

Darkness in Distress



Dan & Cindy Duriscoe / NPS Night Sky Team

An Introduction to Light Pollution

***“Our fantastic civilization has fallen out of touch
with many aspects of nature,
and with none more completely than with night . . .***

***With lights and ever more lights,
we drive the holiness and beauty of night
back to the forests and the sea . . .”***

Dan & Cindy Duriscoe / NPS Night Sky Team

**Henry Beston, “Night on the Great Beach”
from *The Outermost House* (1928)**

Light Pollution

Illumination of the night sky by artificial light sources.

Includes glare, trespass, and disturbance of the natural nighttime landscape.

Much of this light never touches the ground.

Instead, it shines straight up into the sky.

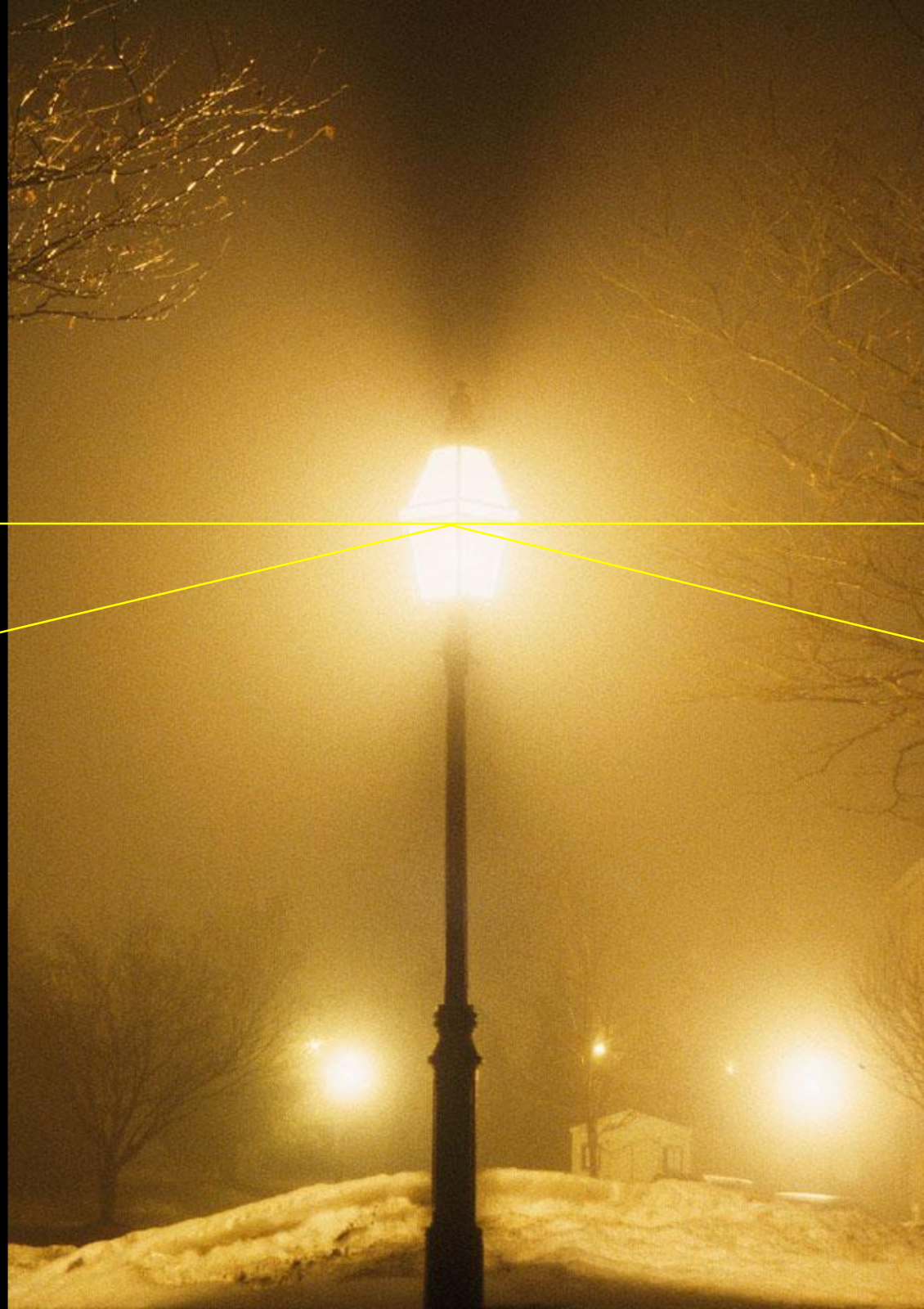




Uplight

Glare

Useful



Streetlights



Security Lights





Floodlights





Consequences of Light Pollution

- **Loss of the starry sky (skyglow)**

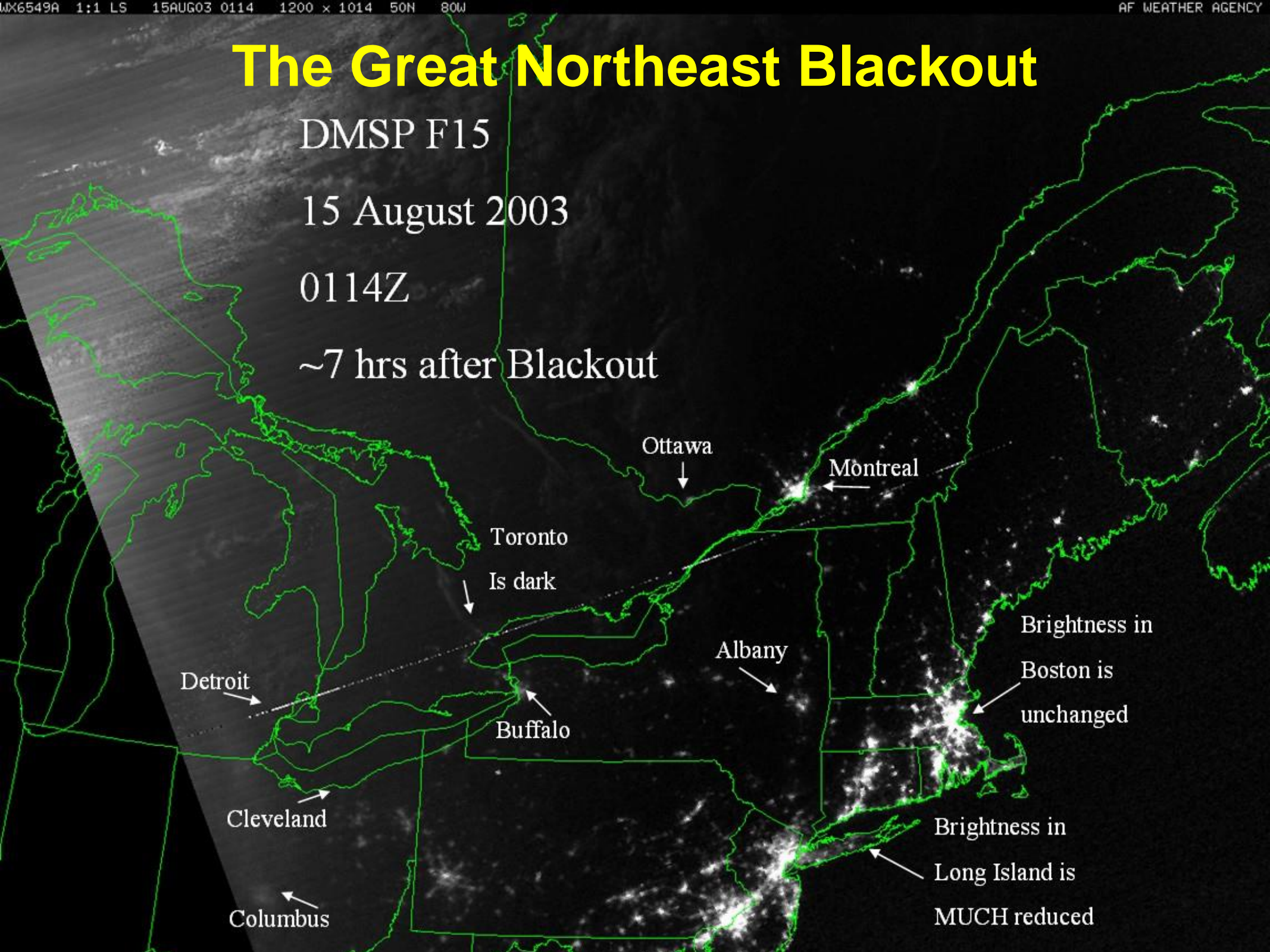
The Great Northeast Blackout

DMSF F15

15 August 2003

0114Z

~7 hrs after Blackout



Ottawa

Montreal

Toronto

Is dark

Brightness in

Boston is

unchanged

Albany

Detroit

Buffalo

Brightness in

Long Island is

MUCH reduced

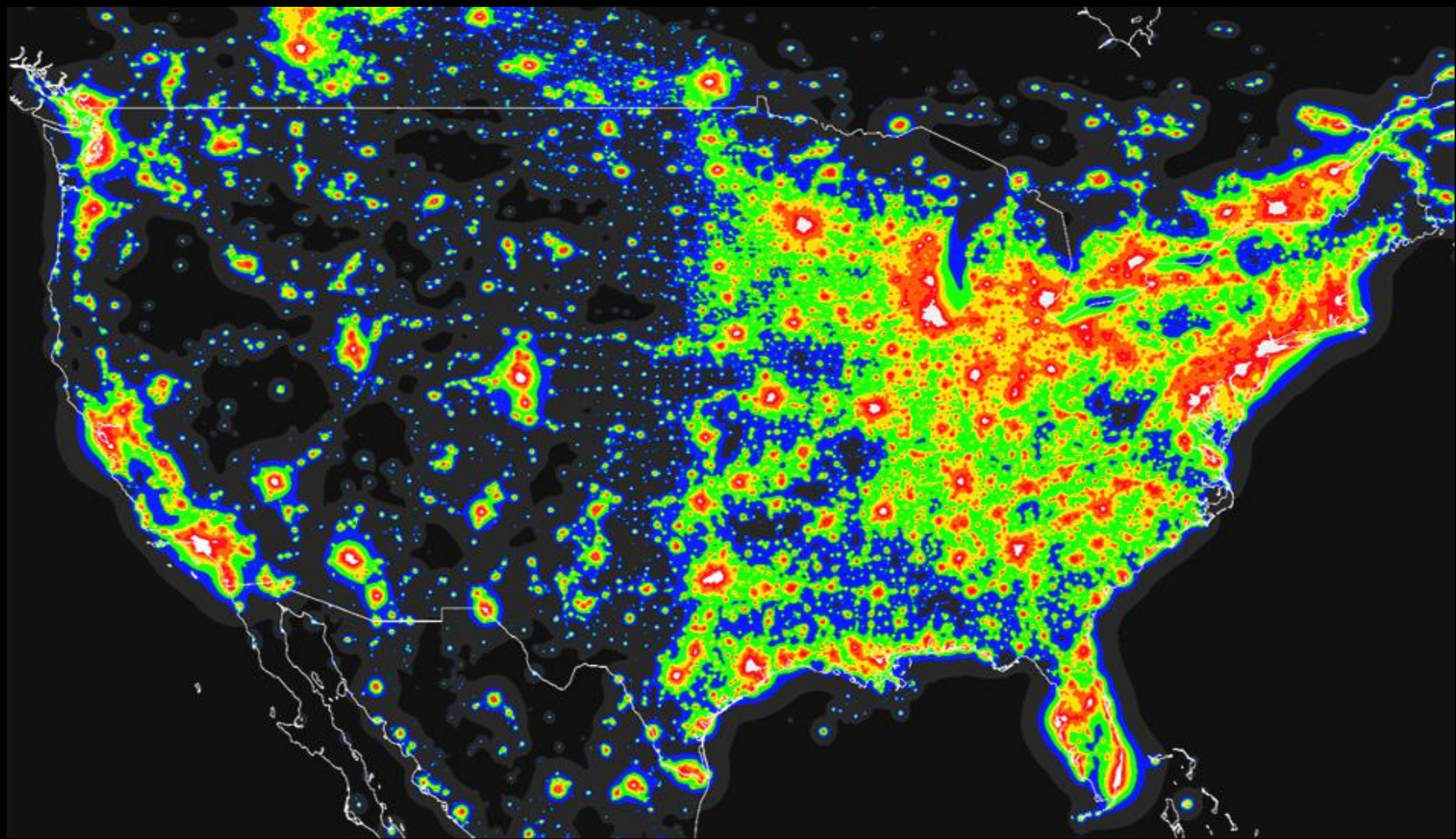
Cleveland

Columbus



© 2003 Todd Carlson





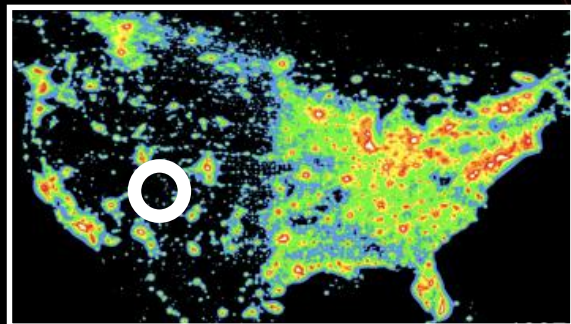
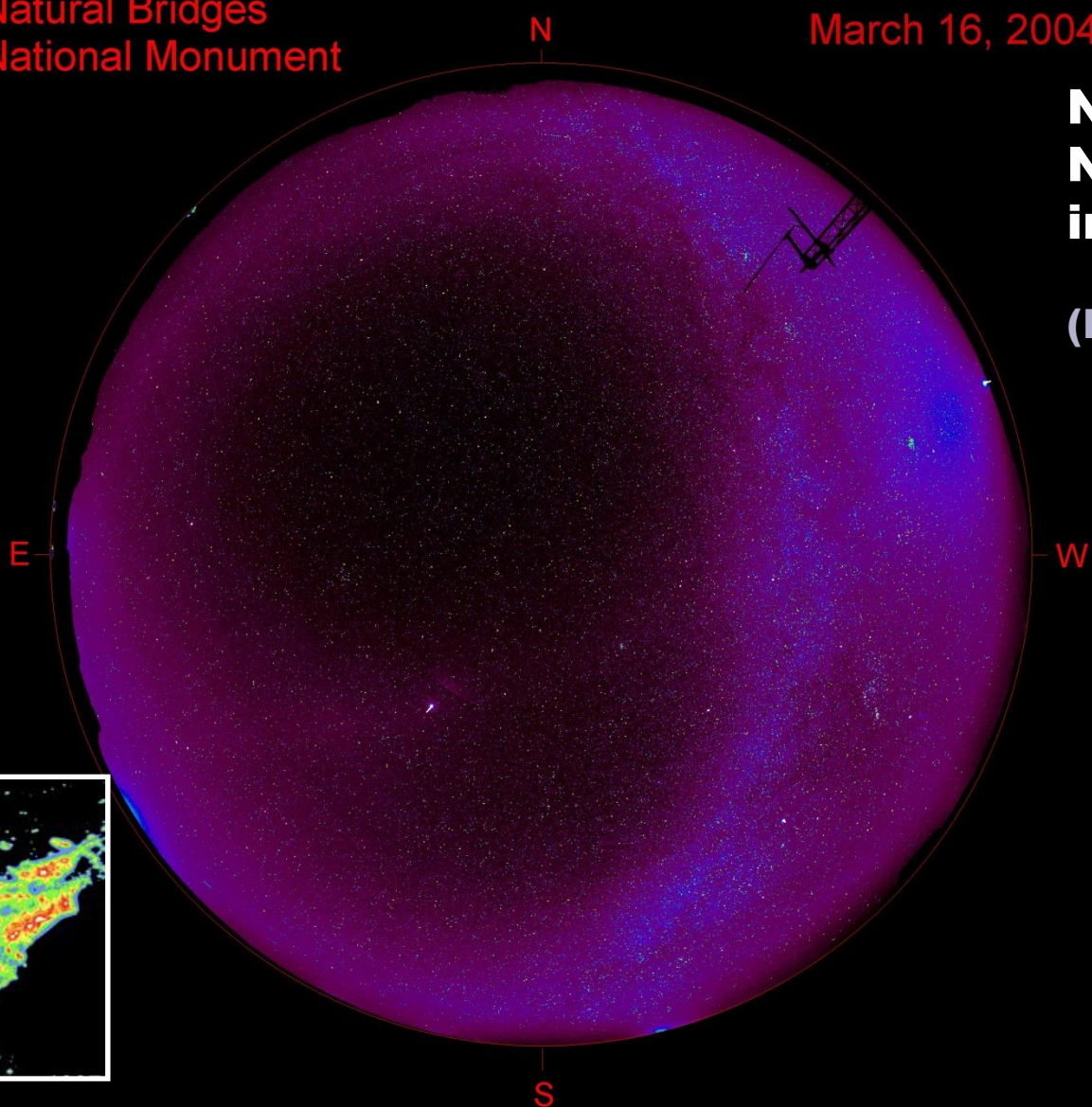


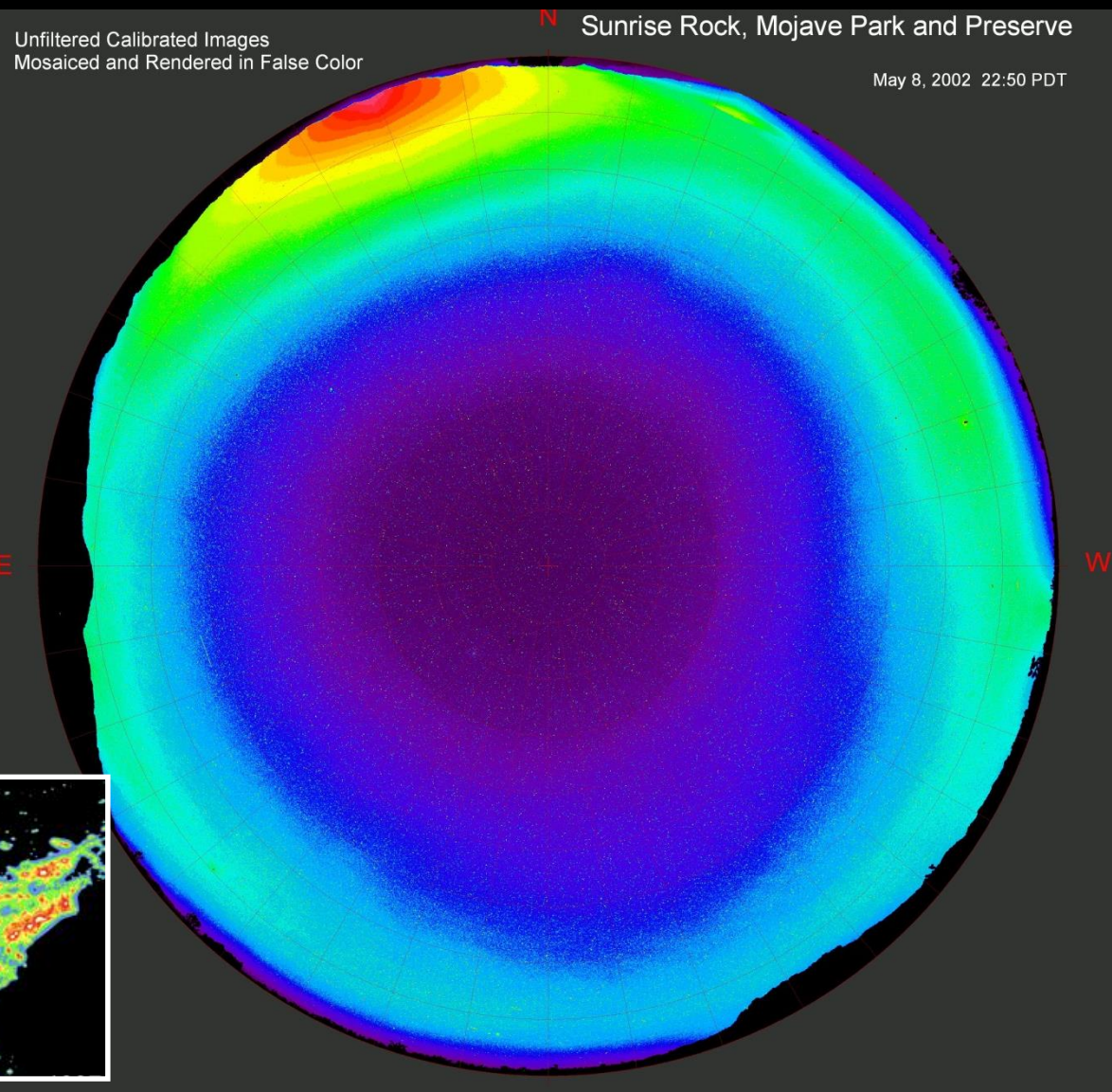
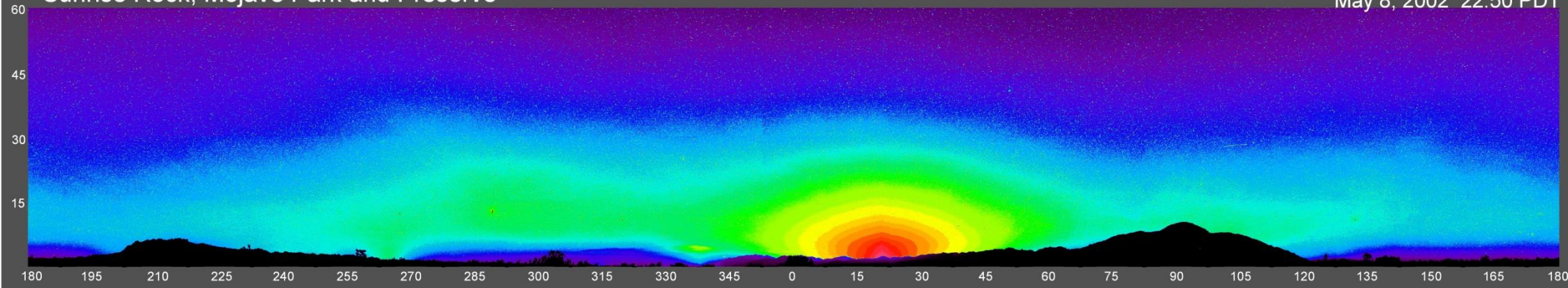
Natural Bridges
National Monument

March 16, 2004

Natural Bridges Nat'l Monument in Utah

(IDA Dark Sky Park)



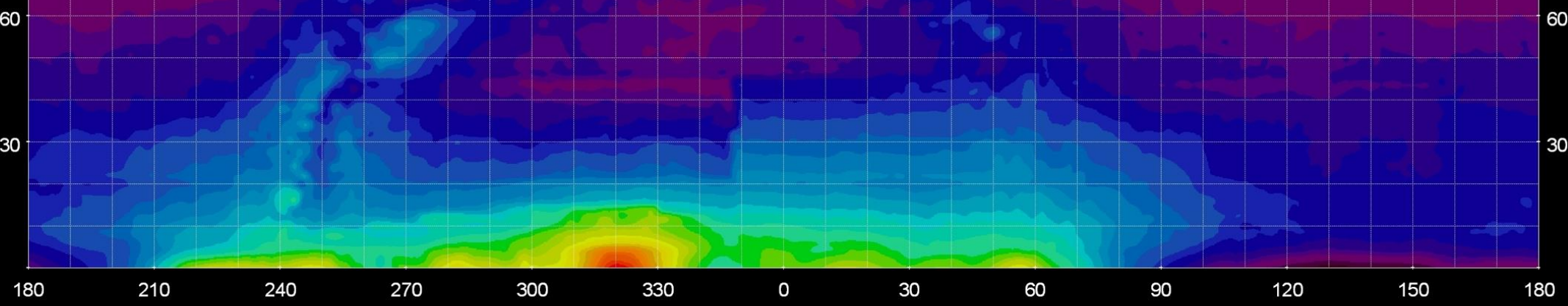


Mojave National Preserve, CA
(Las Vegas, NV)

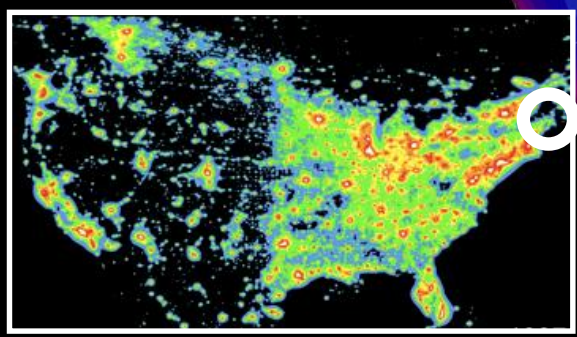
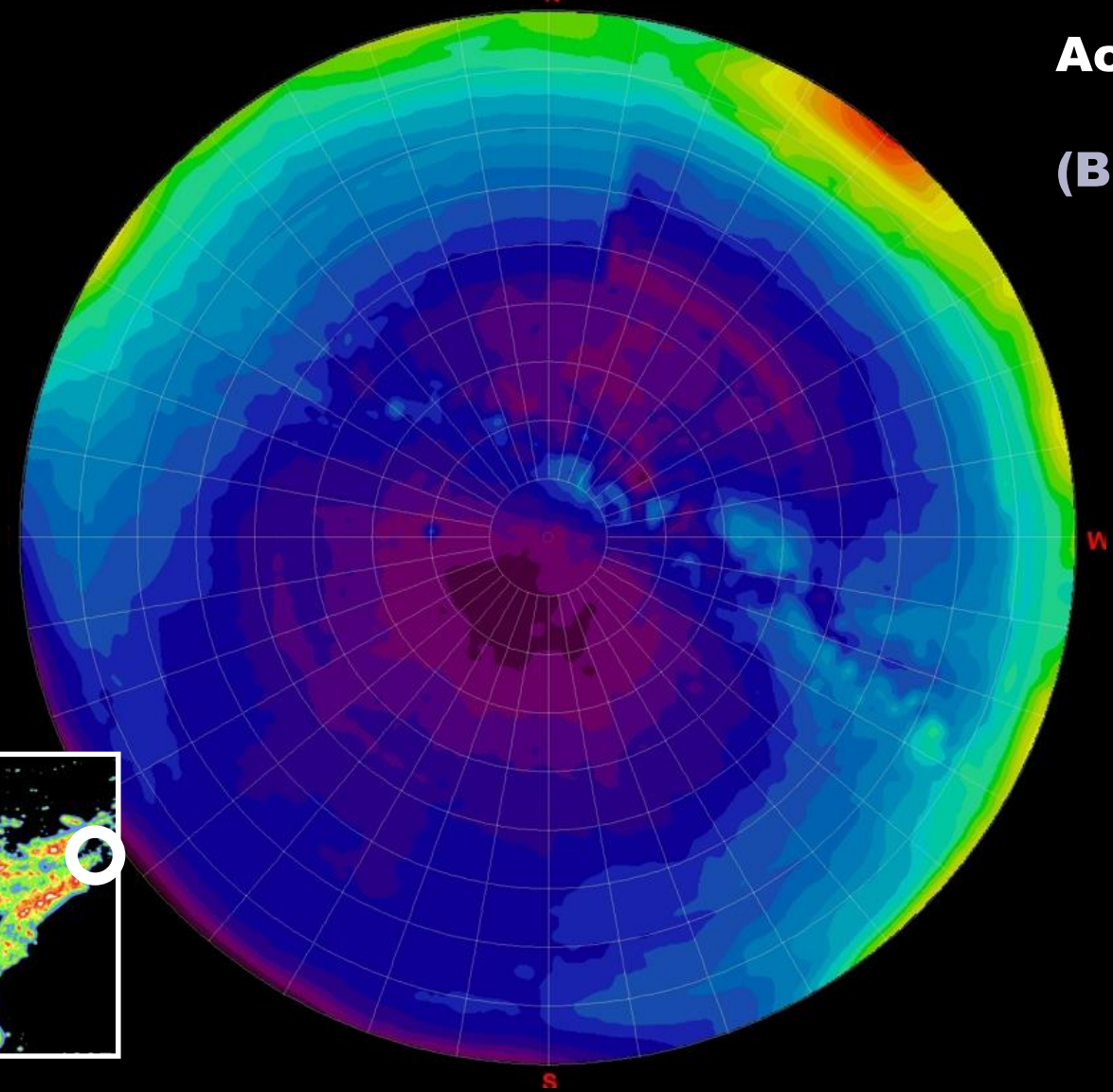


NPS Night Sky Team

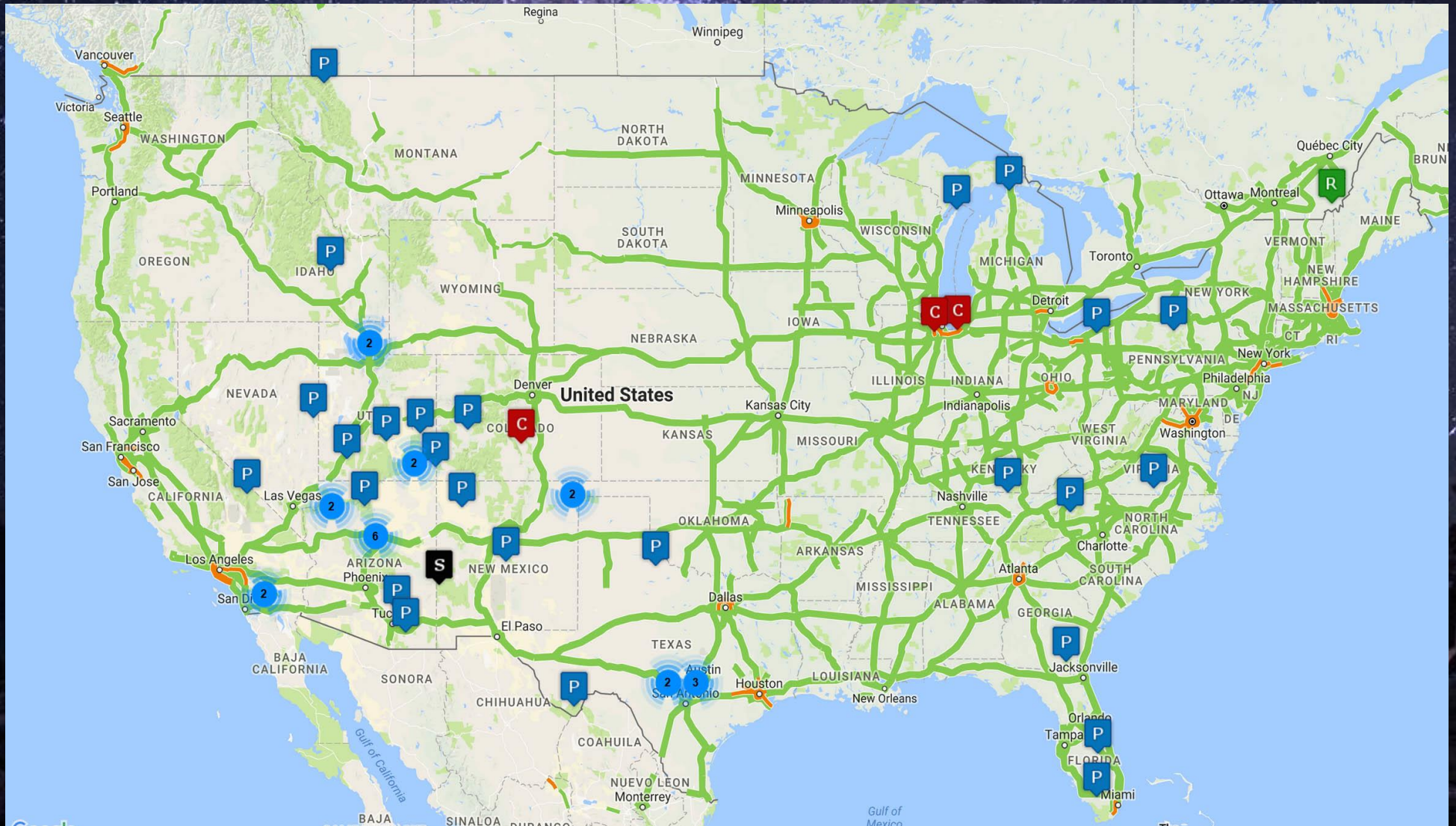




Acadia Natl Park
(Bar Harbor, ME)



IDA Dark-Sky Places in U.S.



Consequences of Light Pollution

- **Loss of the starry sky (skyglow)**
- **Visual impairment (glare, trespass)**

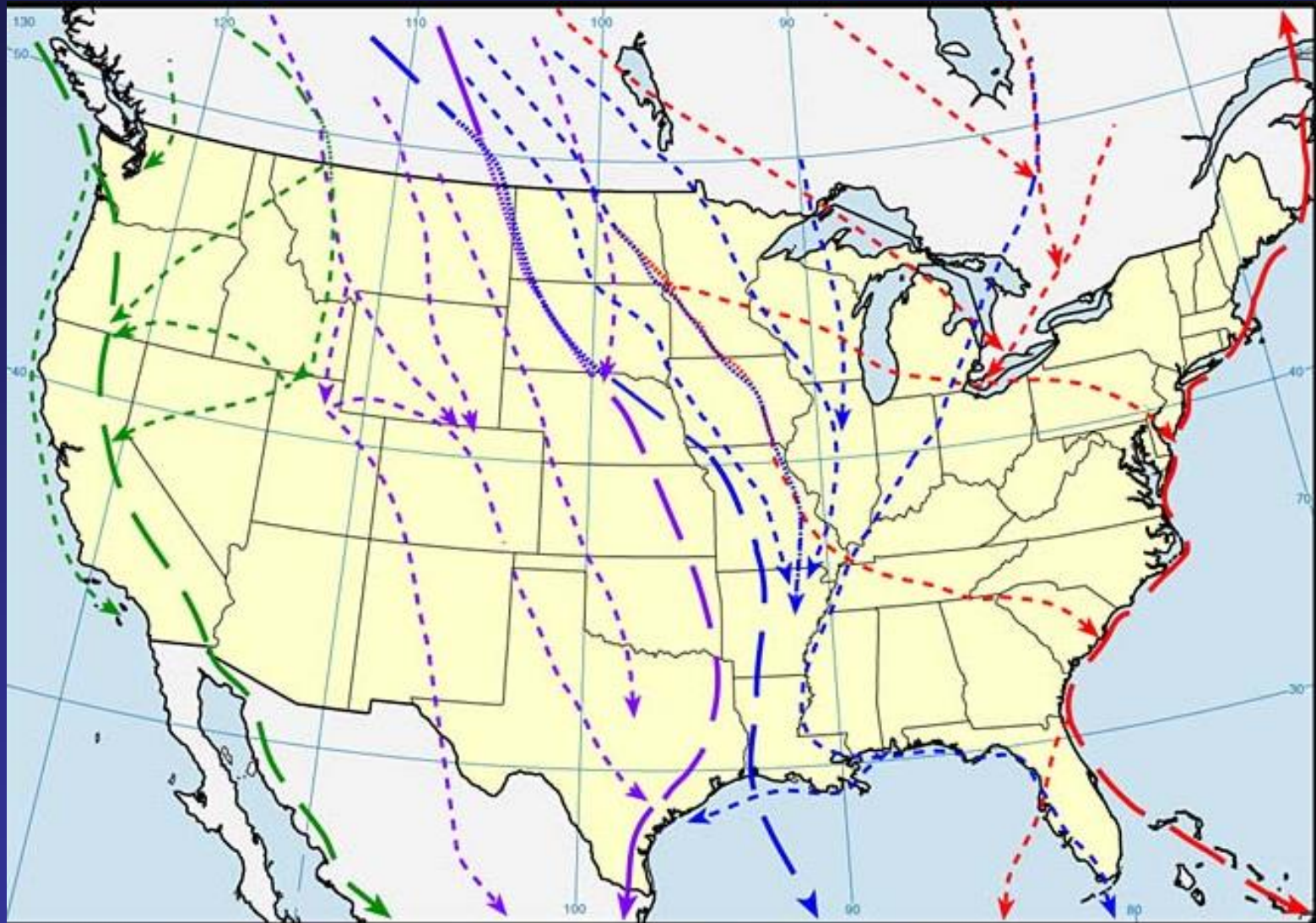




Consequences of Light Pollution

- **Loss of the starry sky (skyglow)**
- **Visual impairment (glare, trespass)**
- **Environmental consequences**

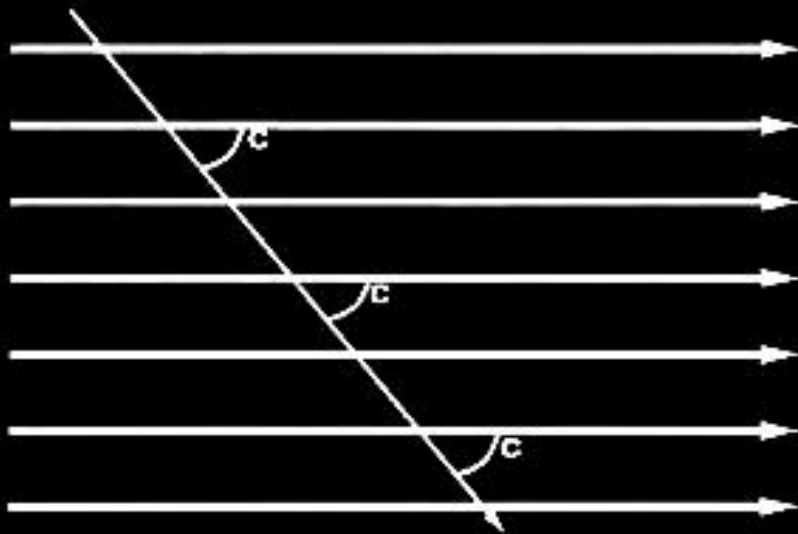
Bird Migratory Flyways



*North American Migration Flyways
(with Principal Routes)*

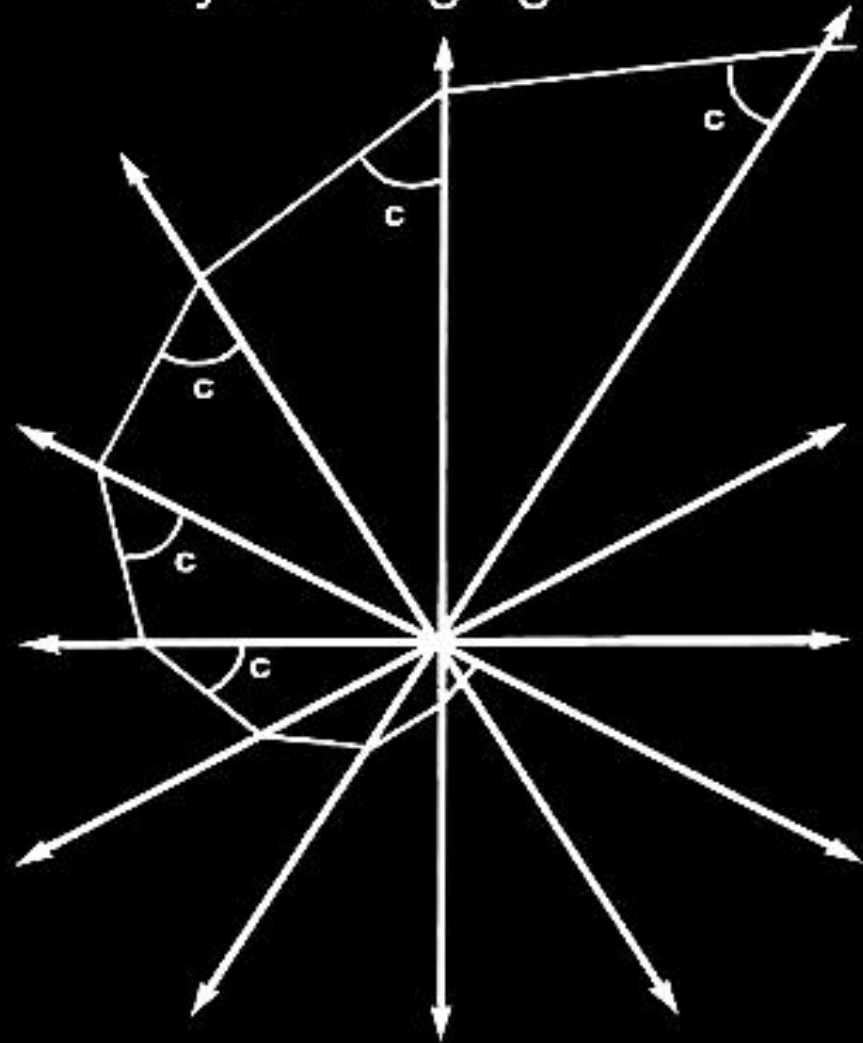
- Atlantic Flyway
- Mississippi Flyway
- Central Flyway
- Pacific Flyway

(a) Moonlight, at infinity
rays "parallel"



C= compass factor

(b) Streetlight, local
rays diverging





Fatal Light Awareness Program

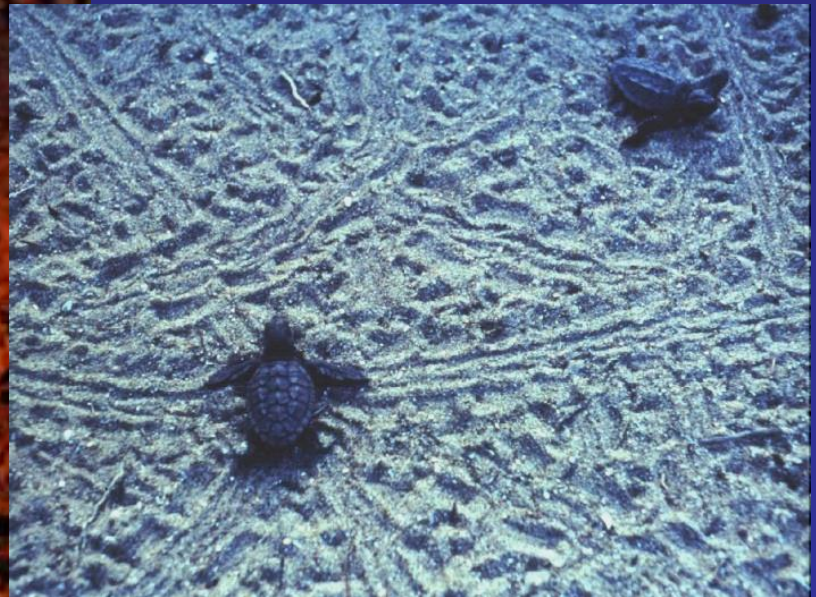
Artificial light contributes to an estimated **10 to 40 million** bird deaths annually in the United States alone.

Movement of Sea Turtle Hatchlings



Newborn hatchlings move toward glints of light on ocean waves.

But bright lights on buildings tempt them, and they often head away from the water.

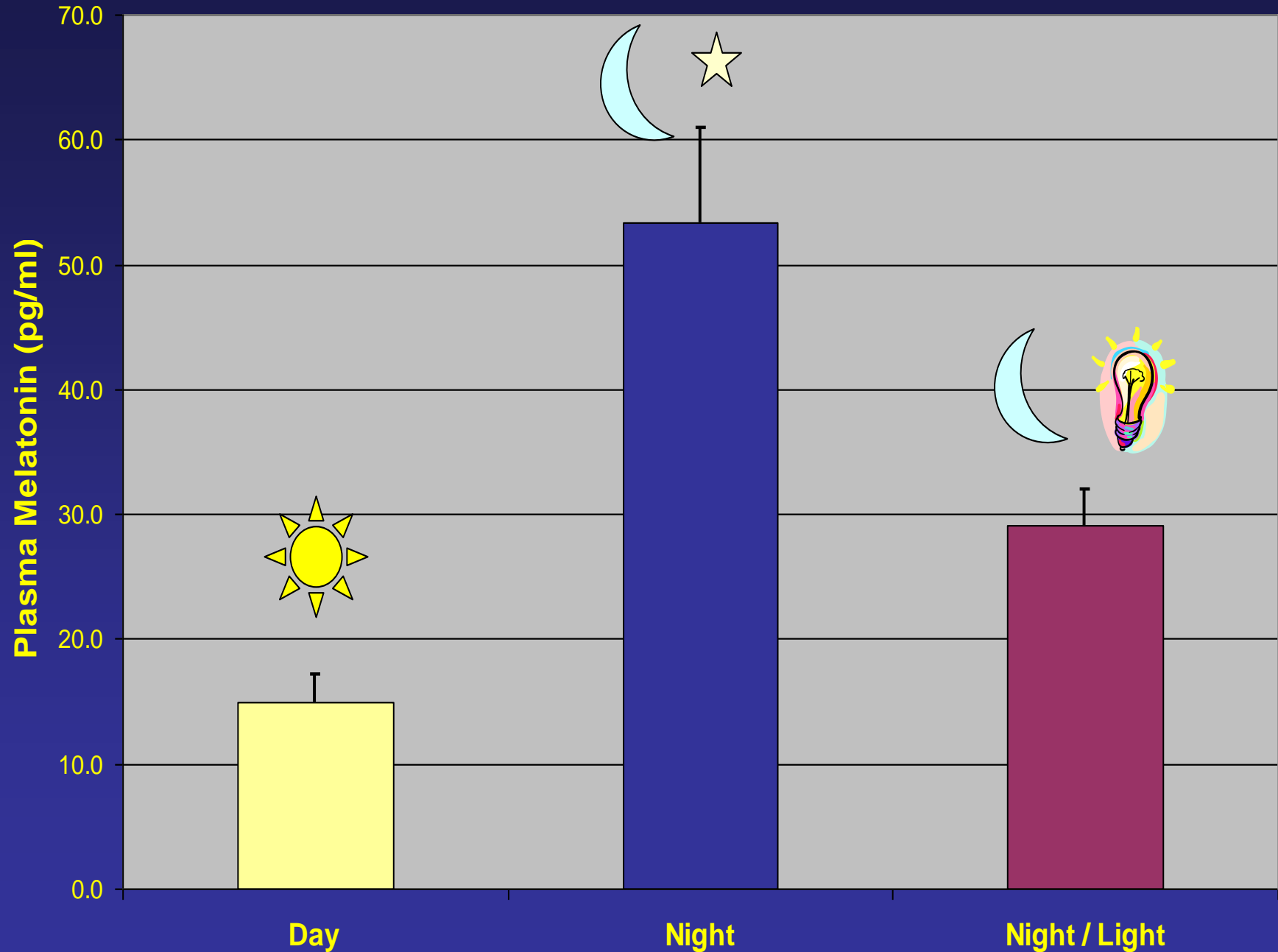




Consequences of Light Pollution

- **Loss of the starry sky (skyglow)**
- **Visual impairment (glare, trespass)**
- **Environmental consequences**
- **Human consequences**

Human Blood Plasma Melatonin Levels



Light-at-Night Hypothesis

Richard G. Stevens, *Amer. J. Epidemiology* (1987)

Exposure to light at night suppresses pineal-gland melatonin production, which may explain some of the high and unaccounted for risk of breast cancer in industrialized 24-hr/day societies (shift work & fat intake at night).

International Agency for Research on Cancer (May 2007):

“Shiftwork that involves circadian disruption is probably carcinogenic to humans.”



American Medical Association (June 2012):

“Pervasive use of nighttime lighting disrupts various biological processes, creating potentially harmful health effects related to disability glare and sleep disturbance.”



Consequences of Light Pollution

- Loss of the starry sky (skyglow)
- Visual impairment (glare, trespass)
- Environmental consequences
- Human consequences
- Energy waste



Earth at Night
More information available at:
<http://antwrp.gsfc.nasa.gov/apod/ap001127.html>

Astronomy Picture of the Day
2000 November 27
<http://antwrp.gsfc.nasa.gov/apod/astropix.html>



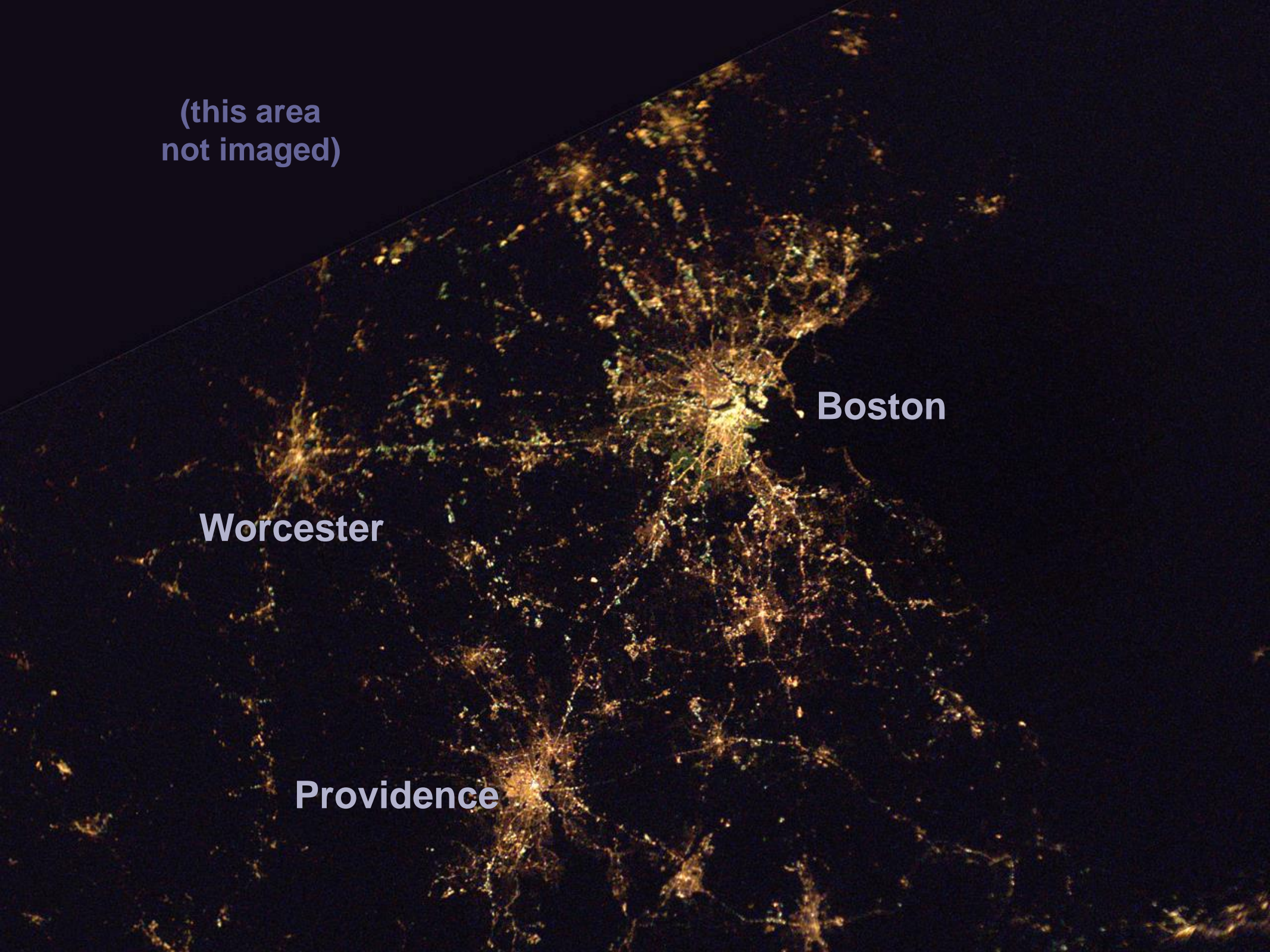
Suomi NPP satellite

(this area
not imaged)

Boston

Worcester

Providence



(this area
not imaged)

Route 9

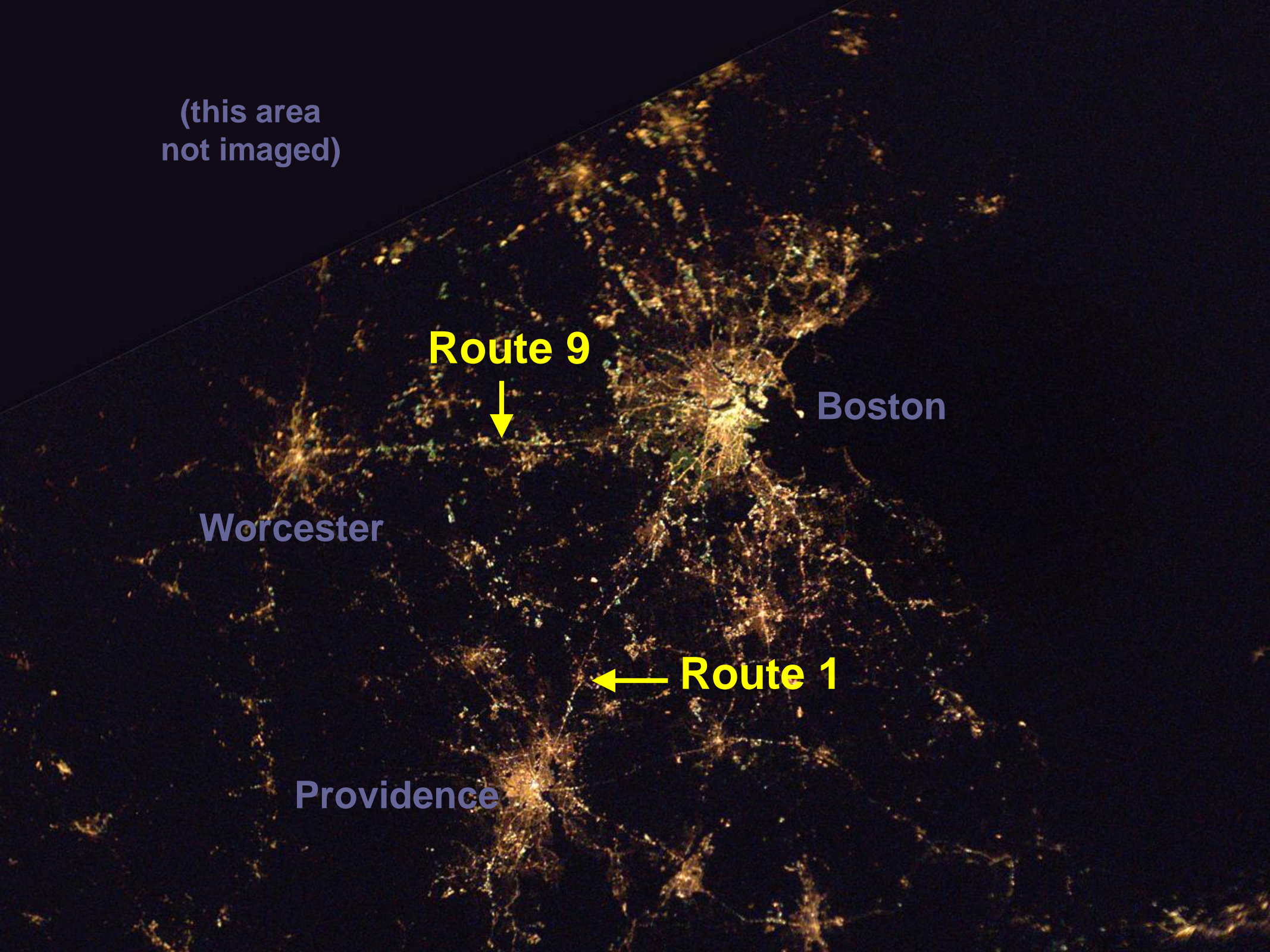


Boston

Worcester

← Route 1

Providence



Wasted Energy (per year) in Greater Boston:

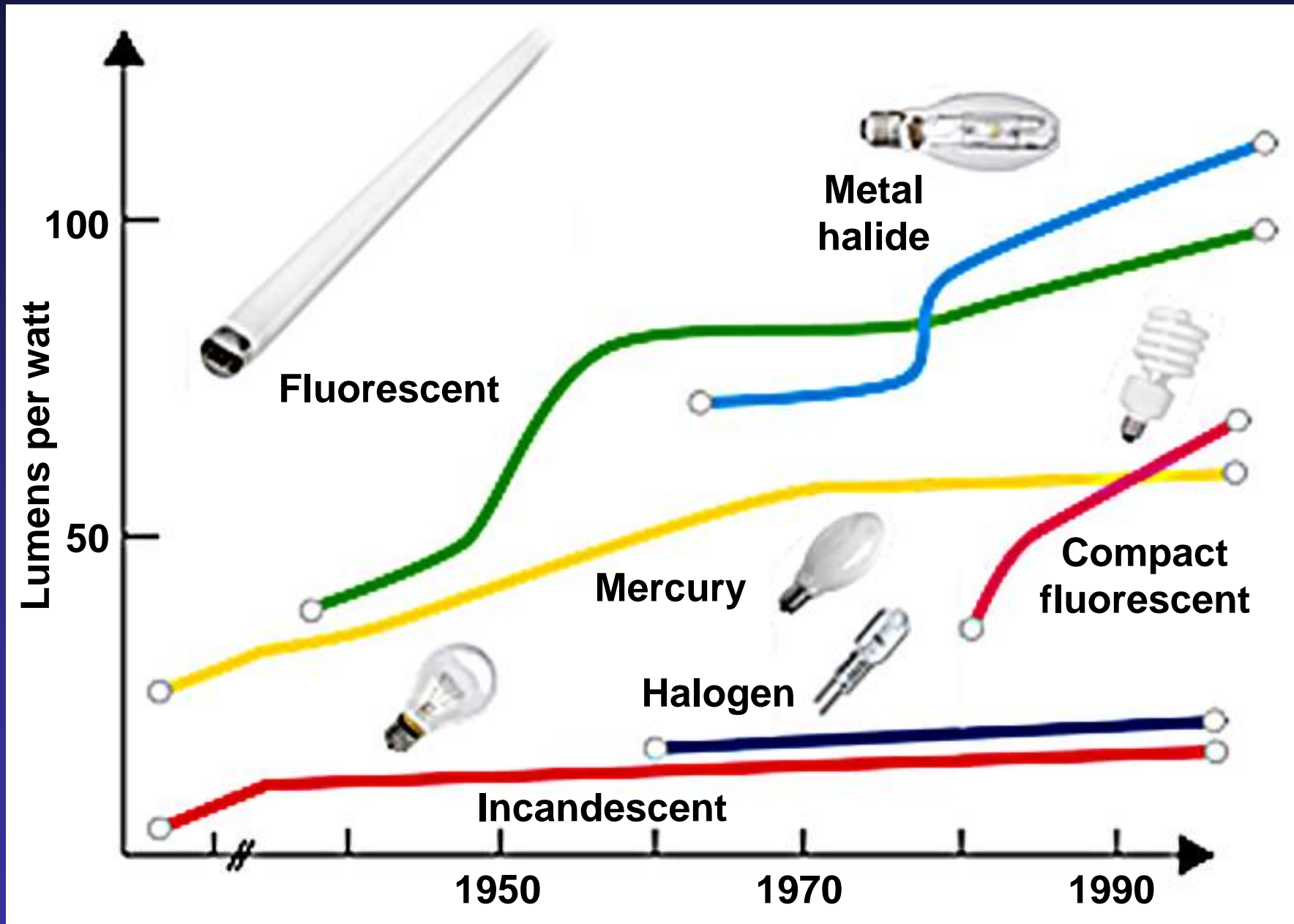
15,000,000 kWh (Isobe 1997) **\$25,000,000** (2015 rates)

An aerial night photograph of Greater Boston, Massachusetts, showing the city's layout and surrounding areas. The image is overlaid with a complex, glowing network of yellow and orange lines and dots, representing energy waste. The glowing patterns are most concentrated in the central urban core and along major transportation corridors, with smaller clusters in surrounding suburban and rural areas. The background is dark, making the glowing energy waste patterns stand out prominently.

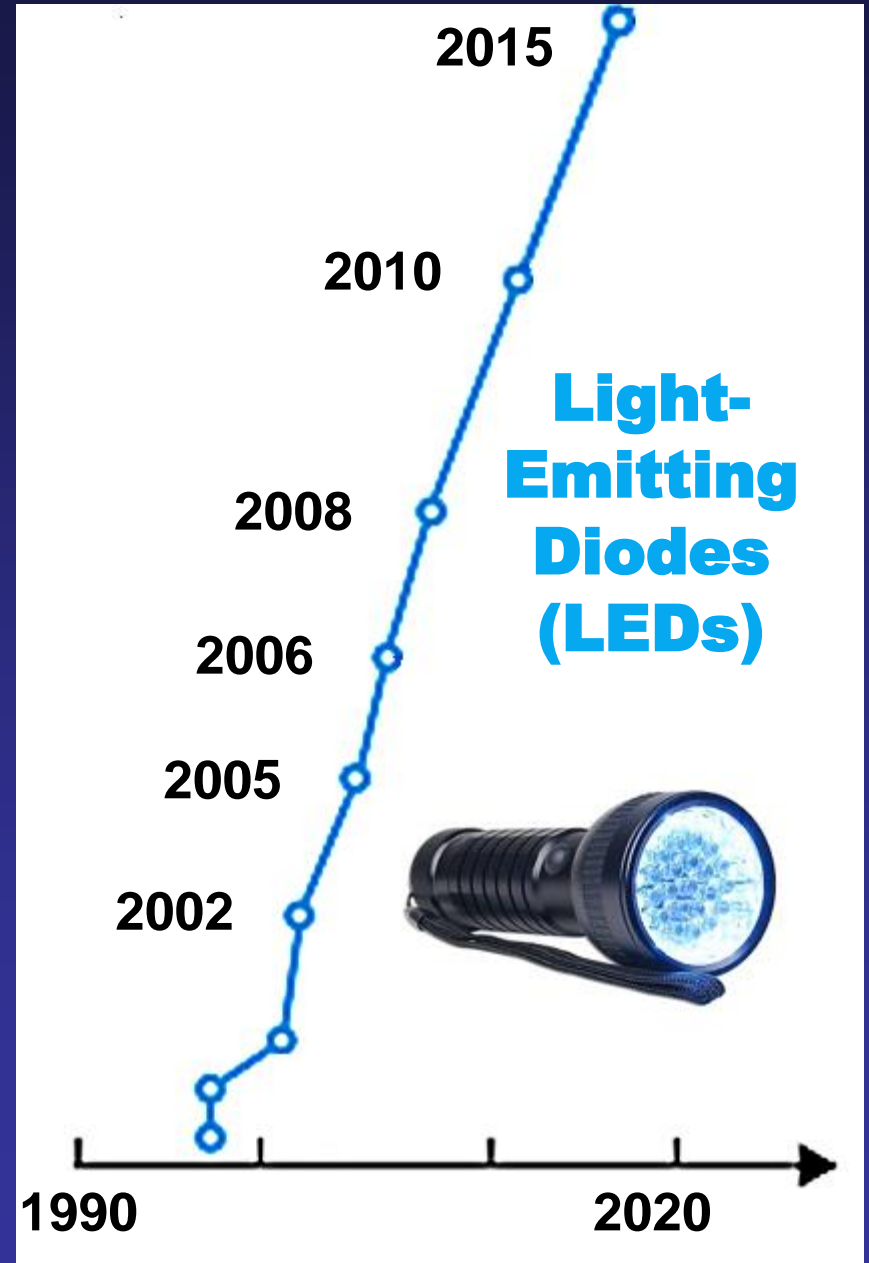
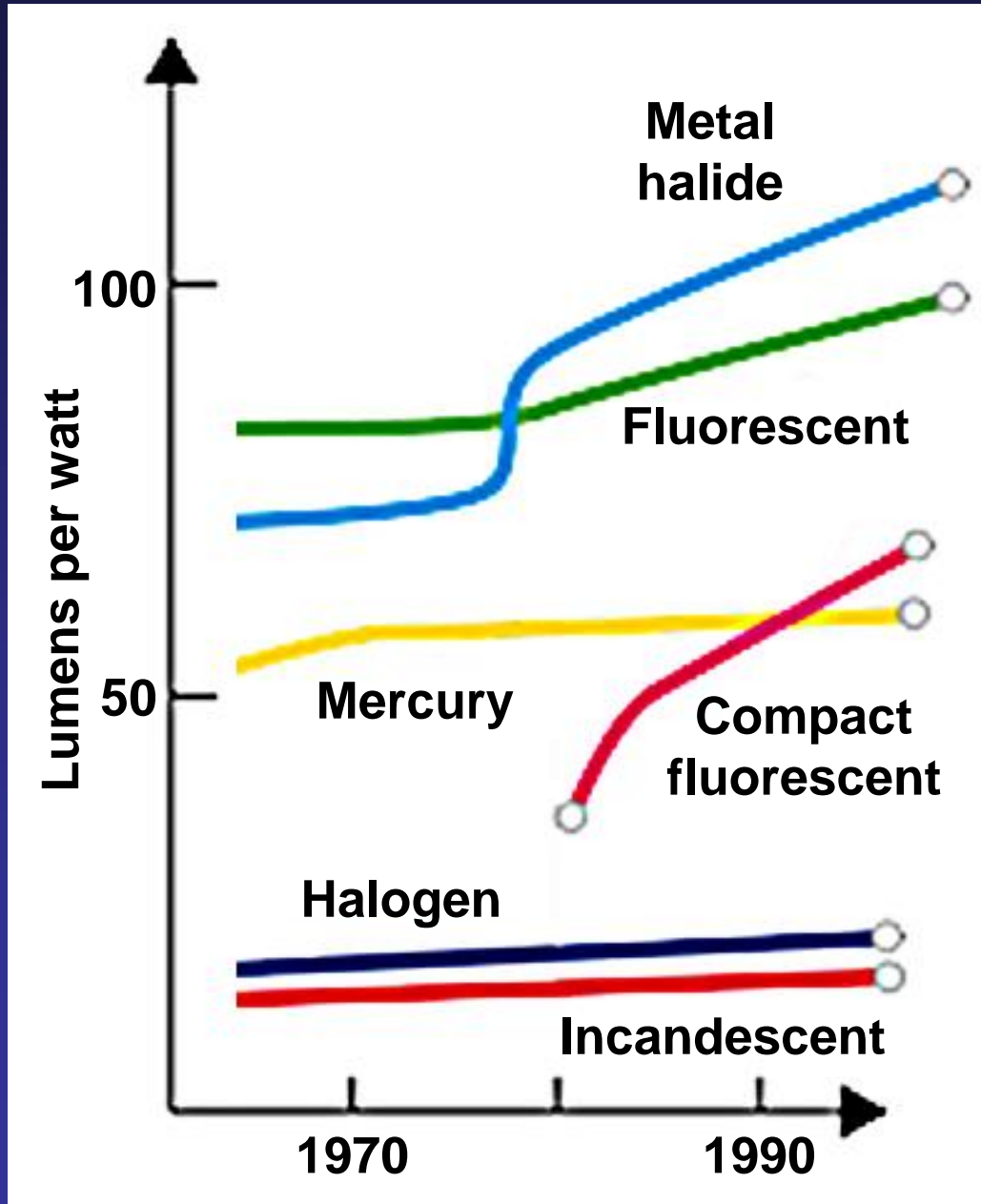
Downtown Chicago



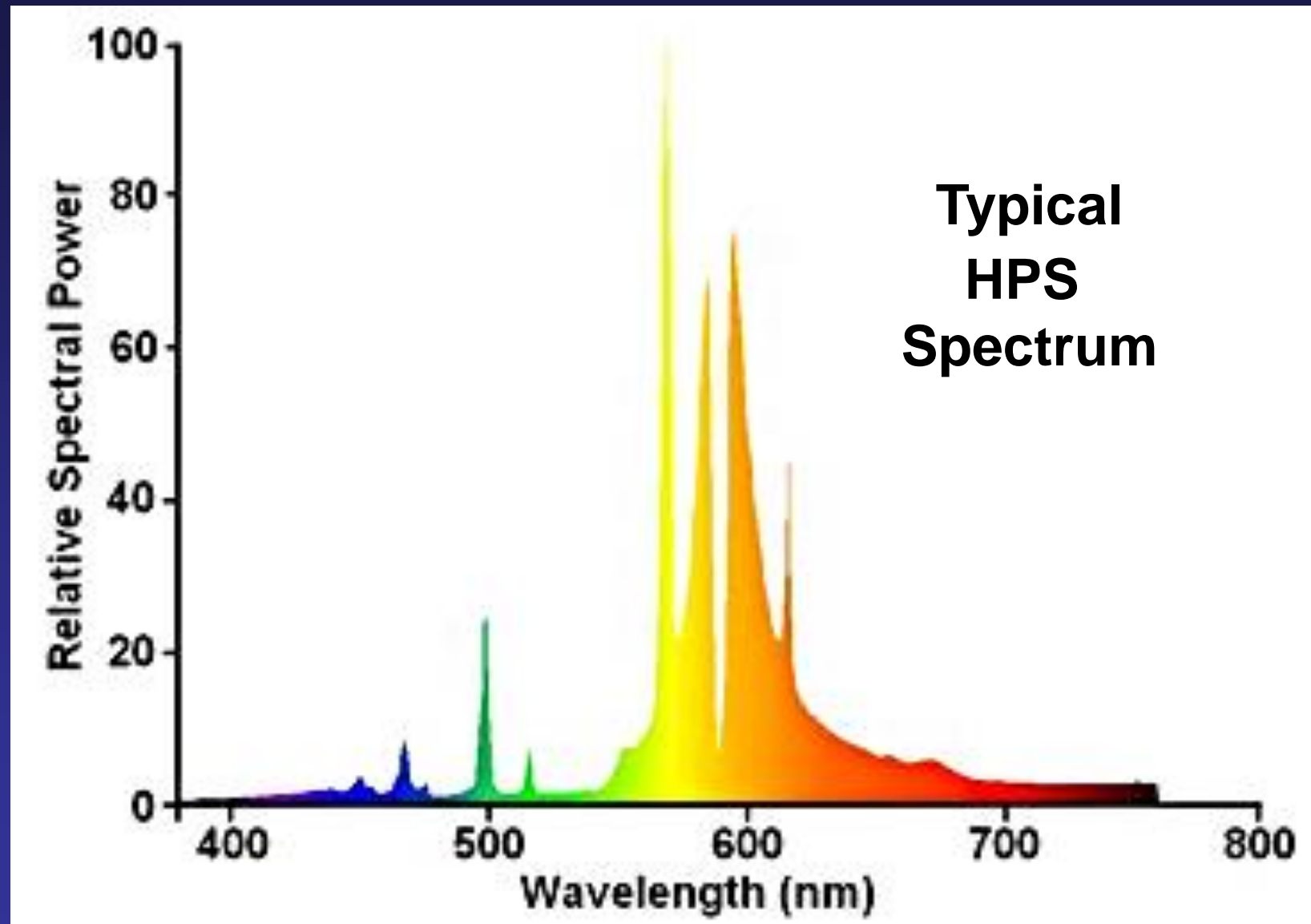
The Promise of LEDs



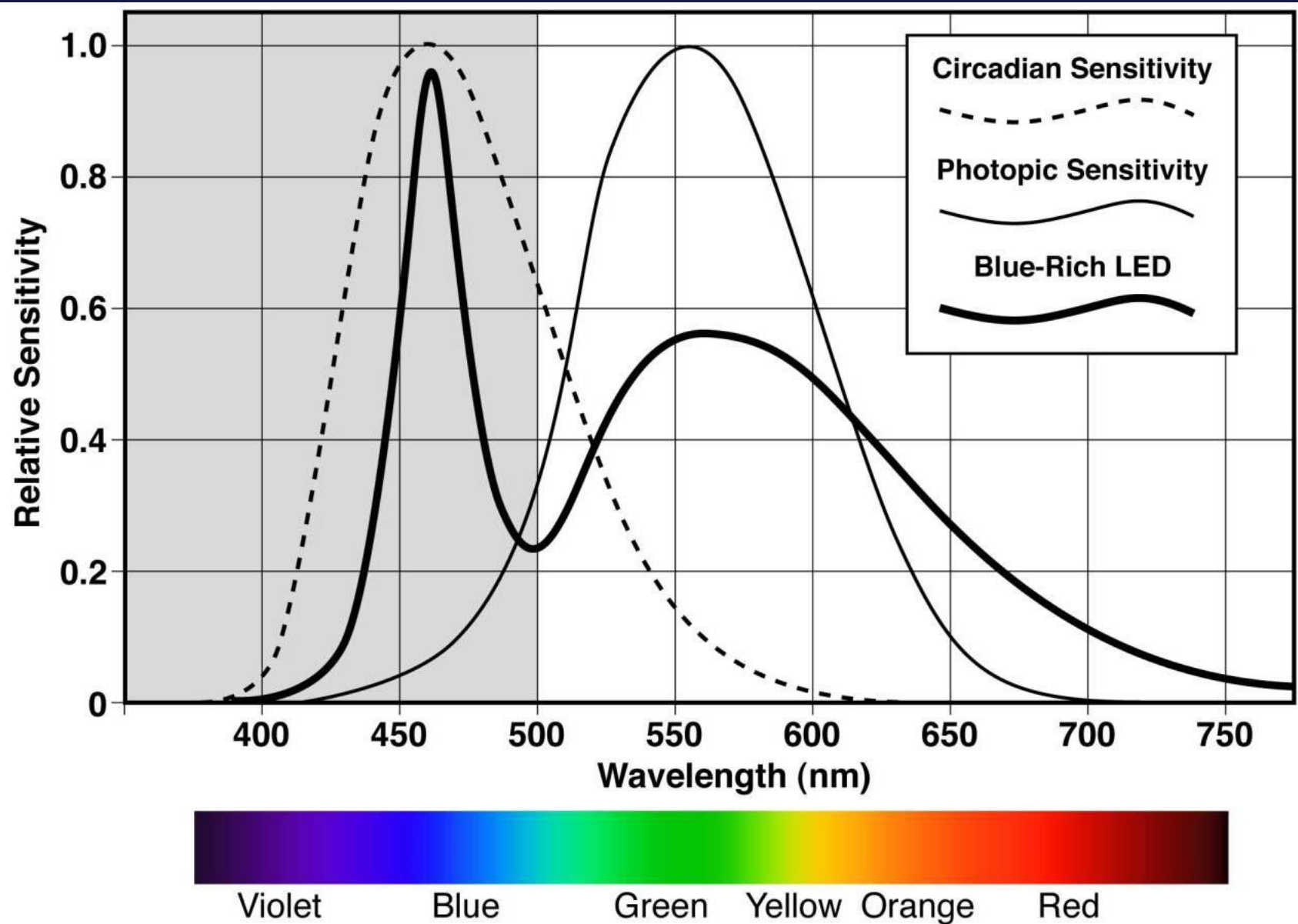
The Promise of LEDs



A Caution About LEDs



A Caution About LEDs



Milan, Italy (seen from orbit)



2012 — before conversion to LED streetlights

Milan, Italy (seen from orbit)



2015 — after conversion to LED streetlights

LED Streetlights, Cambridge, MA



4000K (but dimmed late at night via network)

LED Area Lights, Chelmsford, MA



2700K retrofit of existing HPS lighting

LED Area Lights, Chelmsford, MA



2700K retrofit of existing HPS lighting

American Medical Association (June 2016):

“AMA encourage[s] the use of 3000K or lower lighting for outdoor installations such as roadways.”



Growing Awareness



Pluggers carry on the ancient skill of celestial navigation.

www.darksky.org/losingthedark

Lighting Fundamentals: The Task

Light when you need it,

Where you need it,

In just the amount necessary . . .

Lighting Fundamentals: The Task

Light when you need it,

Where you need it,

In just the amount necessary . . .

and no more. All else is waste.