



National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Effects of atmospheric conditions on night sky brightness

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Why?

- Night lighting does have adverse effects

→ What's the impact?

- Impact = dose • effect

→ What's the dose/exposure?

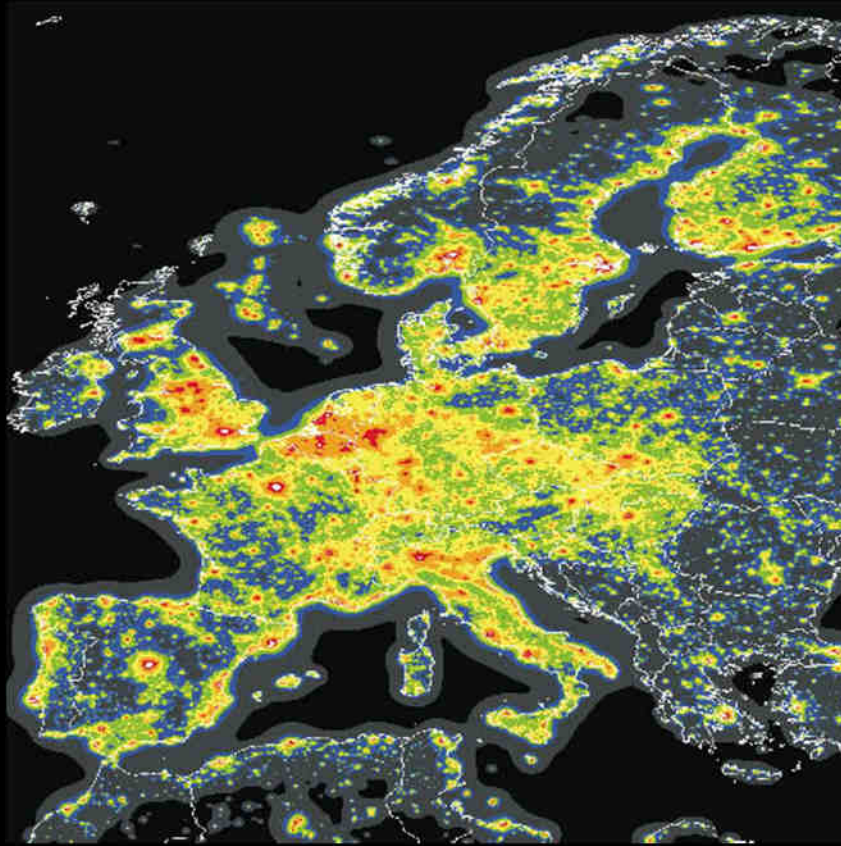
- Emission \neq exposure



Night sky brightness = luminance in zenith



Night sky brightness



Cinzano et al.

Light emission

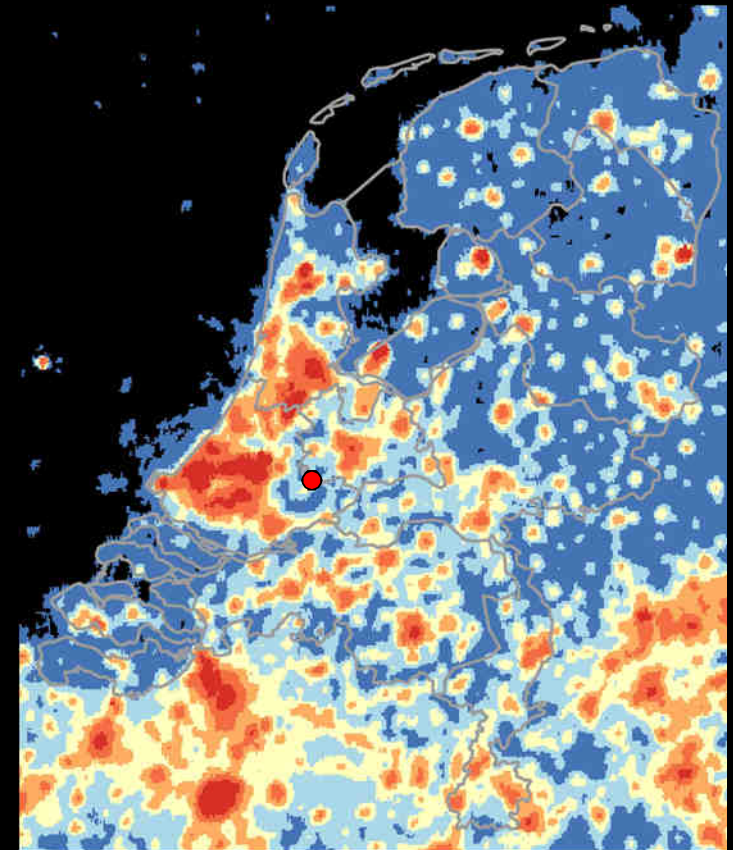




What's the Effect
of
Clouds and Aerosols
on
Night Sky Brightness?



Measurements at CESAR Cabauw Experimental Site for Atmospheric Research





Instruments

- DigiLum (Lumineux Consult)
 - 5° aperture
 - Photopic spectral response
- SQM-LE
 - 20° aperture
 - Broad spectral response
- IYA lightmeter
 - Flat solar panel (=illuminance)
 - Broad spectral response





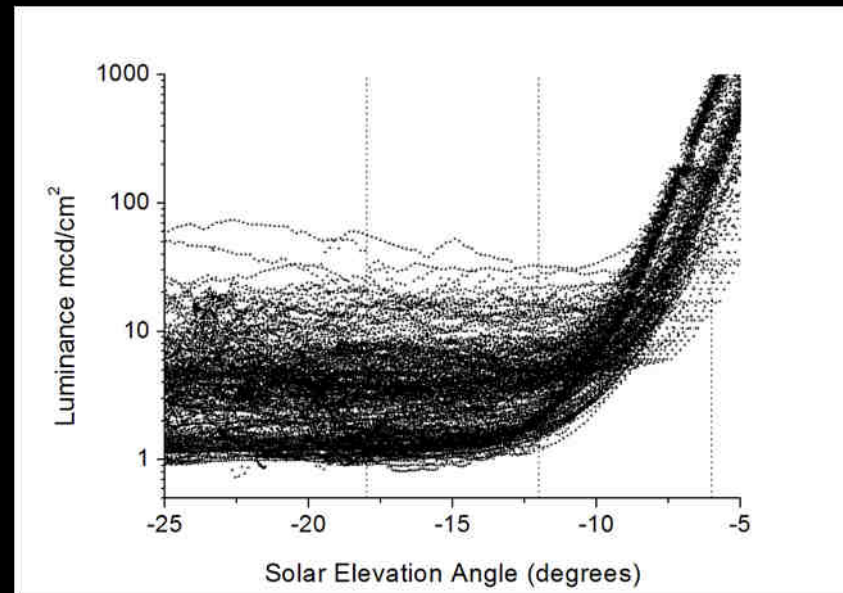
What are typical zenith luminances?

Place	Luminance (mcd/m ²)
Dark place, no artificial lighting, no sun, no moon	< 0.25
City of Amsterdam, clear night	8
CESAR (rural) clear night	1.1
CESAR (rural) cloudy night	> 25



When is it night?

Night type	SEA upper limit
Civil	-6°
Nautical	-12°
Astronomical	-18°
Custom	-15°



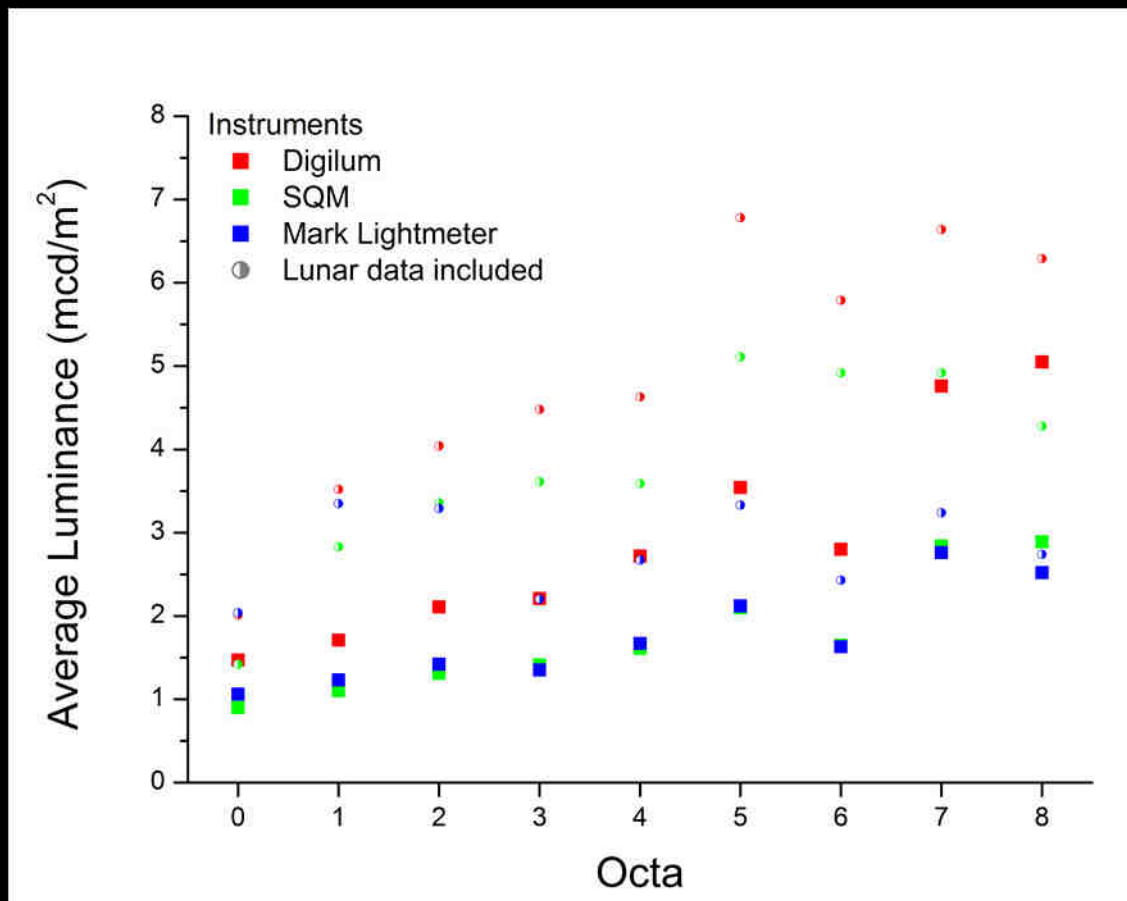


Results

- Cloud cover
- Cloud base height
- Aerosols



Cloud cover



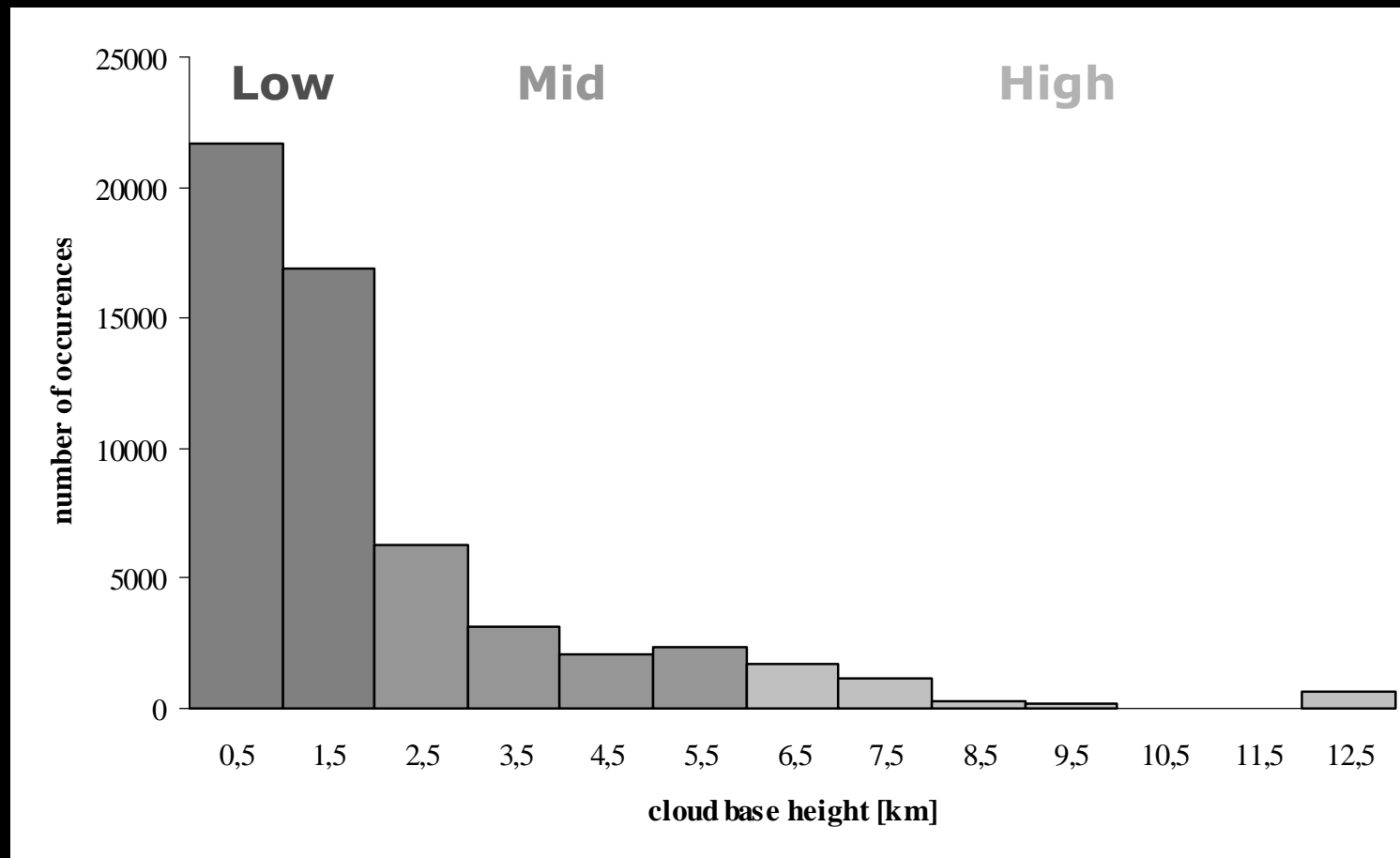
Linear fits*

Instr.	Slope	R
Digilum	0.44 ± 0.06	0.93
SQM	0.24 ± 0.04	0.93
Mark	0.19 ± 0.04	0.90

*MEA<0

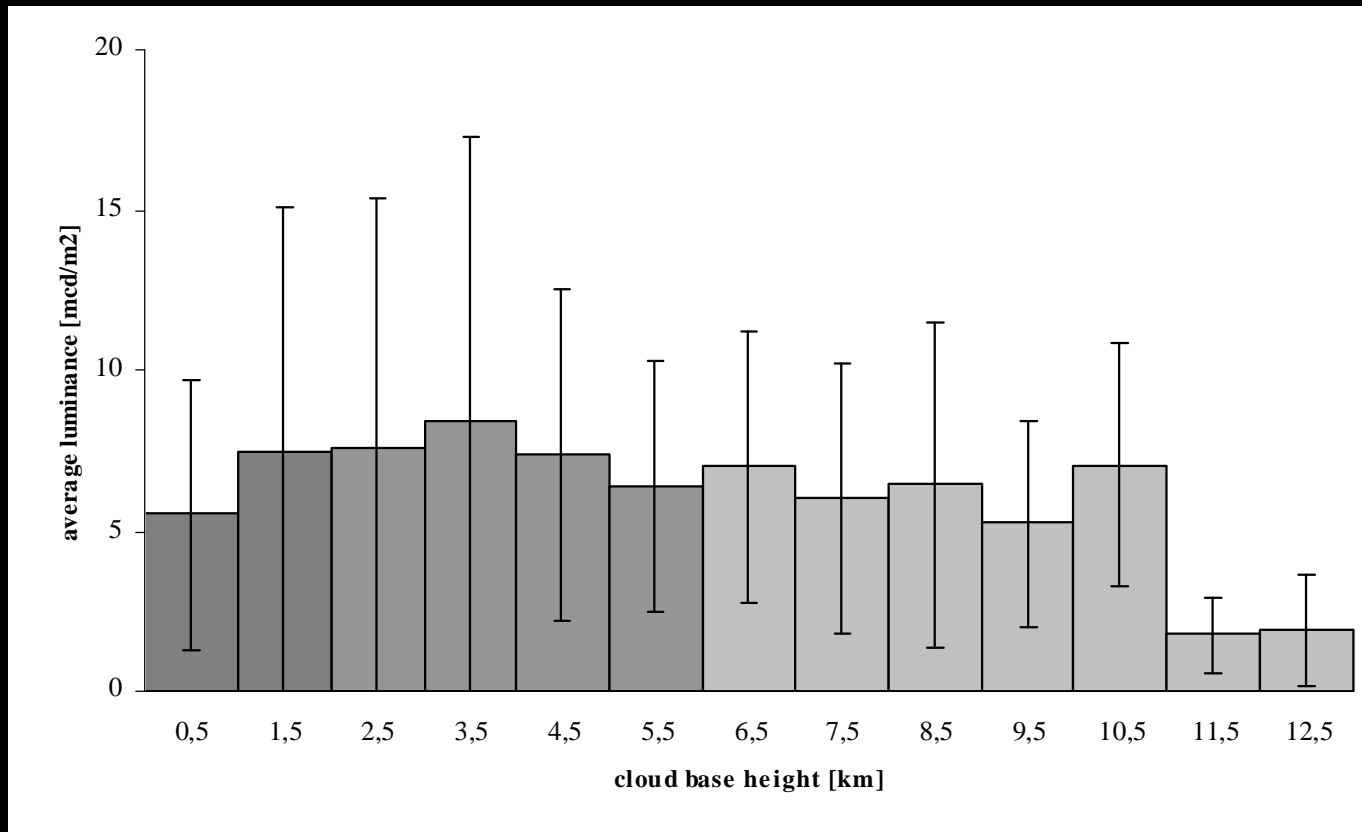


Distribution of cloud base heights at CESAR



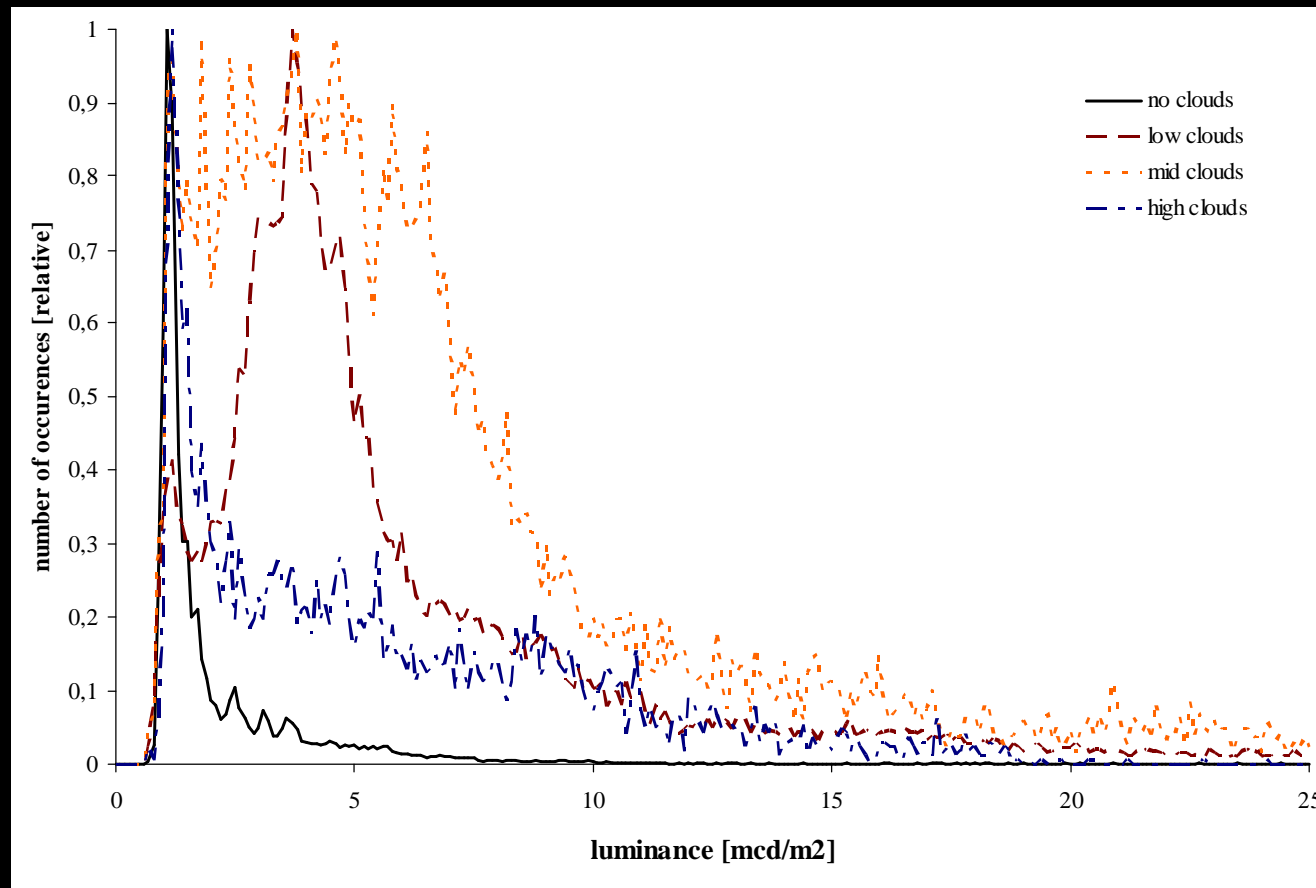


Average luminance vs cloud base height



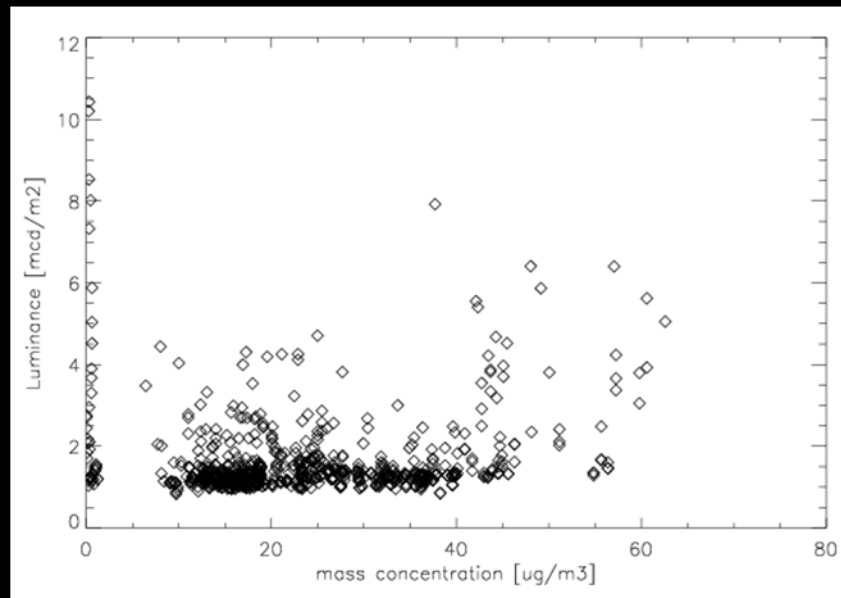


Luminance distribution (relative) per cbh-index

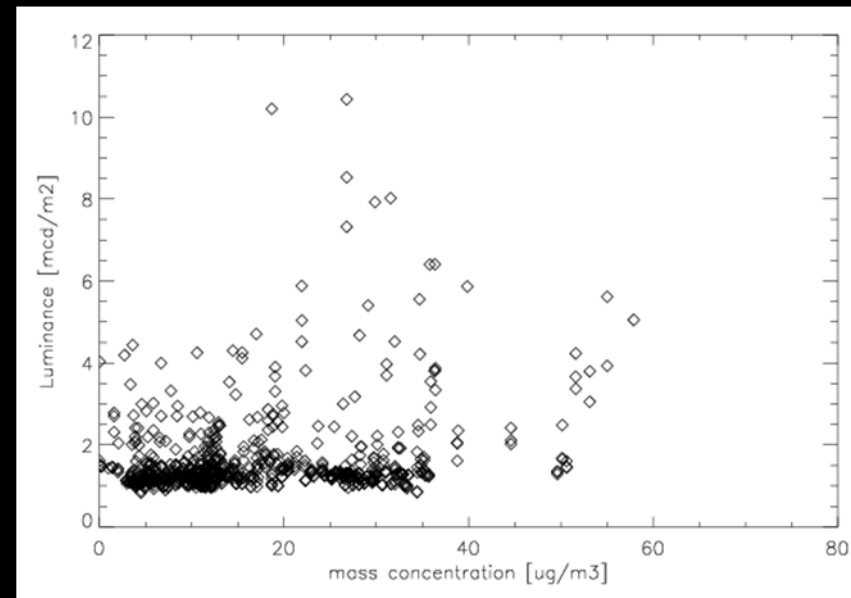




Aerosols -> PM10 / PM2.5



PM10

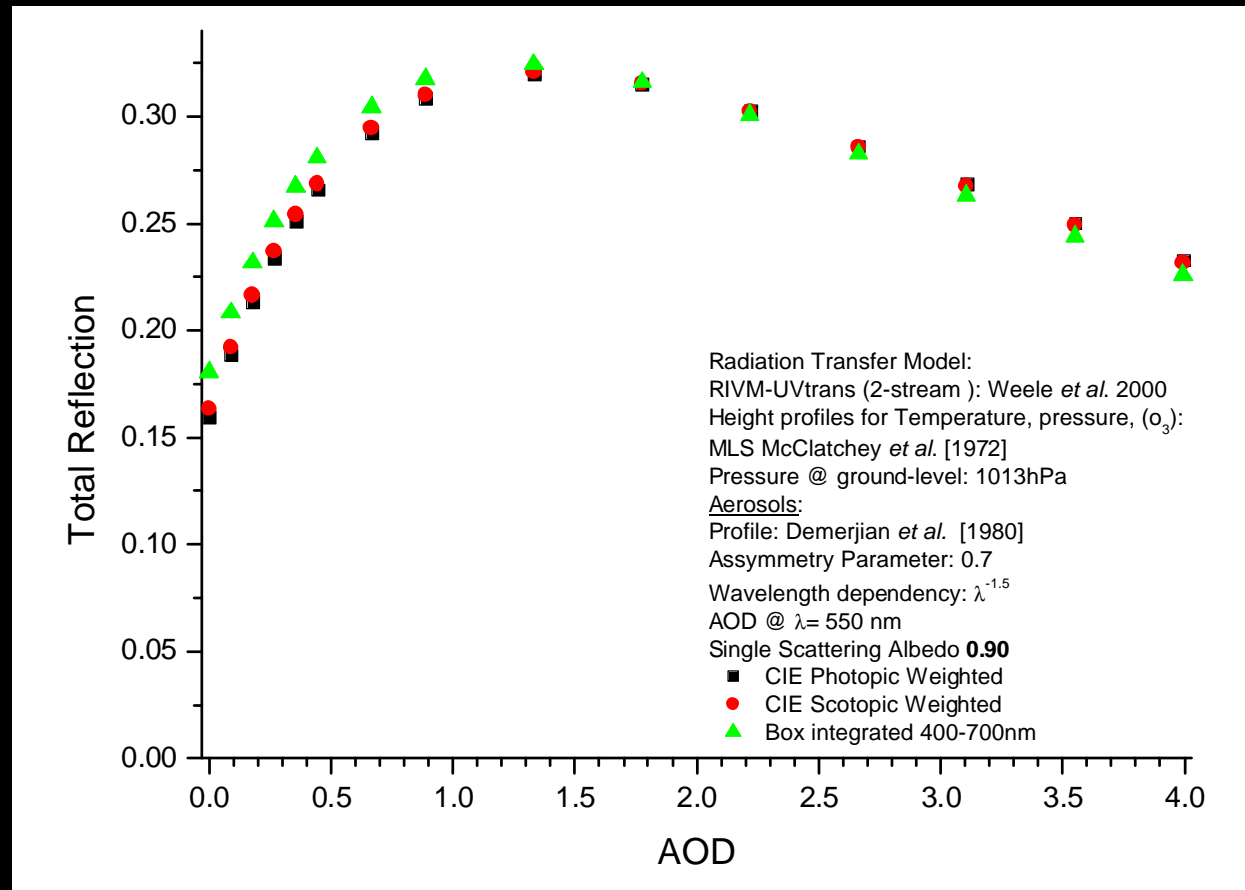


PM2.5



Can we expect to see an effect of aerosols?

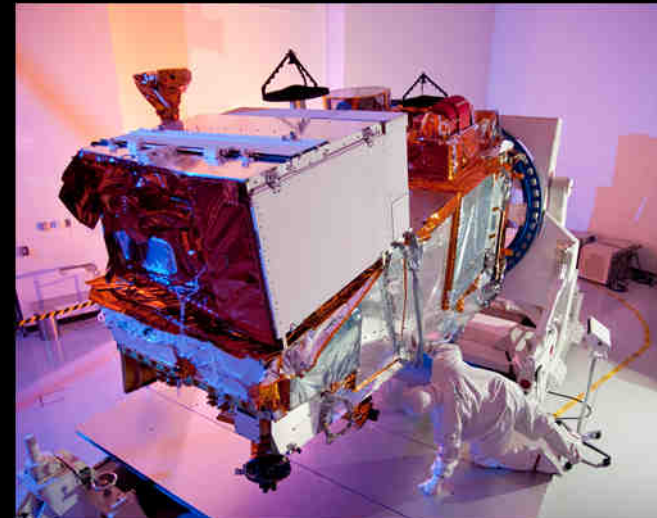
Total downward reflection of diffuse upward light





Outlook

- We want to model night sky brightness for different atmospheric conditions based on emission data (satellite).
- In that way we are able to give information on the exposure of flora, fauna and humans to artificial night lighting (dose).
- Together with knowledge on the effects of artificial night lighting on flora, fauna and humans we can derive the impact of artificial night lighting on flora, fauna and humans.



VIIRS-instrument
Visible-Infrared Imager-Radiometer Suite



More information and contact:

- Report "Effects of atmospheric conditions on night sky brightness" – D.E. Lolkema, M. Haaima, P.N. den Outer & H. Spoelstra, RIVM report 680151002/2010
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