Light Pollution

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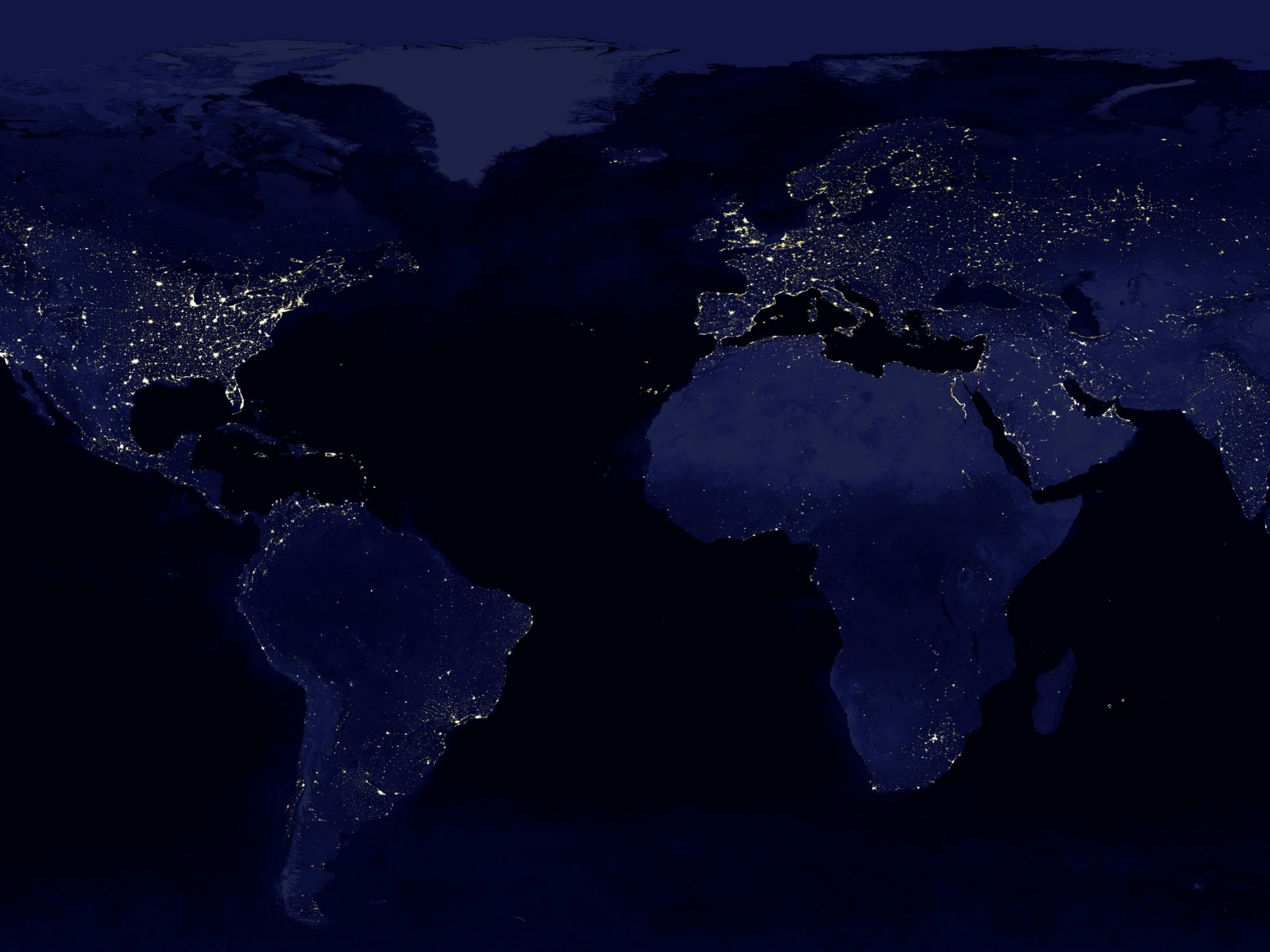
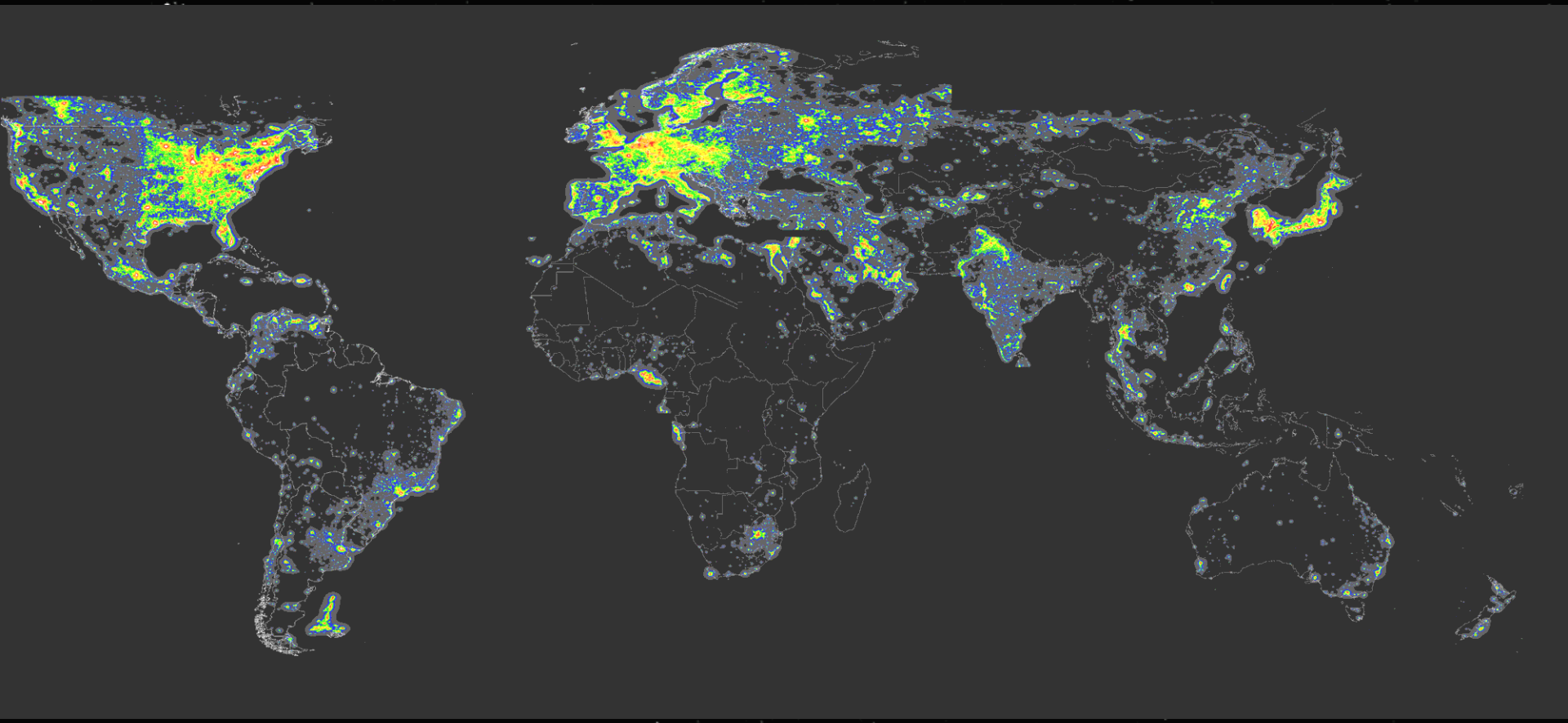
University of Applied Sciences

NoorderRuimte, Area Development





Source: www.lightpollution.it , © 2000, 2006 Pierantonio Cinzano

This presentation

- Definition (see next sheet)
- Effects
- Sources (bronnen, ‘oorzaken’)
- How to measure?
- Solutions

Definition Light Pollution

“Unwanted sky light produced by man” (Riegel, 1973)

Effects

Positive effects and use

- Economic use
- Social use
- Safety and security

Negative effects (1)

- Astronomy
- Ecology
- Human health (see next sheet)

Negative effects (2)

- Physiological and medical
  - Cancer
  - Immunity system
  - Energy metabolism
  - Eating behavior

(Navara & Nelson, 2007; Hölker et al., 2010)

Sources

Sources

Taxonomy 1

- Street lighting
- Commercial lights
- Urban areas
- Yard lights
- Road lights
- Decorative outdoor lights

(Lyytimäki, Tapio, & Assmuth, 2012; Lyytimäki & Rinne)

Taxonomy 2 (see next sheet)

- Sky glow
- Trespass
- Glare
- Over-illumination

(Chepesiuk, 2009)

Sources explained

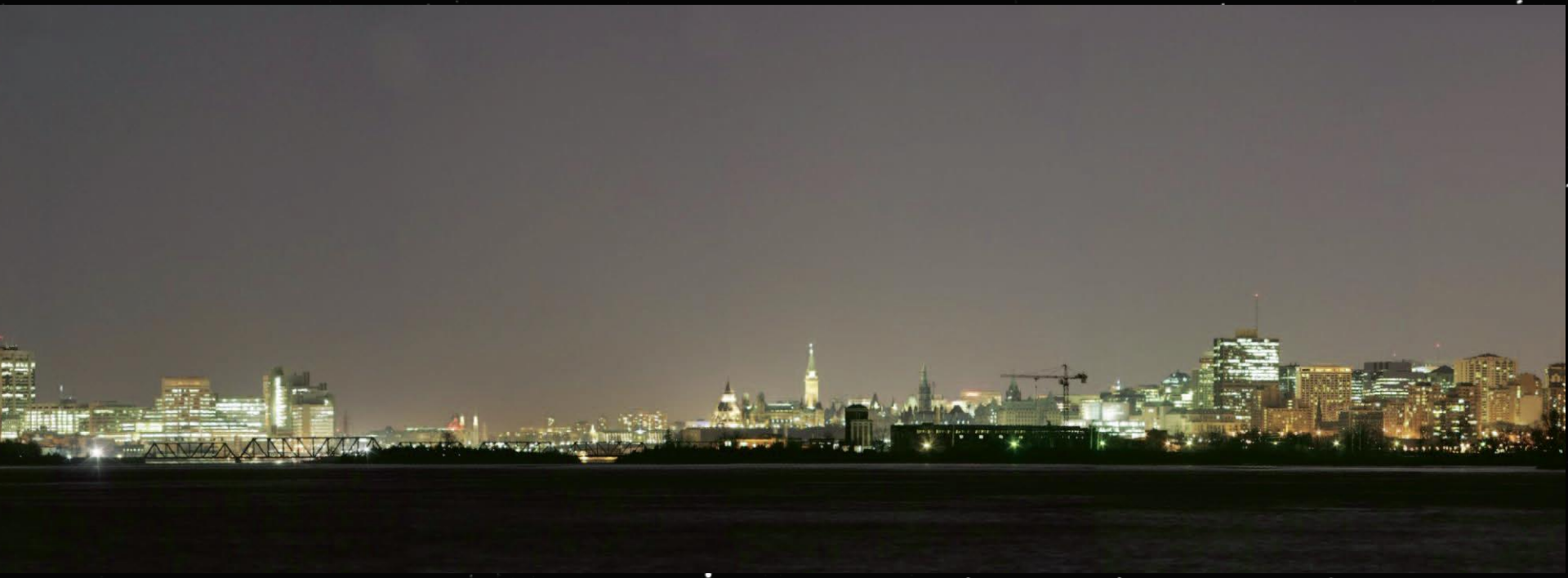
- Sky glow (gloed)
  - Halo over urban areas
- Trespass ('overtreden')
  - Unwanted artificial light spilled over adjacent properties
- Glare (verblindend licht)
  - Unused light that shines horizontally
- Over-illumination
  - Non functional use of light

Example of sky glow (1)

Reduction in glare and circadiandisrupting white light retains the relaxed village quality of the island of Lastovo, Croatia, in the Adriatic Sea

(images courtesy of A. Mohar, colour adjusted by RD to reflect visual appearance.)

Example of sky glow (2)

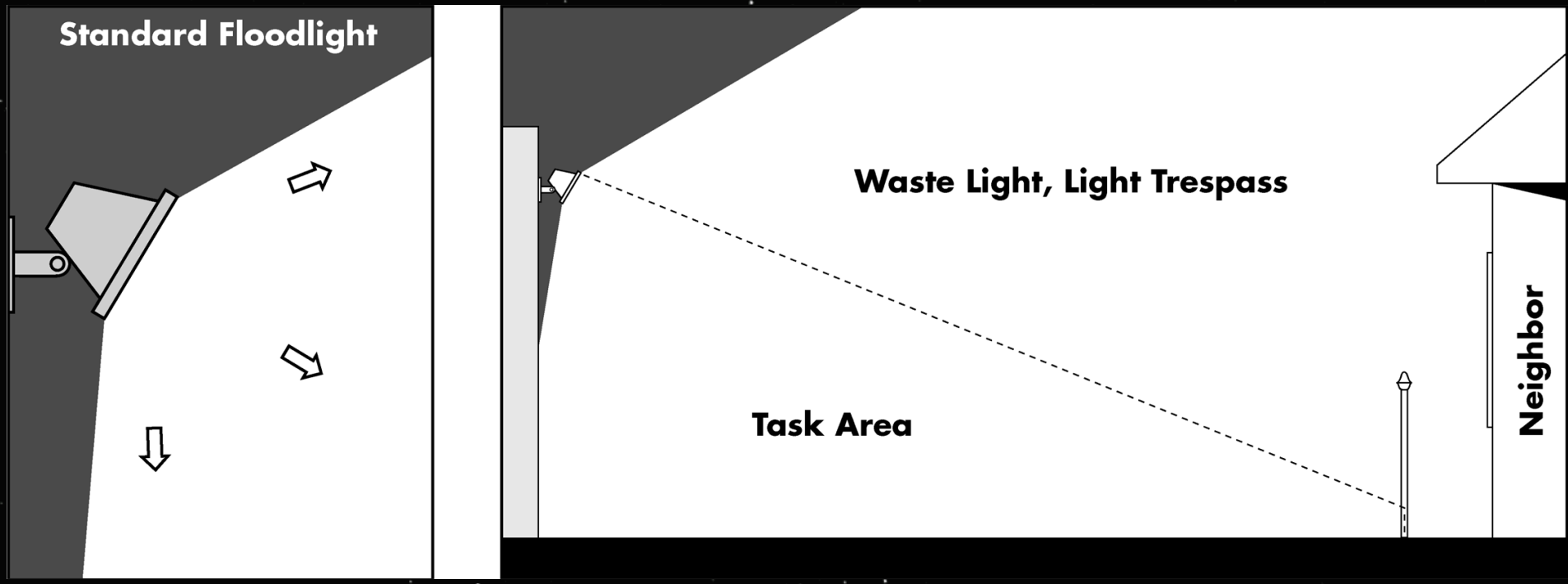


Artificial light at night has become a symbol of our affluent society. This image evokes two motions: one is the impressive display of activity and power, and the other is energy waste and a disregard for the natural night. In reducing light pollution, we must be conscious of both these perspectives (April 2008, R. Dick).

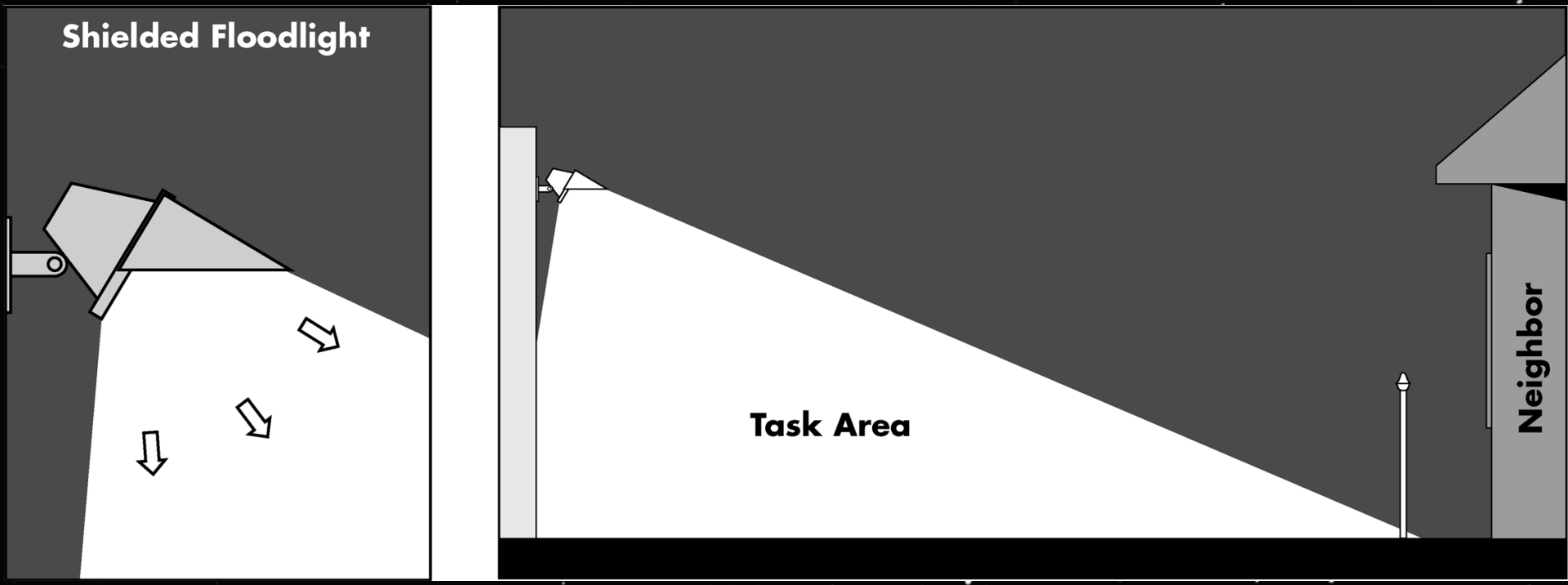
Source: The Royal Astronomical Society of Canada | Environmental Impact of Light Pollution and its Abatement | December 2012

Example of sky glow (3)

Example of trespass

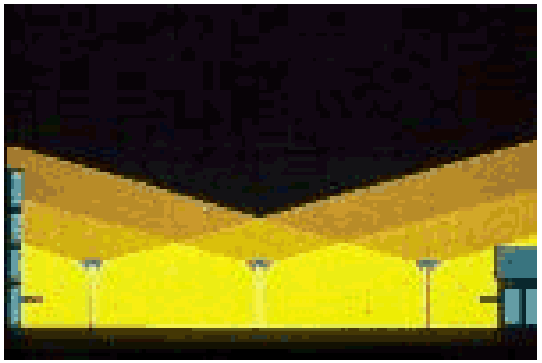


Source: www.rasz.org.nz , Royal Astronomical Society of New Zealand

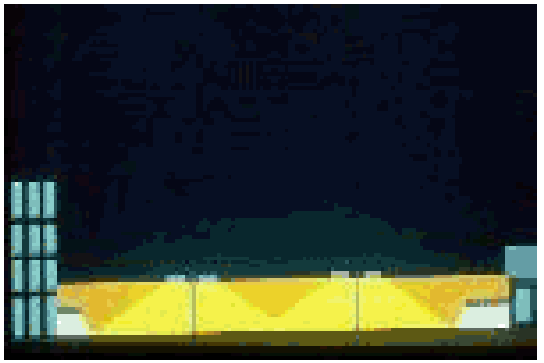


Source: www.rasz.org.nz , Royal Astronomical Society of New Zealand

Non Cut-off



Semi Cut-off



Full Cut-off

Source: www.rasz.org.nz , Royal Astronomical Society of New Zealand

Example of glare

Our eyes have adapted to bright daylight and faint nightlight. Isolated bright lights at night raise a conflict where the glare renders our night vision ineffective. As a result "more light" on one property results in "less visibility" over a wider area.

Source: The Royal Astronomical Society of Canada | Environmental Impact of Light Pollution and its Abatement | December 2012

Example of over-illumination ☹

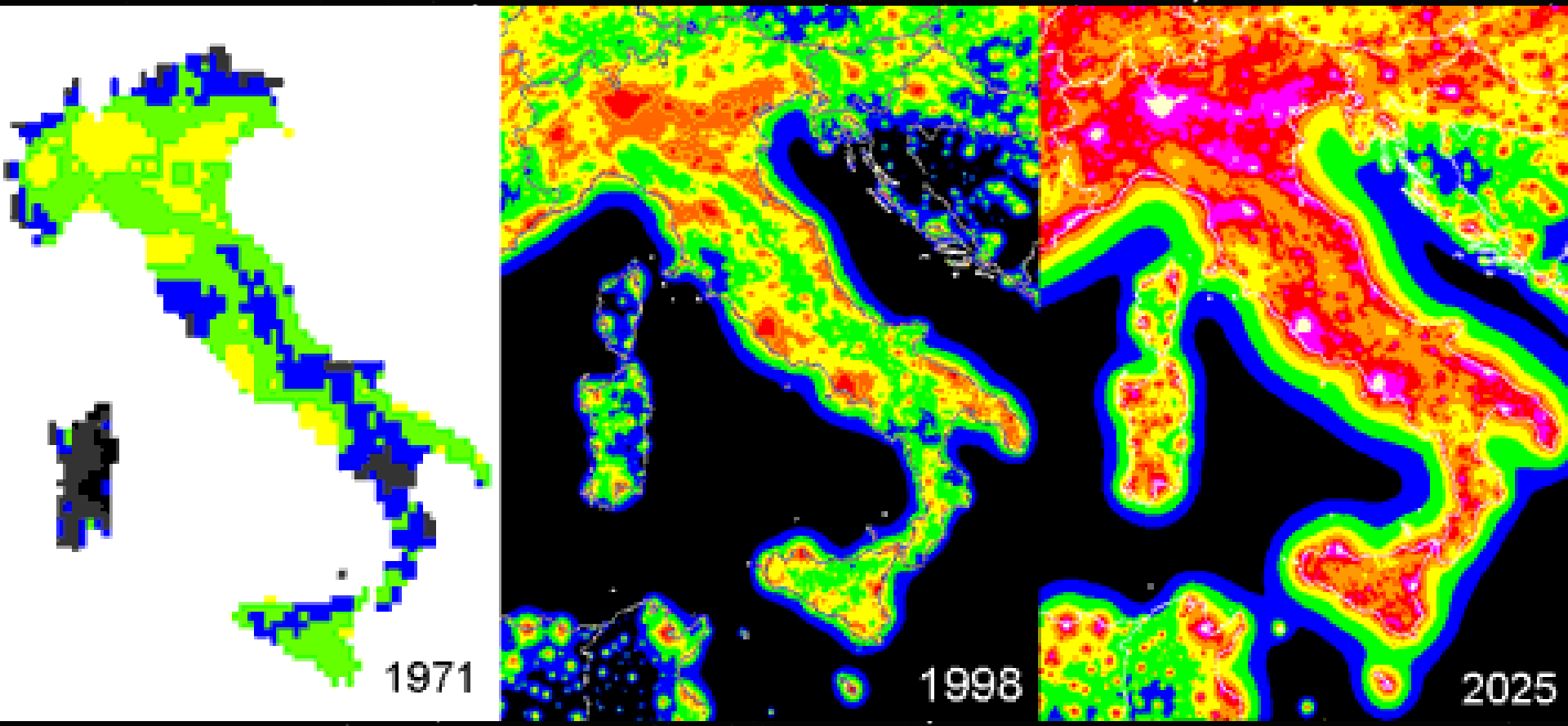
Roadway lighting highlights an area where heightened attention is needed, such as in this interchange with Hwy 416 and Hunt Club Road in western Ottawa. These full-cut-off luminaires improve visibility while limiting the impact on the surrounding forest and open fields.

(Nov. 2011, R. Dick)

How to measure?

Measure by Explanatory Variables

- Gross Domestic Product (bruto nationaal product)
- Population density (bevolkingsdichtheid)



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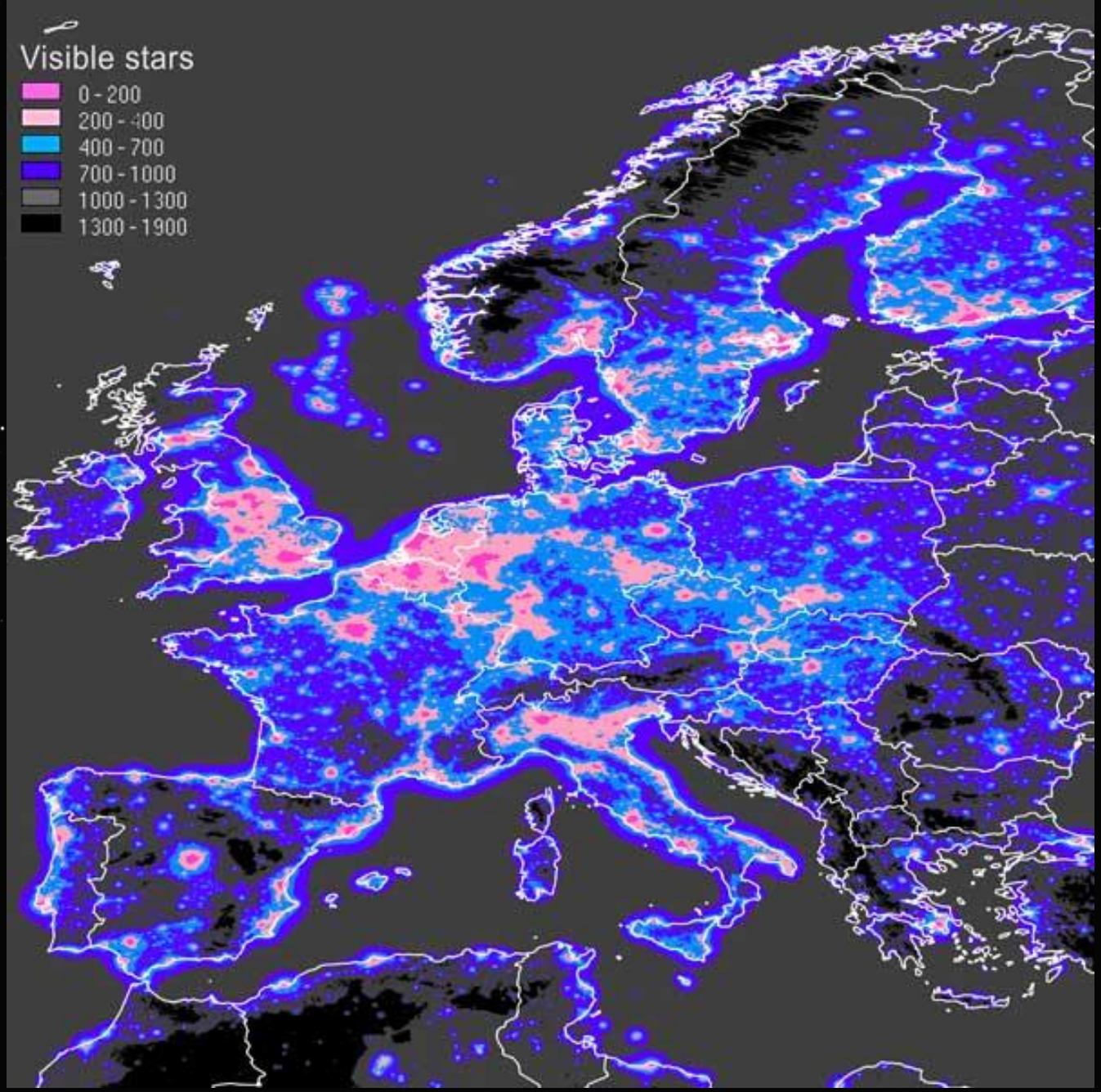

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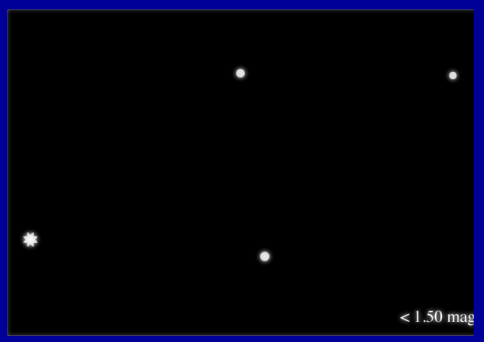
Measure by the Stars: Methode 1: Magnitude Charts

1



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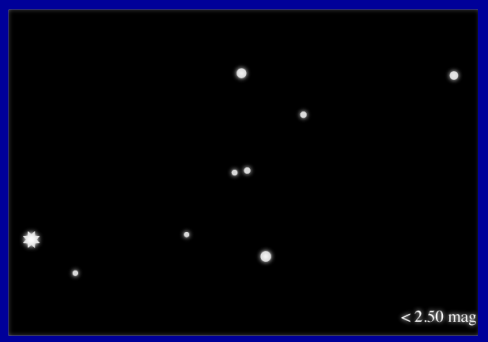

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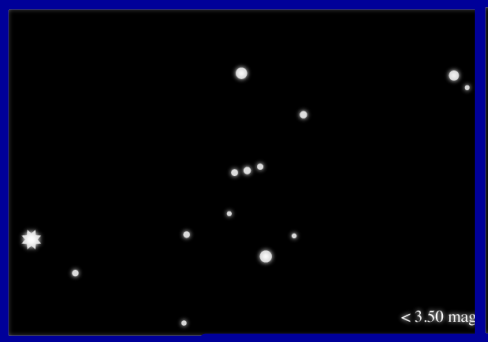

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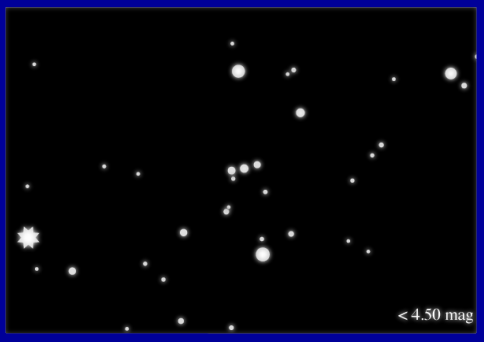

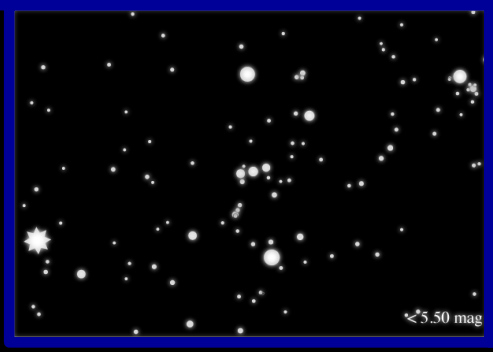

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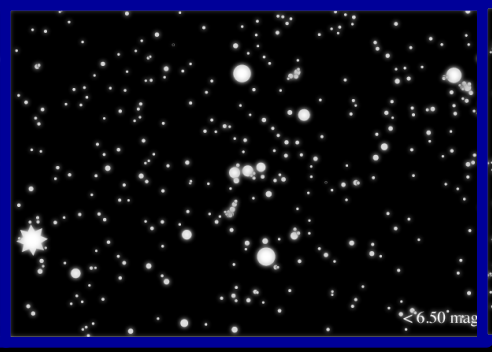

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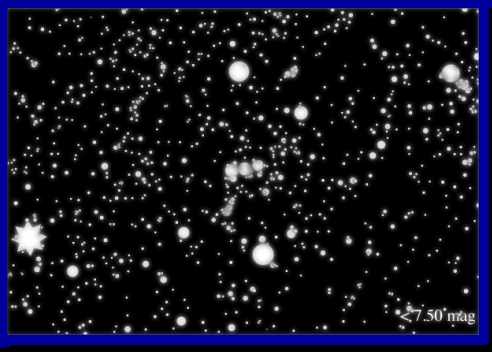

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Methode 2: Visible celestial bodies (zichtbare hemellichamen)

- ☐ Big Dipper (Grote Beer): 81-243 x Sky Br.
- ☐ North Star (poolster): 27-81 x Sky Bright.
- ☐ More than 100 stars: 9-27 x Sky Brightn.
- ☐ Milky Way (Melkweg): 3-9 x Sky Brightn.

Source: Cinzano, Falchi, & Elvidge, 2006

Solutions

FM interventions

- Preservation of unlit areas
- Trespass
- Intensity
- Spectrum
- Duration

(Gaston, Davies, Bennie, & Hopkins, 2012)

Solutions & Results

Design

- Adaptation of distribution of light
- Reduction of glare

Results

- Reduction emission
- Lower energy use
- Lower exploitation costs

(o.a. Borg, 1996; Struijs et al., 2009)

More information:

- http://bit.ly/Ny6LXj this presentation
- http://bit.ly/PV20cm paper on light pollution (in Dutch) by Lechner & Arns (2013)
- www.darksky.org International Dark-Sky Association
- www.lightpollution.it Pierantonio Cinzano