

# Monitoring the Sky with the IYA lightmeter network

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# 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

Change Area: Europe Sky conditions: all Since: 2000 Note: < 2006 takes time. Until: 2011

Visual:  SQM:  SQM-L:

Sky condition colours: 1, no stars. 2, very bad, 3, bad, 4, moderate, 5, good, 6, very good, 7, natural sky;

# Why a Lightmeter?

- Snapshot vs. Monitor --- light-weather vs. light climate
- Quantify night brightness as environmental factor
- Building an network fast ---> low cost (100 €) + existing technology (Windows/Linux system)
- Easy to use long-term continuous monitor
- Long term comparability

# Lightmeter

- Mark 2.3: August 2009 – IYA-Lightmeter
  - amorphous Si solar cell
  - USB-connection
  - daylight part non-linear (from full moon)
  - 1 Hz (up to 2 kHz with the linux-version)
  - extra pre-calibrated day-sensor 1 lx to 60 klx
  - non-linearity from 0.1 lx (Moon!)
  - detection limit a few micro lx (single stars)

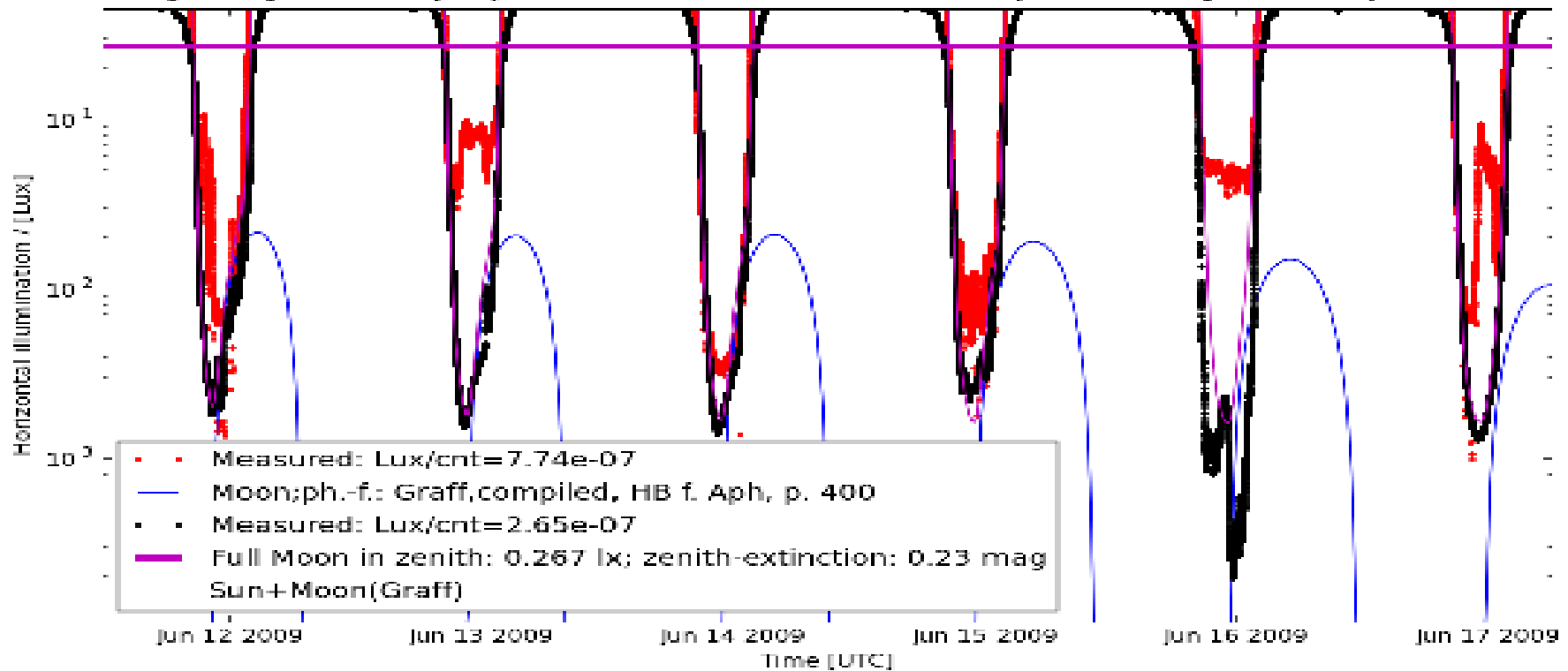
New Lightmeter Mark 2.3 pro: less latency, linear to 10 Lux, lower noise amplifier

# Lightmeter: simple, continuous sky-monitoring



How many stars can we still see? - Year of Astronomy Lightmeter Network

Night brightness: city sky (Berlin in red) and near natural sky (Tautenburg in black), June 2009



# 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)

# Watt Quantity?

- Magnitudes per area – magnitudes (which magnitudes?)
- Illumination - Lux
- Energy flux-density –  $\text{Watt/m}^2$

# 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)**

→ Do it at night and keep the  $\text{Watt/m}^2$  – but how?

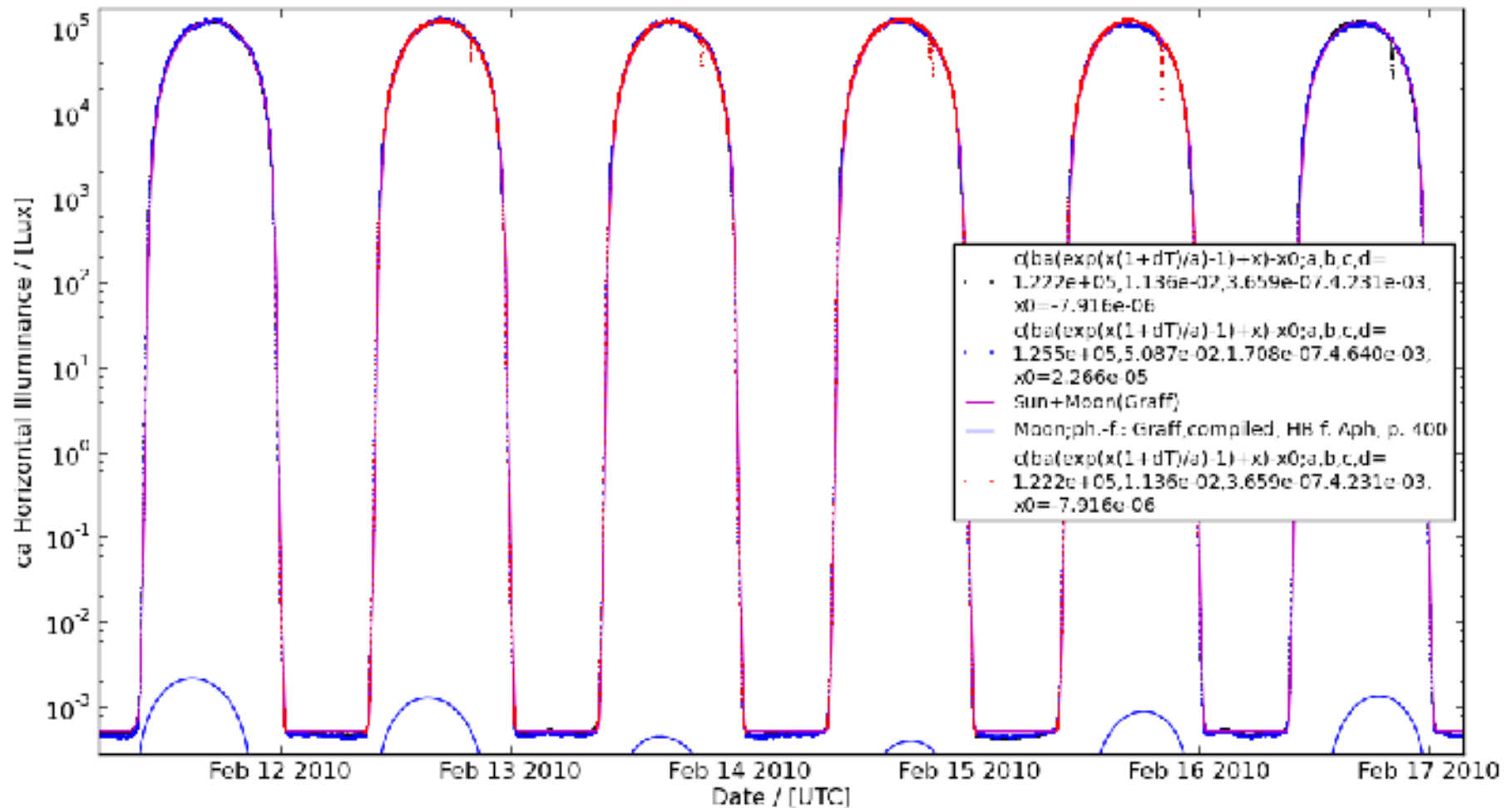


# Calibrating the lightmeter network

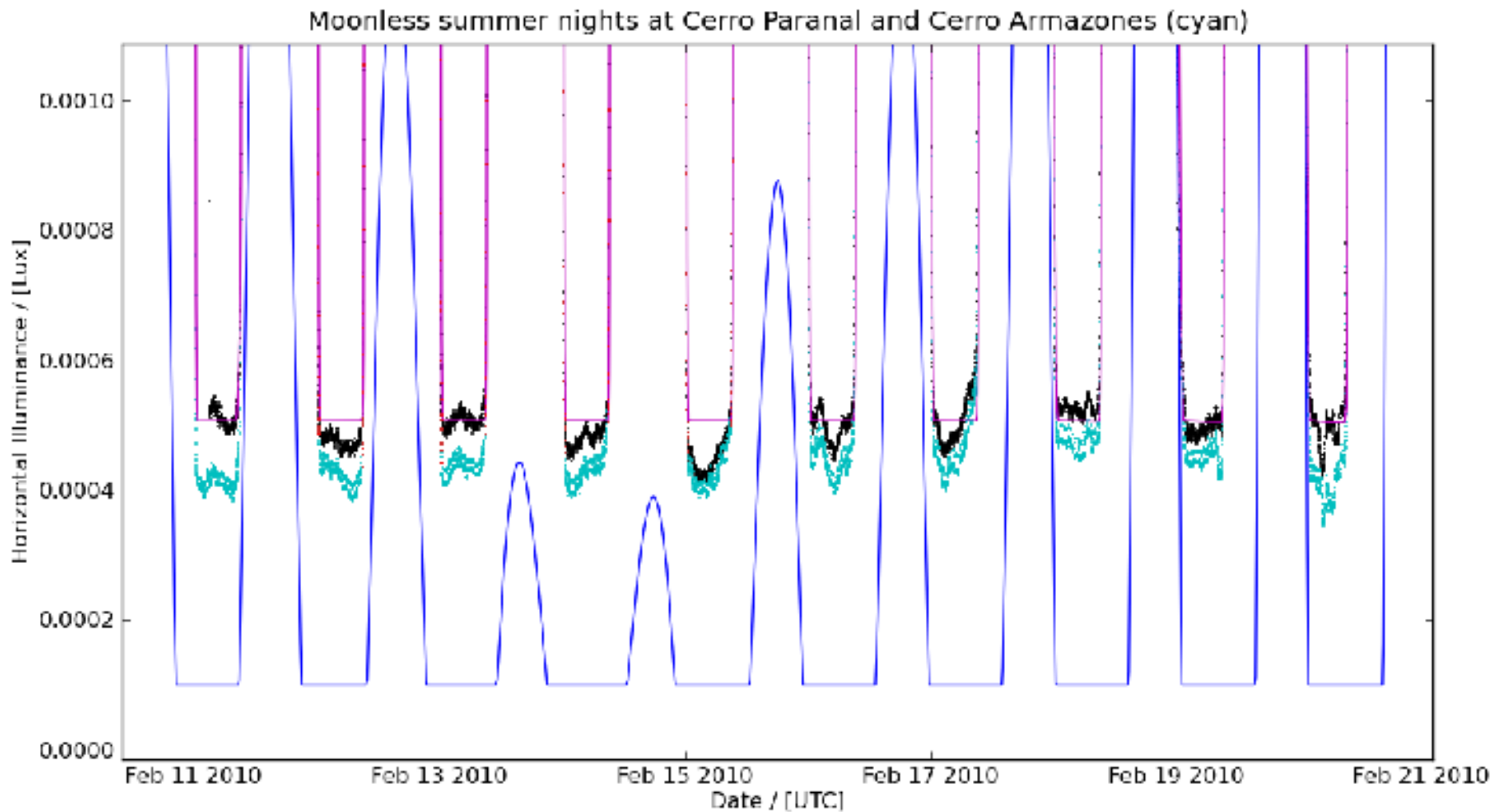


# Atacama summer nights Feb 2009

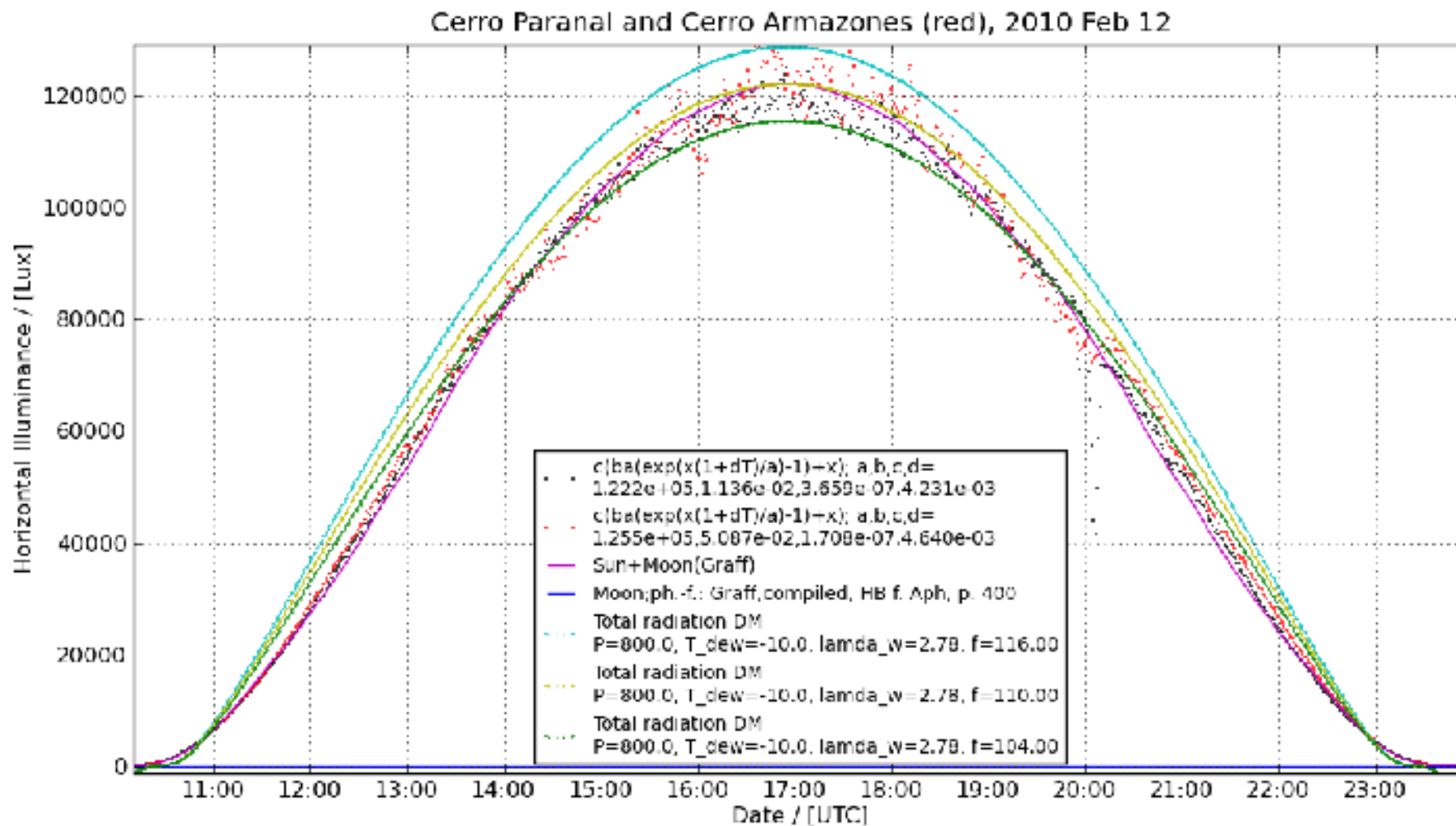
Moonless summer nights at Cerro Paranal and Cerro Armazones



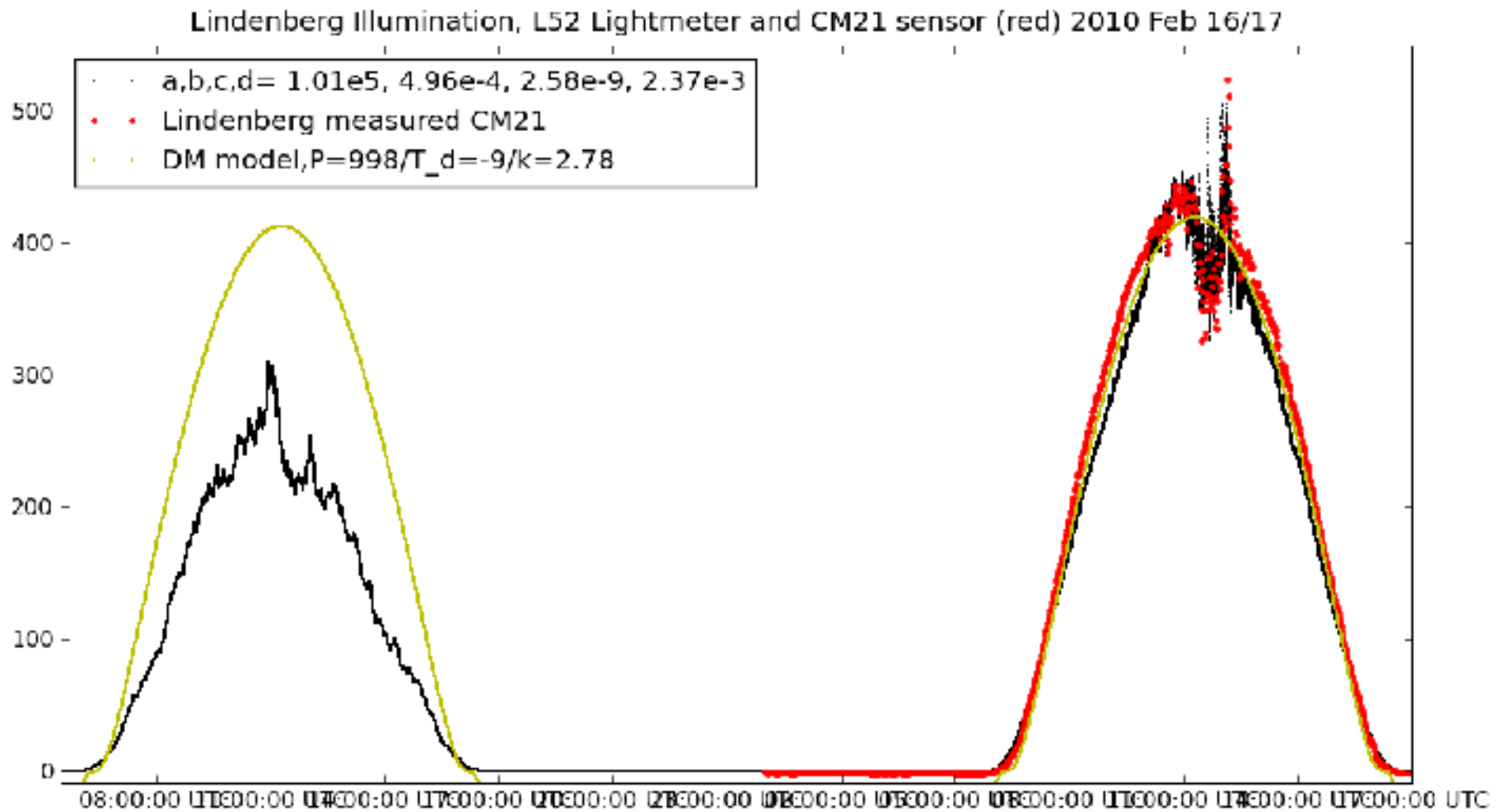
# Micro-Lux at Atacama



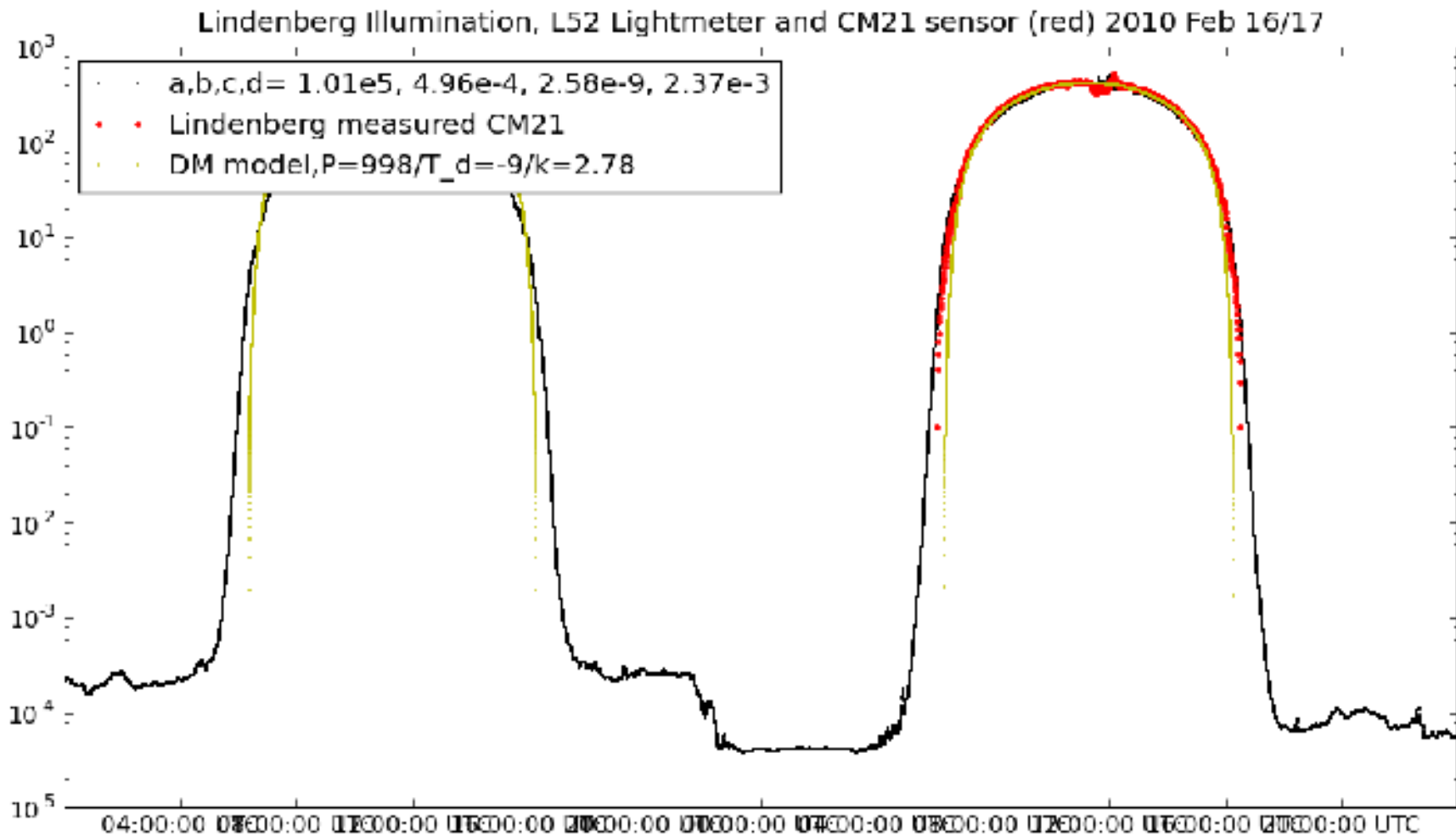
# Atacama - total radiation - W/m<sup>2</sup>




# Check with total-rad. measurements



# Check with total-rad. measurements

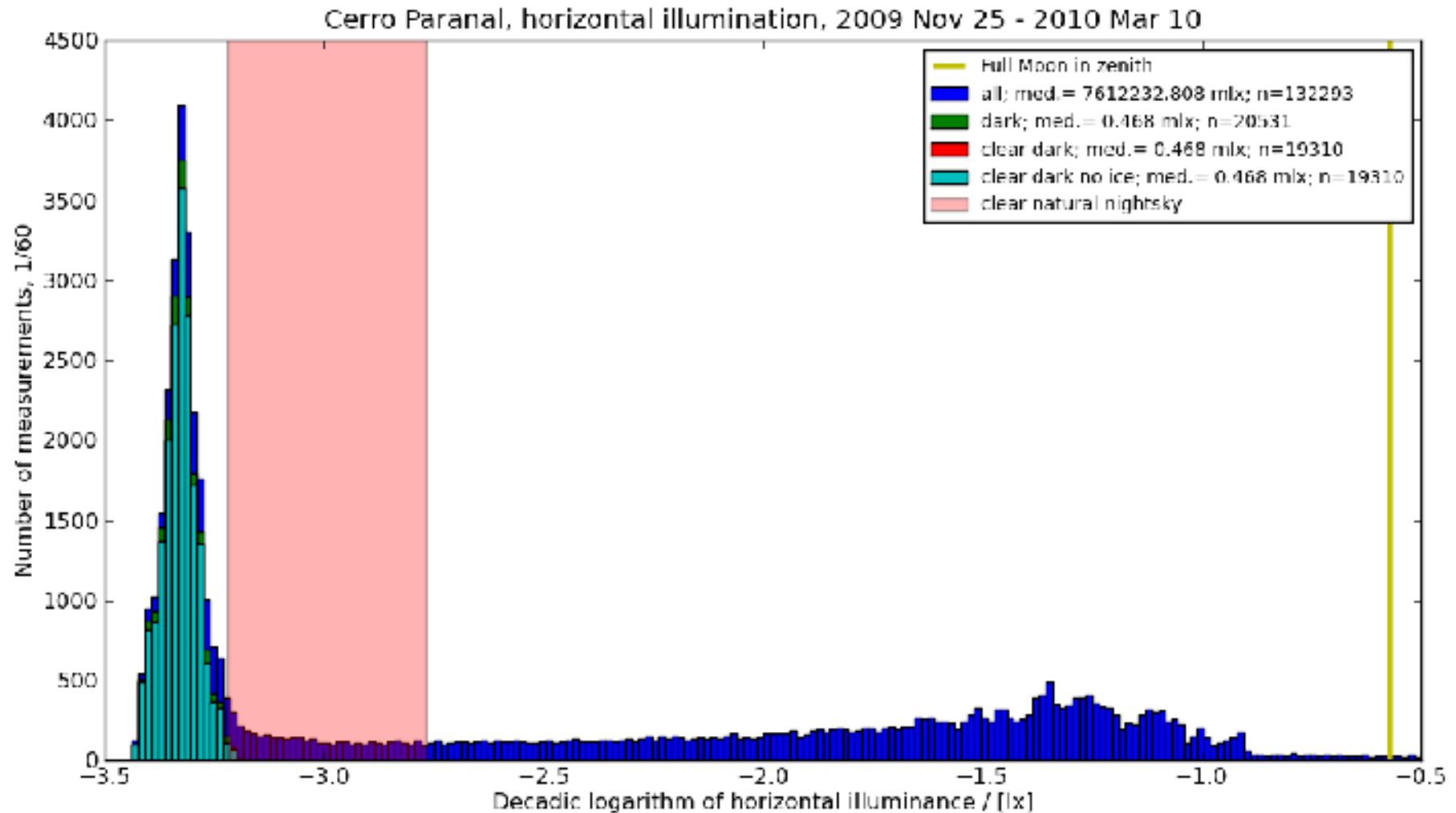




Results from the  
International Year of Astronomy  
Lightmeter Network

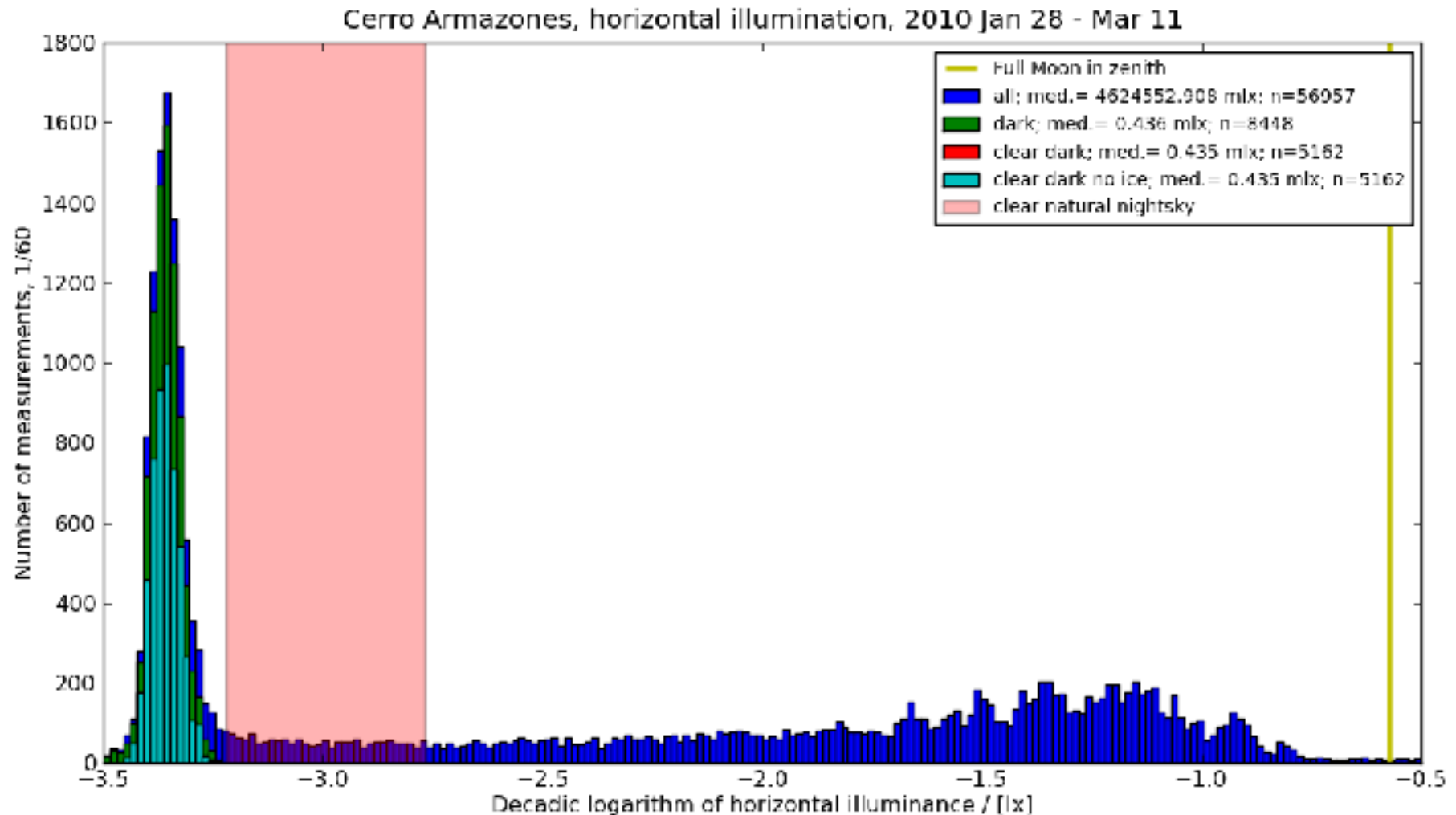
<http://lightmeter.astronomy2009.at>

# Paranal 2009 / 2010

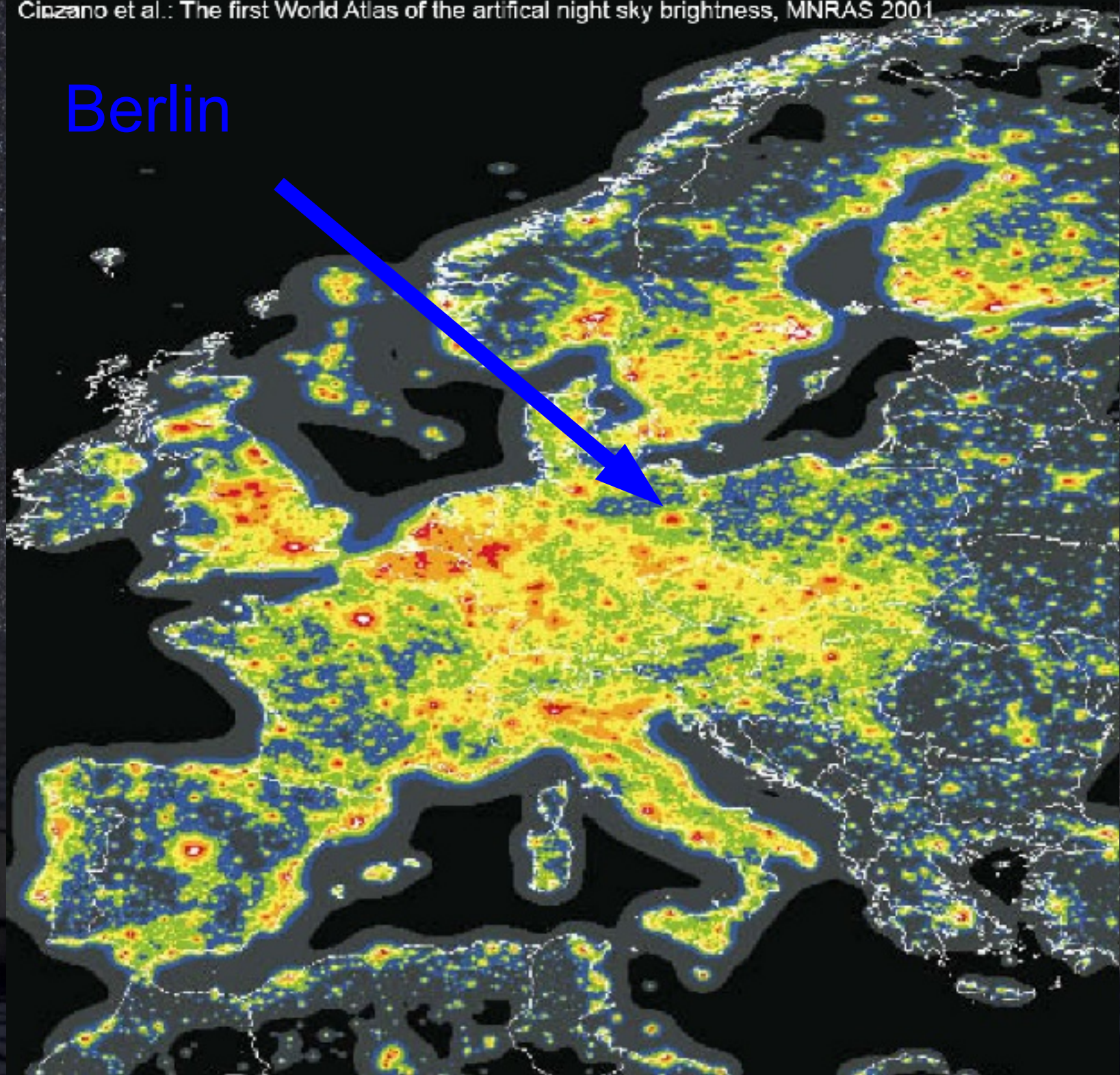




# Cerro Armazones Feb 2010



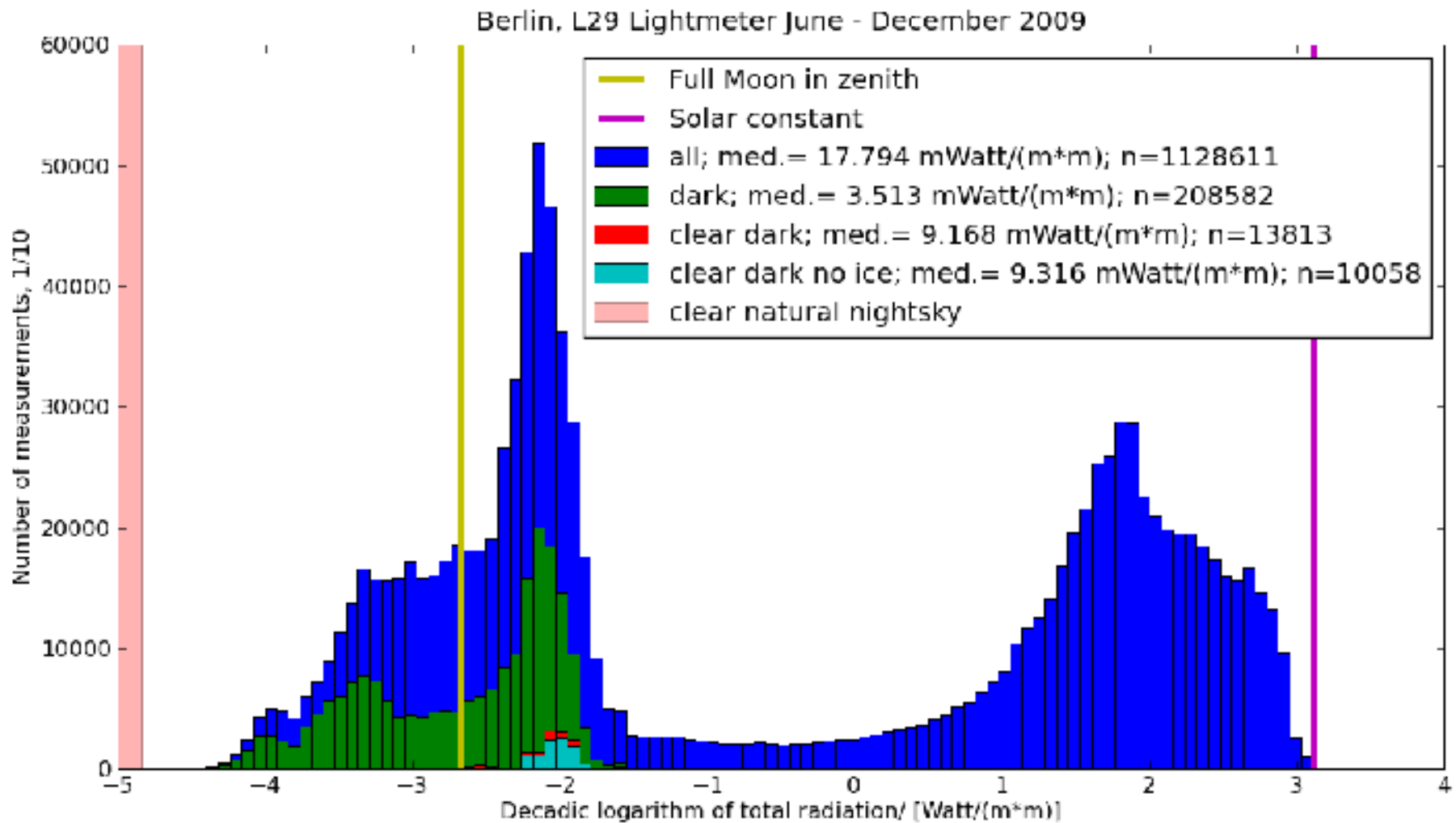
Berlin



# Berlin - centre



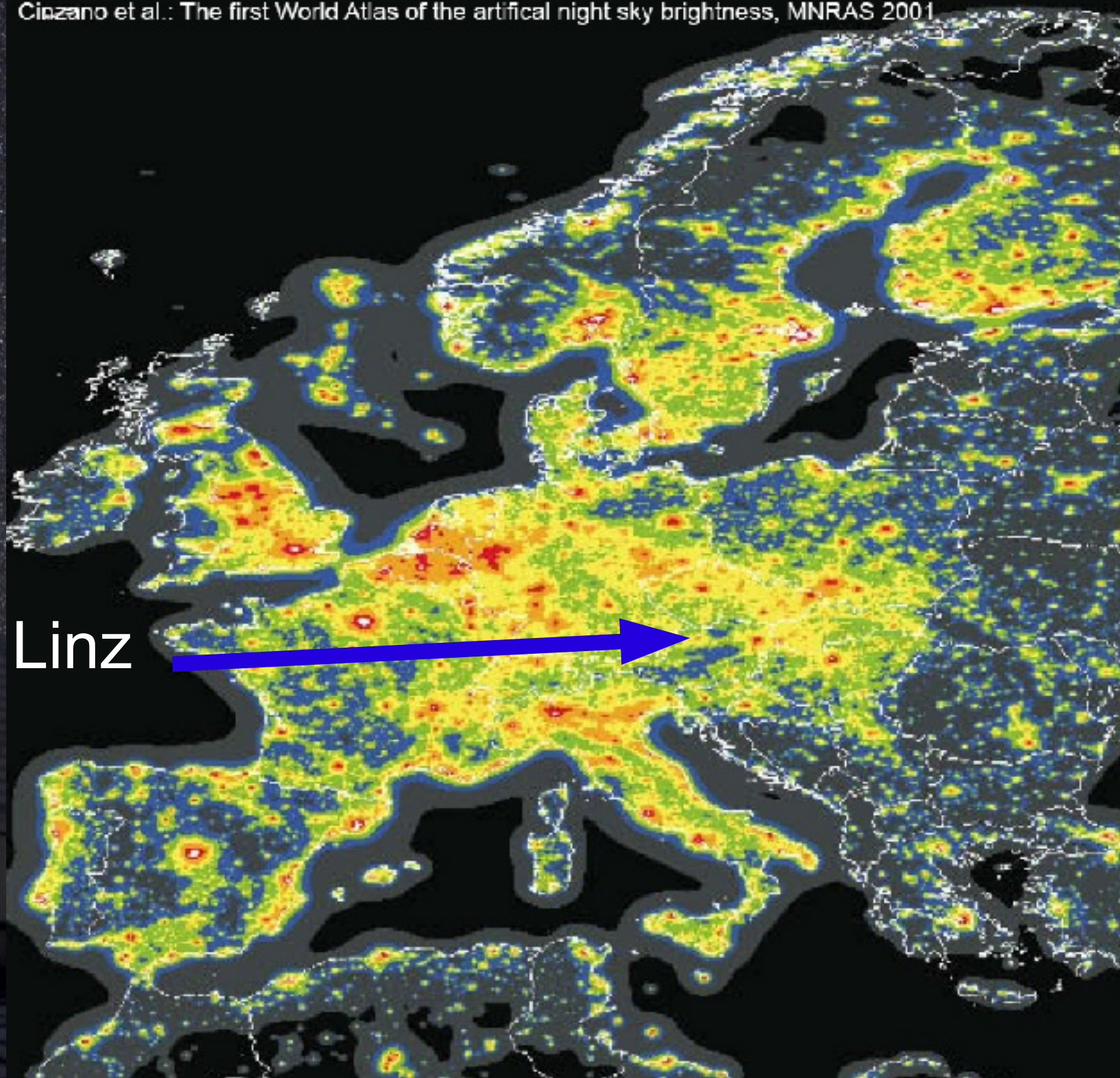
# Berlin 2009



# Linz

## Johannes Kepler Observatory

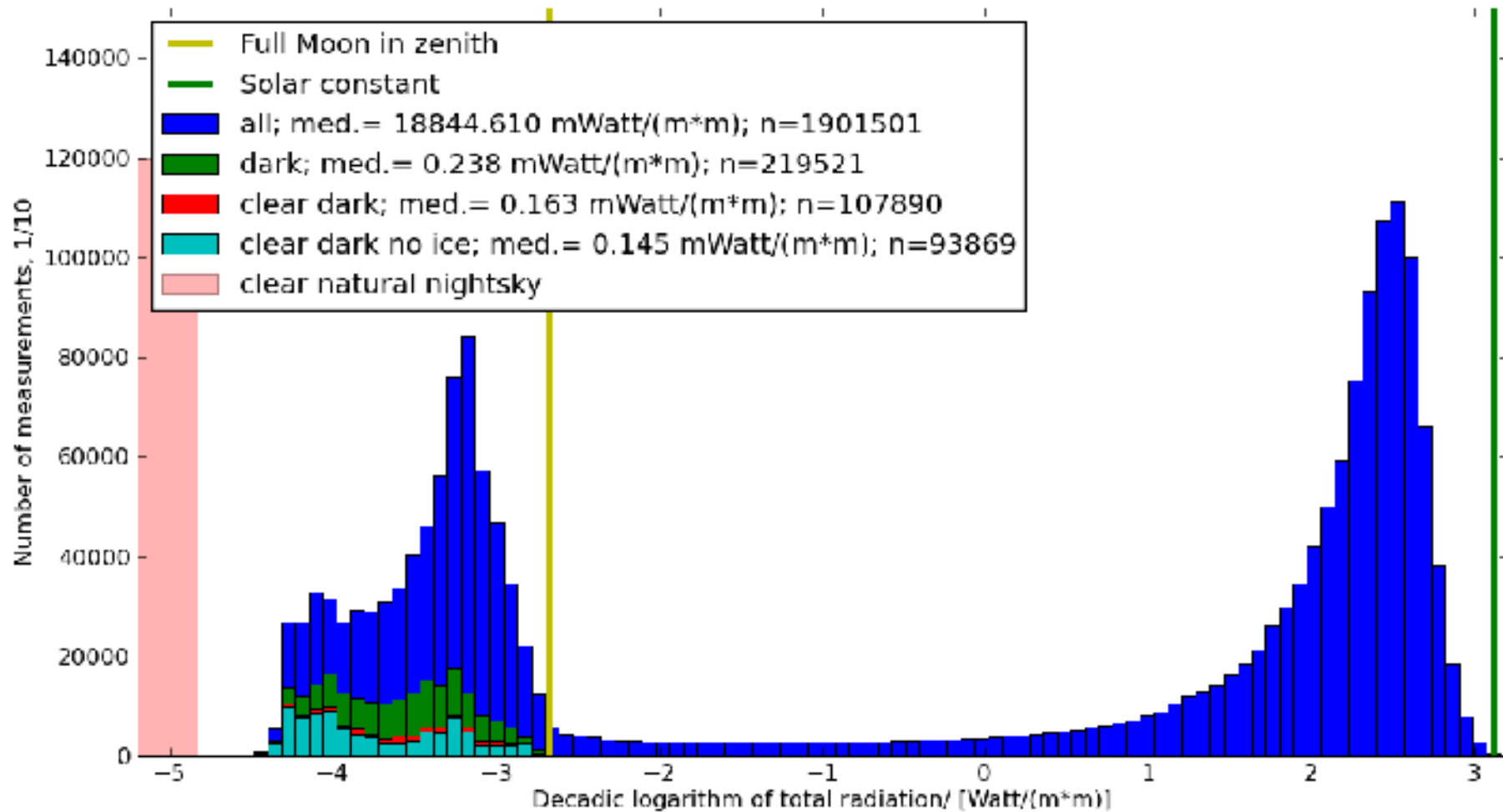
20.624 luminaries,  
23.206 lights,  
86,59 Watt / light average  
2 MW total



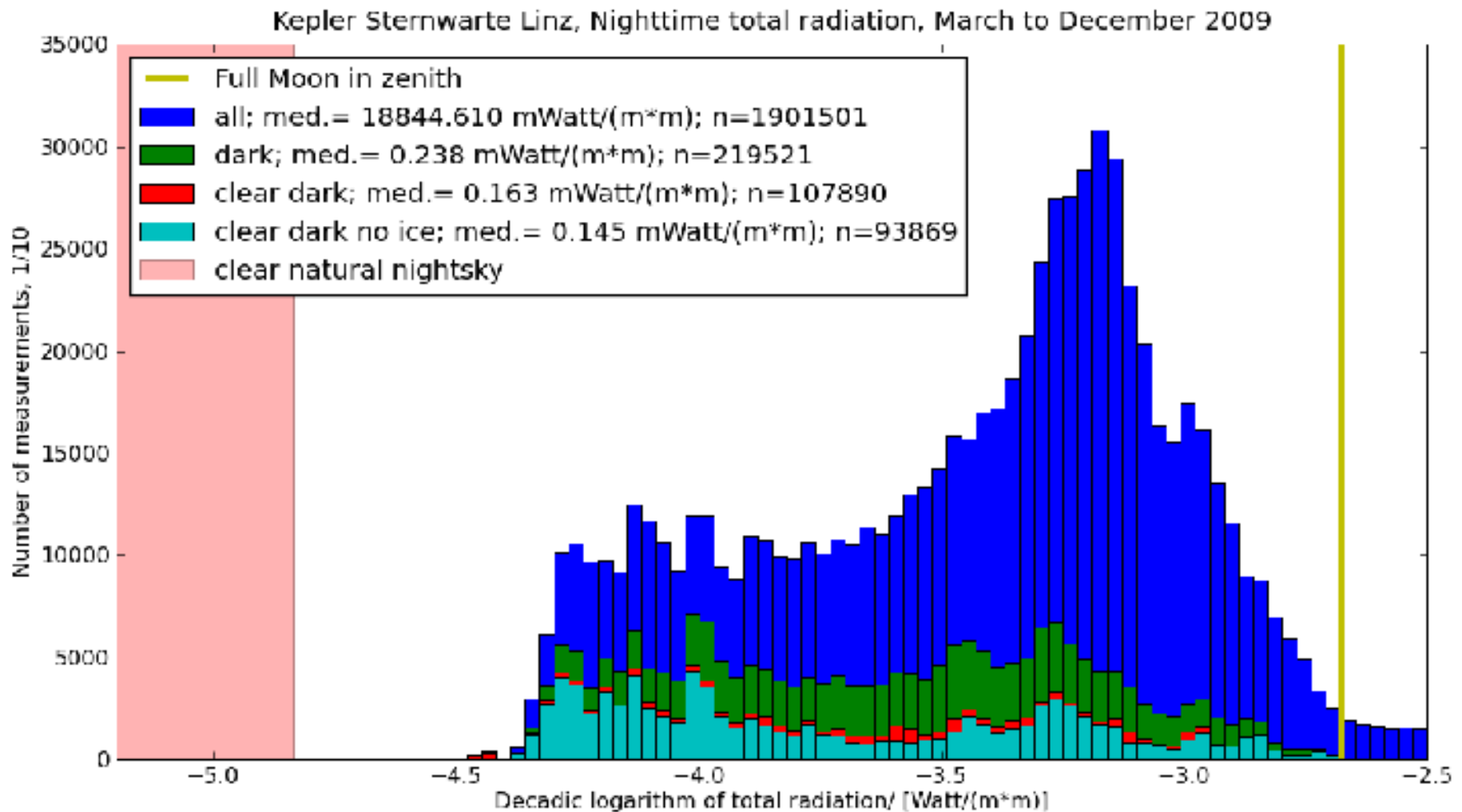
Linz

# Kepler Observatory Linz

Kepler Sternwarte Linz, Total Irradiation, March to December 2009

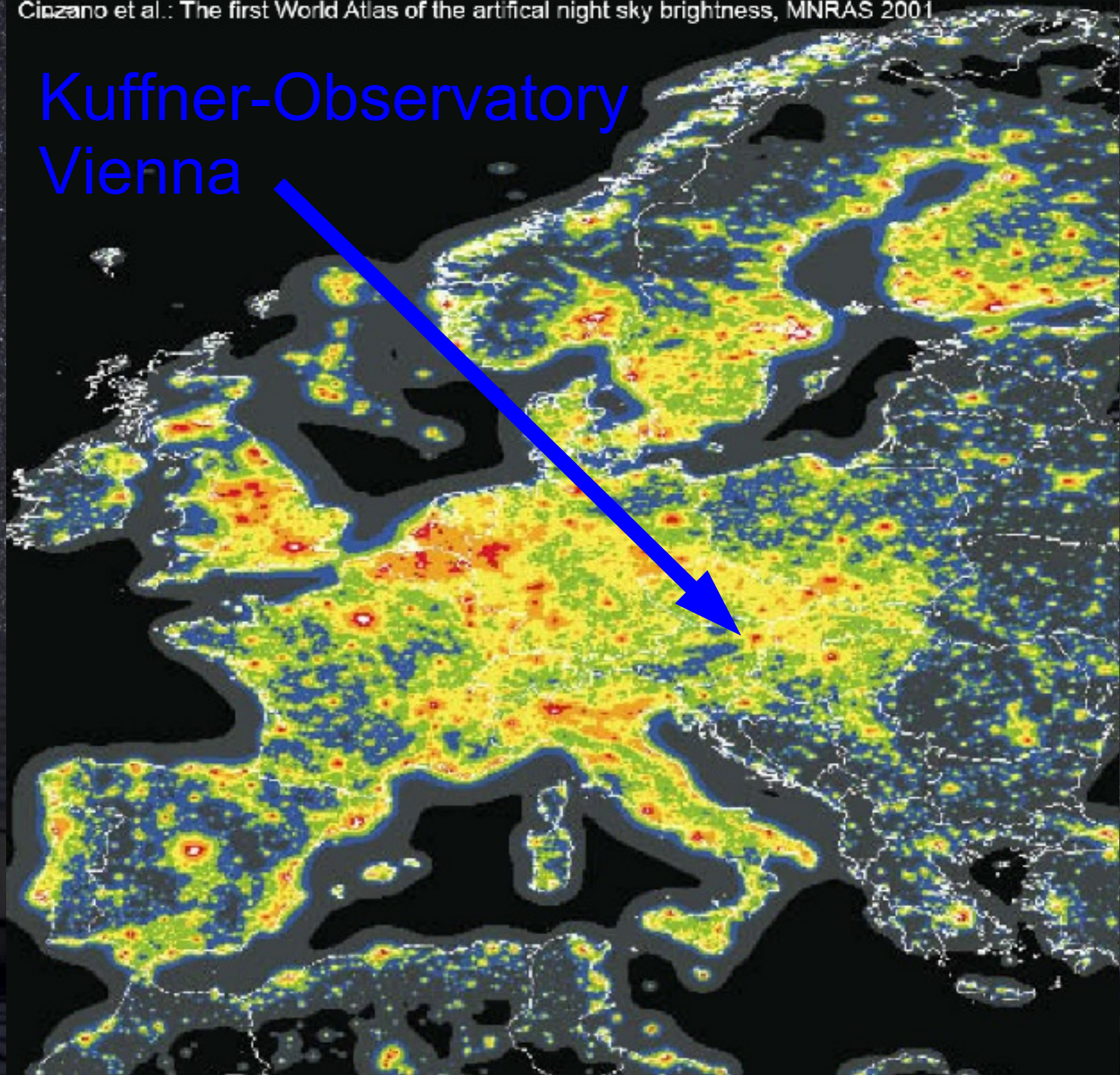


# Kepler Observatory Linz

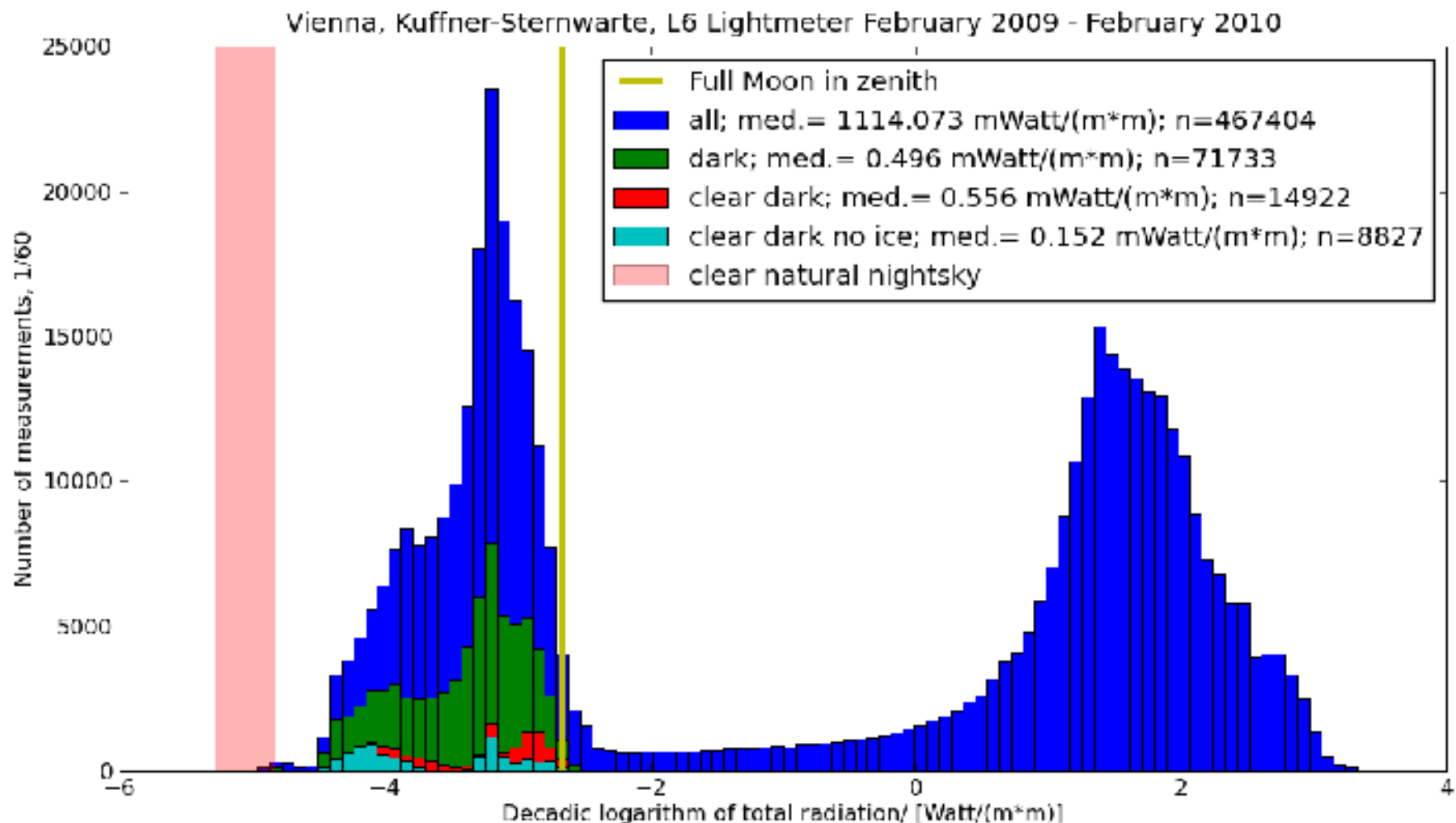




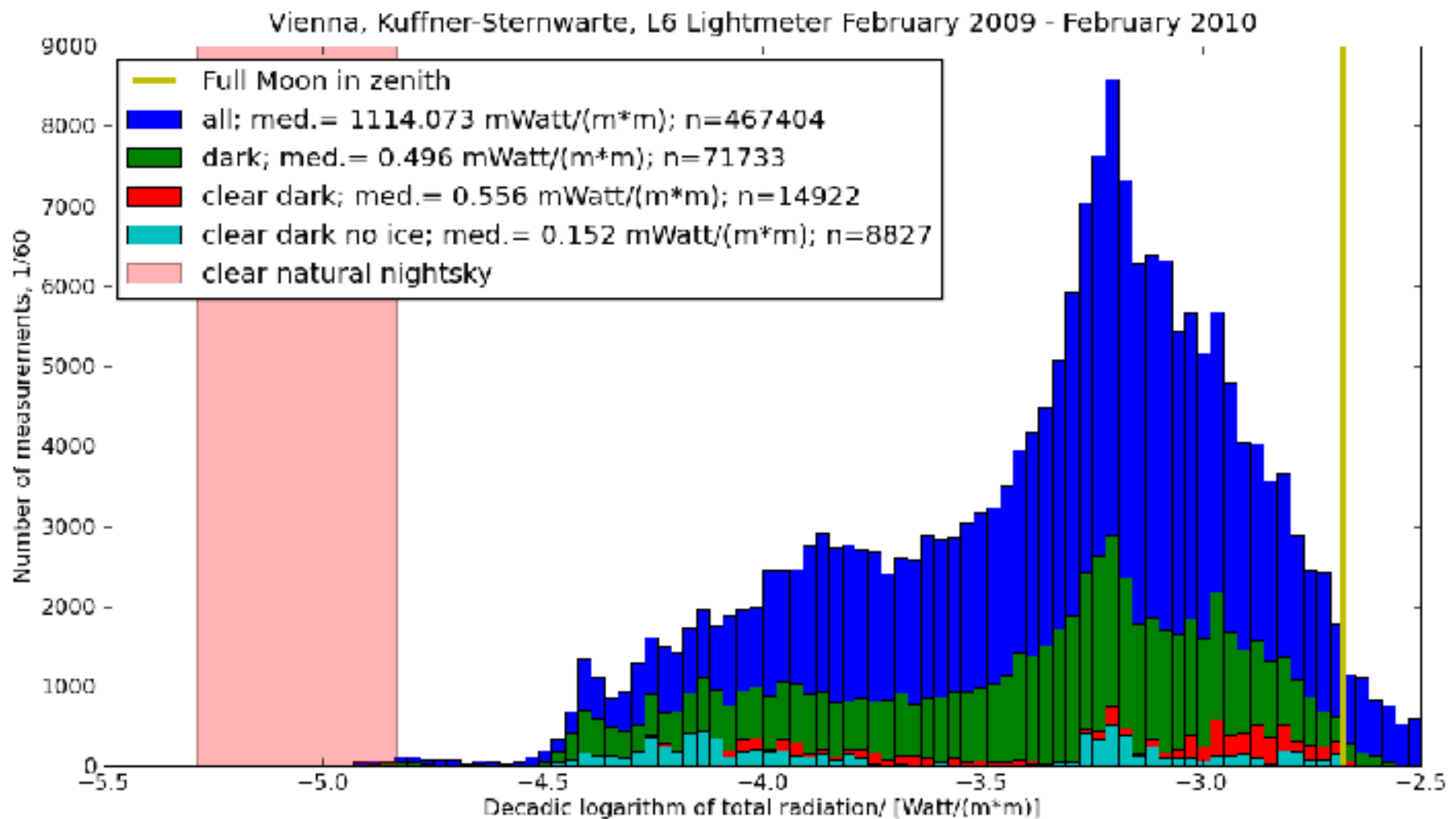
Kuffner-Observatory  
Vienna



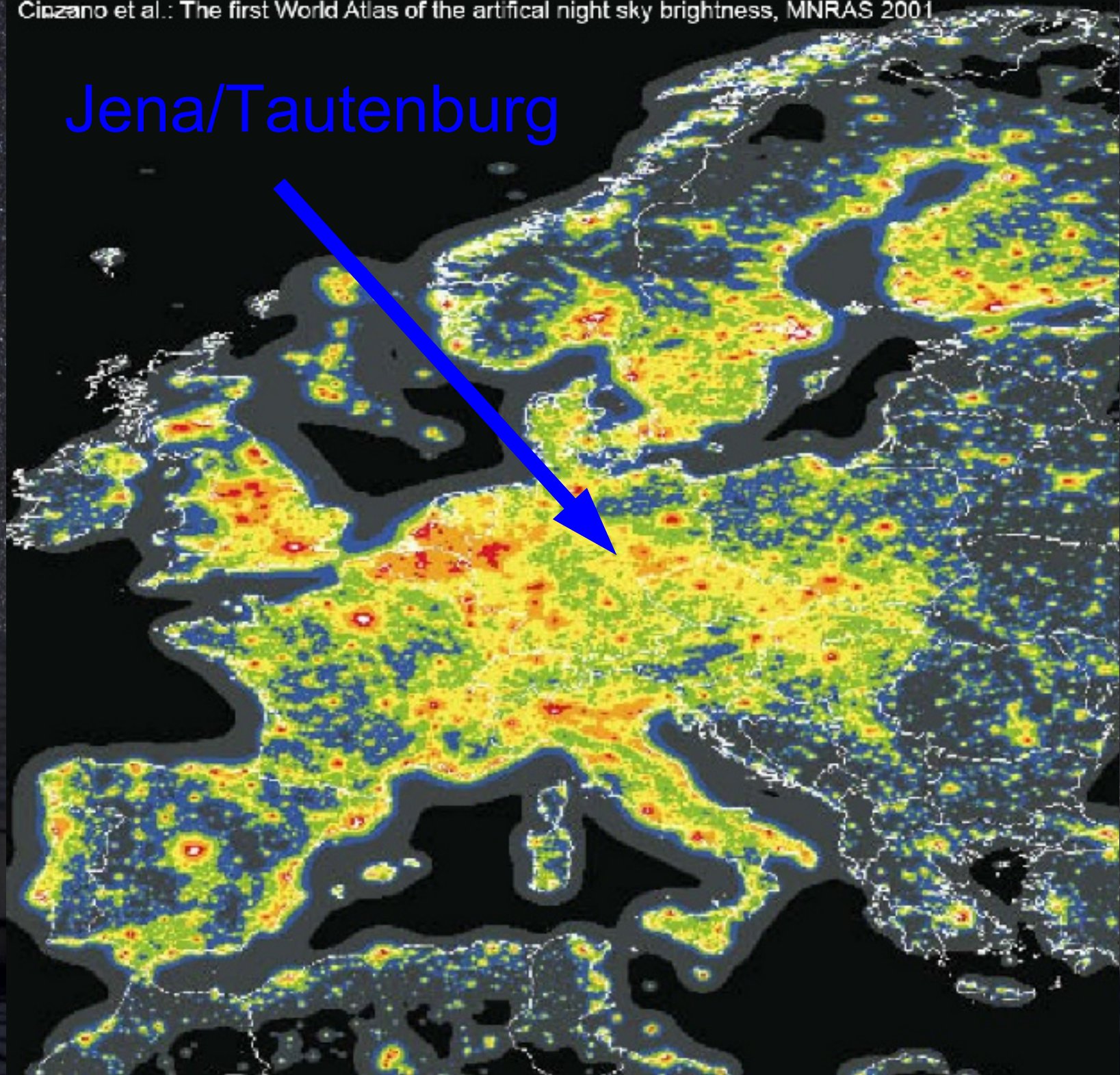
# Kuffner-Observatory / Vienna 2009



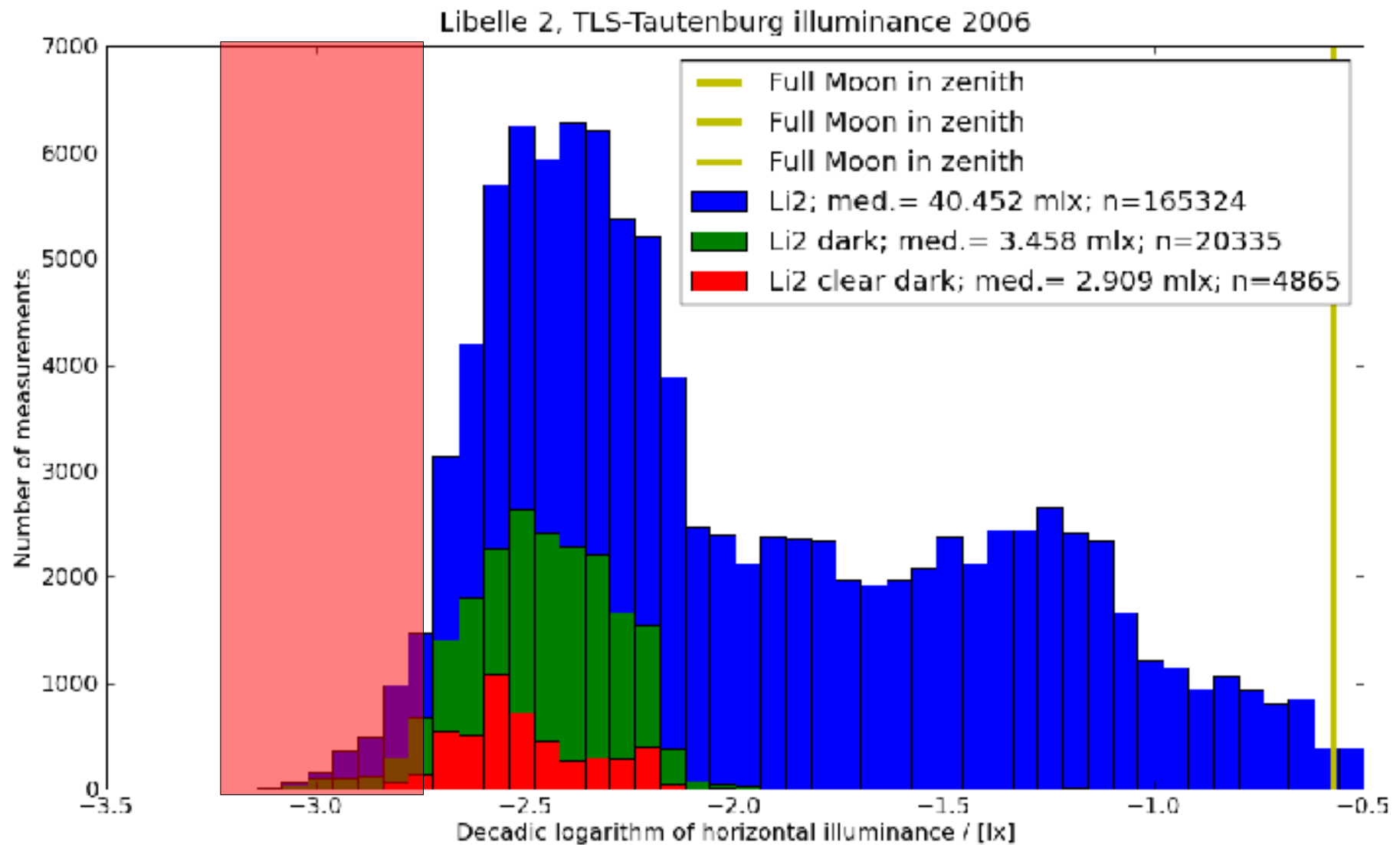
# Kuffner-Observatory / Vienna 2009



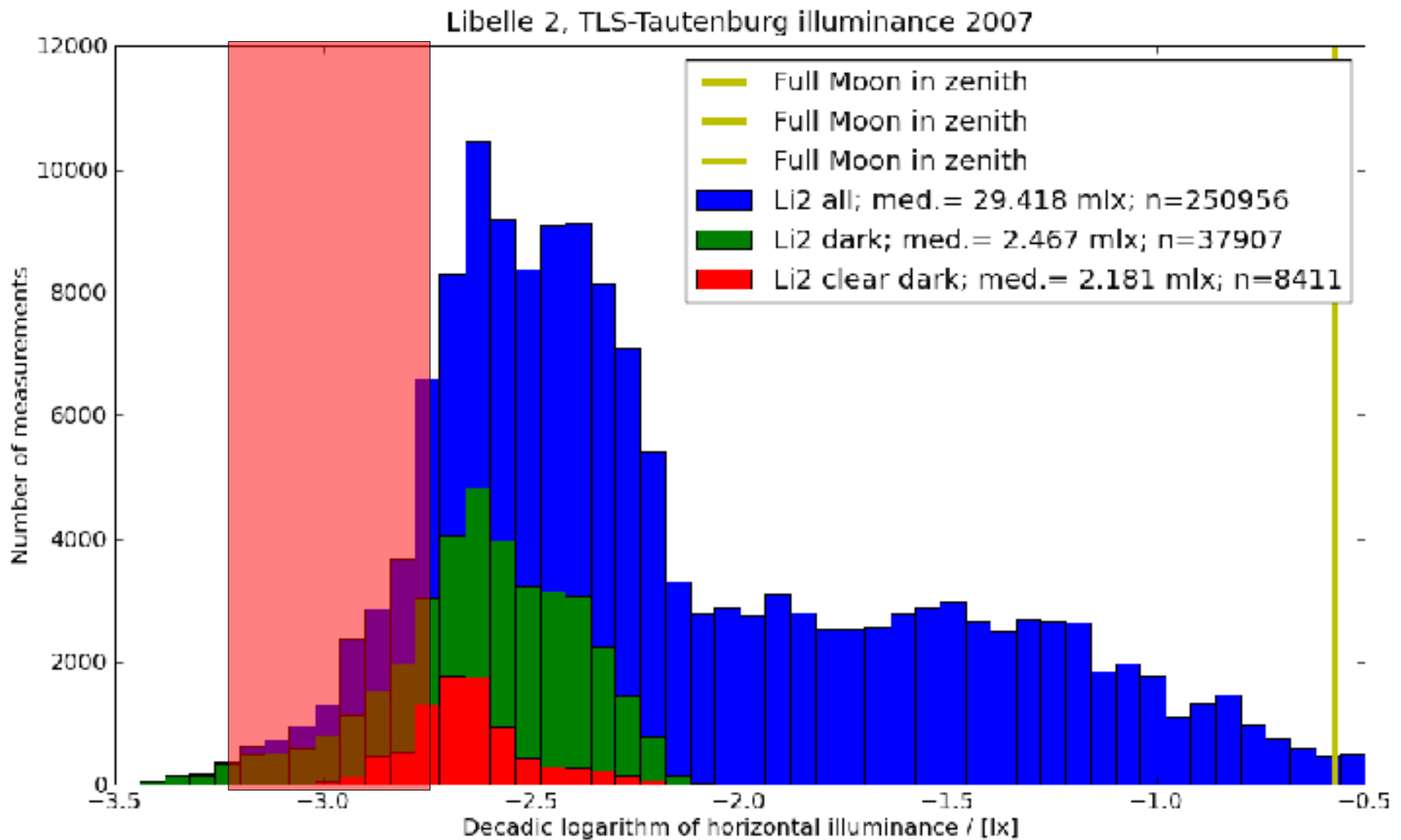
Jena/Tautenburg



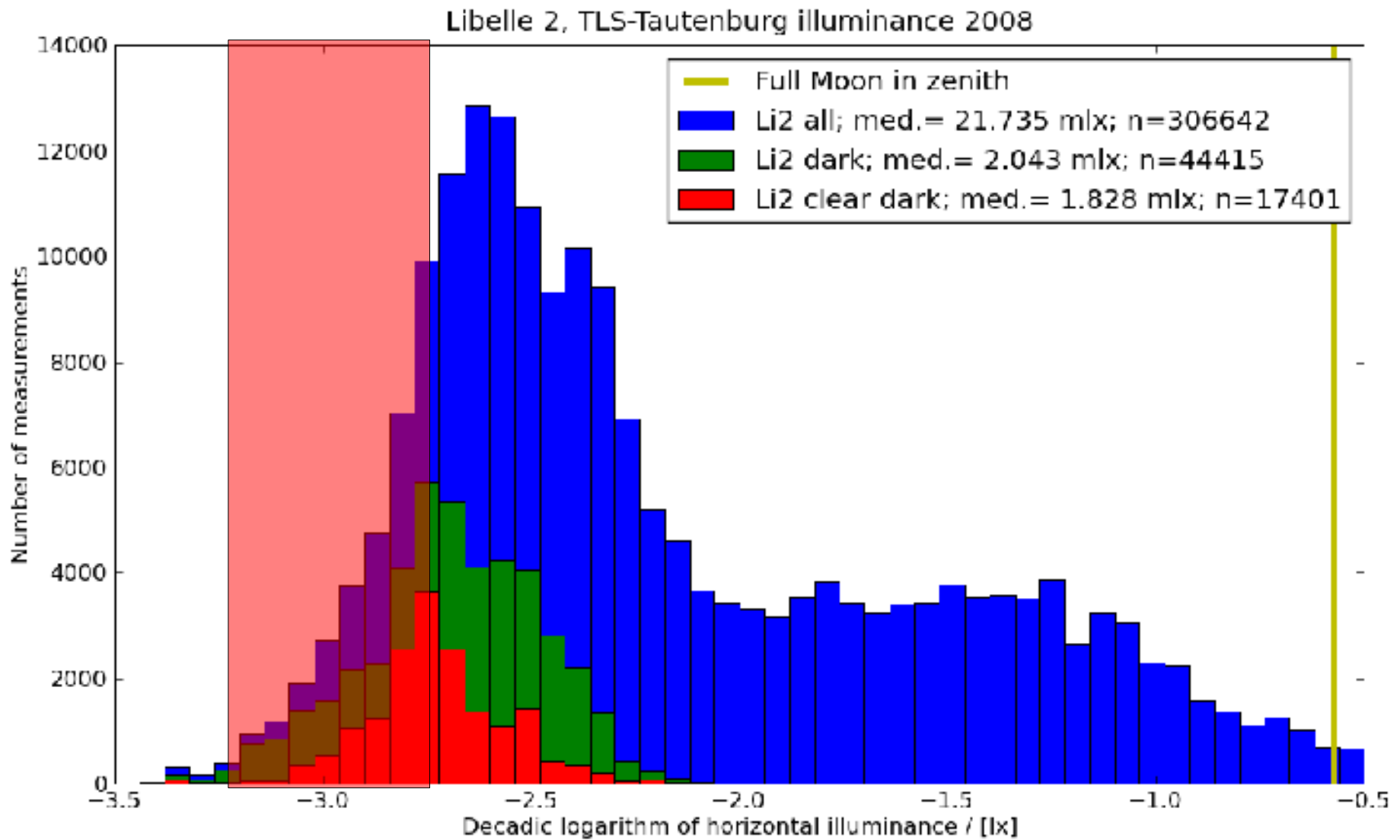
# Tautenburg 2006



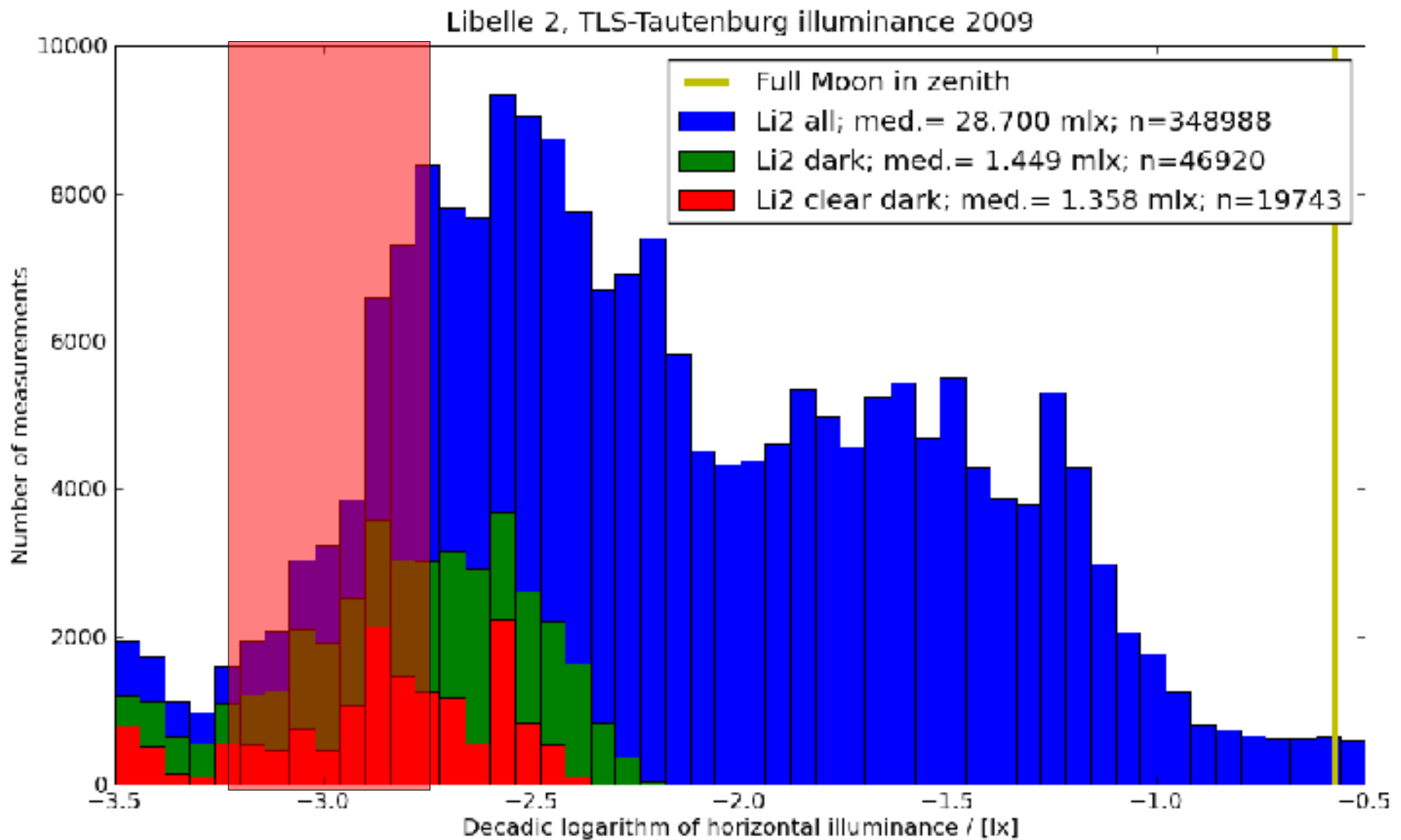
# Tautenburg 2007



# Tautenburg 2008



# Tautenburg 2009





# Lightmeter Datacenter at GAVO

<http://vo.uni-hd.de/lightweather>



Help

Service info

## Related

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## Metadata

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Try [ADQL](#) to query our data.

## Information on Service 'Light Pollution Weather'

We give continuous night and day light measurements at all natural outdoor light levels by a network of low-cost lightmeters. Developed to start simple, global continuous high cadence monitoring of night sky brightness and artificial night sky brightening (light pollution) in 2009. The lightmeter network is a project of the Thüringer Landessternwarte, Tautenburg, Germany and the Kuffner-Sternwarte society at the Kuffner-Observatory, Vienna, Austria. It started as part of the Dark Skies Awareness cornerstone of the International Year of Astronomy.



Use this Service from your Browser

Further access options are discussed [below](#)

## Overview

You can access this service using:

- *form* -- allows access via an [HTML form](#)

This service is **published** as follows:

# Lightmeter Datacenter at GAVO

<http://vo.uni-hd.de/lightweather>

GERMAN ASTROPHYSICAL  
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Try ADQL to query our data.

## Light Pollution Weather

**Date**  /  /  (day/month/year)

**Time (UTC)**

**plus/minus [minutes]**   
*Give measurements within this many minutes of your chosen date and time. The sampling rate is 20 minutes*

**Station ID**   
AT\_LINZ\_1  
AT\_GMUNDEN\_1  
AT\_GRAZ\_1  
AT\_Gahberg  
AT\_KLOSTERNEUBURG\_1  
AT\_KSO\_1  
No selection matches all, multiple values legal  
Identifier of the measuring station, starting with an ISO CC

**Table** Sort by  Limit to  items.

**Output format**

[\[Result link\]](#) ★

Enjoy and feed the database!

Instructions at

<http://lightmeter.astronomy2009.at>

If you forgot your user, mail to  
[lightmeter@astronomy2009.at](mailto:lightmeter@astronomy2009.at)

or use

Guest and IYA2009

One of many uses: calibrate the satellites...

# 2009 DMPS + A. Trawöger

<http://light.datenscheibe.org/>

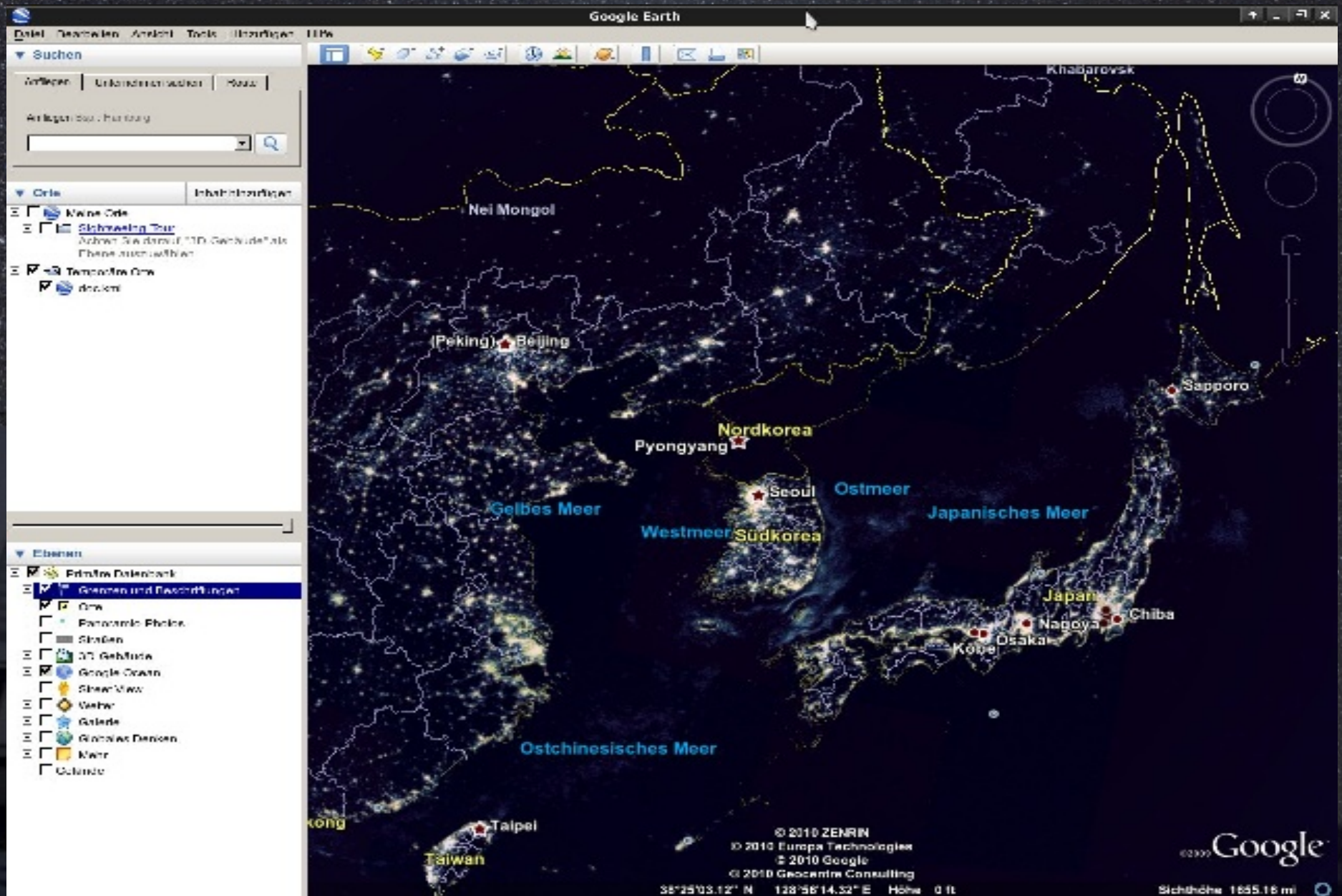


16 GB looking for high traffic host

<http://light.datenscheibe.org/>



# Google-Earth Overlays



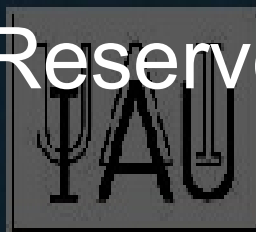
# World Heritage

- 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 and Starlight Oasis

<< September 2010 >>

Mo	Tu	We	Th	Fr	Sa	Su
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26

ICOMOS IAU Thematic Study on astronomical heritage is now available for download



IAU's Working Group on Astronomy and World Heritage

Astronomy and World Heritage is the theme of issue 54 of UNESCO's World Heritage magazine

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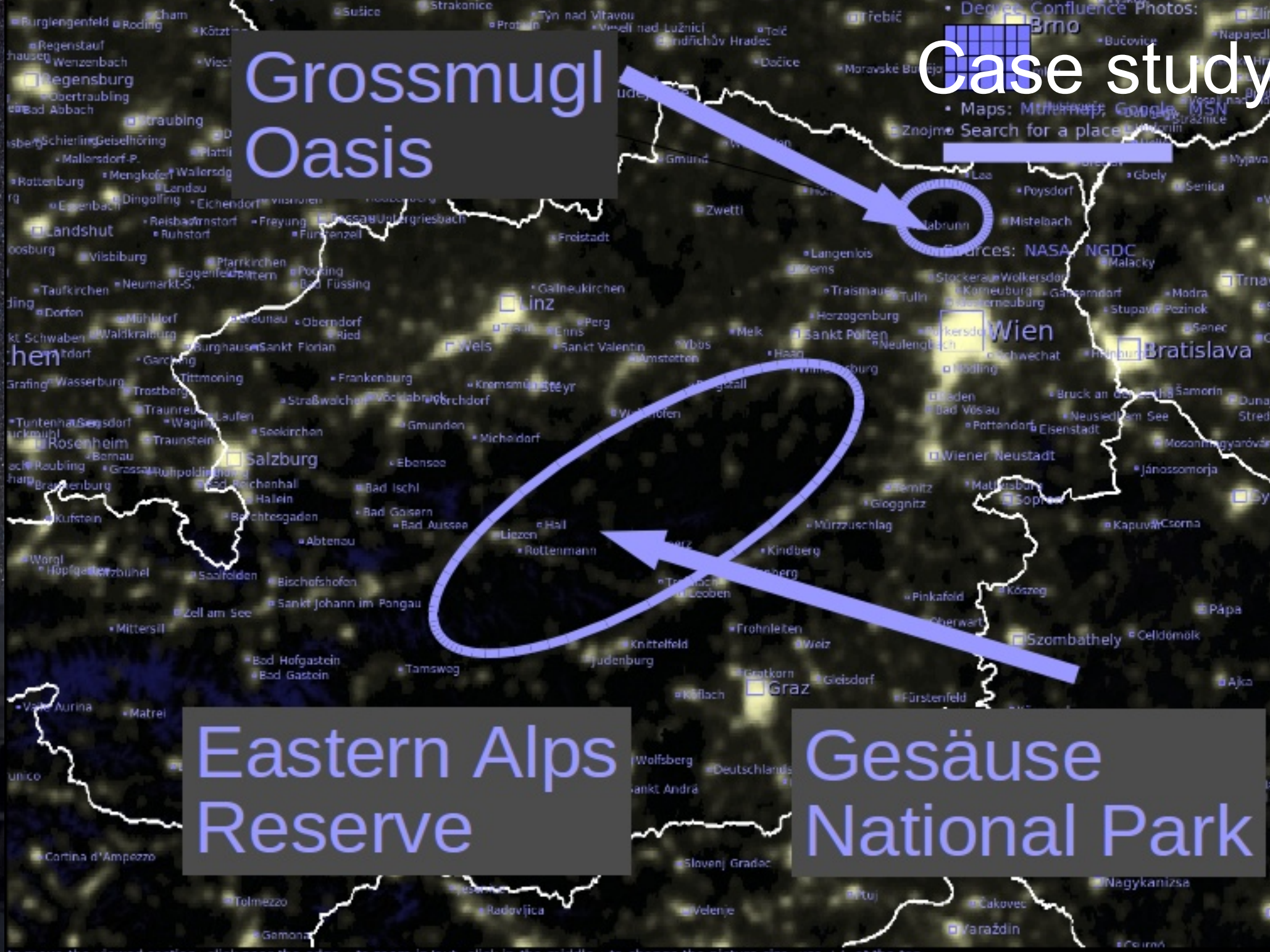
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# Grossmugl Oasis

# Case study



# Eastern Alps Reserve

# Gesäuse National Park

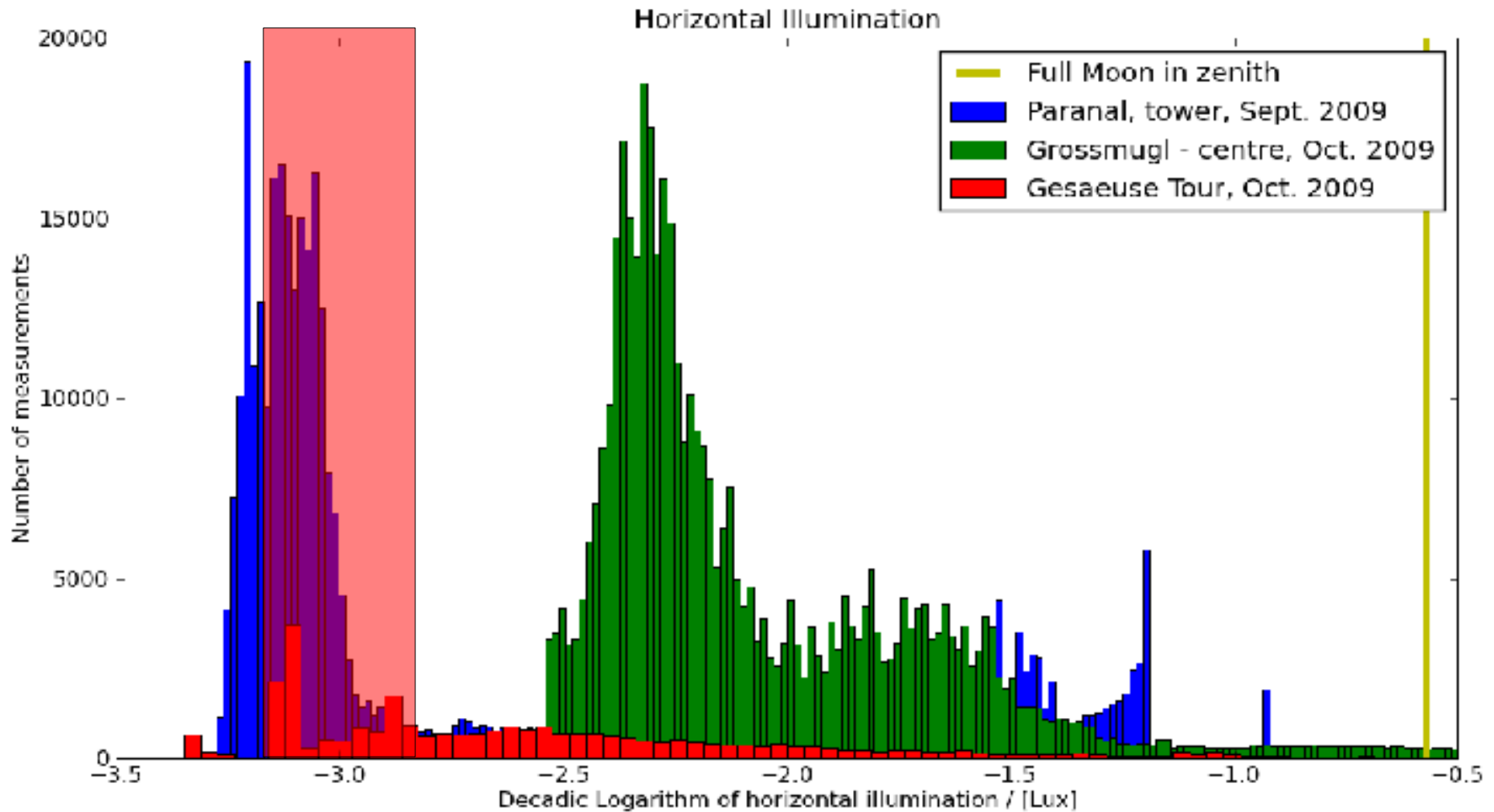


# Grossmugl Starlight Oasis – July 31



Alexander Pikhard

# Lightmeter: Oasis to Reserve



Grossmugl at bronze-age tumulus:  $21.15 \text{ mag}''^2$ ,  
Gesäuse NP SQM-L  $21.63 \pm 0.14 \text{ mag}''^2$  (UMa 21.8 , zenith, Milky way: 21.6)





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



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

# Calibration with high background

