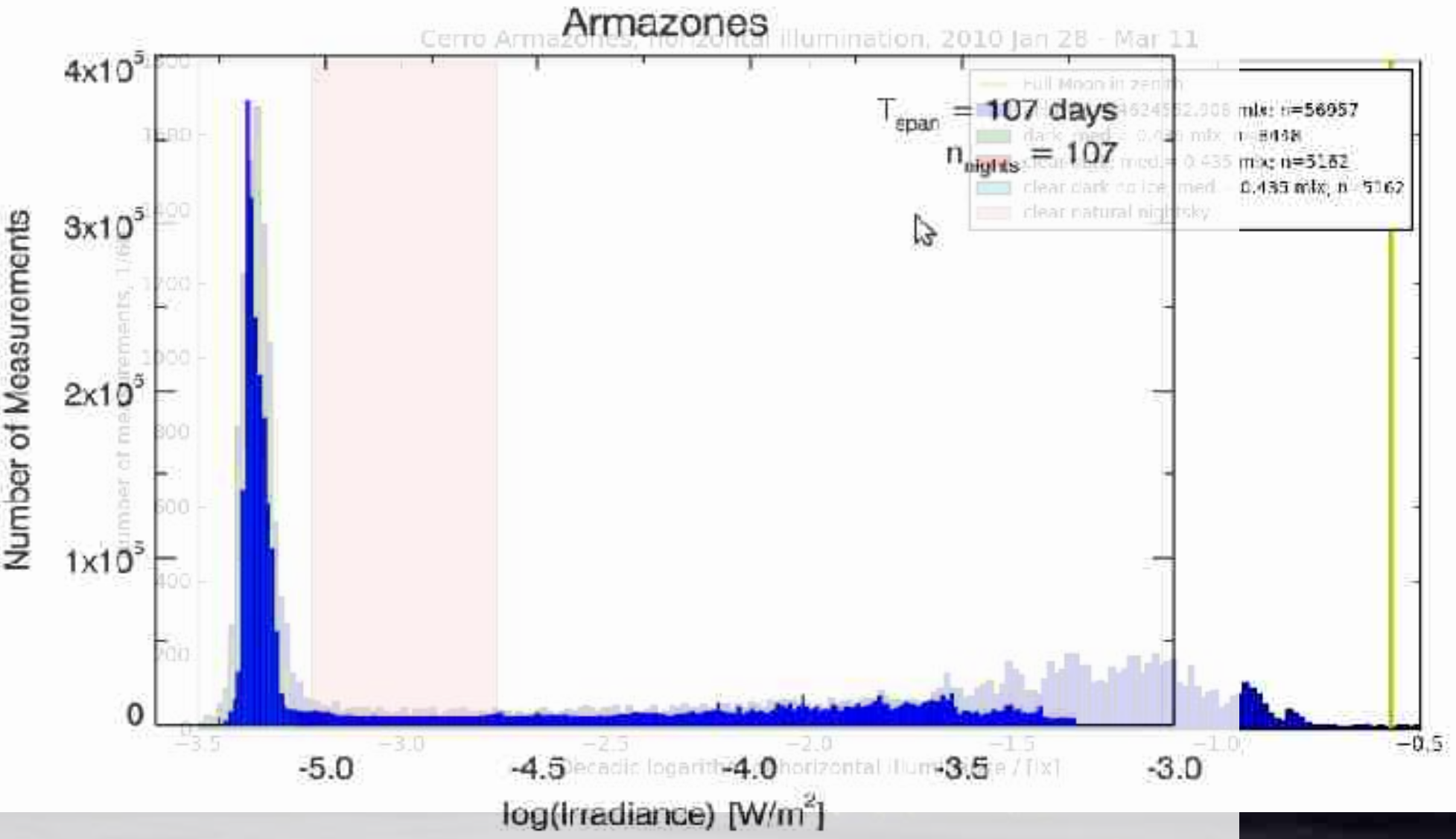
Paranal 2009 / 2010



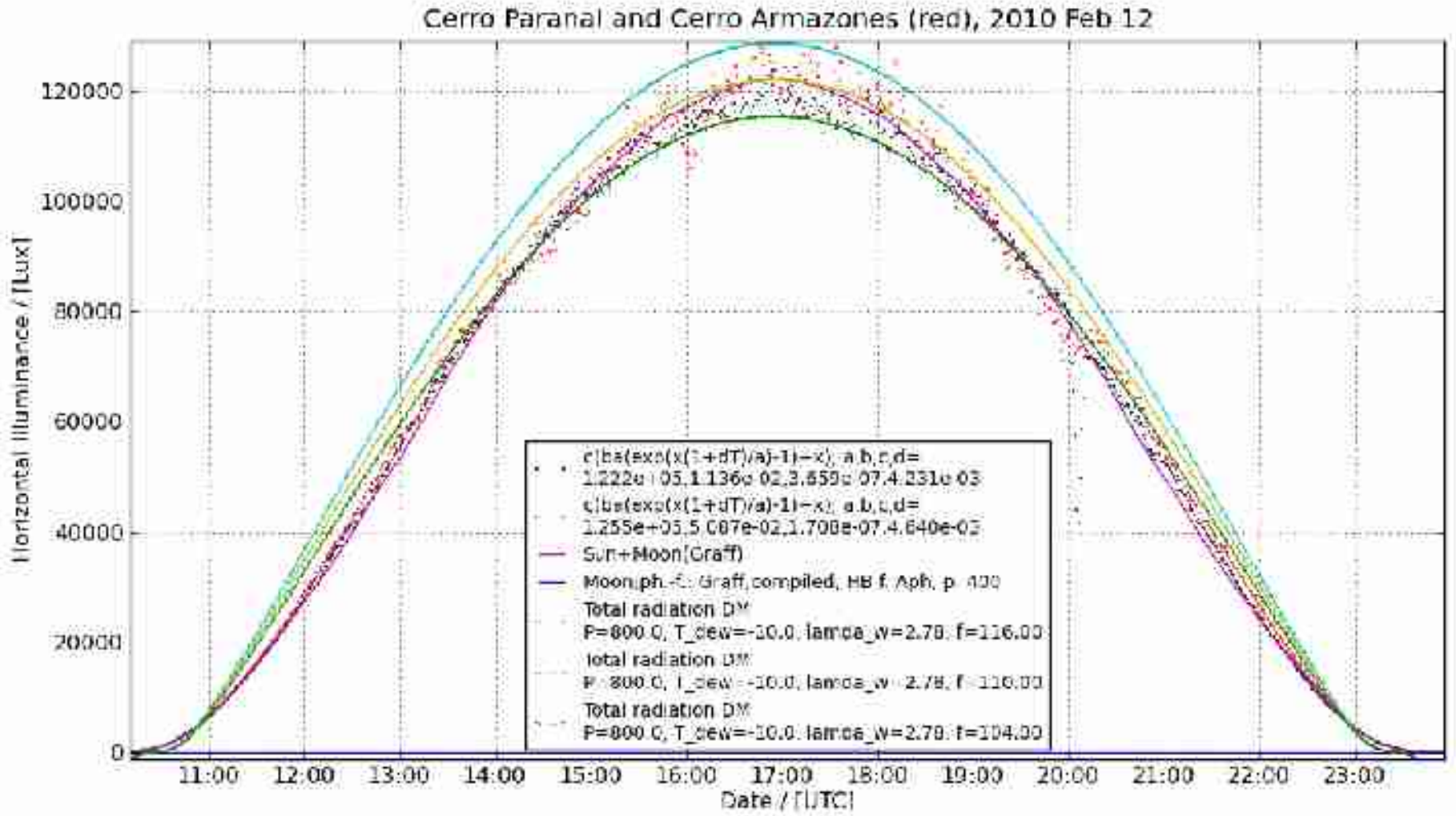
42m ELT-site Cerro Armazones



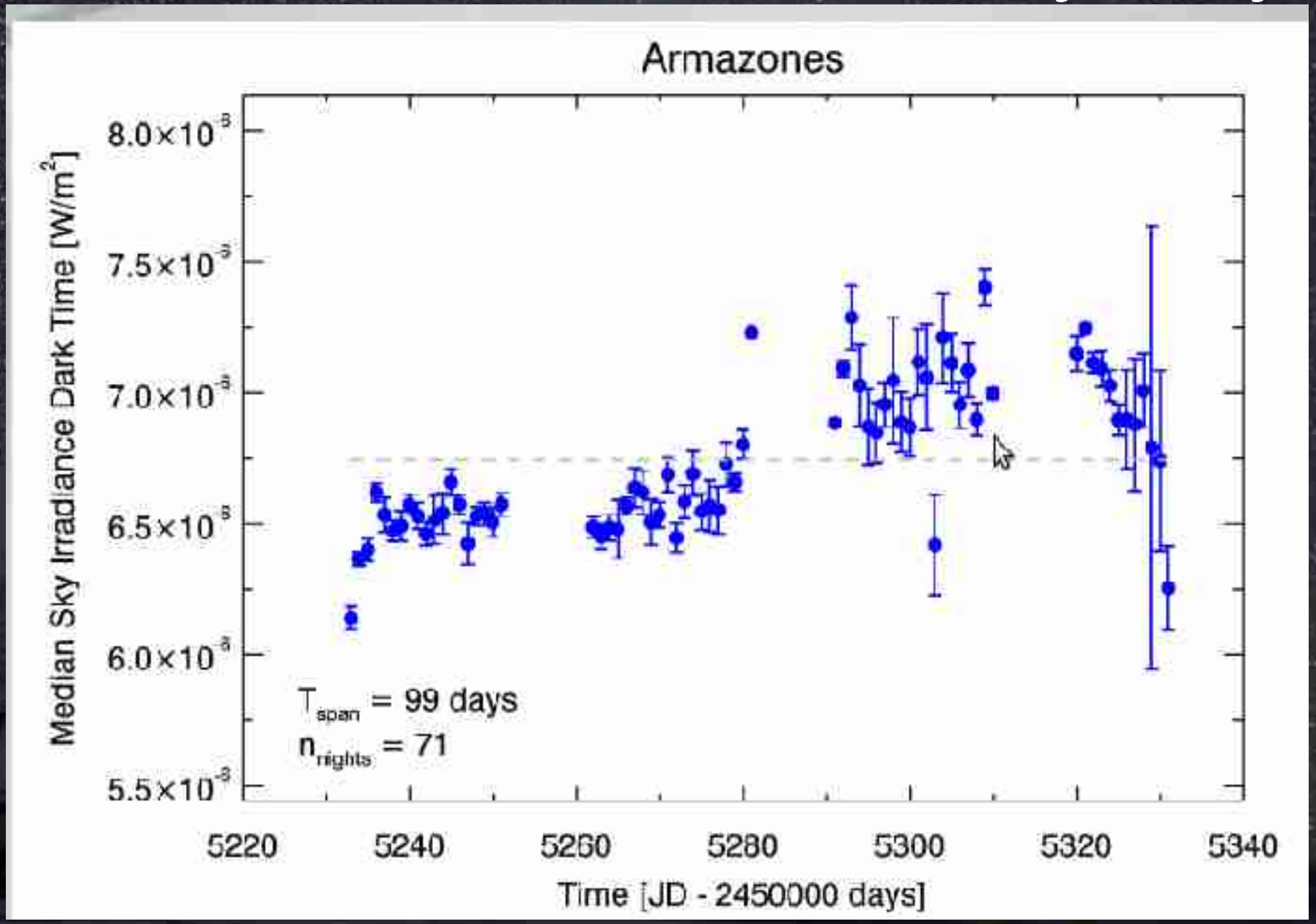
Cerro Armazones Feb 2010



Atacama - total radiation - W/m²

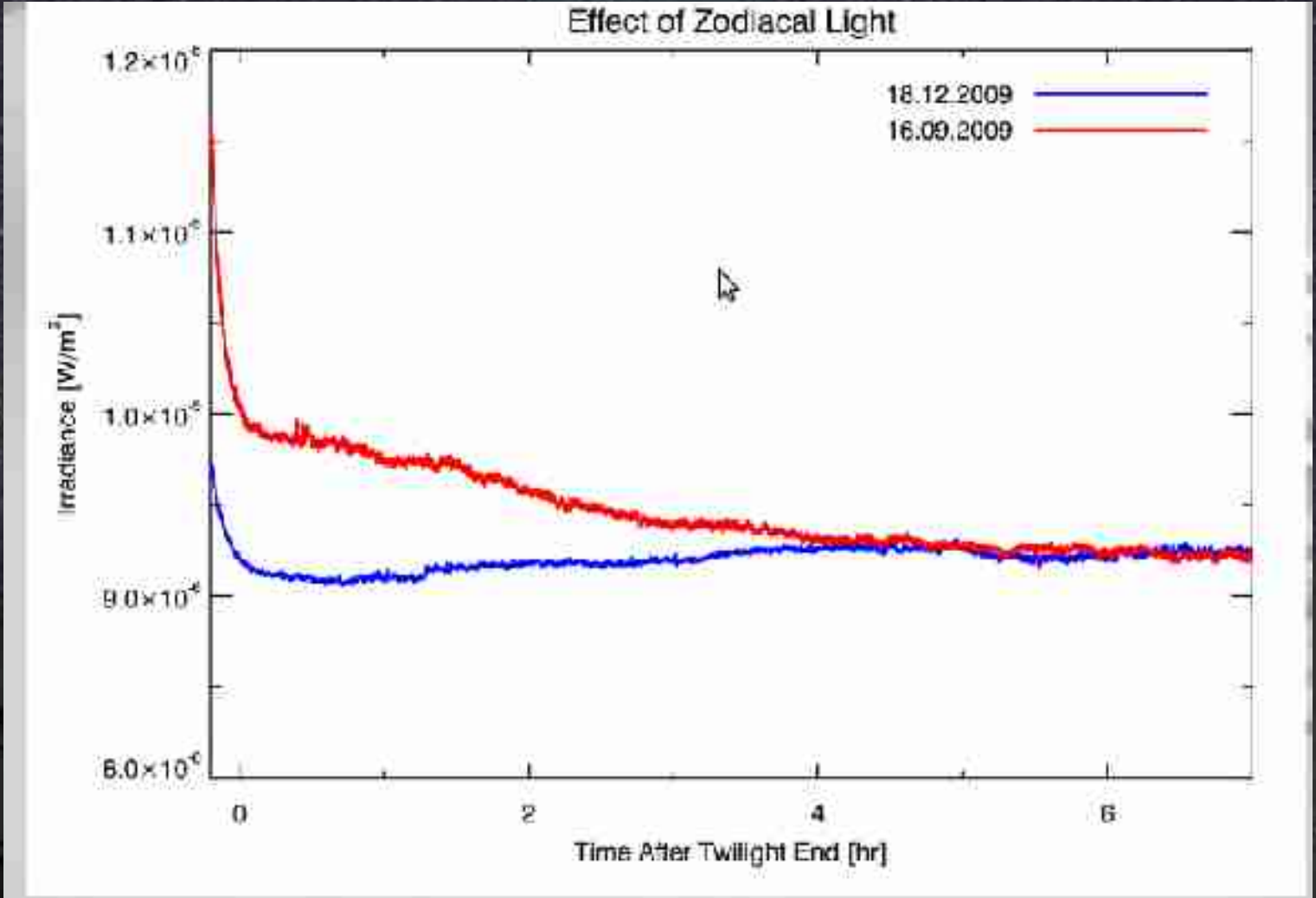


Seasonal variations – Milky Way

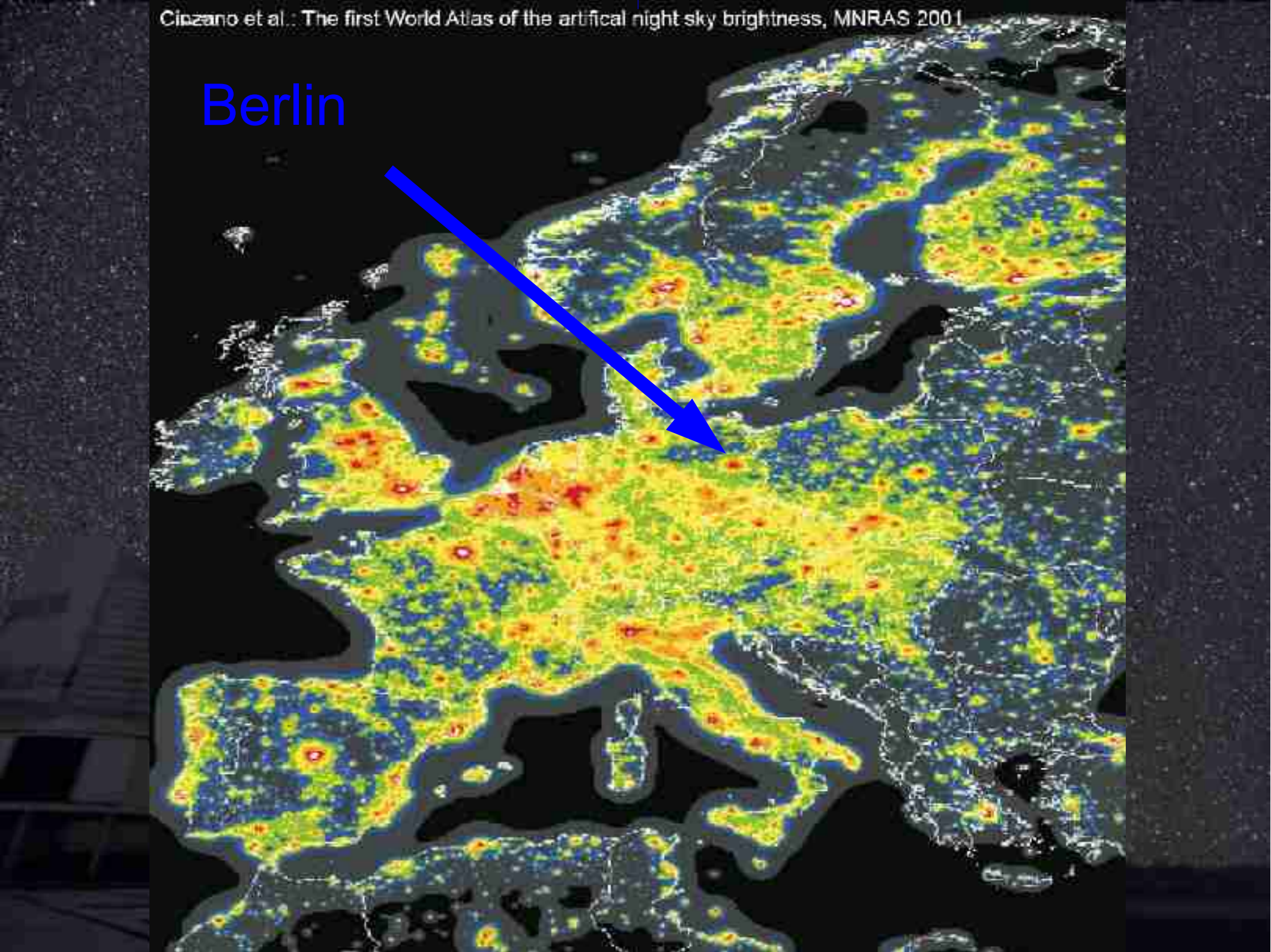


Müller et al 2011

Zodical Light

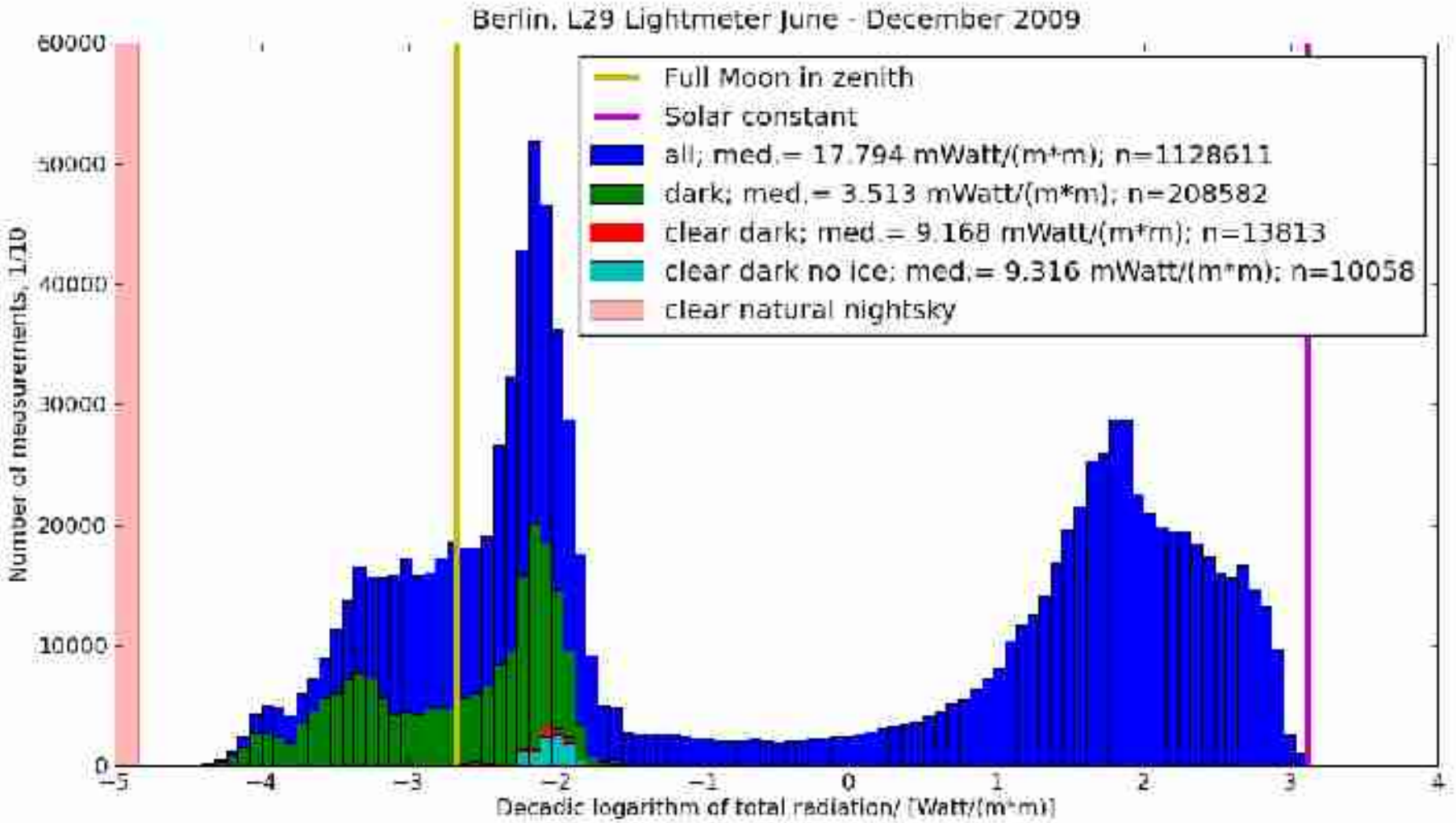


Müller et al 2011

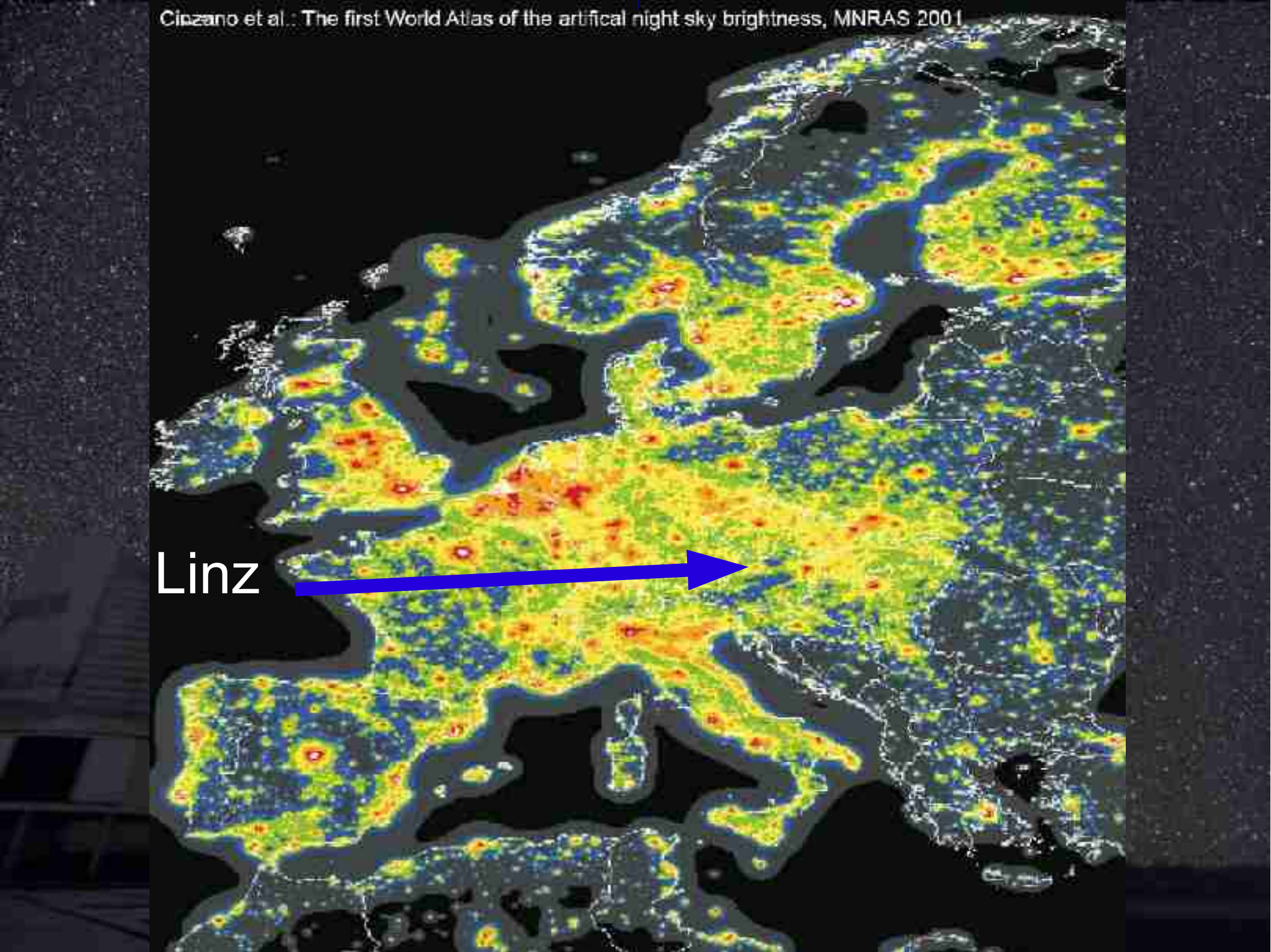

Cinzano et al.: The first World Atlas of the artifical night sky brightness, MNRAS 2001
Berlin

Berlin - centre

Berlin 2009


Berlin, L29 Lightmeter June - December 2009
Full Moon in zenith
Solar constant
all; med.= 17.794 mWatt/(m*m); n=1128611
dark; med.= 3.513 mWatt/(m*m); n=208582
clear dark; med.= 9.168 mWatt/(m*m); n=13813
clear dark no ice; med.= 9.316 mWatt/(m*m); n=10058
clear natural nightsky
Number of measurements, 1/10
60000
50000
40000
30000
20000
10000
0
−5
−4
−3
−2
−1
0
1
2
3
4
Decadic logarithm of total radiation/ [Watt/(m*m)]


Linz
Johannes Kepler Observatory
20.624 luminaries,
23.206 lights,
86,59 Watt / light average
2 MW total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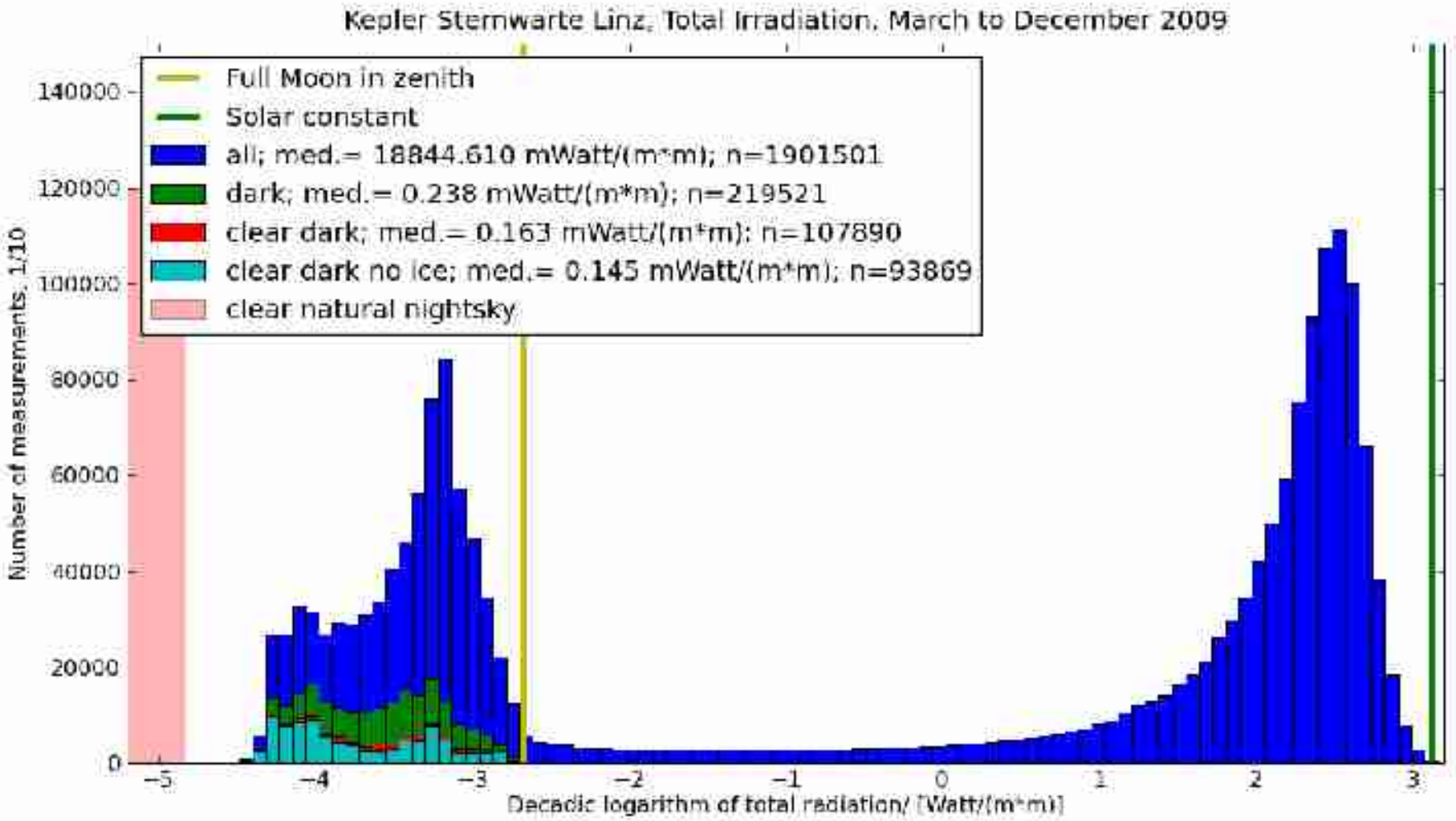
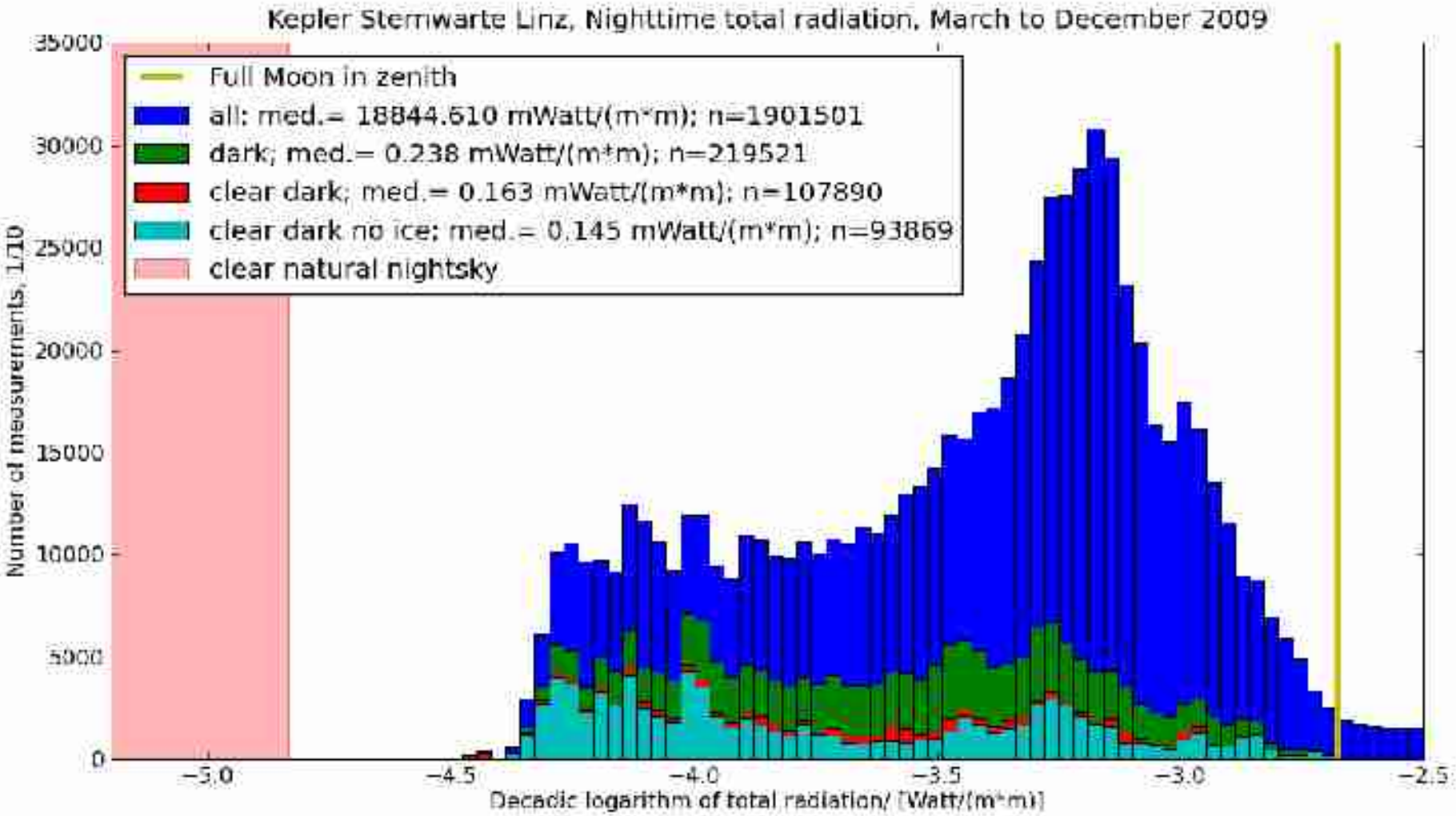
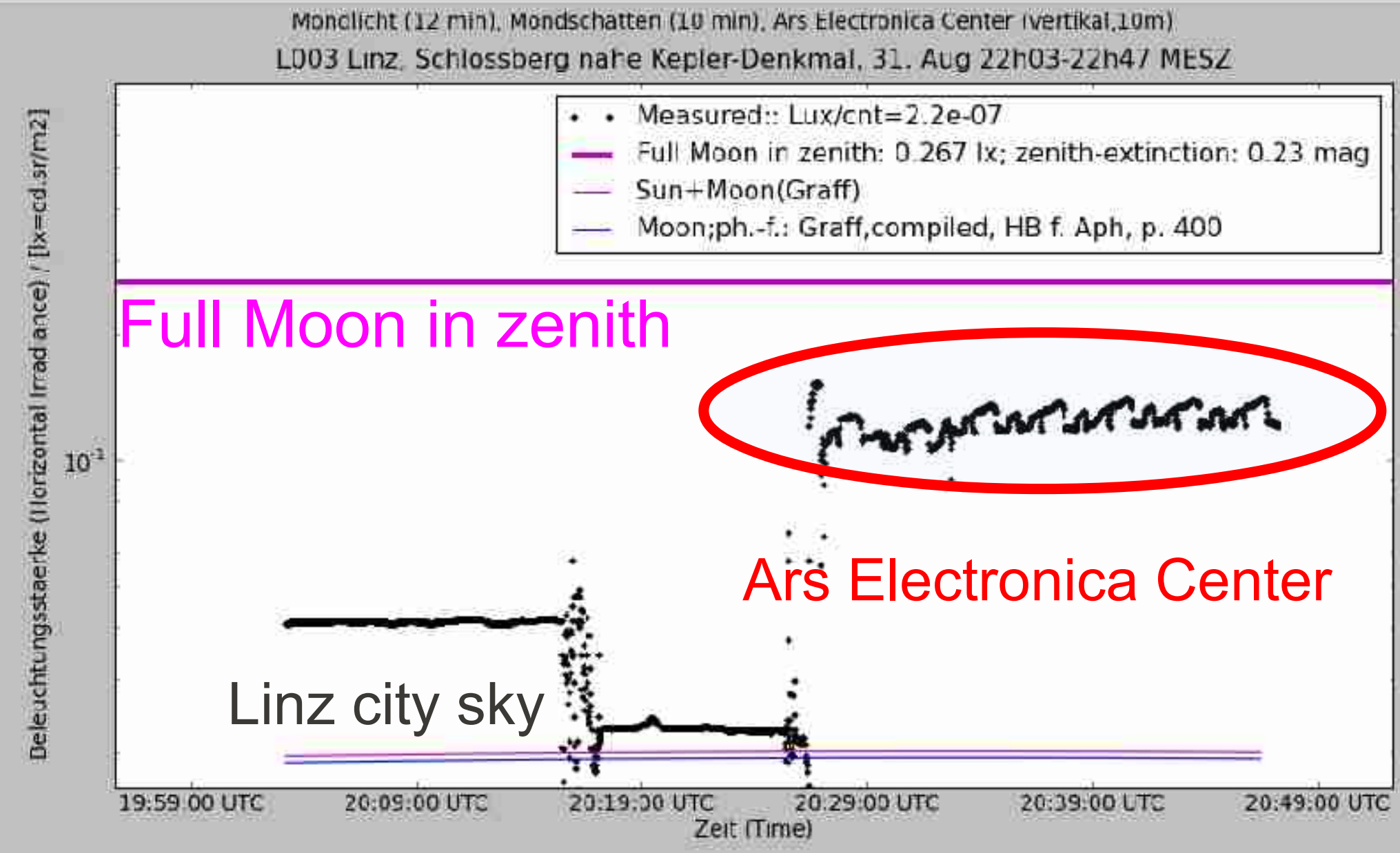
Kepler Observatory Linz

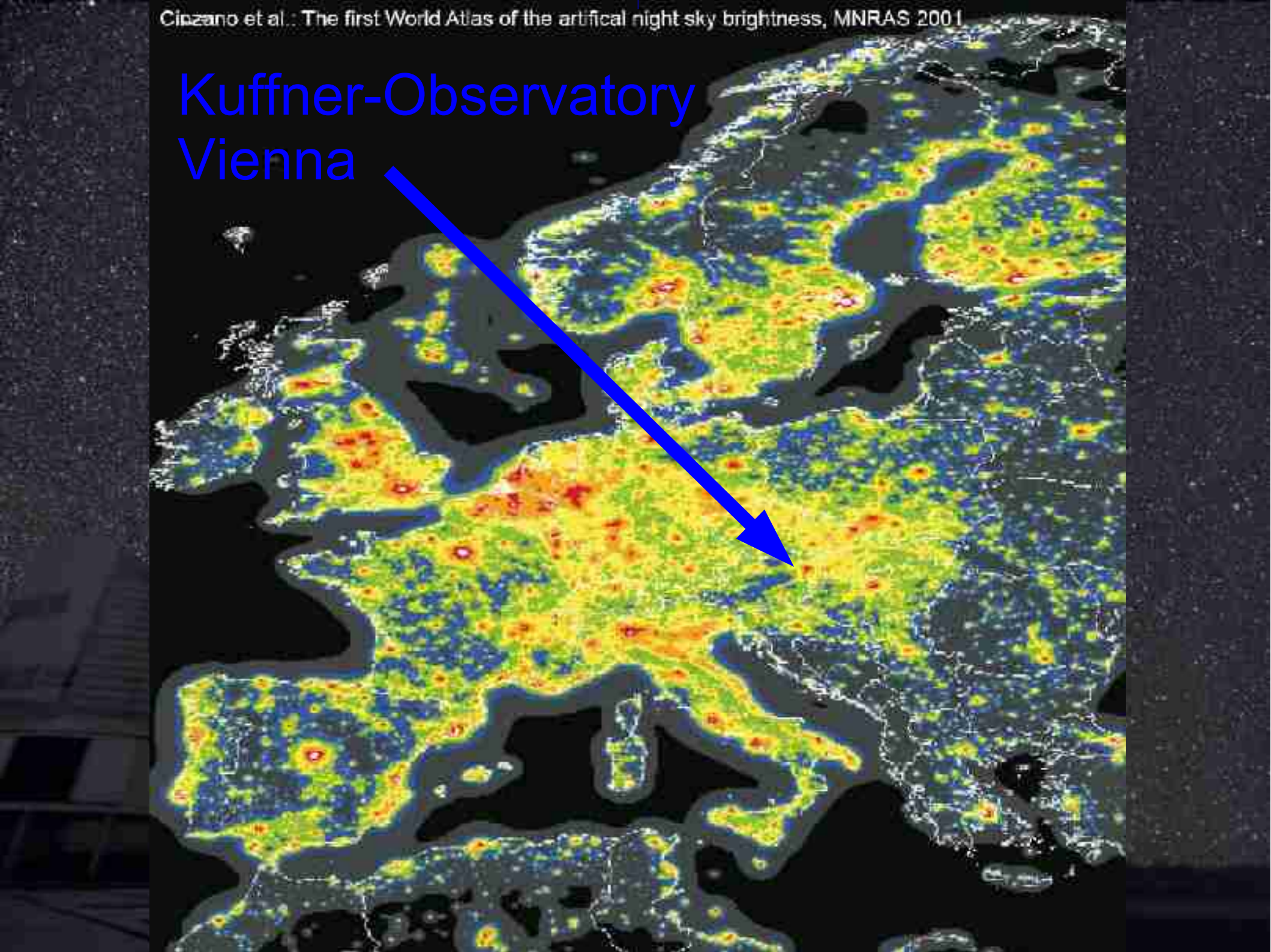


Kepler Observatory Linz

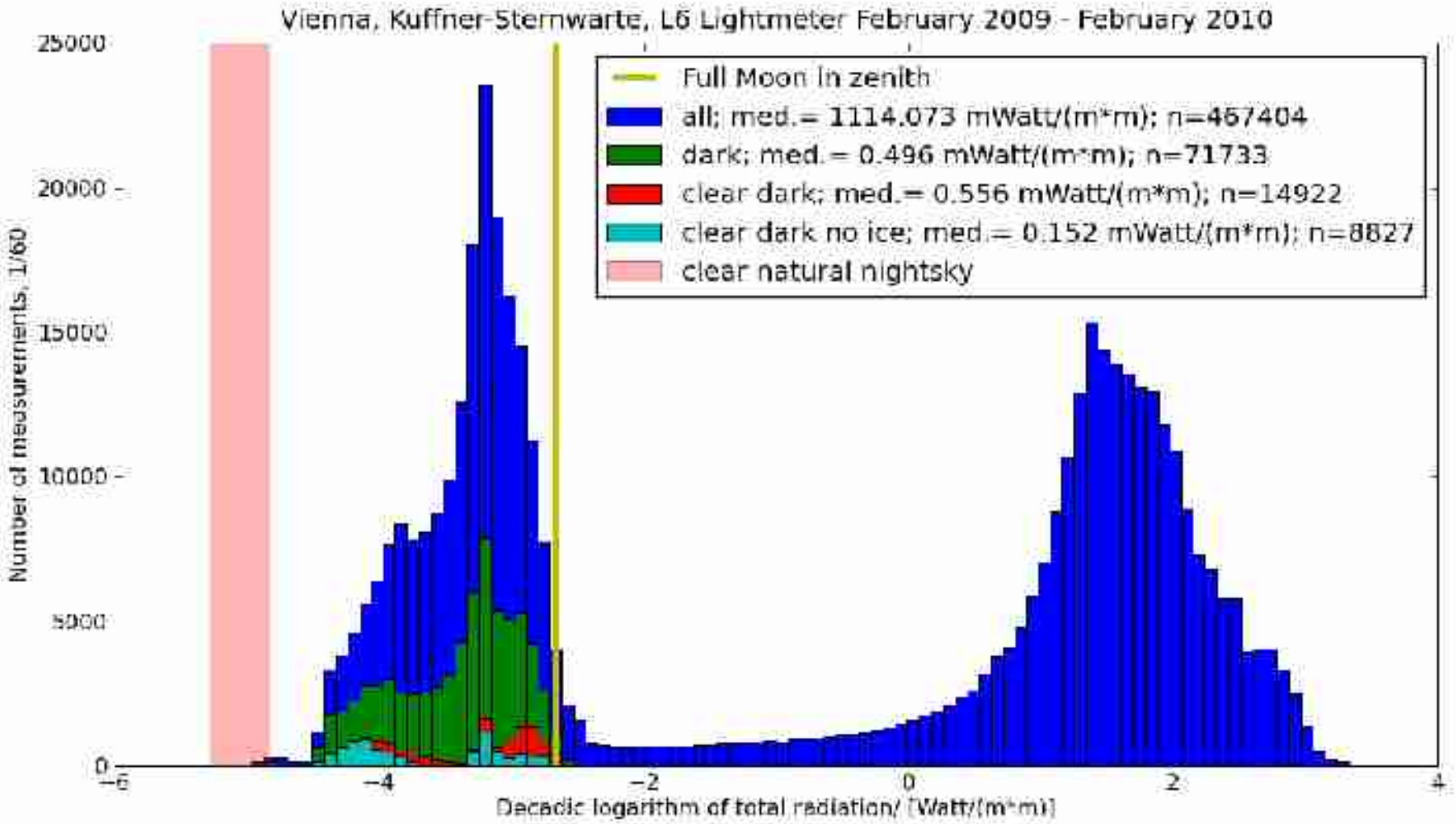


AEC from Schlossberg, 31. Aug.

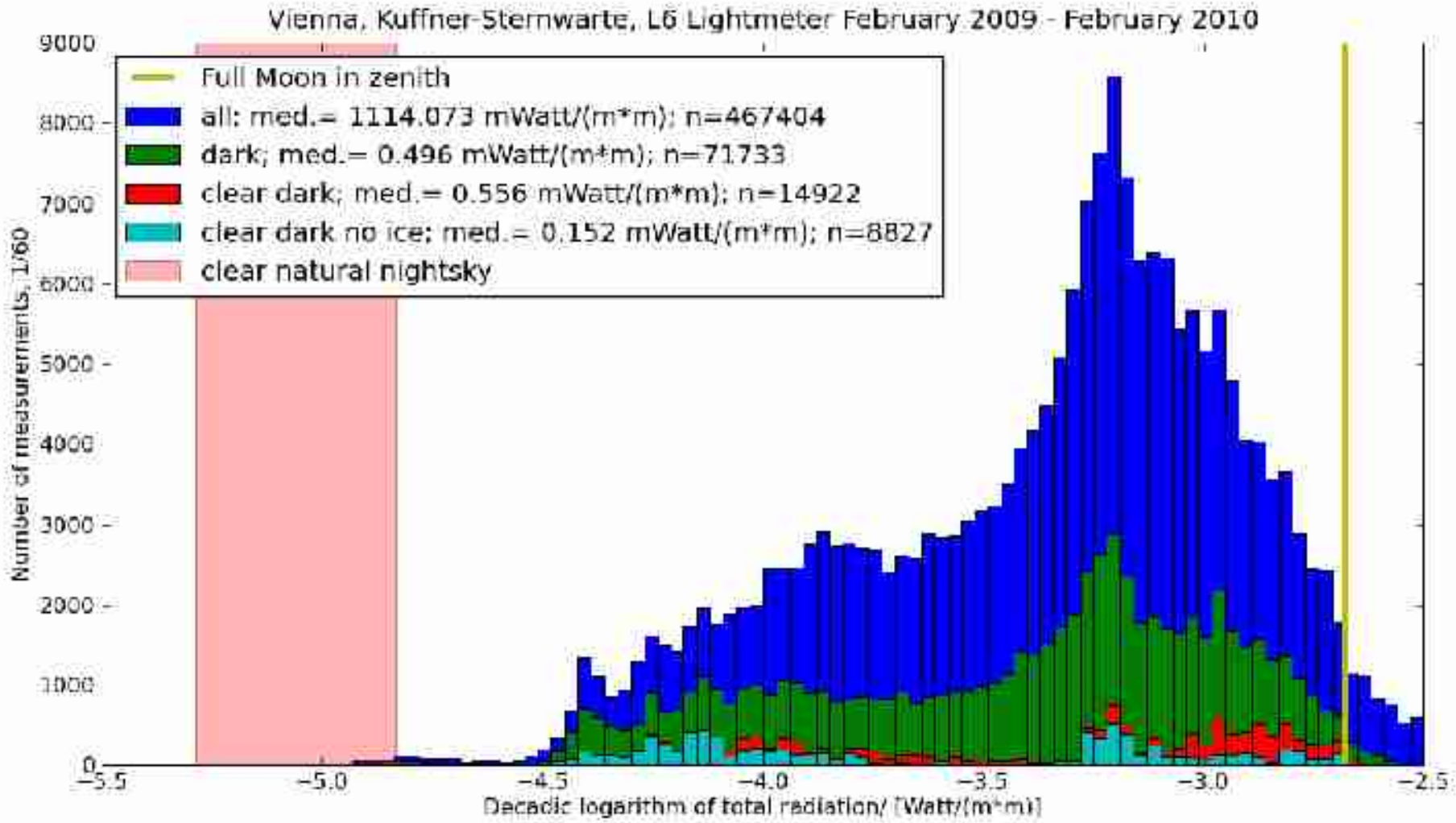



Cinzano et al.: The first World Atlas of the artifical night sky brightness, MNRAS 2001
Kuffner-Observatory
Vienna

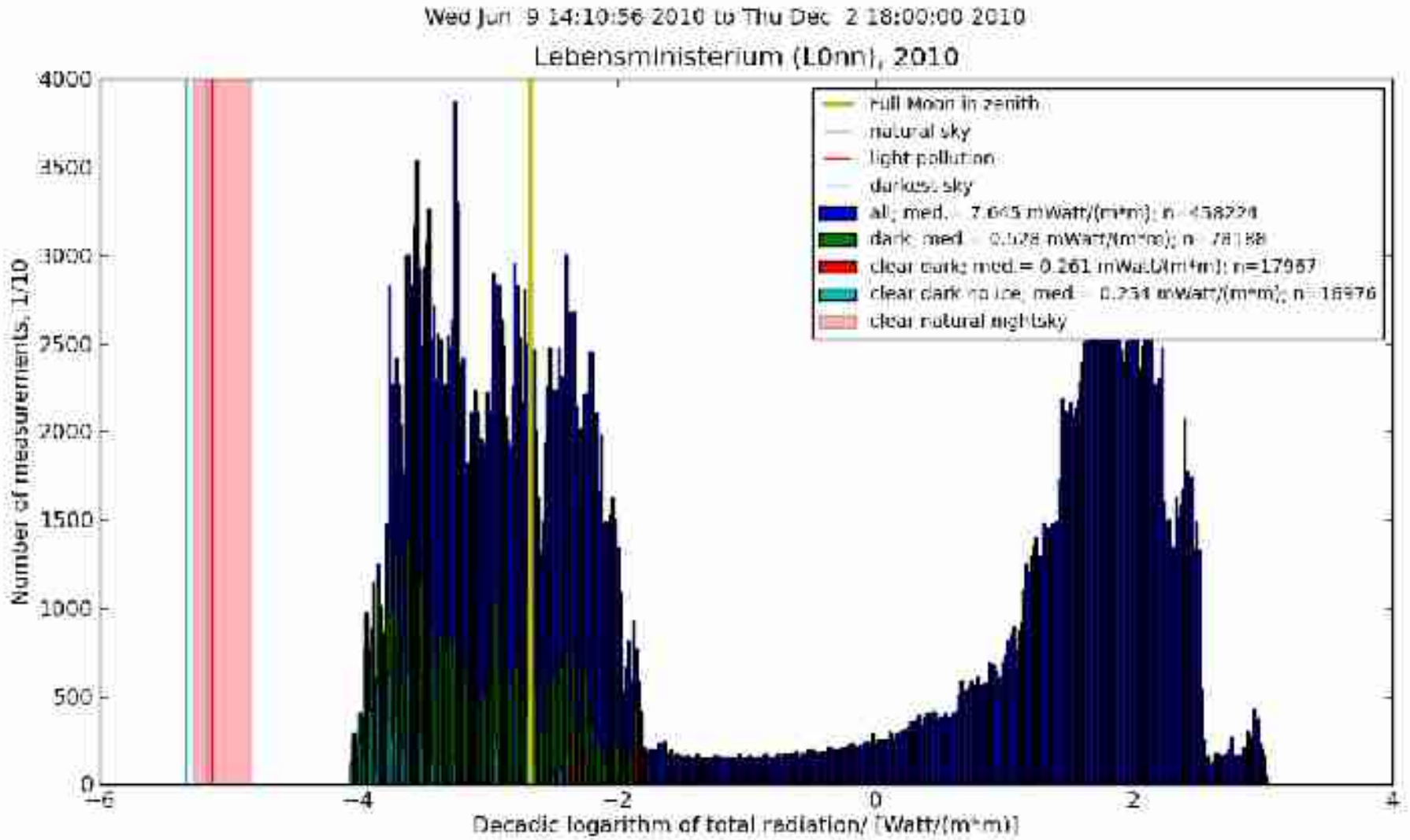
Kuffner-Observatory / Vienna 2009

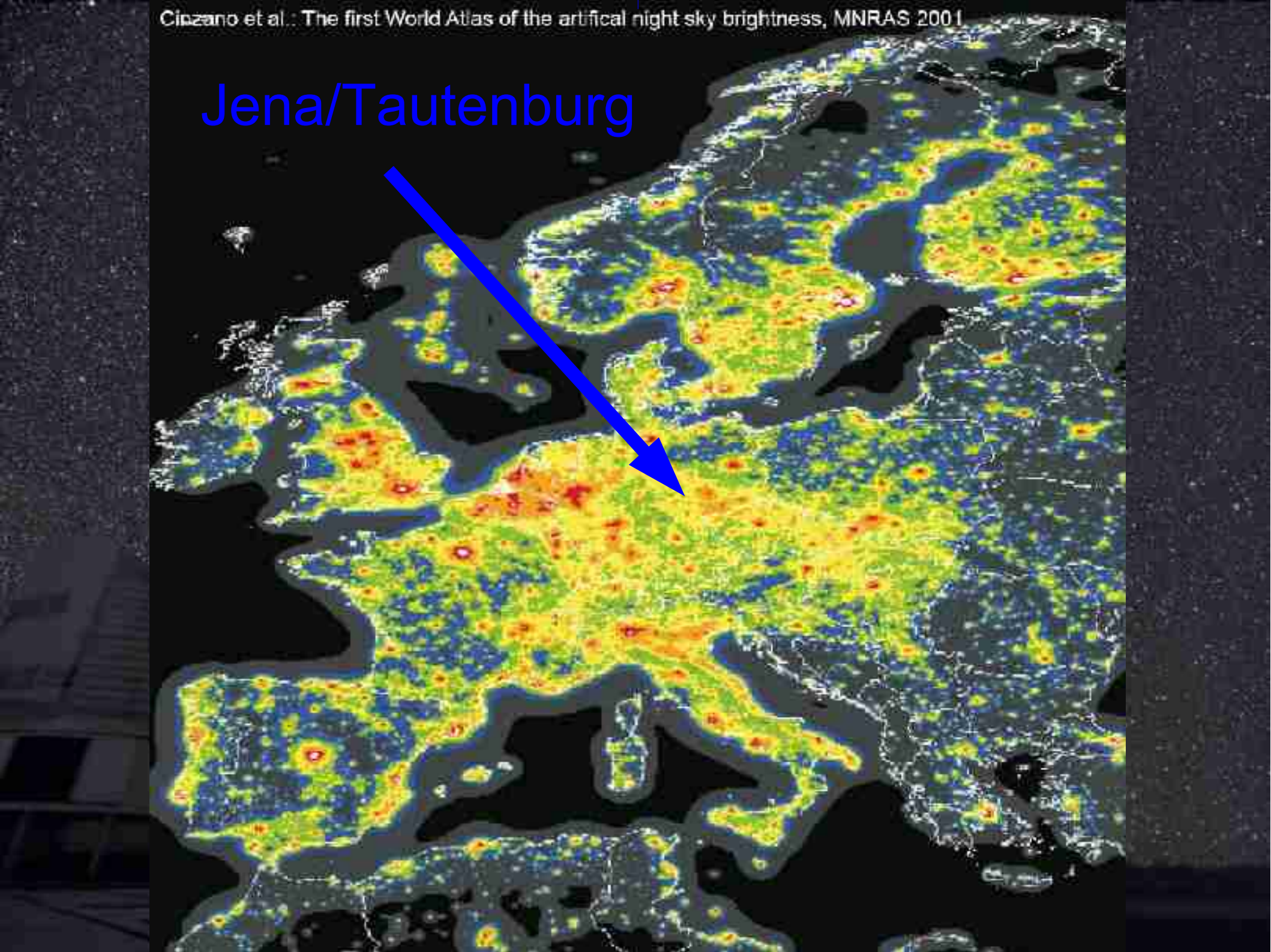


Kuffner-Observatory / Vienna 2009

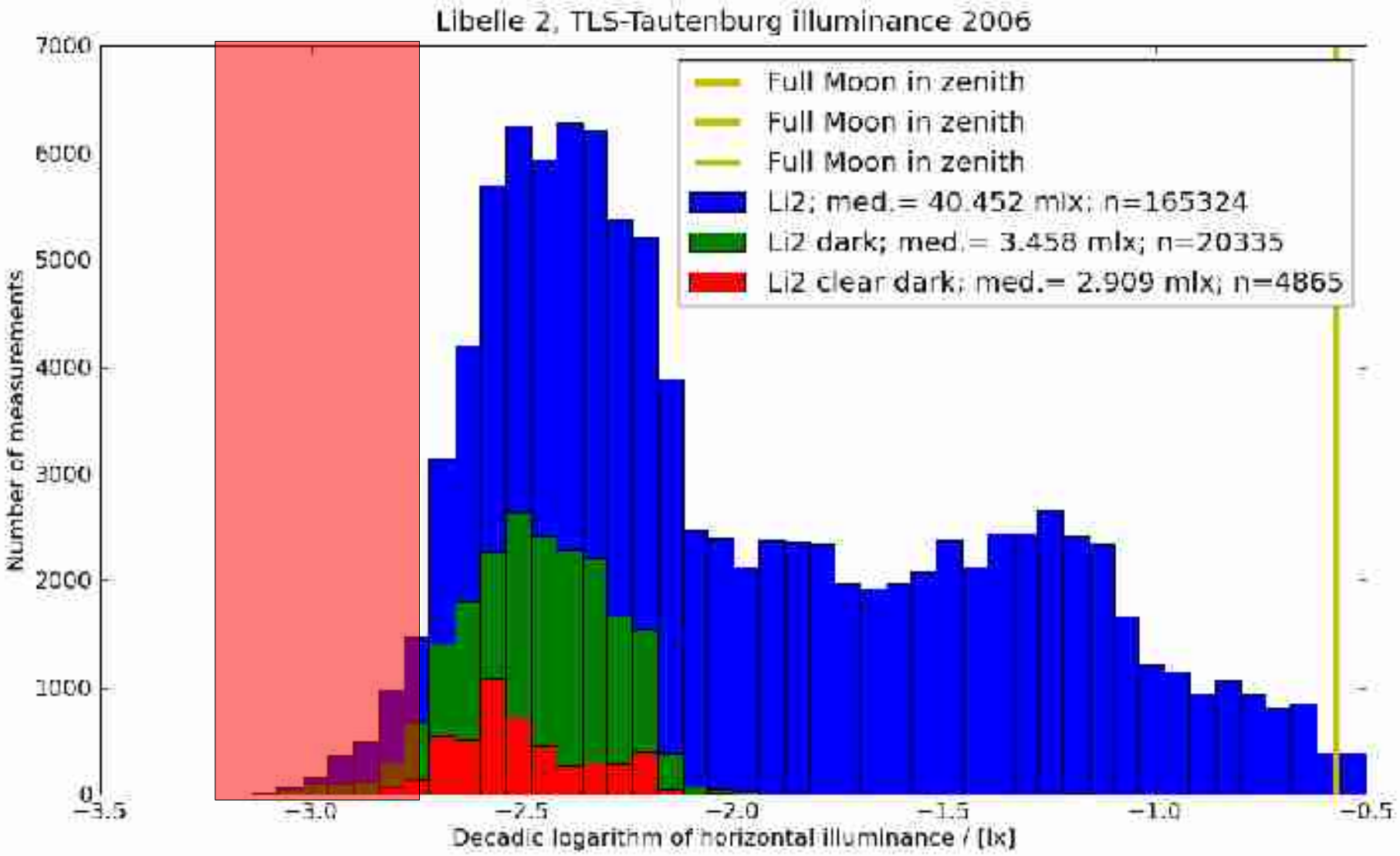


Vienna Centre

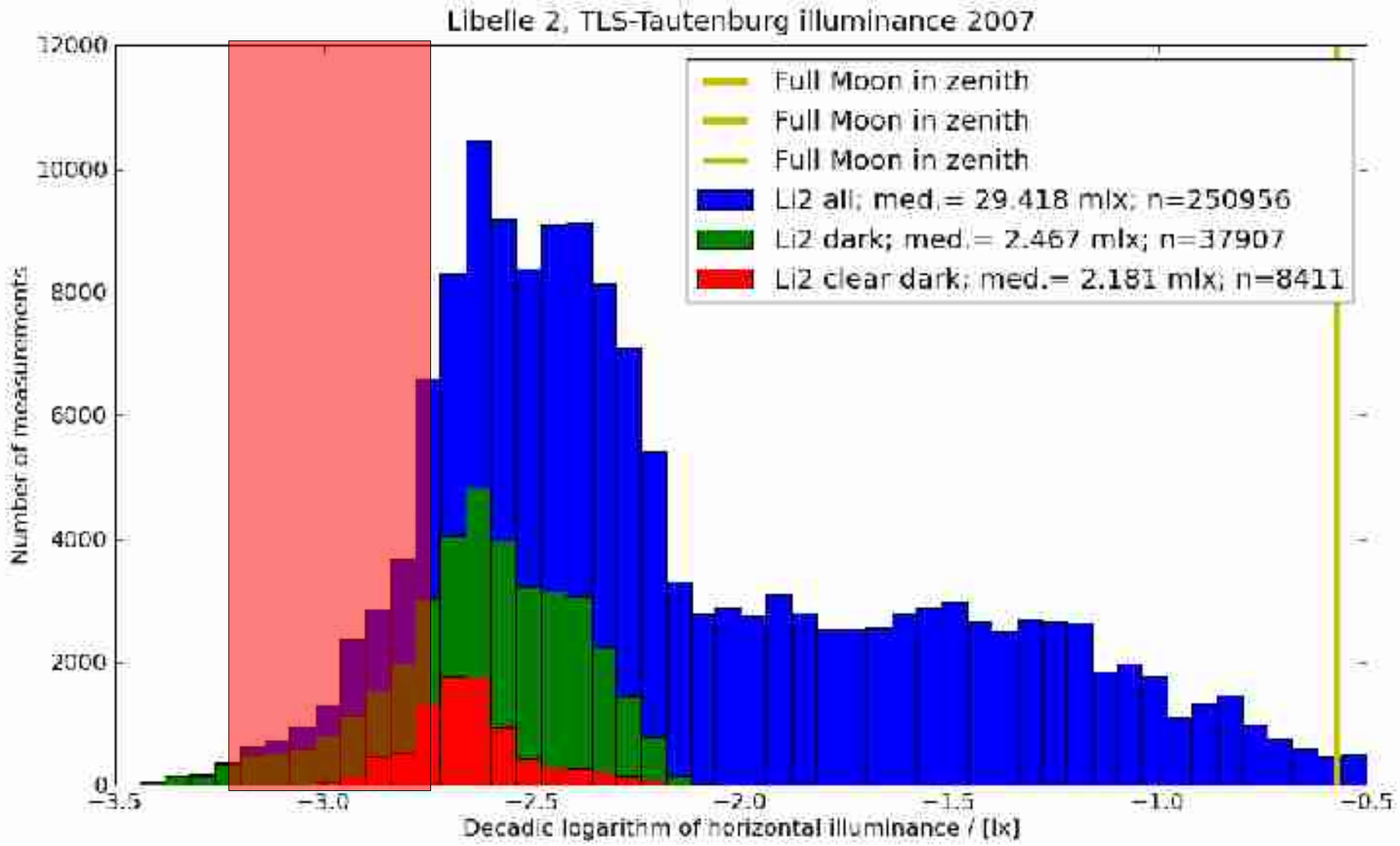



Cinzano et al.: The first World Atlas of the artifical night sky brightness, MNRAS 2001
Jena/Tautenburg

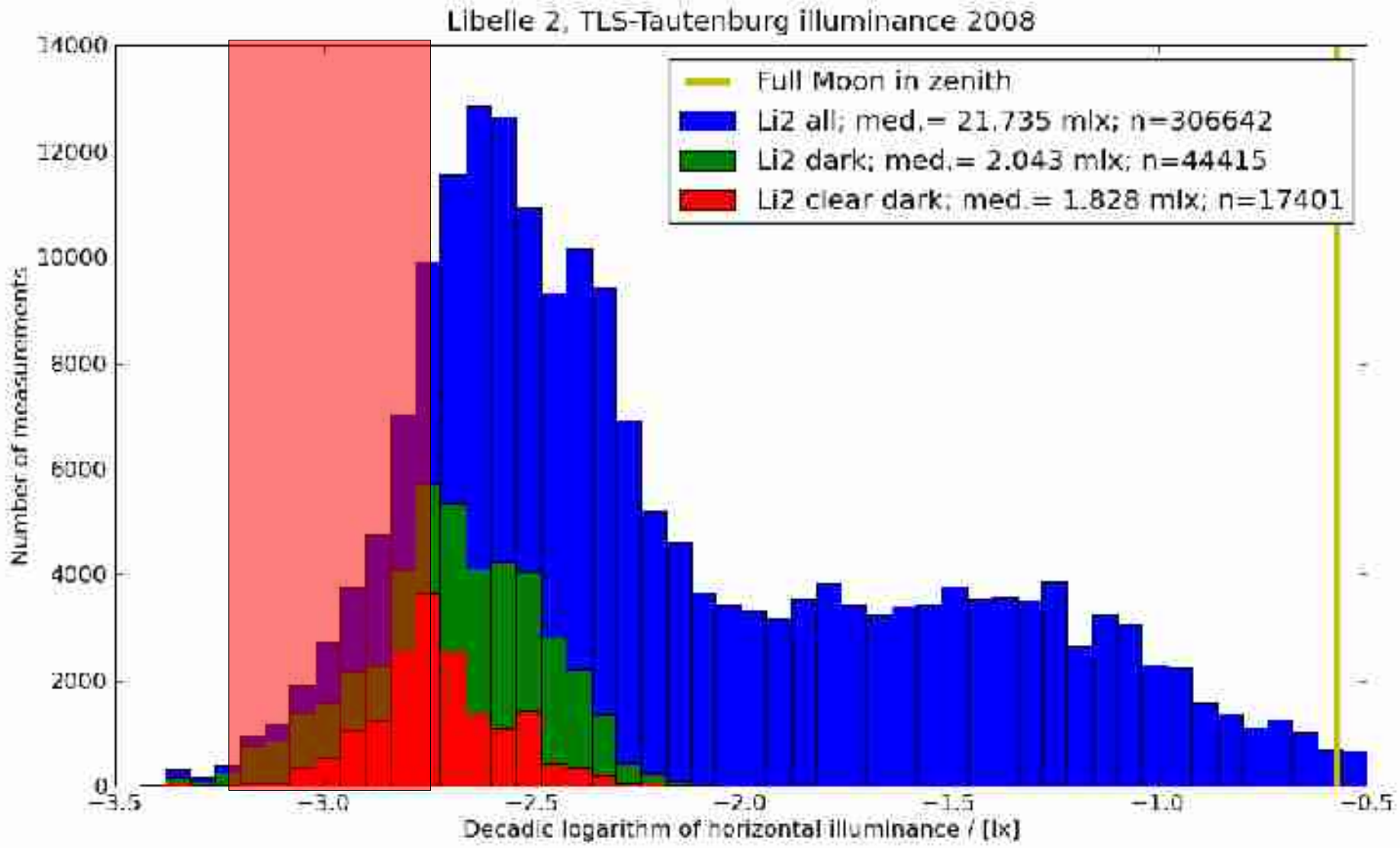
Tautenburg 2006



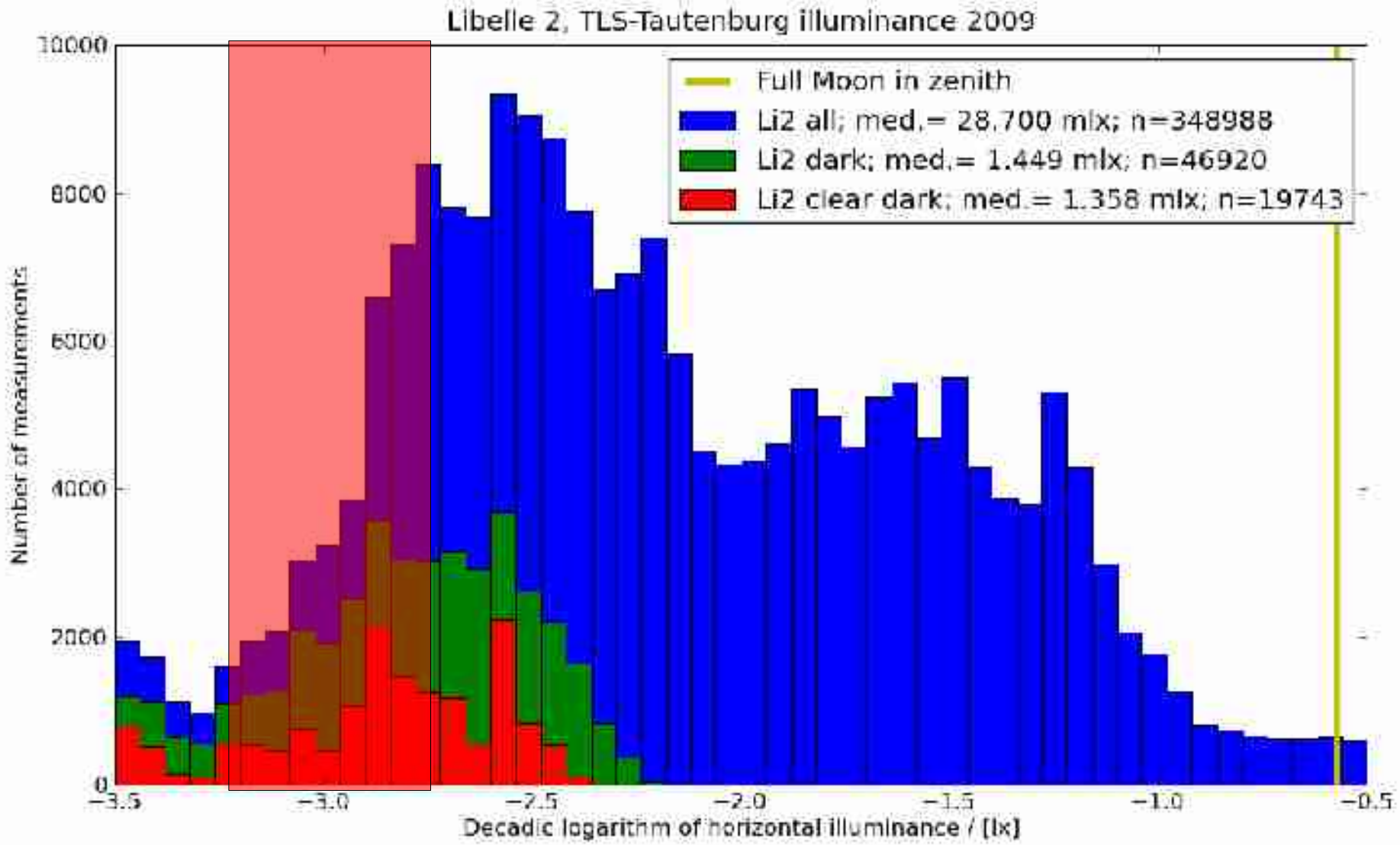
Tautenburg 2007



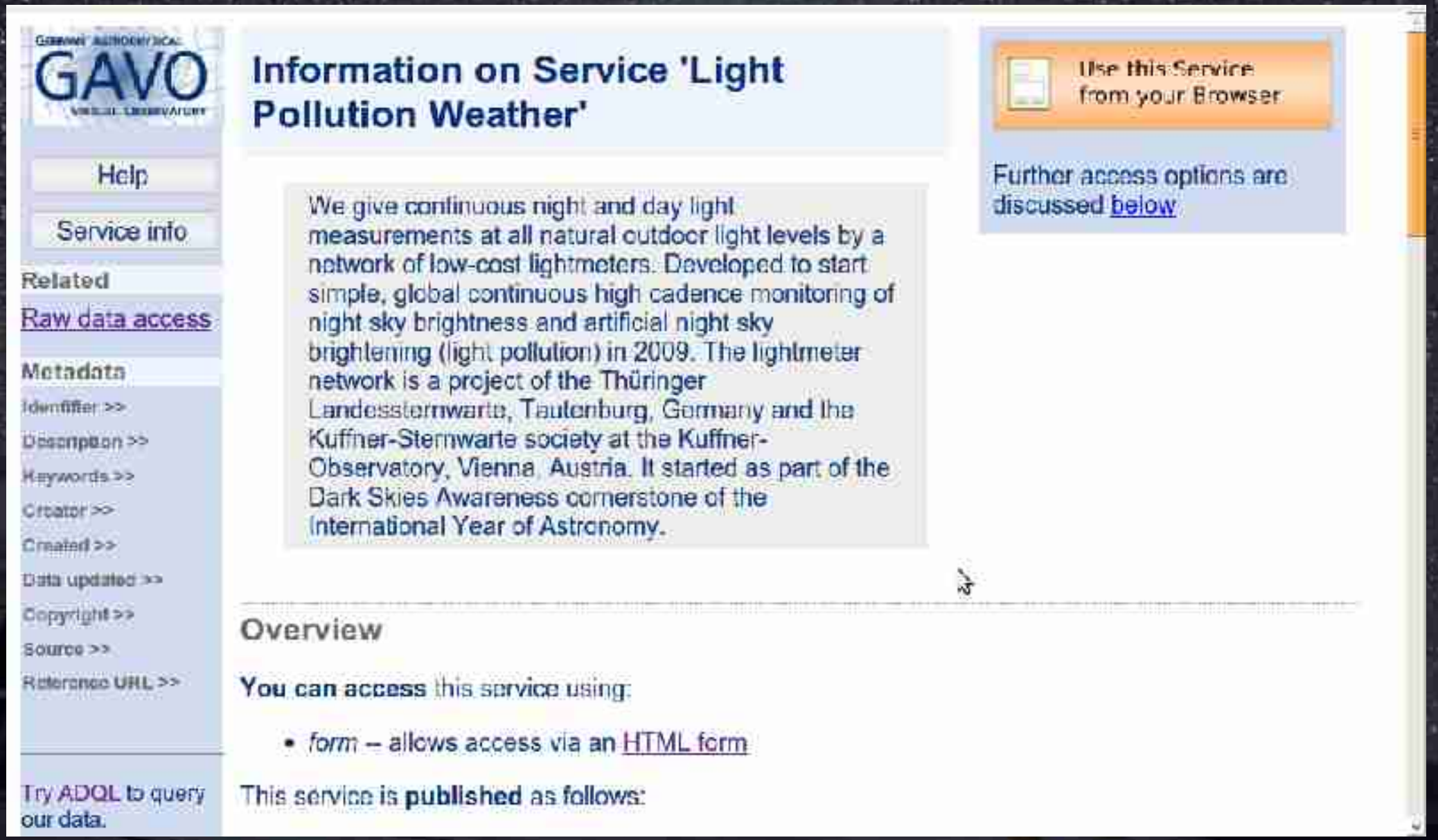
Tautenburg 2008



Tautenburg 2009



Lightmeter Datacenter at GAVO
http://vo.uni-hd.de/lightweather



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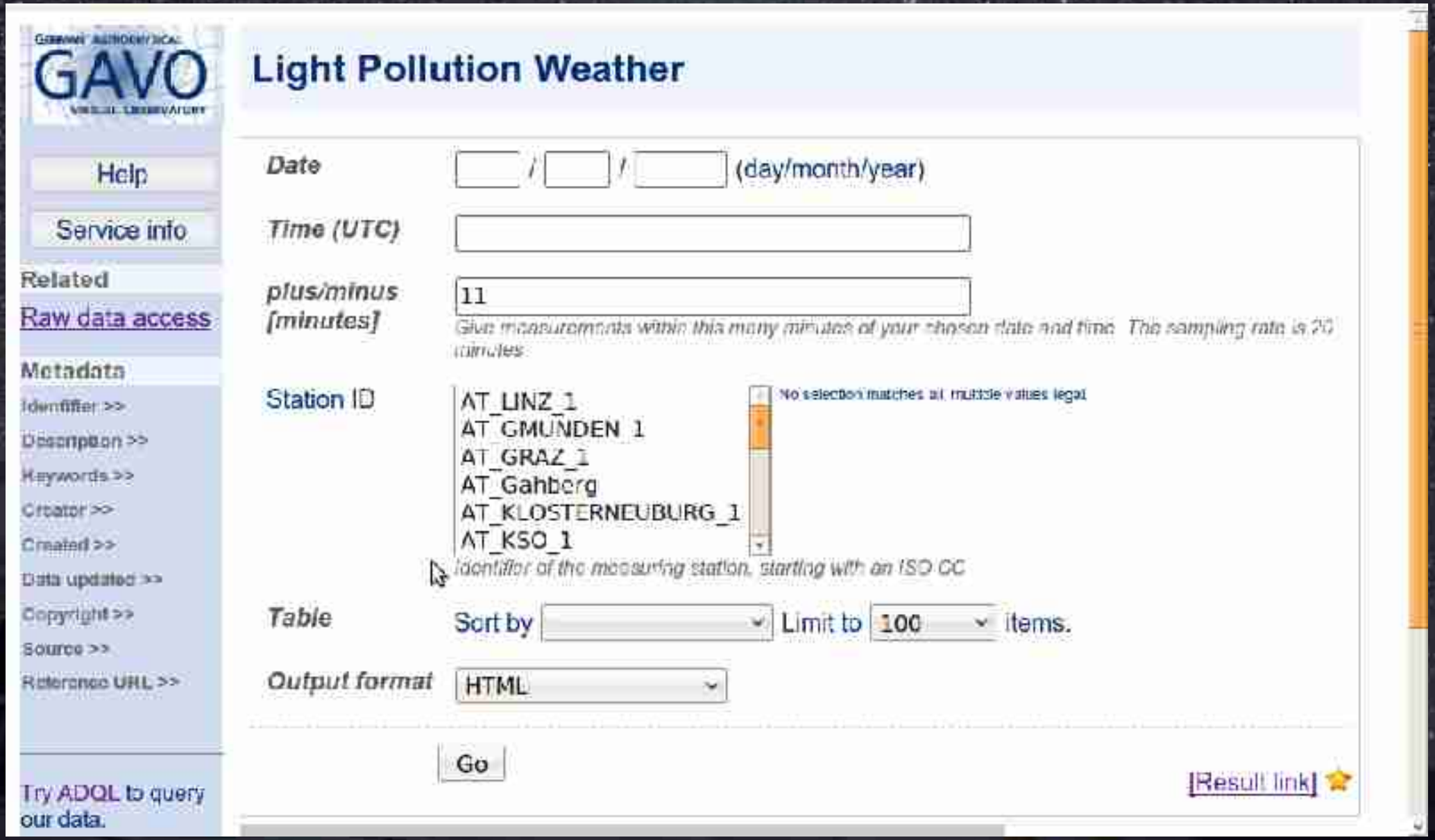


Feed the database!

Instructions for set-up
http://lightmeter.astronomy2009.at

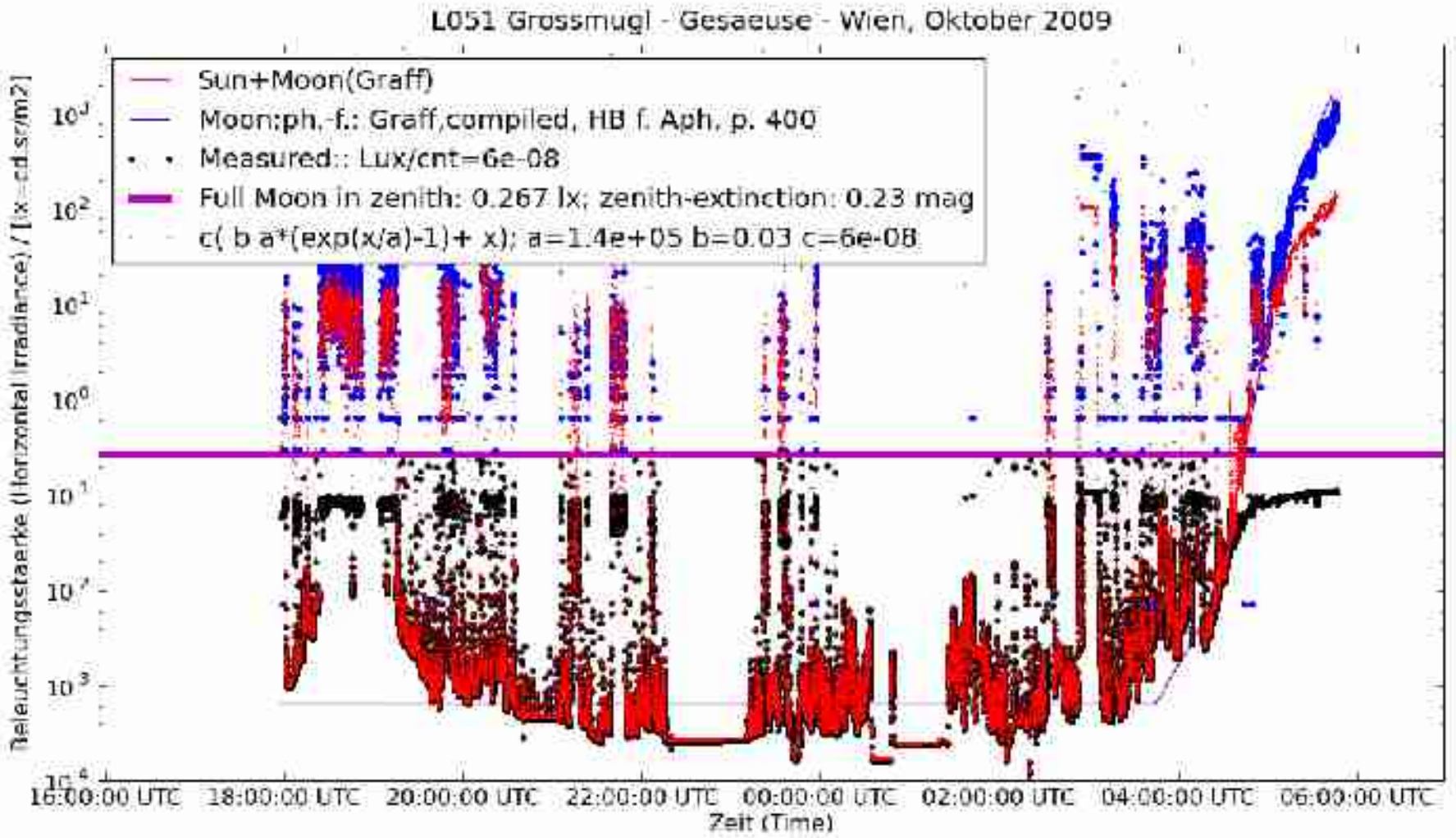
Lightmeter requests and wiki-UID

lightmeter@astronomy2009.at

One of many uses: calibrate the satellites...


In search of Alpine starlight

In search for Alpine Starlight



Starshine mapping: Gesäuse

Admonter Kalbling, 2196m at Moonset – Gesäuse National Park
Thomas Posch

Orion drowning in stars – Gesäuse National Park
Markus Reithofer

Mountains in starlight – Gesäuse National Park, Austria – Andreas Trawöger

Visual Limiting Magnitude | Luminous intensity (radiance) | Illumination | Energy Flux Density

IMO | HMS | GaN | GWWSC | mag/arcsec² | cd/m² | Lux | Watt/m²

Conclusion: How to keep it deep

- Monitor your home-sky with a lightmeter
- Find and protect a starlight reserve near you
- Create a starlight oasis near the people
- Reconnect people to the firmament and nightscape
- Find the artistic means for it

How many stars can we still see?

http://starlit.astronomy2009.at

- always and everywhere
- worldwide applicability
- by Orion and UMi
- many languages -

create your own access

- same method for 10 years, 2001 -2010 ...
- real-time result maps
- SQM and lightmeter integration
- time and weather anchor by lightmeter network

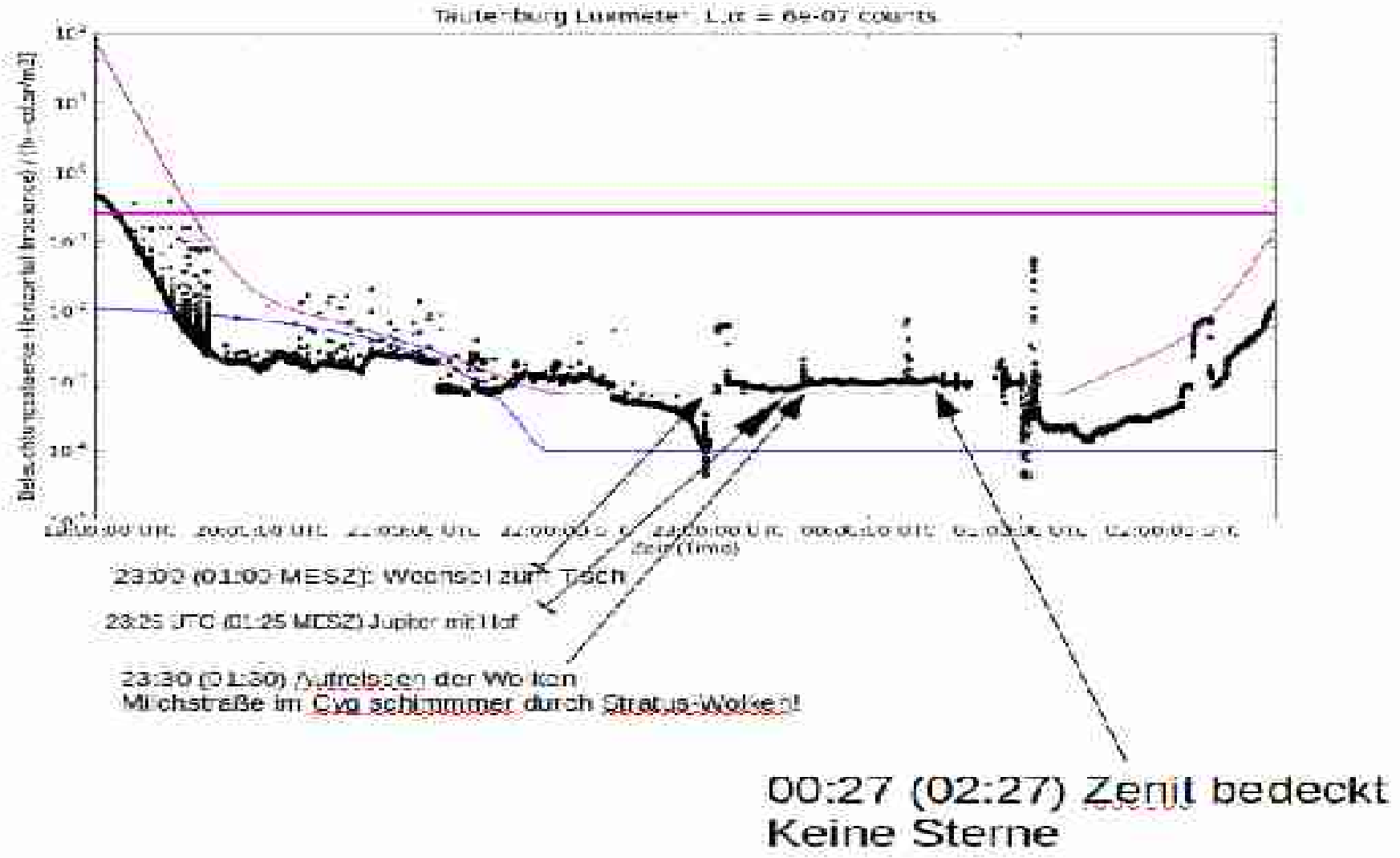
Calibration
always and everywhere

- ~~*Simultaneous measurements with other instruments (Luxmeter, SQM)*~~
- ~~*Daylight-Sensor (Mark 2.3 IYA-Lightmeter)*~~
- Sun
- Twilight
- Moon (less available; use for checks)

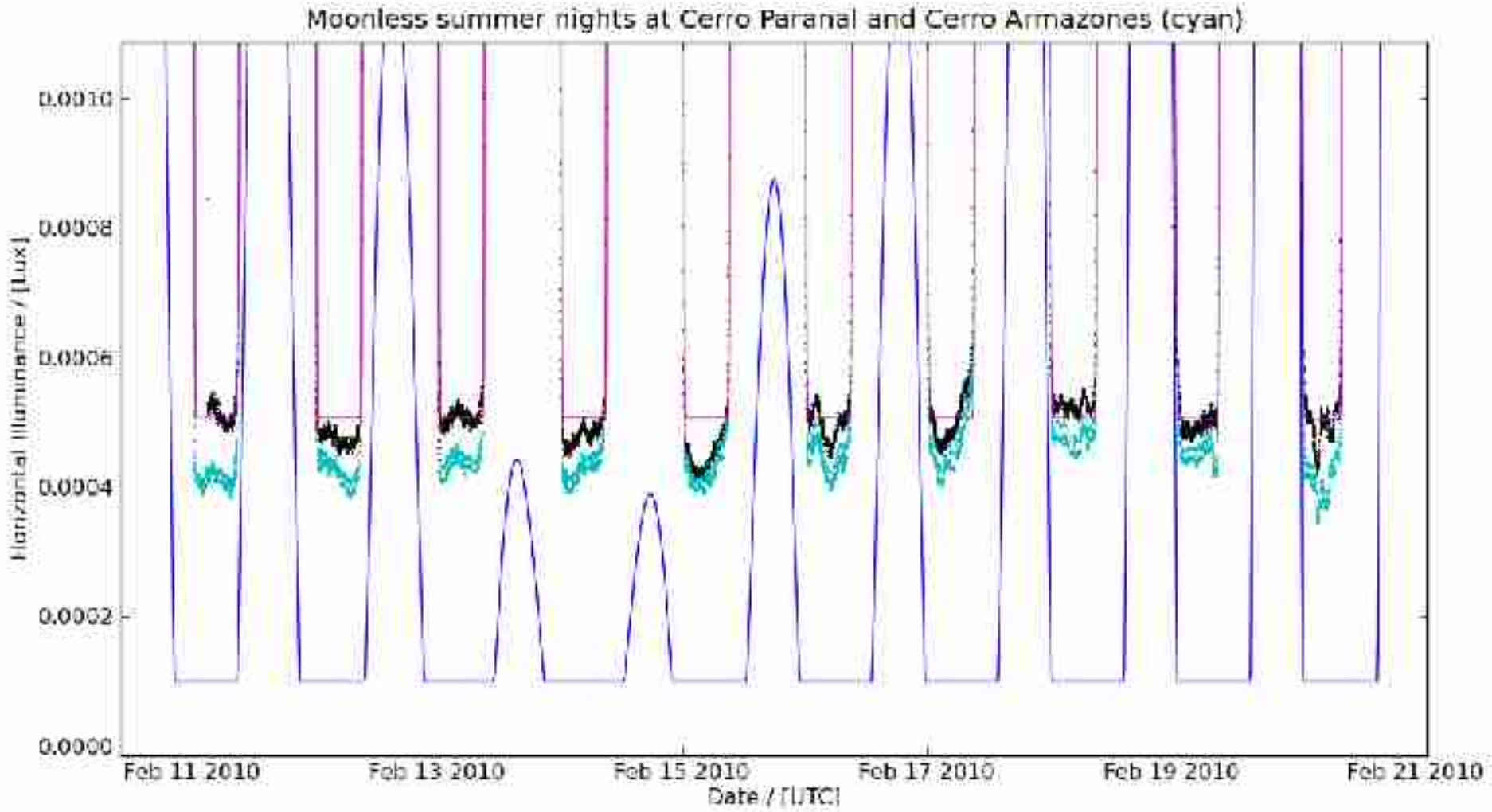
Milky way during the nautical twilight with the Moon rising, A. Trawöger

When brighter is better

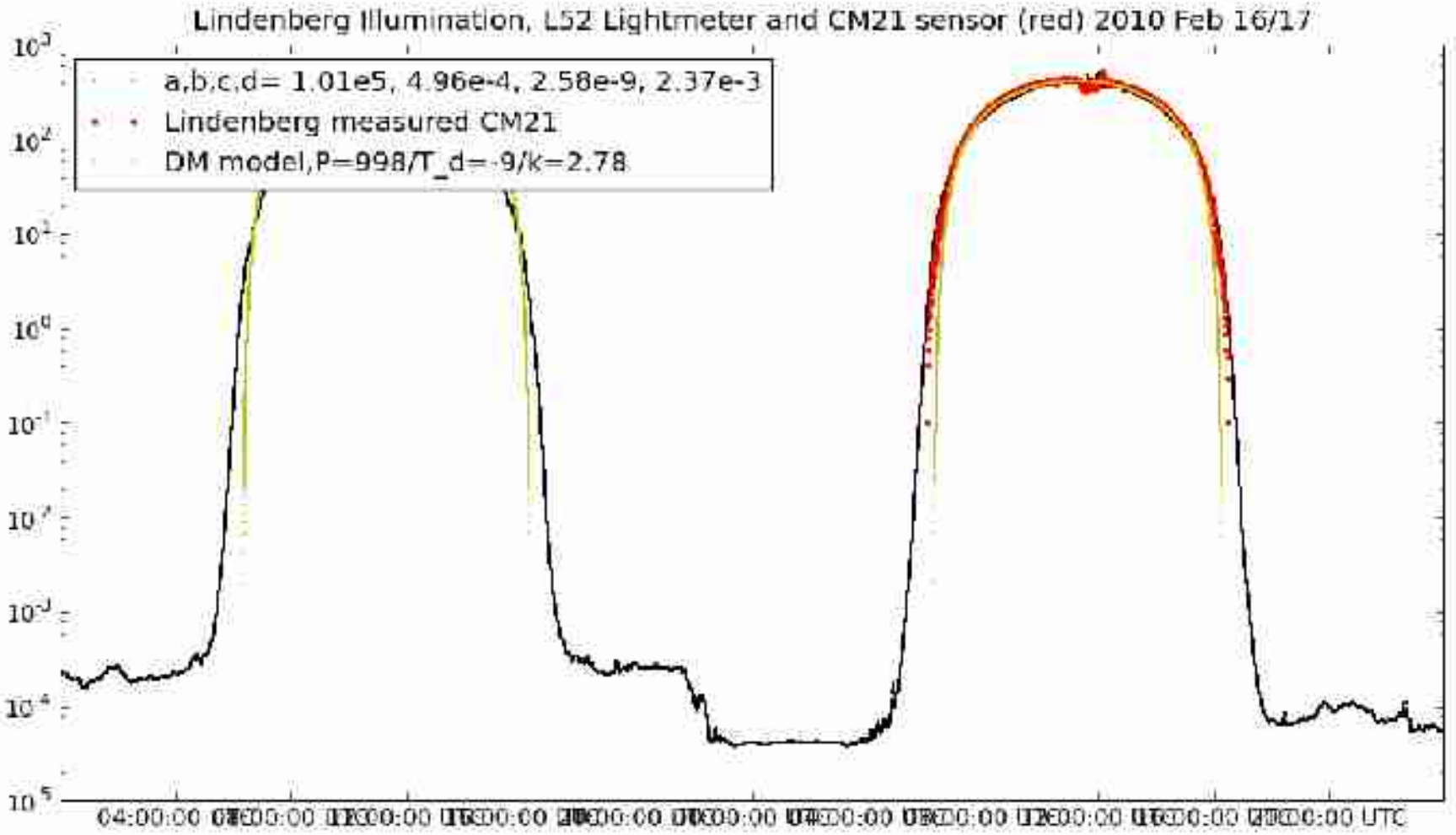
Life is not always sunshine ...



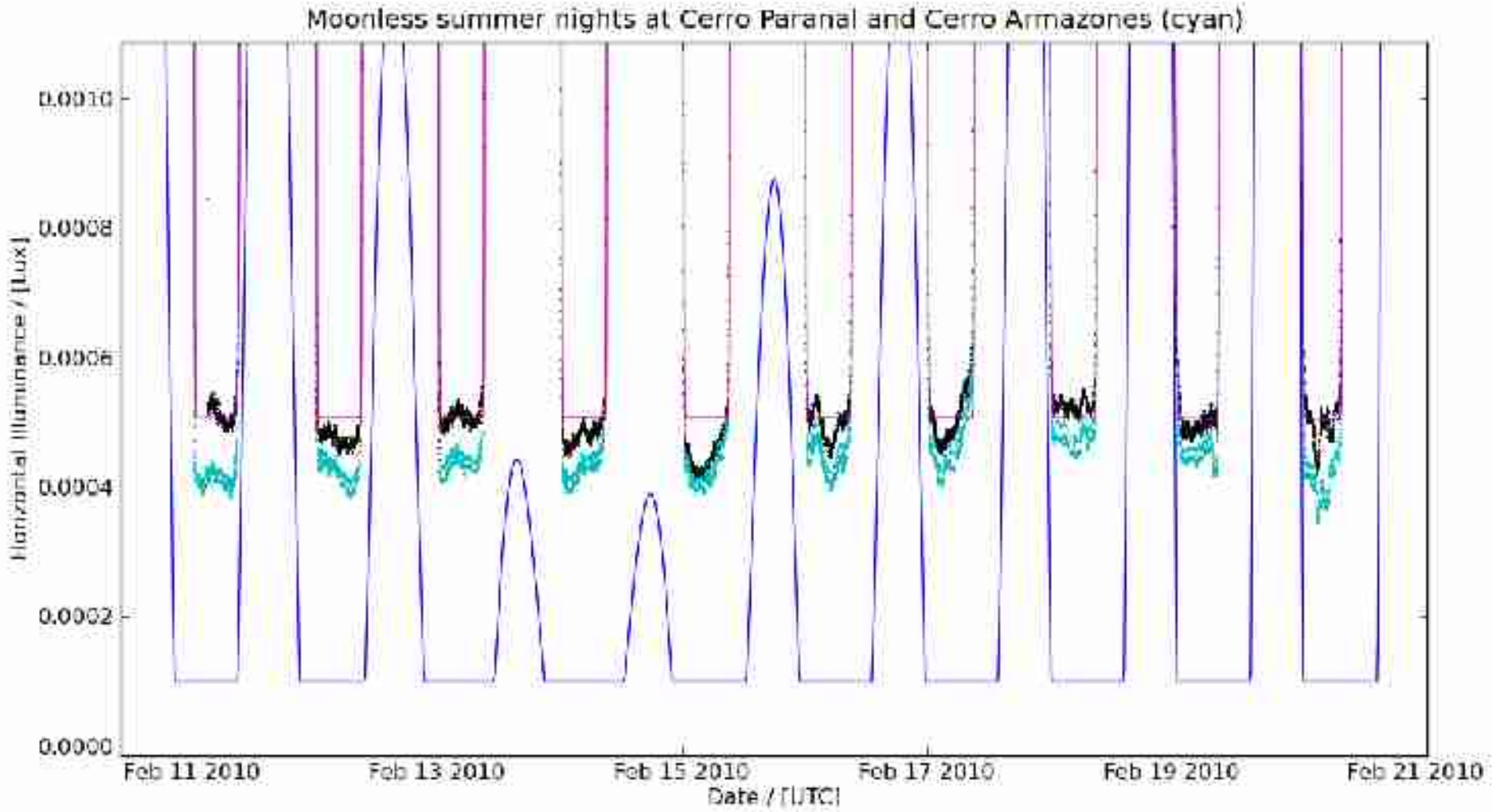
Micro-Lux at Atacama



Check with total-rad. measurements



Micro-Lux at Atacama



Check with total-rad. measurements

At your local weather station!