



# Long-term Multispectral Measurements of Skyglow Using Sky Quality Meters

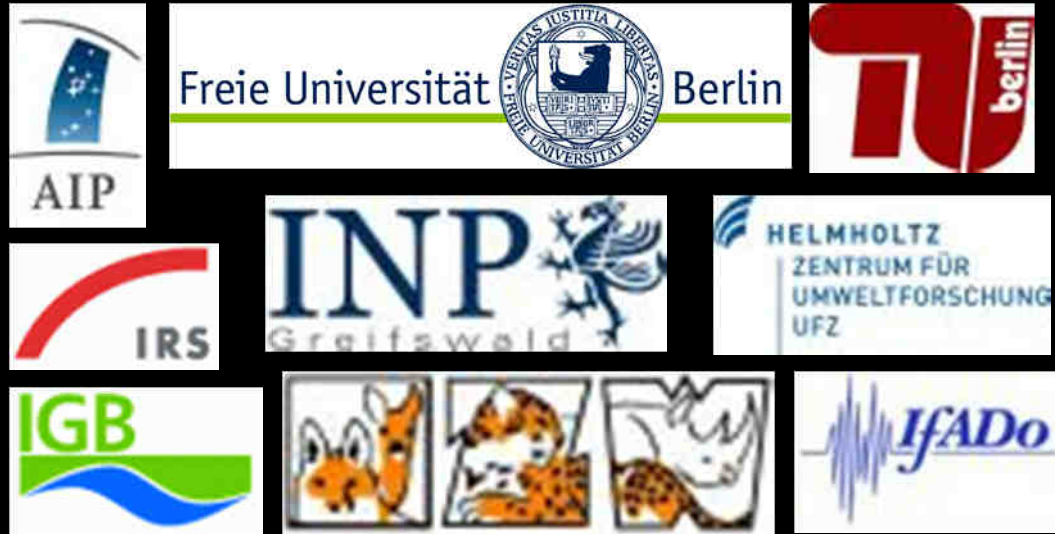
Christopher Kyba<sup>1,2</sup>, Thomas Ruhtz<sup>1</sup>,  
Jürgen Fischer<sup>1</sup>, Franz Hölker<sup>2</sup>

<sup>1</sup>Freie Universität Berlin

<sup>2</sup>Leibniz-Institute of Freshwater Ecology and Inland  
Fisheries

11th Dark Sky Symposium, Osnabrück  
October 6, 2011

# *Verlust der Nacht* (Loss of the Night)



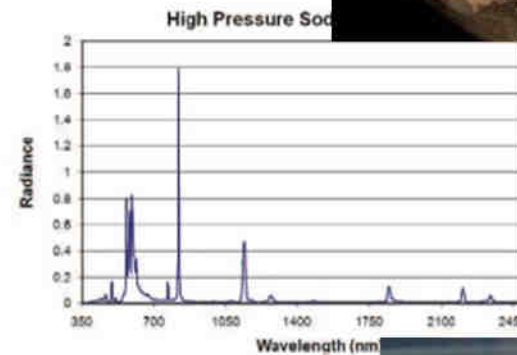
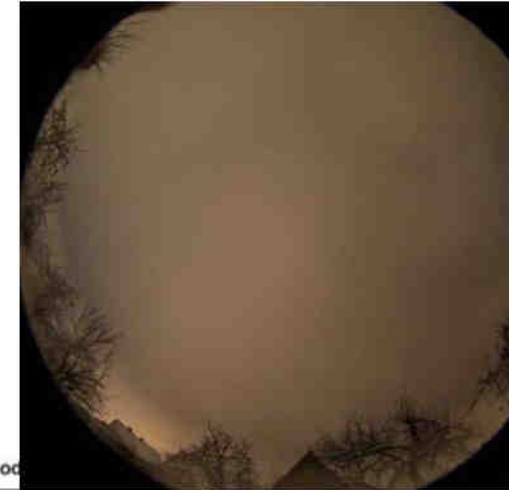
- Collaboration of 9 Universities / Institutes
- 14 Integrated Subprojects
- Many aspects of light pollution considered, from measurement to ecology to sociology

# Requirements for Long Term Light Pollution Monitoring Devices

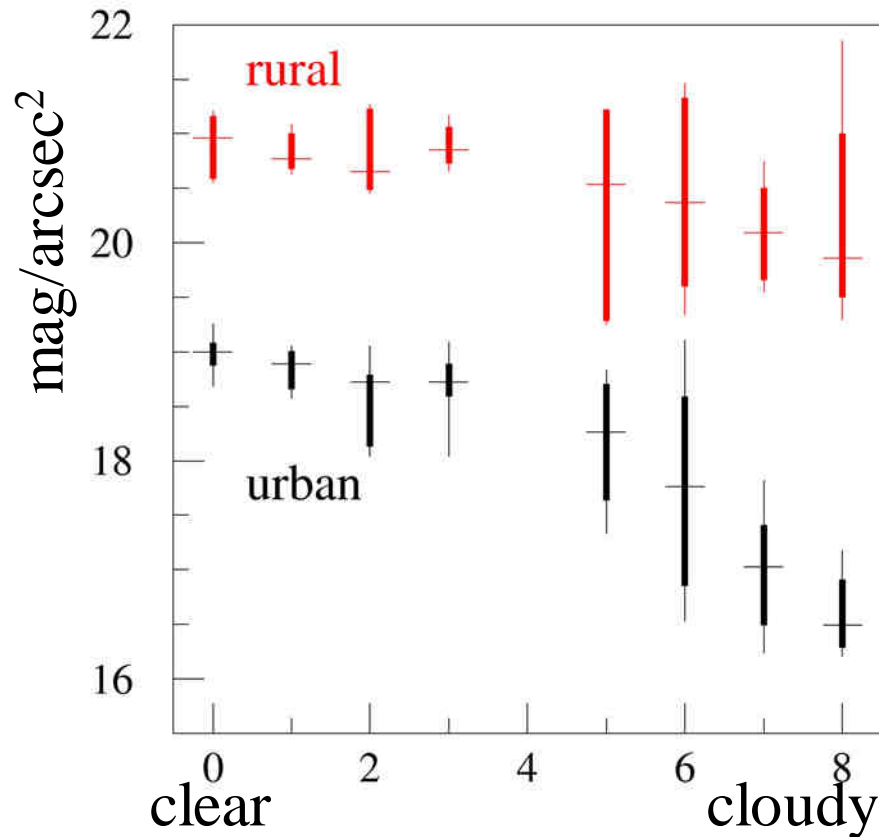
- Must be robust
- *In situ* calibration should be possible
- Multispectral
  - Circadian disruption
  - Monitor shift to LED lighting
- Inexpensive / Easy to operate
- Temperature stable (ideally warmed)
- Zenith vs.  $180^{\circ}$

# Existing Light Pollution Detectors

- Human eye
- Phototubes
- Imaging spectrometers
- Digital color cameras
- Cell phone cameras
- Custom devices
- IYA Lightmeter
- SQM



# Cloud Amplification of Light Pollution



- Urban overcast sky is ~10x brighter than clear
- Effect is reverse of what happens in nature
- Summer comparison published in Kyba *et al.*, PLoS ONE (2011)



# Prototype Detector



- Set of SQM-LU with 5 different filters
- Standard SQM-LU
- Luminous 370-700nm
- Red 590-690 nm
- Green 490-580 nm
- Blue 370-510 nm
- Operated April-Sept, 2011

# Cross-Calibration and Alignment

Please contact me if you would like to see this data. It's not on the web to avoid prior-publication issues

- Compared at start and end of experiment

# Preliminary Results 1

Please contact me if you would like to see this data. It's not on the web to avoid prior-publication issues



# Preliminary Results 2

Please contact me if you would like to see this data. It's not on the web to avoid prior-publication issues

- Can monitor nightly and seasonal changes
- Can monitor long term switch to LED lighting
- Results could be used to build a “circadian exposure” dataset
- Work in progress

# Acknowledgements

## Funding

BMBF 033L038A  
MILIEU (FU Berlin)

## Photo Credits

Skyglow (Orion): Jeremy Stanley (Wikipedia Commons)

Map of Berlin: FU Berlin

Globe at Night

HPS Spectrum: Elvidge *et al.* 2010

Fisheye Photo: Andreas Hänel

IYA Lightmeter: Lightmeter wiki

Glacier National Park: Ray Stinson

Urban Sky+SQM: Christopher Kyba

Light pollution map: WEW FU Berlin

# Requirements for Long Term Light Pollution Monitoring Devices

- Must be robust
- *In situ* calibration should be possible
- Multispectral
  - Circadian disruption
  - Monitor shift to LED lighting
- Inexpensive / Easy to operate
- Temperature stable (ideally warmed)
- Zenith vs.  $180^{\circ}$