

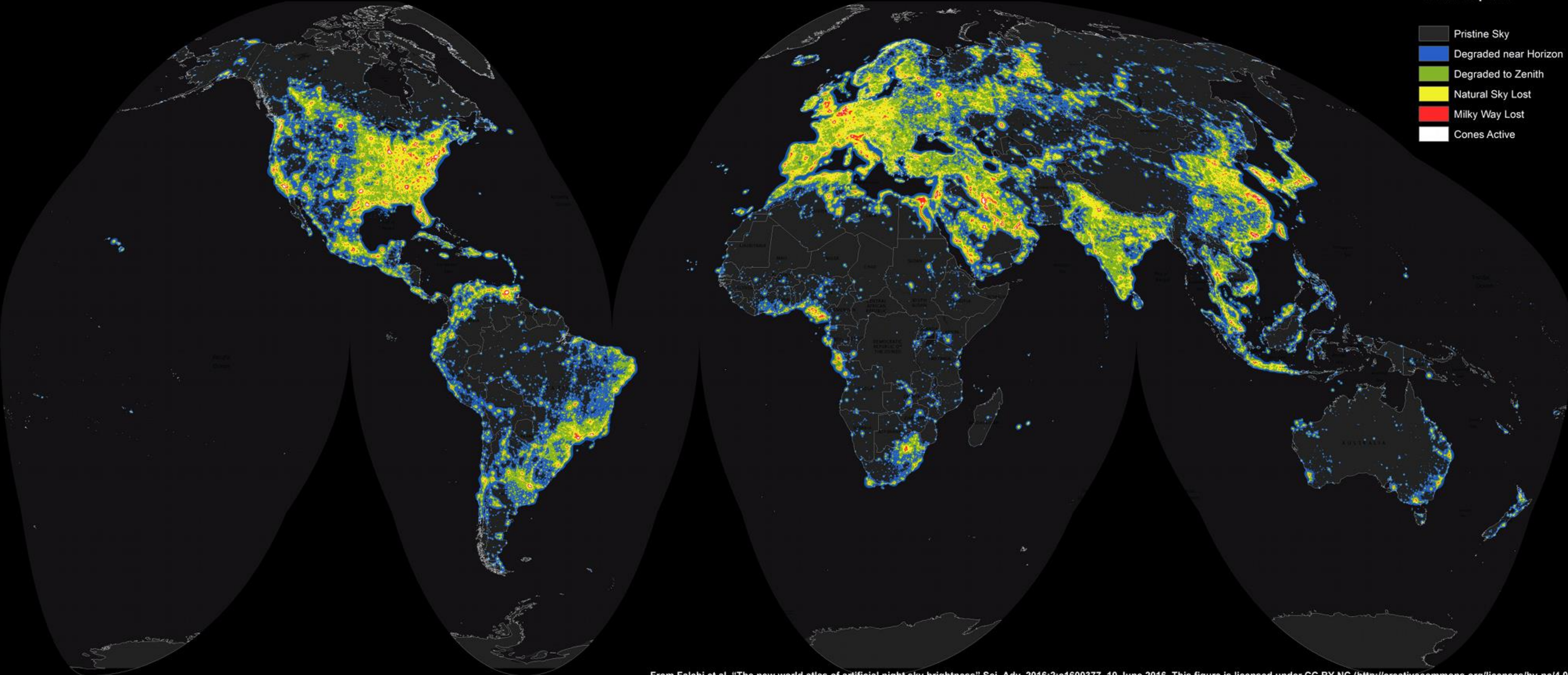


**McDonald Observatory**  
Fort Davis, Texas



**Visual Impacts**

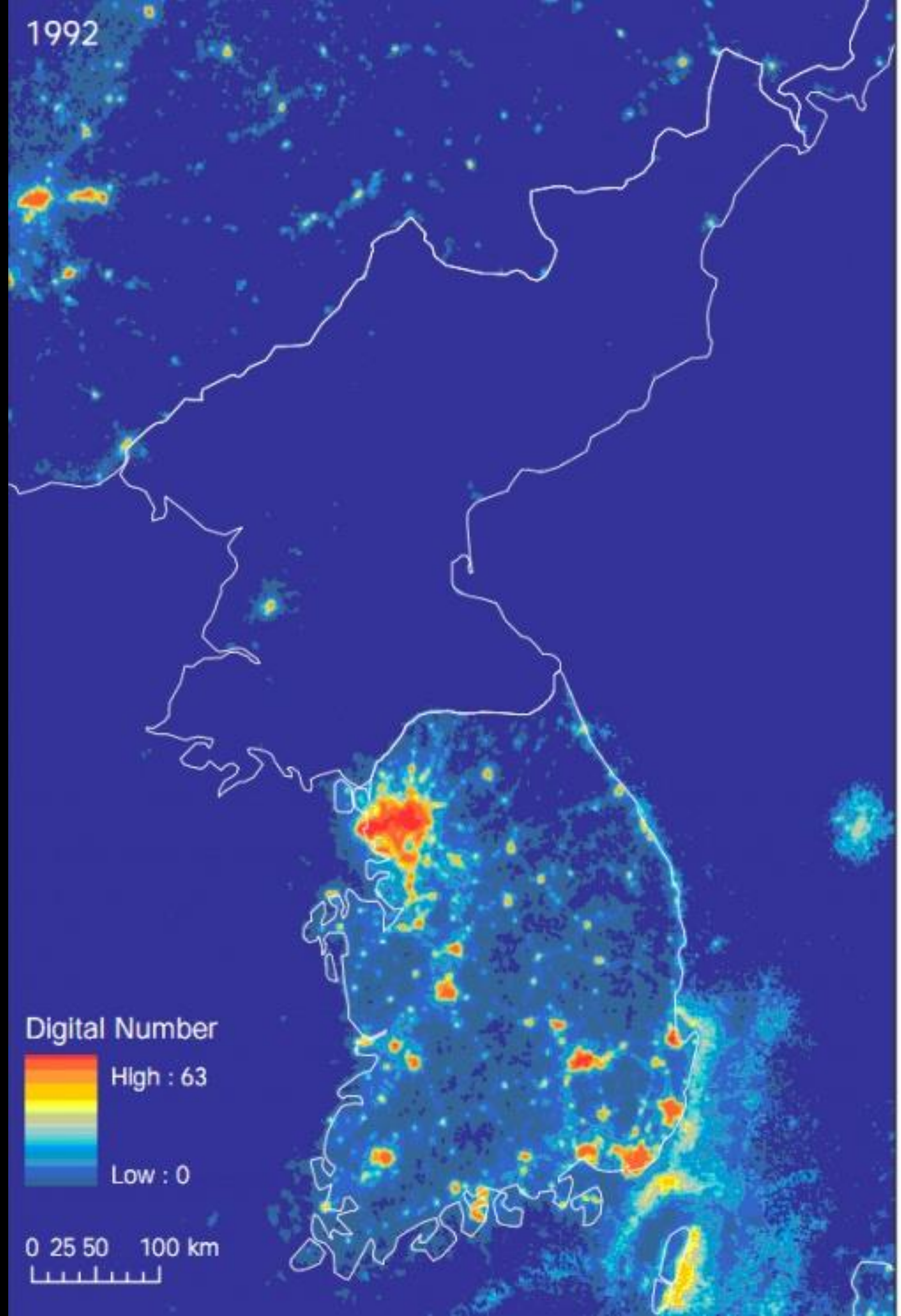
-  Pristine Sky
-  Degraded near Horizon
-  Degraded to Zenith
-  Natural Sky Lost
-  Milky Way Lost
-  Cones Active



From Falchi et al. "The new world atlas of artificial night sky brightness" Sci. Adv. 2016;2:e1600377, 10 June 2016. This figure is licensed under CC BY-NC (<http://creativecommons.org/licenses/by-nc/4.0/>).



1992



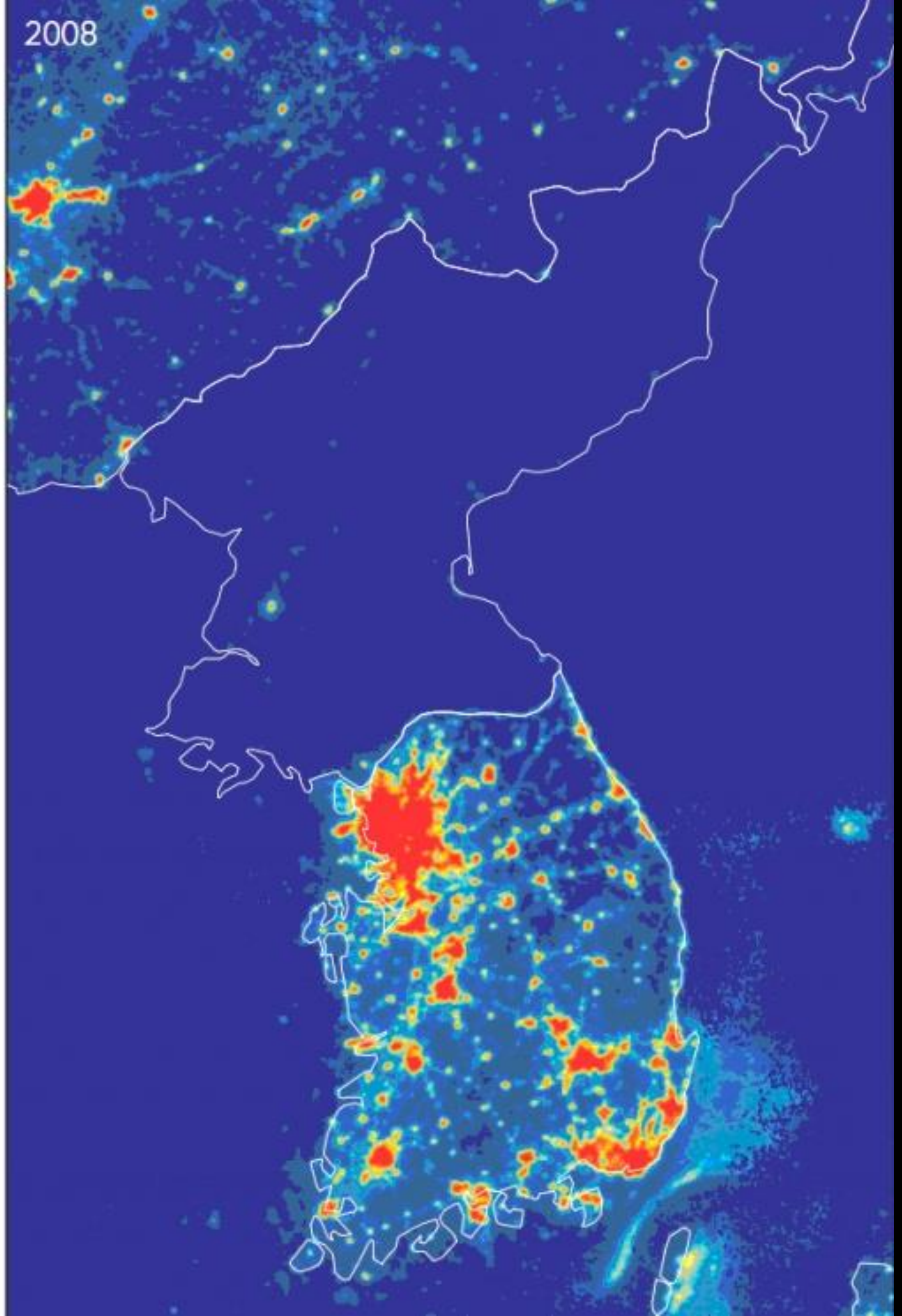
Digital Number



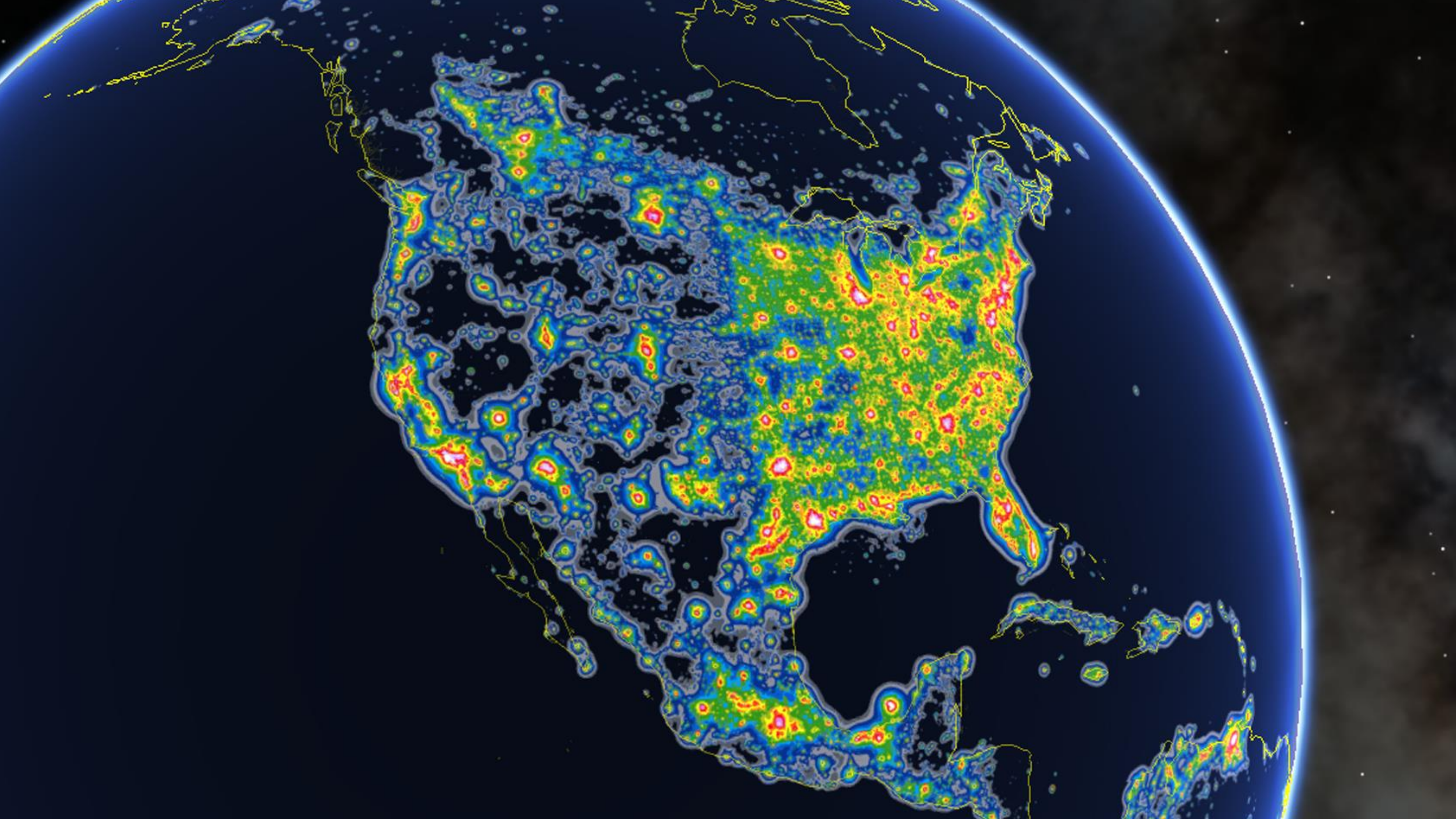
0 25 50 100 km



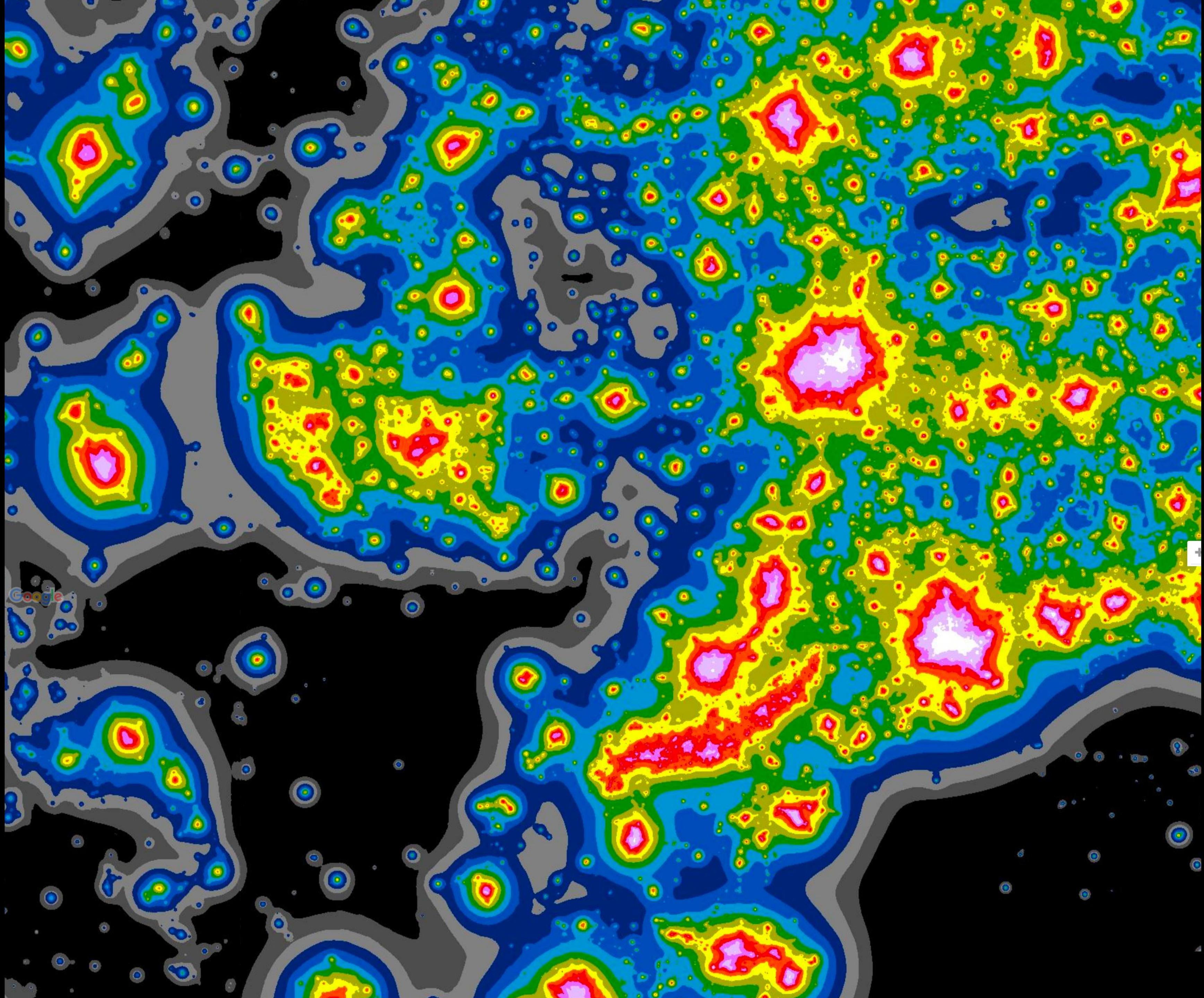
2008



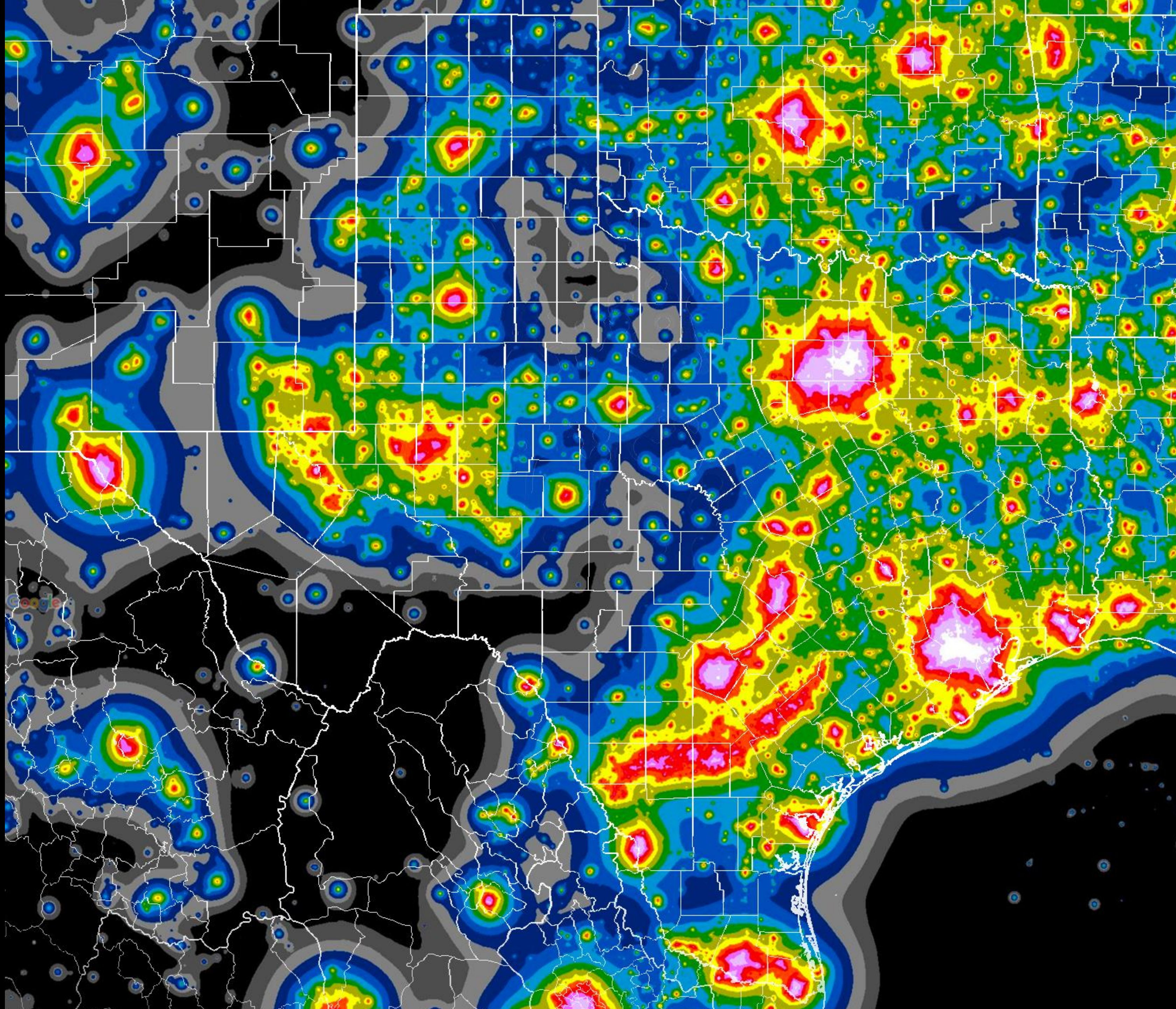






















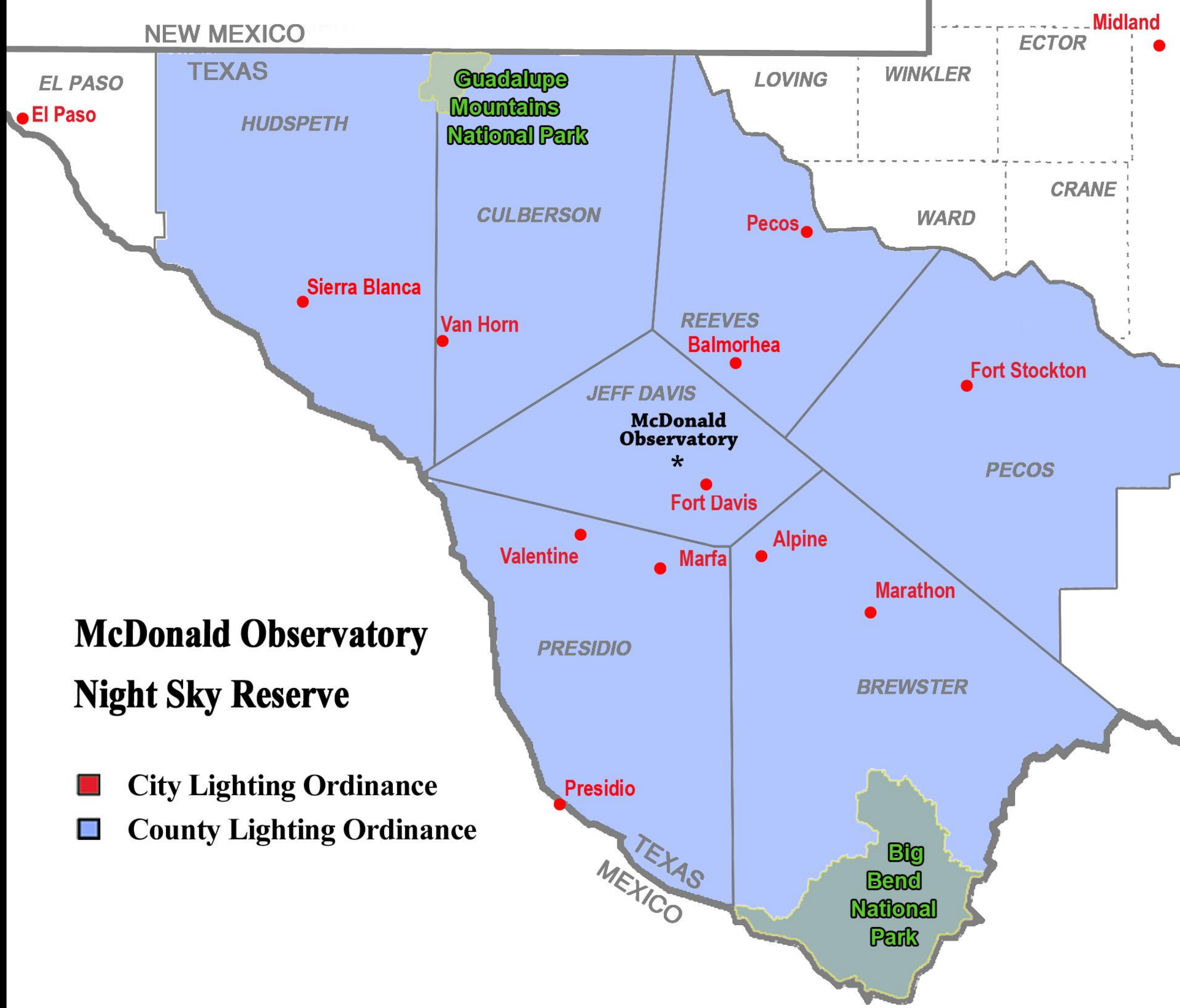




# Dark Sky Destination



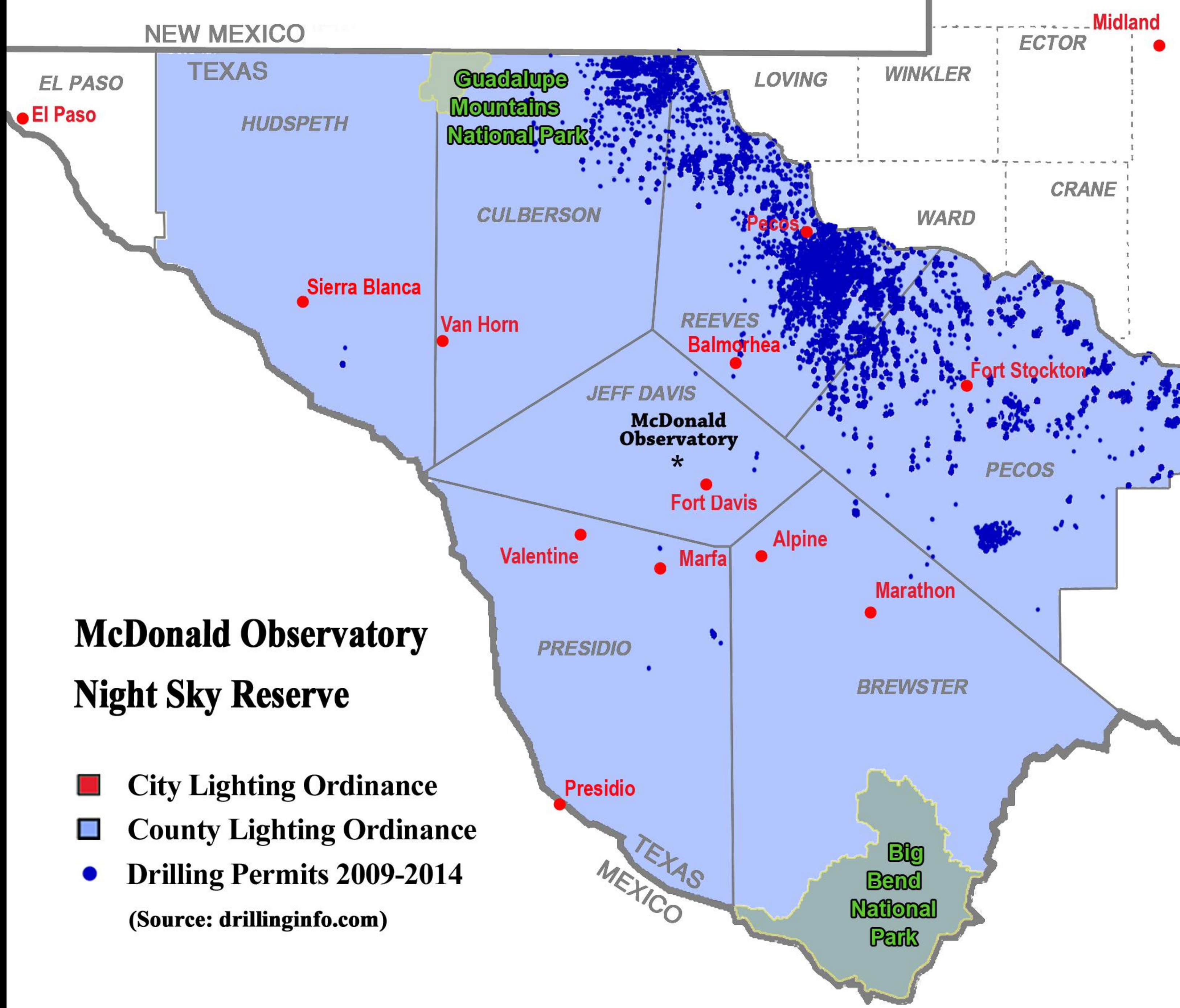




**McDonald Observatory  
Night Sky Reserve**

- City Lighting Ordinance
- County Lighting Ordinance



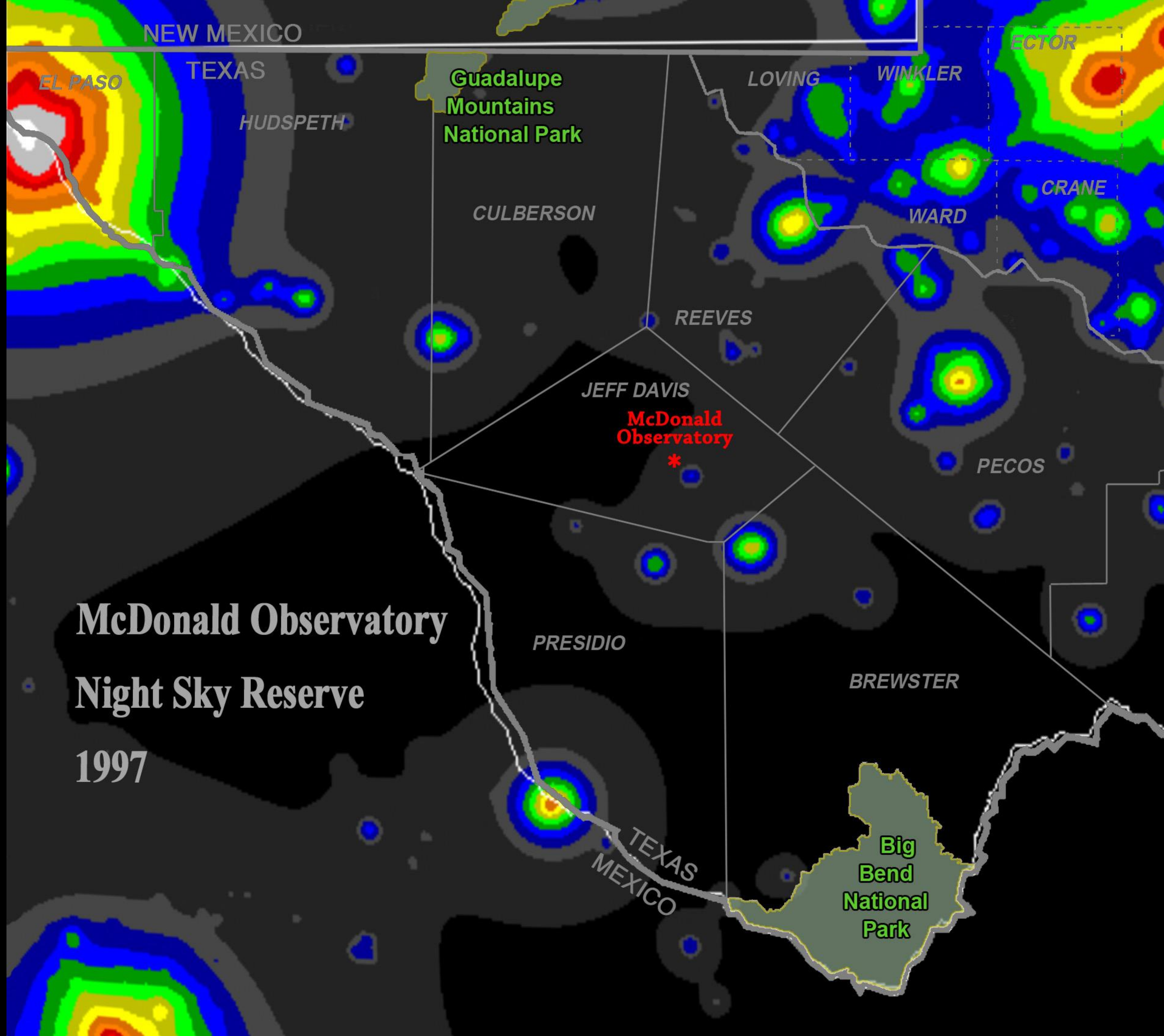


## McDonald Observatory Night Sky Reserve

- City Lighting Ordinance
- County Lighting Ordinance
- Drilling Permits 2009-2014

(Source: [drillinginfo.com](http://drillinginfo.com))

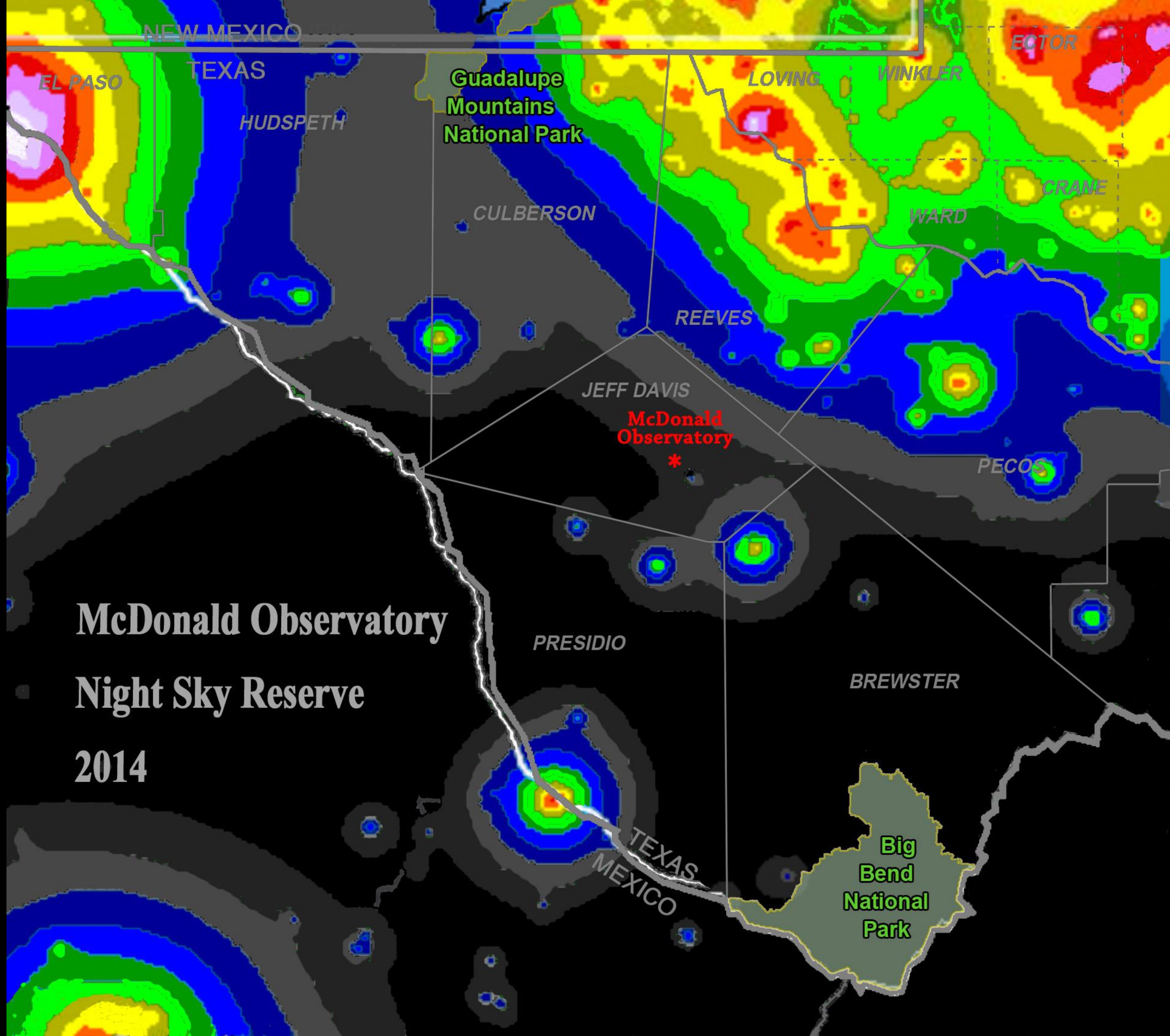




**McDonald Observatory  
Night Sky Reserve**

1997





**McDonald Observatory**

**Night Sky Reserve**

**2014**









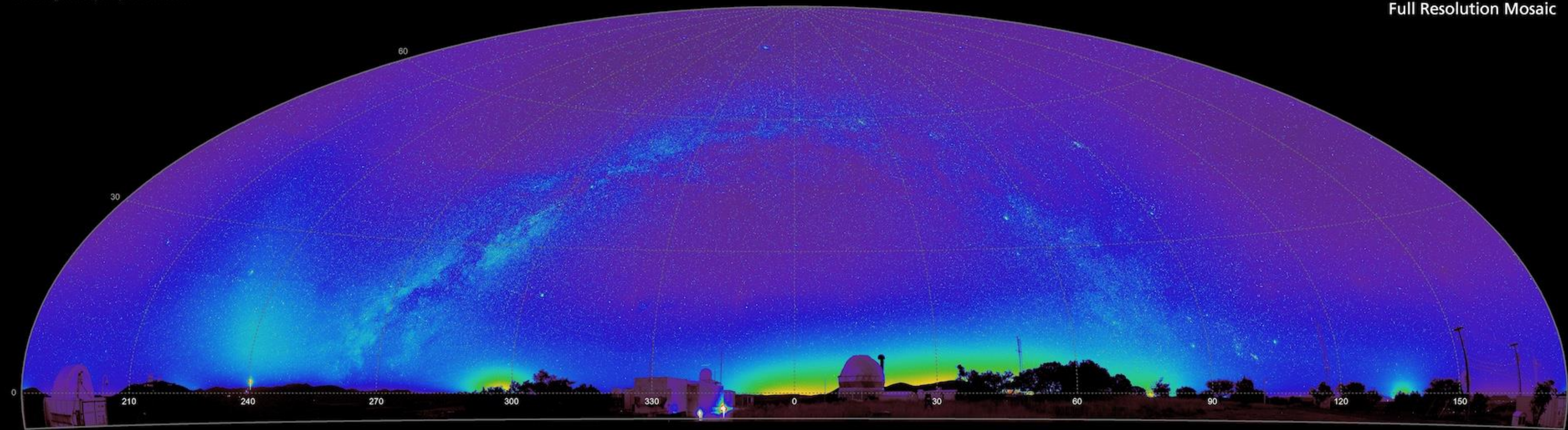




Visual Magnitudes per square arc-second

McDonald Observatory Mt Fowlkes November 30, 2016 19.7 hours LMT

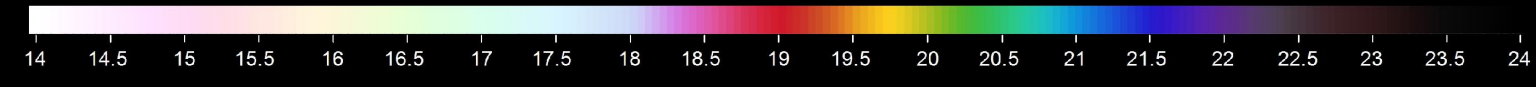
Full Resolution Mosaic



U.S. National Park Service  
Night Skies Program

Data collected by: B Wren  
Data processed by: B Meadows

Hammer-Aitoff Equal Area Projection

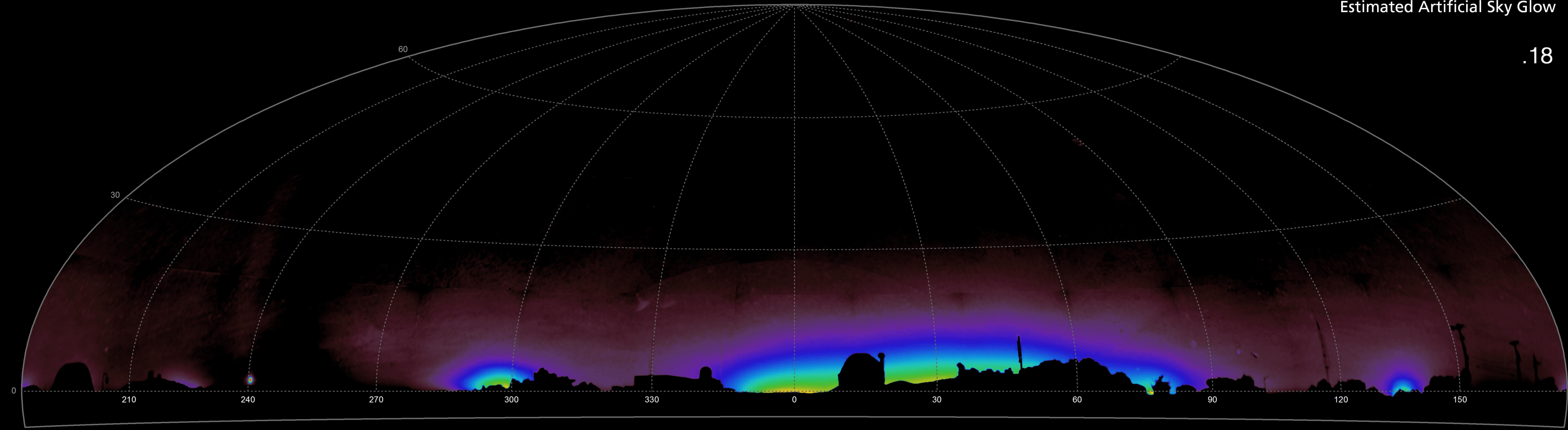


Visual Magnitudes per square arc-second

McDonald Observatory Mt Fowlkes November 30, 2016 19.7 hours LMT

Estimated Artificial Sky Glow

.18

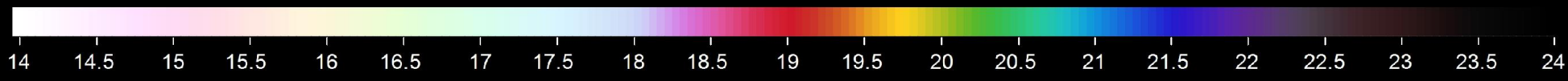


U.S. National Park Service  
Night Skies Program

Data collected by: B Wren  
Data processed by: B Meadows

Hammer-Aitoff Equal Area Projection



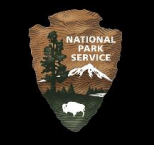
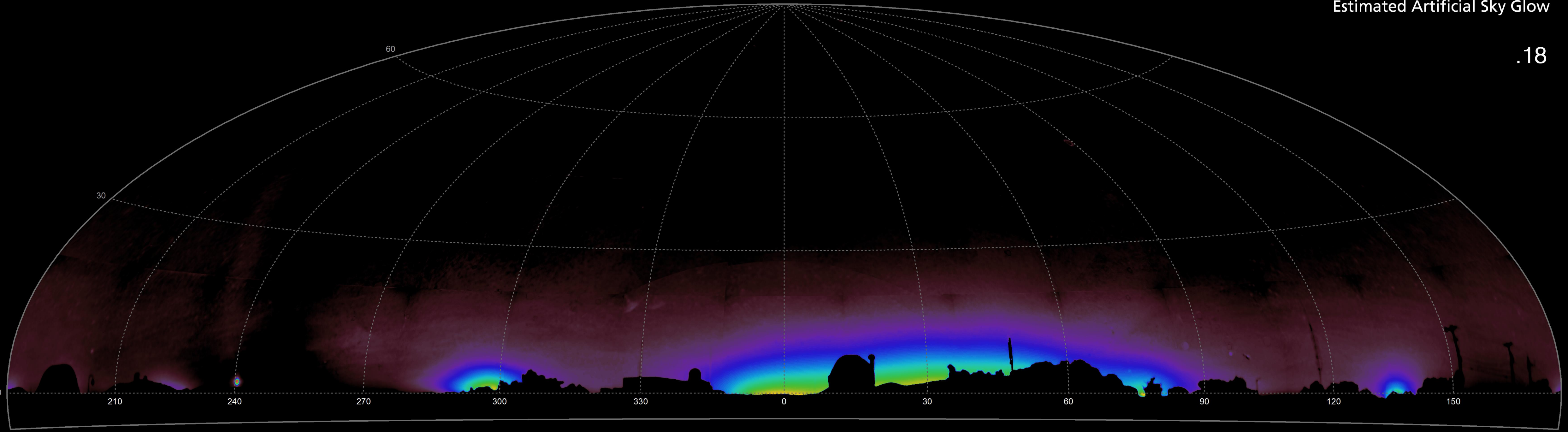


McDonald Observatory Mt Fowlkes November 30, 2016 19.7 hours LMT

Visual Magnitudes per square arc-second

Estimated Artificial Sky Glow

.18

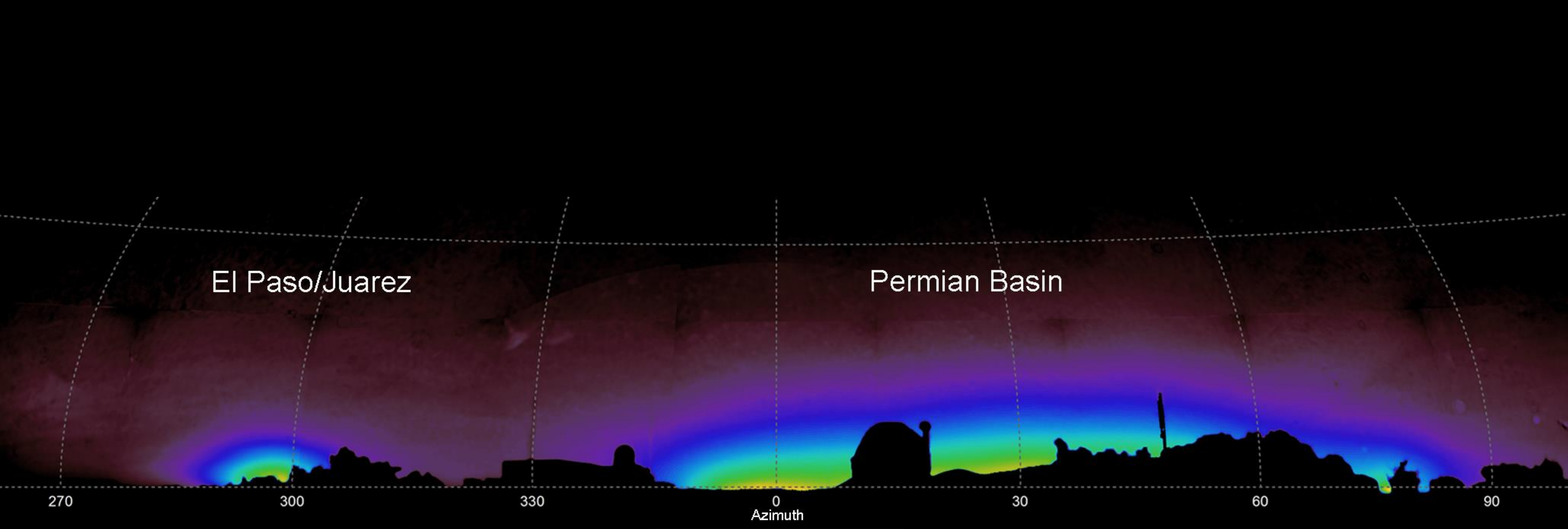


U.S. National Park Service  
Night Skies Program

Data collected by: B Wren  
Data processed by: B Meadows

Hammer-Aitoff Equal Area Projection





U.S. National Park Service  
Night Skies Program



McDonald Observatory  
Fort Davis, Texas

**McDonald Observatory**  
November 30, 2016 19.7 hours LMT

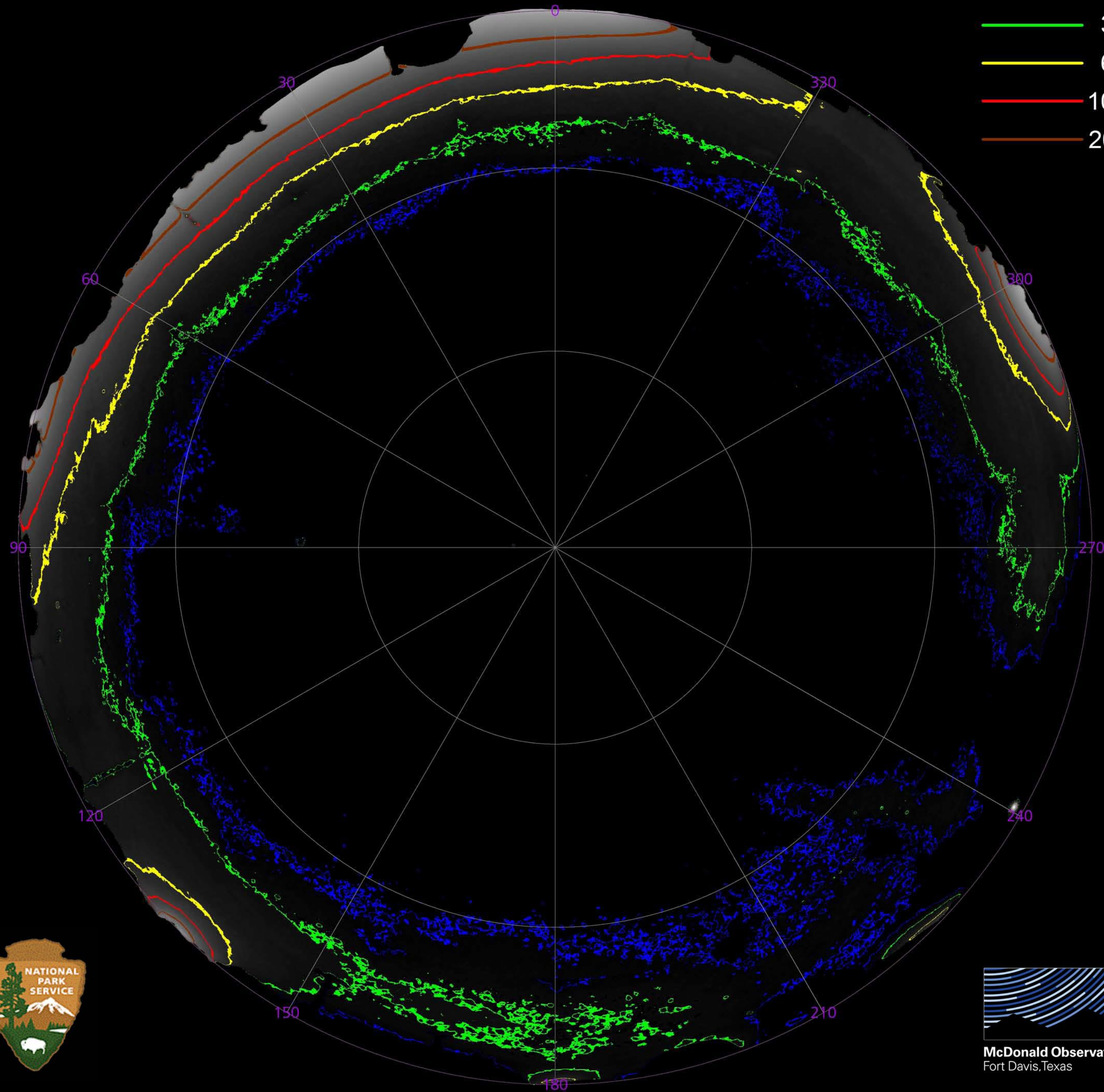
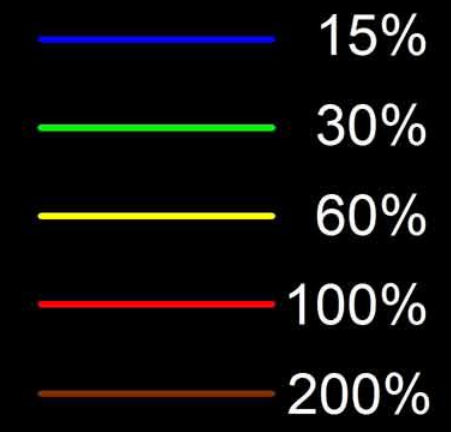
Data collected by: B Wren  
Data processed by: B Meadows



# McDonald Observatory, Texas, U.S.A

November 30, 2016 19.98 Hours LMT

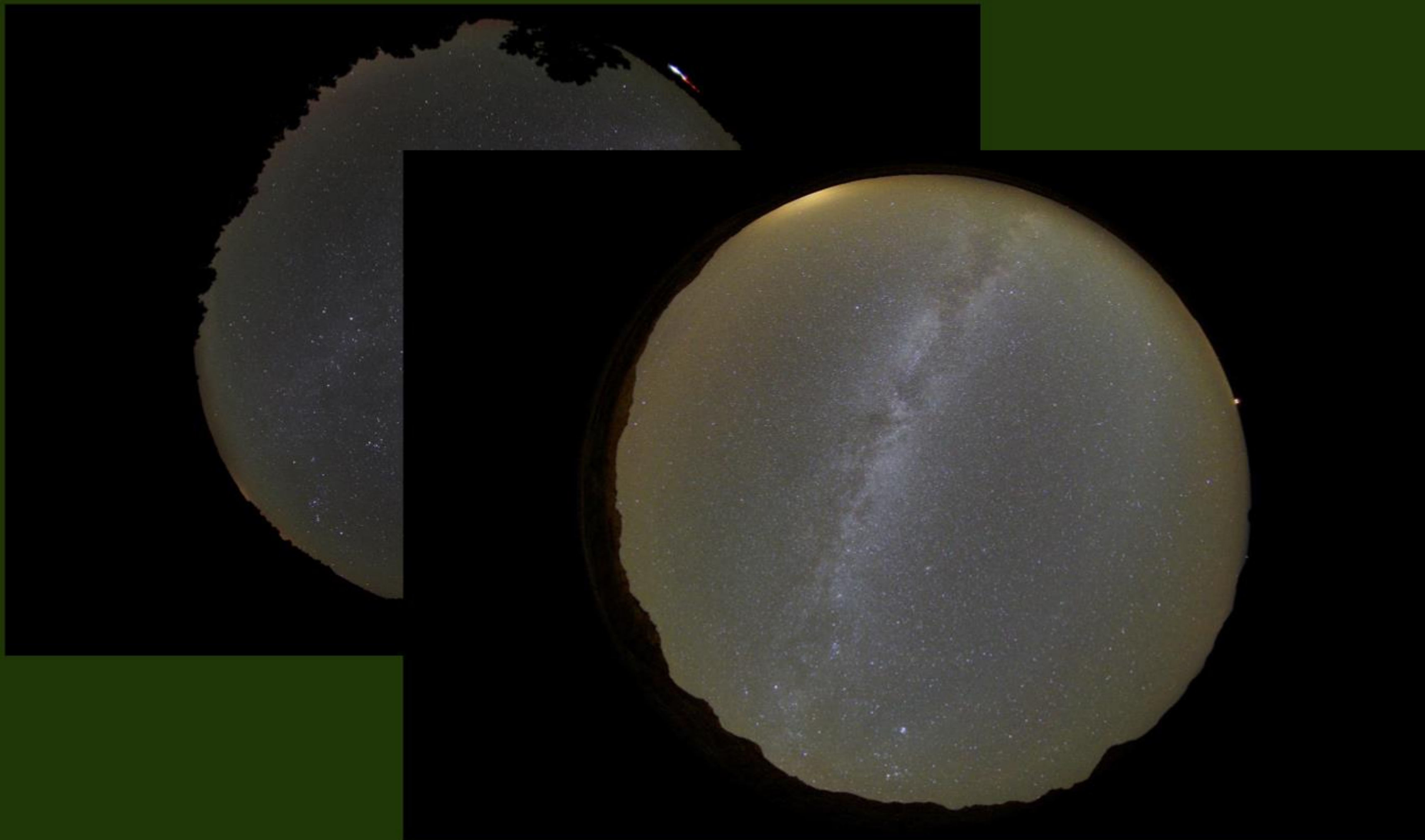
Estimated Artificial Sky Glow  
Fraction Above Natural Background



McDonald Observatory  
Fort Davis, Texas



# Future: using a fisheye lens for long-term monitoring



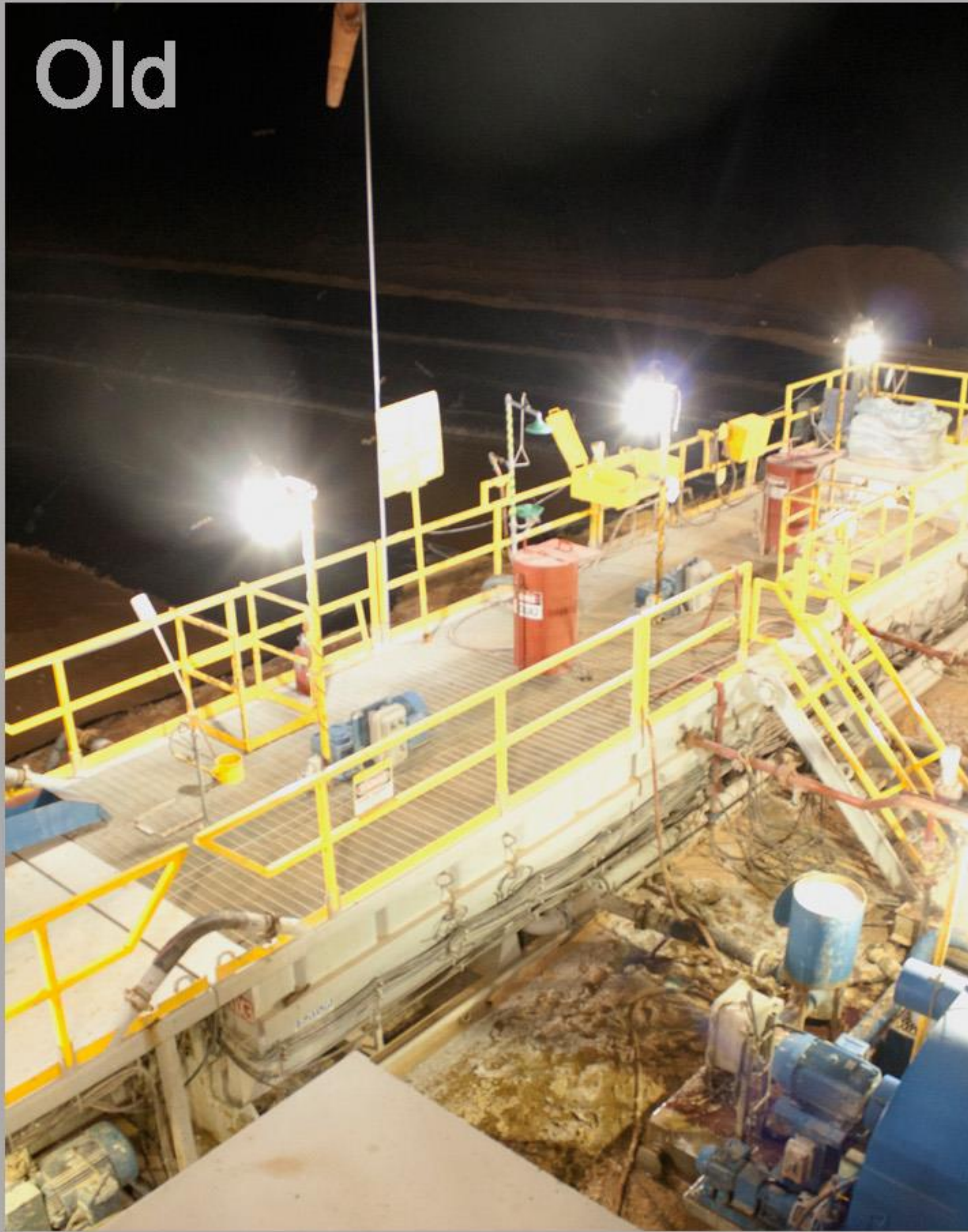






# Mud tank lighting

Old



Locke/Wren

New



Pioneer Energy Services/McDonald Observatory



# Triple Crown Gas Plant

# Aim Lights Down



Wittenbach/Wren

Cimarex/Chevron/McDoanId Observatory





From: Judge Carlos G. Urias & Culberson County Commissioners Court  
 To: Oil and Gas Operators in Culberson County  
 To Whom It May Concern,

We are writing to all companies involved in oil and gas exploration and production to inform them of the outdoor lighting ordinance in effect in Culberson County and request that they light nighttime activities accordingly. We are one of seven counties set aside by the State of Texas as part of a Dark Sky Reserve in West Texas. The goal of the county ordinance is to prevent light from shining into the sky and interfering with ongoing astronomical research at the University of Texas McDonald Observatory near Fort Davis.

We recognize the need to light activities at night for safety. A joint project between McDonald Observatory and Pioneer Energy Services has demonstrated that glare from poorly aimed light fixtures can impair visibility. Aiming lights down and installing optional glare shields can put more light on the worksite, improve visibility, enhance safety, while helping to protect the dark skies overhead.

We ask that you take the following steps for all outdoor lighting fixtures which you operate, maintain, or rent:

- 1) Adjustable fixtures - Aim all lights down to prevent light from shining above the horizon or off the worksite. This applies particularly to portable light towers with adjustable floodlights.
- 2) Shielding - Shield all fixtures to prevent light from shining above the horizon. Lighting manufacturers offer optional glare shields which reflect wasted light down onto the worksite for better visibility.

Your cooperation in this matter is appreciated.

Sincerely,

  
 The Honorable Judge Carlos G. Urias  
 Culberson County Commissioners Court



April 21, 2015

AMTEX ENERGY, INC.  
 P O BOX 3418  
 MIDLAND, TX 79702

Dear Permian Basin Operator:

The Permian Basin Petroleum Association (PBPA) needs your help in addressing some problems in activities are causing some of our Permian Basin neighbors.

As you know, the Permian Basin is the most prolific oil producing region in North America. Correspondingly, the Permian Basin has the largest rig count of any region in the world.

The Permian Basin is also home to a true Texas treasure, the University of Texas McDonald Observatory. This state of the art facility is on the cutting edge of scientific research in the field of astronomy.

As an operator, you understand the demand for continual round-the-clock operations. However, the increased nighttime drilling operations in the Permian Basin and the lighting required to conduct this work safely and effectively have contributed to the brightening of the night sky making it more challenging for the scientists at the McDonald Observatory to conduct their research.

In addition, the Texas Legislature in 2011 passed a measure requiring county commissioner's courts in counties that lie within 57 miles of a major observatory to adopt ordinances regulating outdoor lighting. The counties where this requirement applies is Brewster, Culberson, Hudspeth, Jeff Davis, Pecos, Presidio, and Reeves.

The PBPA strongly encourages oil and gas operators and contractors in the region to adopt simple lighting changes at their locations to reduce ambient light and increase safety of their employees. These changes include: (1) re-angling your lights below the horizon and (2) placing shrouds on the lights.

Additionally, the University of Texas has stated that it would be pleased to highlight those cooperating companies in their university promotional and media efforts. This is a great opportunity for Permian Basin operators to receive some well-deserved recognition for being good neighbors.

Should you have any questions or need any additional information, please do not hesitate to contact me, Ben Shepperd at (432) 684-6345. To learn more about the PBPA, please visit our website at [www.PBPA.info](http://www.PBPA.info).

Sincerely,



Ben Shepperd  
 President  
 Permian Basin Petroleum Association



RAILROAD COMMISSION OF TEXAS  
 Oil and Gas Division

**NOTICE TO OPERATORS**

**MINIMIZING LIGHTING IMPACTS FROM OIL AND GAS ACTIVITIES**

The Railroad Commission of Texas (RRC) has been contacted about concerns related to light originating from oil and gas rigs in the Permian Basin, specifically in the vicinity of the University of Texas McDonald Observatory in the Davis Mountains of West Texas. Since 2010, the development associated with the exponential growth of oil and gas drilling and production in the Permian Basin has generated light reflecting off the sky.

The McDonald Observatory is a state-of-the-art facility on the cutting edge of scientific research in the field of astronomy. Astronomers there focus on measuring objects at the very edge of the observable universe. Without mitigation, the gleam of light from oil and gas operations could compromise the research for which the McDonald Observatory is famous.

The McDonald Observatory will also soon complete a major upgrade to its historic Hobby-Eberle telescope. If a solution to bright skies is found, the upgrade will allow three-dimensional glimpses deep into the universe.

In 2011, the Texas Legislature revised Section 240.032 of the Local Government Code to require the commissioners court of a county, any part of which is located within 57 miles of the McDonald Observatory, to adopt orders regulating the installation and use of outdoor lighting in any unincorporated territory of the county. The counties where this requirement applies are Brewster, Culberson, Hudspeth, Jeff Davis, Pecos, Presidio, and Reeves. You are advised to check with any of these counties in which you operate regarding applicable outdoor lighting requirements.

In addition, the McDonald Observatory is working with its local neighbors to promote simple solutions to minimize lighting impacts. Stacy Locke with Pioneer Energy Services and Bill Wren with the University of Texas McDonald Observatory have developed a report titled "Oilfield Lighting Can Coexist with Dark Skies," which is available on the observatory's website at: [http://mcdonaldobservatory.org/sites/default/files/oilfield\\_lighting\\_can\\_coexist.pdf](http://mcdonaldobservatory.org/sites/default/files/oilfield_lighting_can_coexist.pdf). More general information about the McDonald Observatory's Dark Skies Initiative is available at: <http://mcdonaldobservatory.org/darkskies>.

You are encouraged to consult these resources and consider ways to reduce stray light. The solutions can be simple and cost effective and can actually improve nighttime visibility and increase worker safety.

**PLEASE FORWARD TO THE APPROPRIATE SECTION OF YOUR COMPANY**

Austin, Texas  
 February, 2016





**RAILROAD COMMISSION OF TEXAS  
Oil and Gas Division**

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**PLEASE FORWARD TO THE APPROPRIATE SECTION OF YOUR  
COMPANY**





RAILROAD COMMISSION OF TEXAS  
Oil and Gas Division

---

NOTICE TO OPERATORS

*“The solutions can be simple and cost effective and can actually improve nighttime visibility and increase worker safety.”*

observatory's website

at: [http://mcdonaldobservatory.org/sites/default/files/oilfield\\_lighting\\_can\\_coexist.pdf](http://mcdonaldobservatory.org/sites/default/files/oilfield_lighting_can_coexist.pdf).

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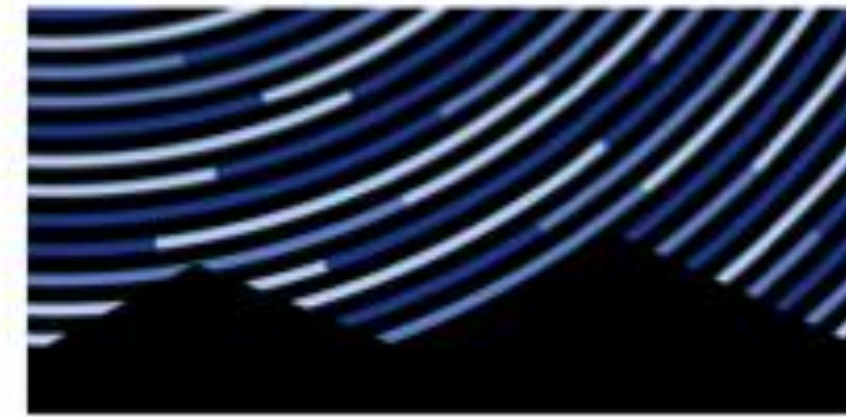
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**PLEASE FORWARD TO THE APPROPRIATE SECTION OF YOUR COMPANY**

Austin, Texas  
February, 2016

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**McDonald Observatory**  
The University of Texas at Austin

# **RECOMMENDED LIGHTING PRACTICES**

**A COLLABORATIVE EFFORT BY THE  
PERMIAN BASIN PETROLEUM ASSOCIATION AND THE  
MCDONALD OBSERVATORY**



- **3000K Color Temperature**

## RECOMMENDED LIGHTING PRACTICES

A COLLABORATIVE EFFORT BY THE  
PERMIAN BASIN PETROLEUM ASSOCIATION AND THE  
MCDONALD OBSERVATORY



**Warm White**   **Natural White**   **Day White**   **Cool White**  
**2700K-3500K**   **4000K-4500K**   **5000K-5500K**   **6000K-7000K**







• **3000K Color Temperature**

**RECOMMENDED LIGHTING PRACTICES**

• **Internal Combustion Units**

A COLLABORATIVE EFFORT BY THE  
PERMIAN BASIN PETROLEUM ASSOCIATION AND THE  
MCDONALD OBSERVATORY





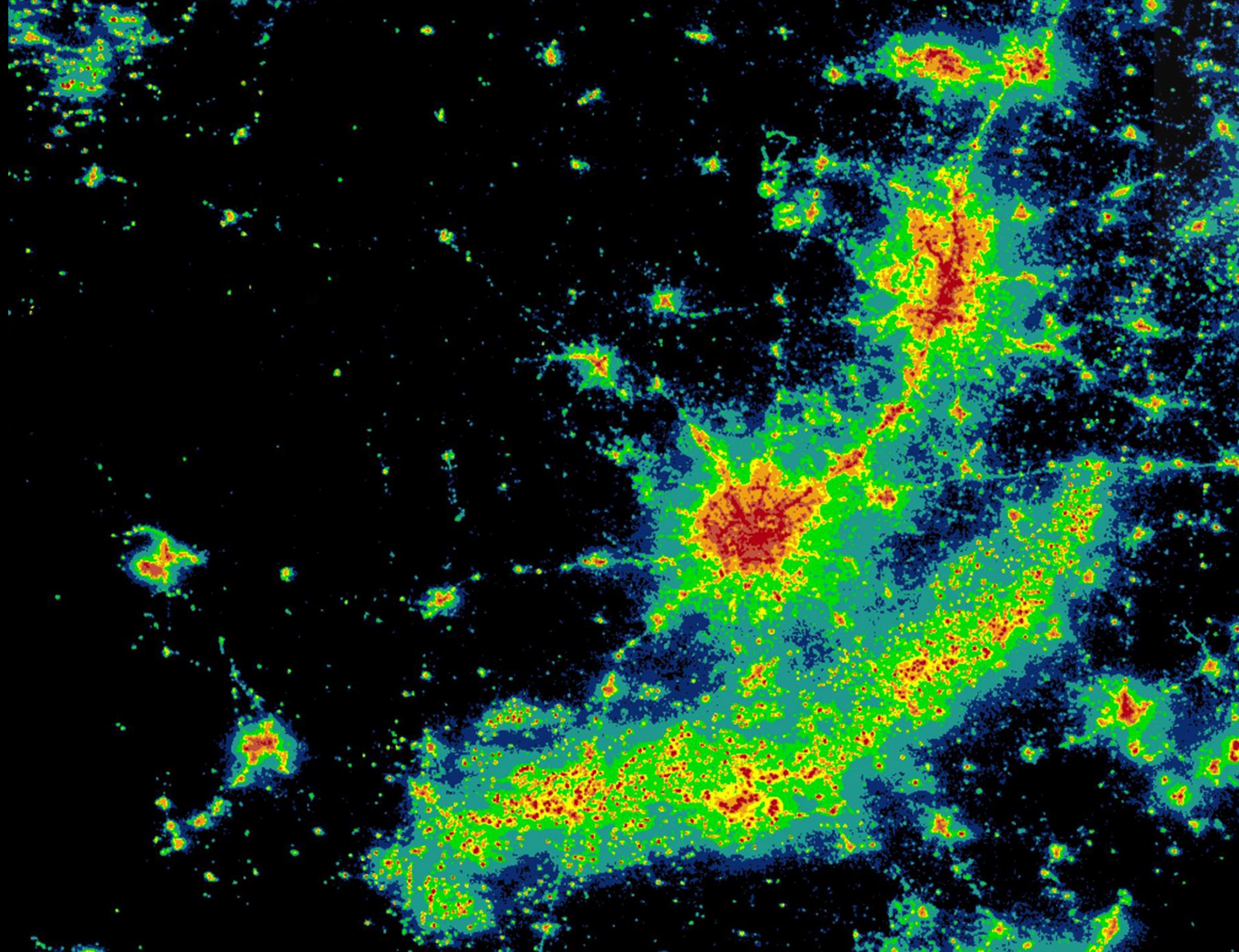


- Education & Awareness

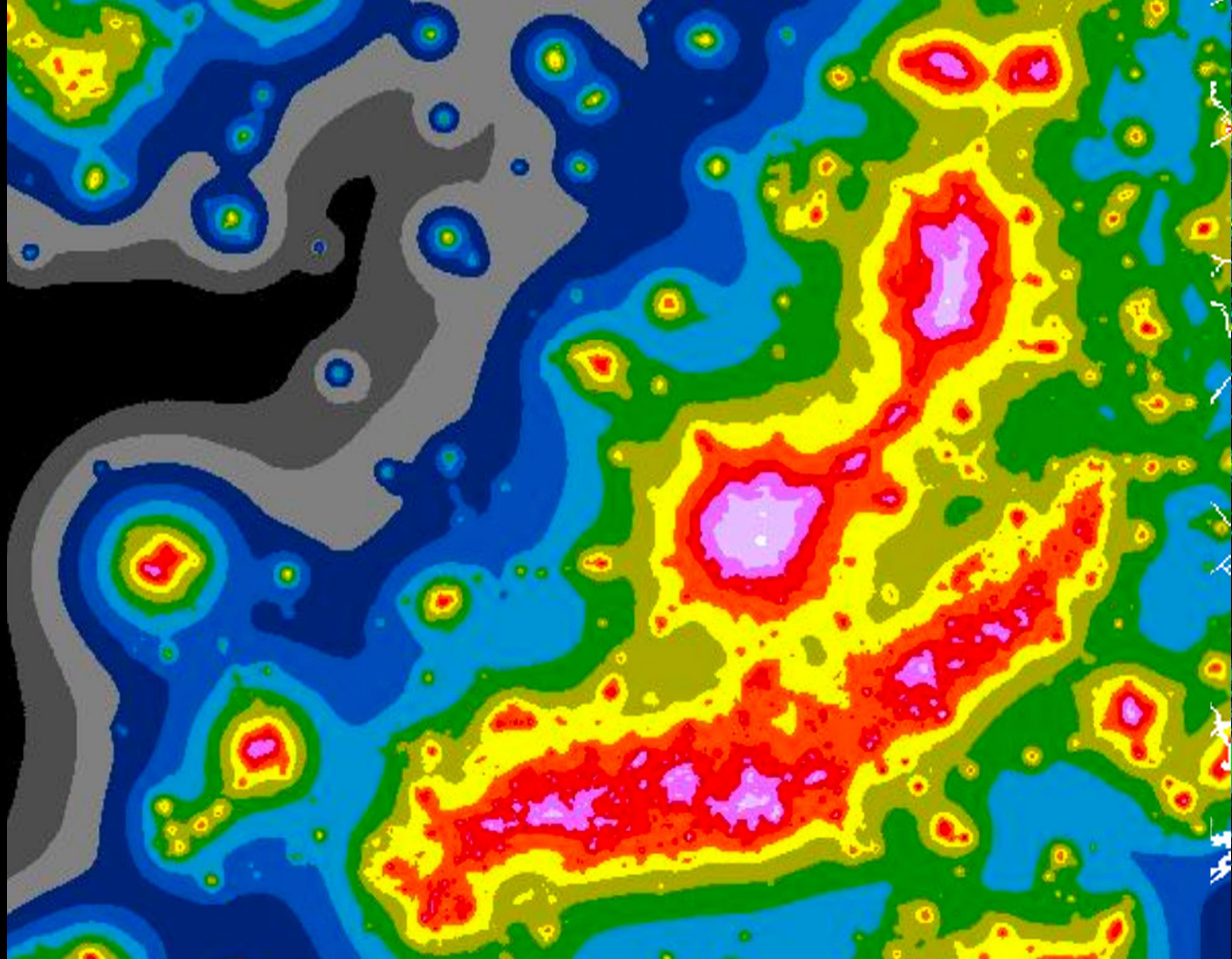
*“Mount high; aim low.”*

- Exploration & Production
- Flaring
- Commercial Development

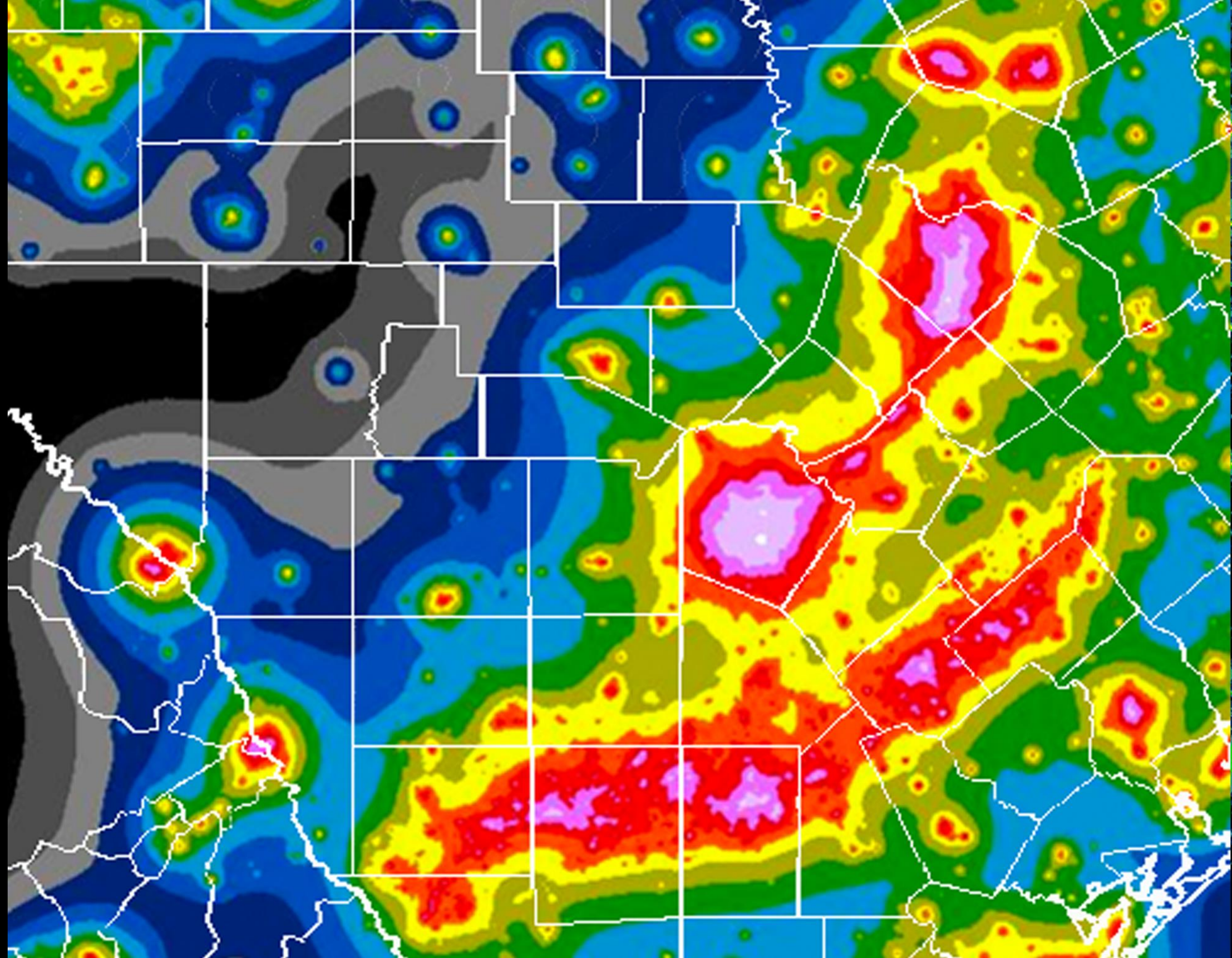








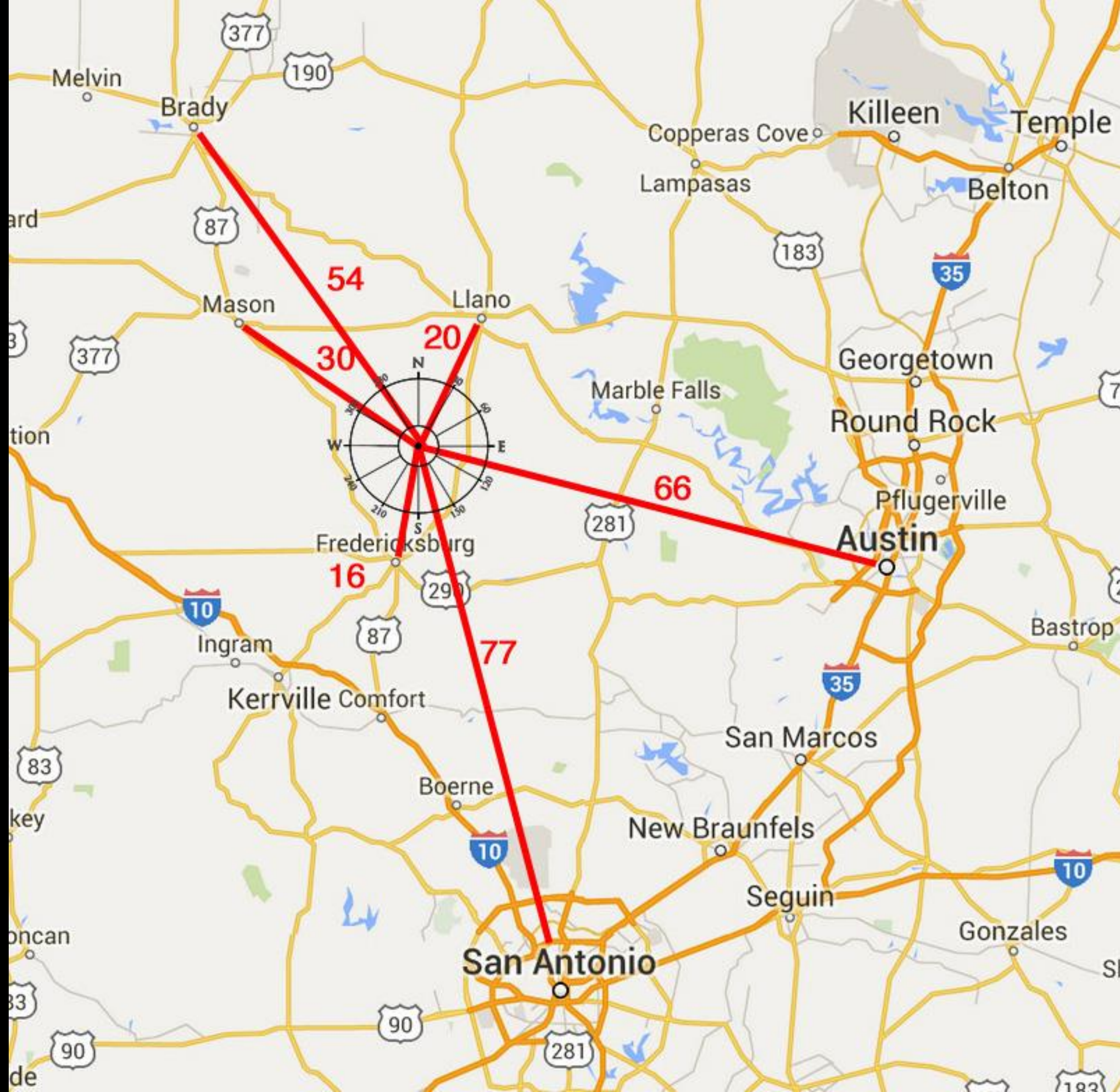












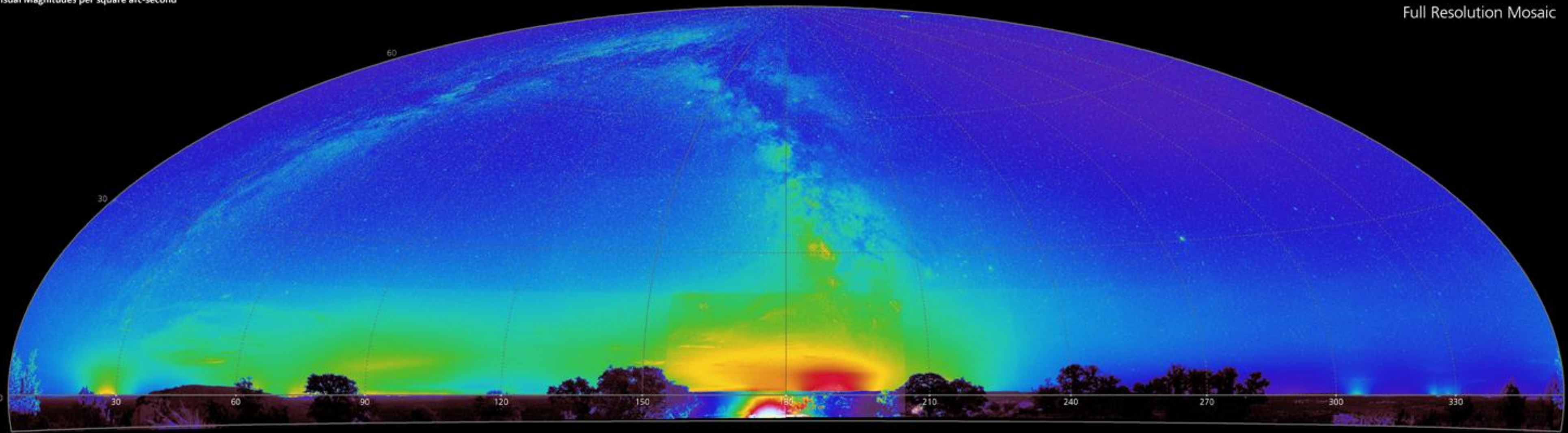




Enchanted Rock S P Little Rock August 17, 2015 20.9 hours LMT

Visual Magnitudes per square arc-second

Full Resolution Mosaic



U.S. National Park Service  
Night Skies Program

Data collected by: B Wren  
Data processed by: D Duriscoe

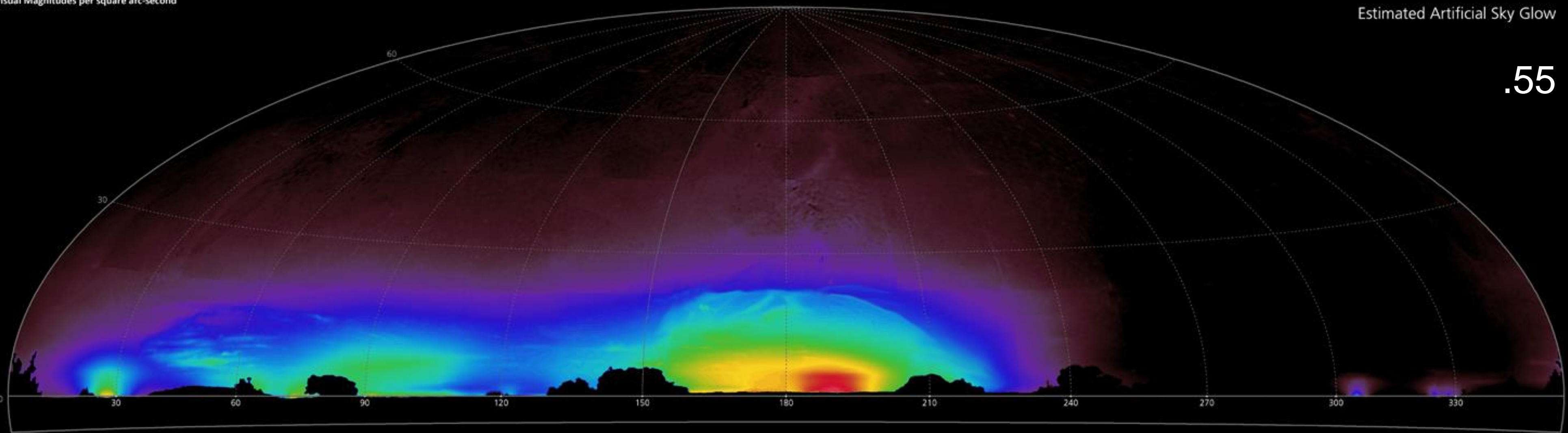
Hammer-Aitoff Equal Area Projection



Enchanted Rock S P Little Rock August 17, 2015 20.9 hours LMT

Visual Magnitudes per square arc-second

Estimated Artificial Sky Glow



.55



U.S. National Park Service  
Night Skies Program

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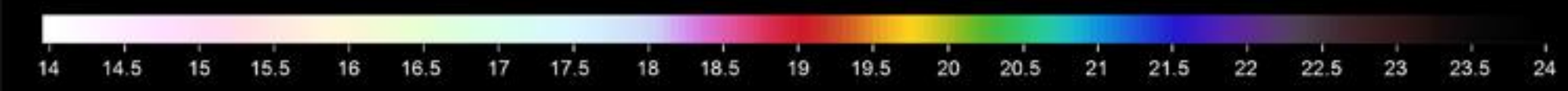
Hammer-Aitoff Equal Area Projection



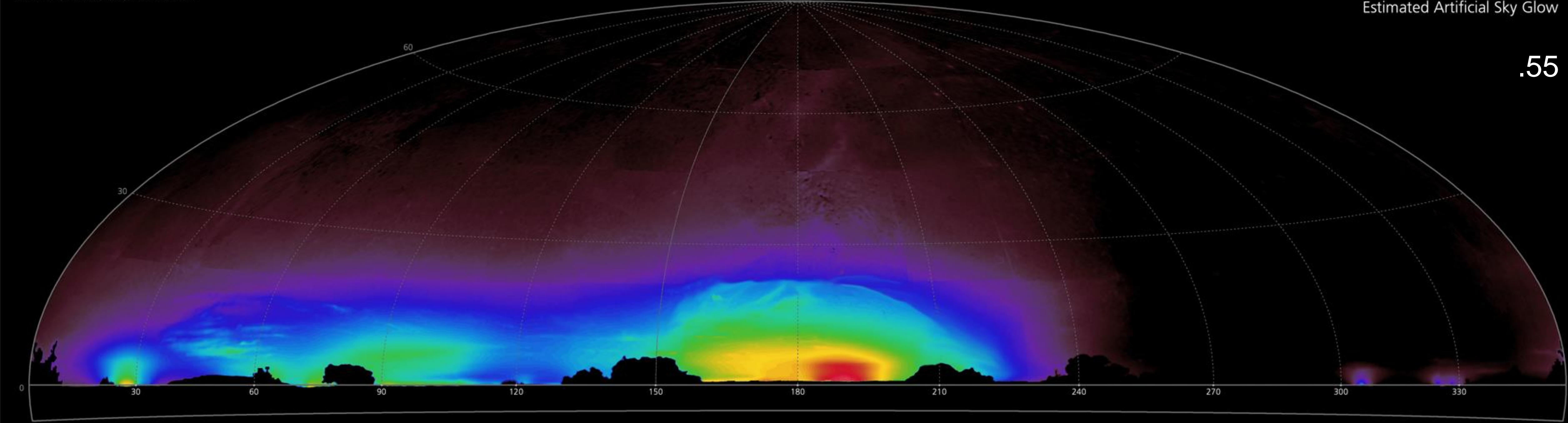
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Estimated Artificial Sky Glow

.55



Visual Magnitudes per square arc-second

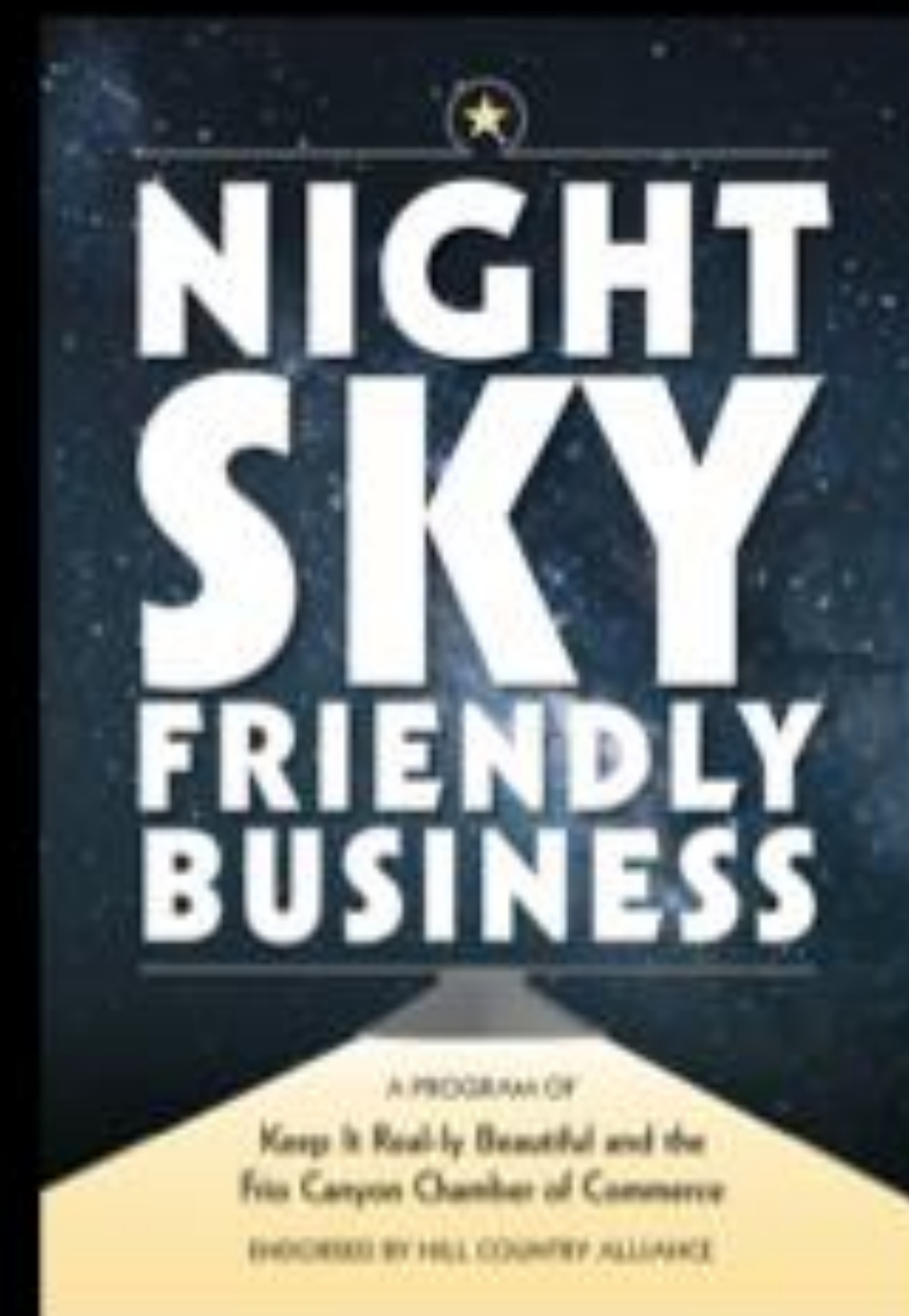


U.S. National Park Service  
Night Skies Program

Data collected by: B Wren  
Data processed by: D Duriscoe

Hammer-Aitoff Equal Area Projection





**Communities are preserving the night skies through:**

- Public presentations and star parties
- Ordinances and resolutions
- Business Recognition Programs
- IDA Dark Sky Places
- Defending against threats





# Auto Dealer Group Trades In Old Lighting for \$400,000 in Energy Savings from GE Lighting LEDs

\* Reuters is not responsible for the content in this press release.

Tue Nov 13, 2012 1:30pm EST

## Auto Dealer Group Trades In Old Lighting for \$400,000 in Energy Savings from GE Lighting LEDs

When Collection Auto Group learned it could save more than it would spend to light its lots with new outdoor LED fixtures, the Ohio-based auto dealer struck a sweet deal with GE Lighting. As the proud new owner of GE's energy-efficient ecomagination<sup>SM</sup> Evolve<sup>TM</sup> LED Area Lights, Collection Auto Group's five-year lighting expense will be discounted by nearly \$400,000 as the result of using 660,000 fewer kilowatt hours (kWhs) while virtually eliminating upkeep for years to come.



The switch to GE LED outdoor lighting will save Collection Auto Group about \$400,000 over five years. (Photo: GE)

Operating across Northeast Ohio, Collection Auto Group represents 21 brands including Mercedes-Benz, Maserati and Aston Martin. The company's goal is to convert all of its 14 dealerships to new outdoor LED lighting in the next 12 months, starting with its flagship Mercedes-Benz location in North Olmsted.



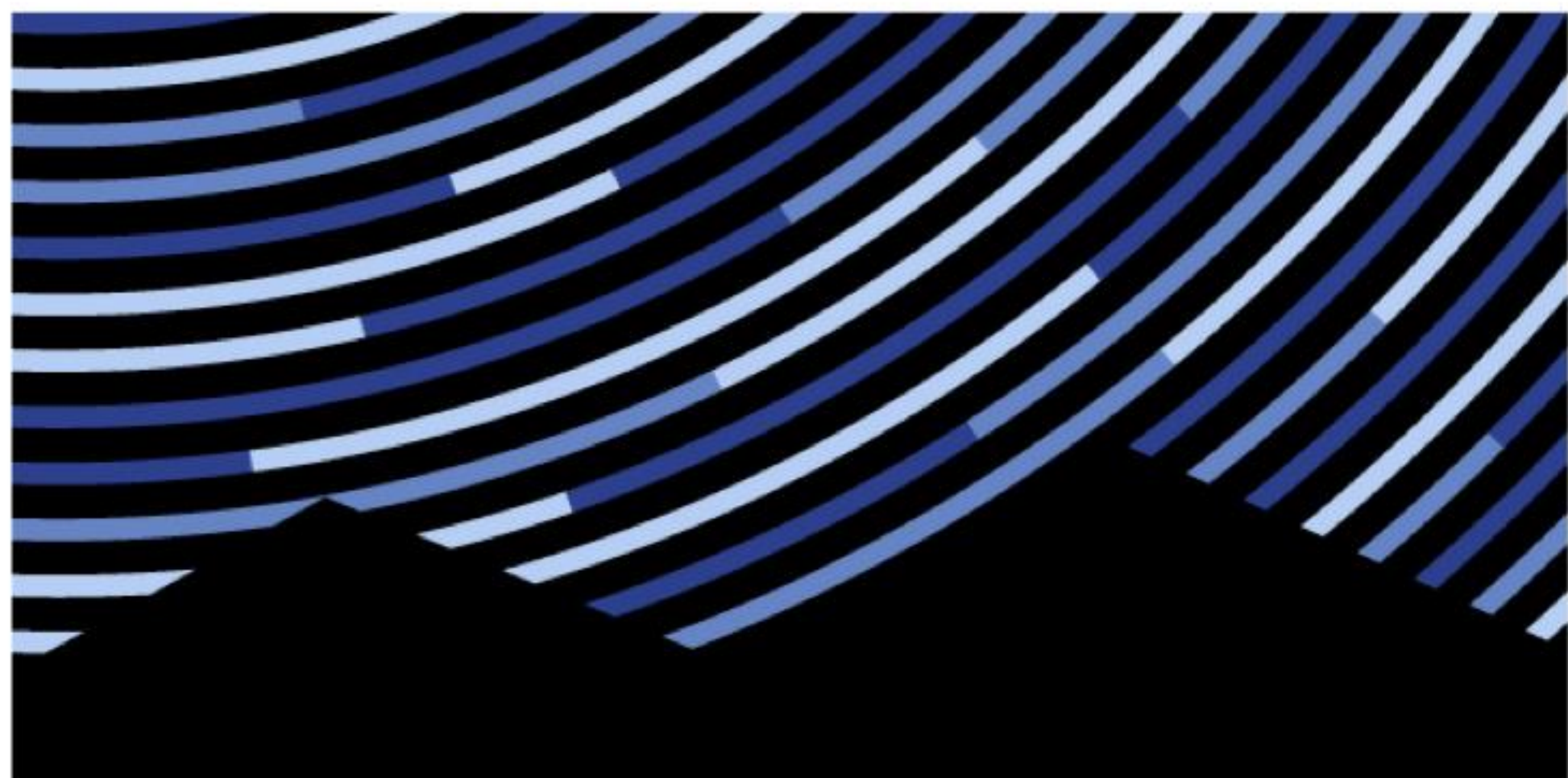


Courtesy Soft Lighting Systems



Questions?





**McDonald Observatory**  
Fort Davis, Texas