



# GLOBE at Night: Classic and Digital Observations by Citizen Scientists

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National Optical Astronomy Observatory (NOAO)

Tucson, Arizona, USA

Geological Society of America
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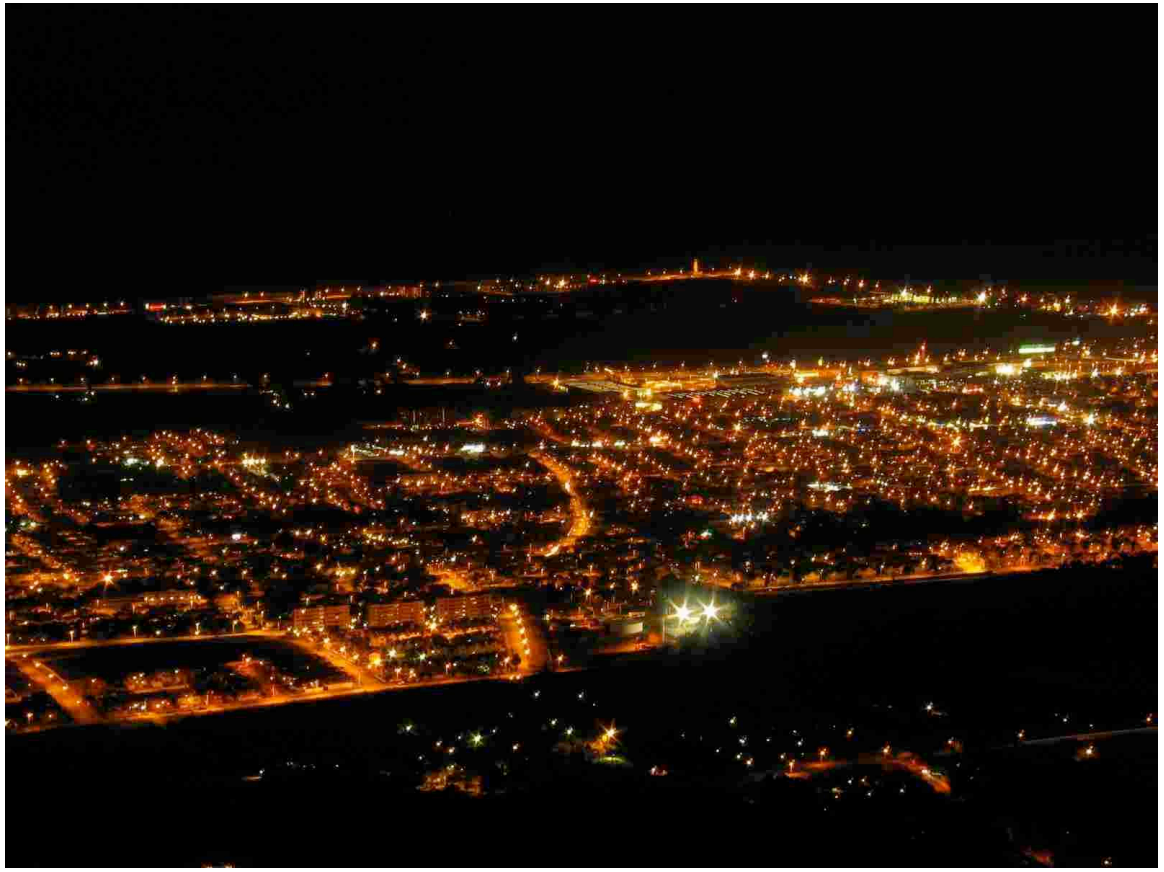
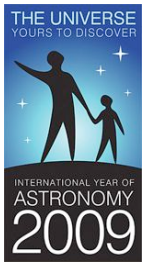
Denver, Colorado

# City Lighting







# Thanks to Prime Collaborators

- Connie Walker, Doug Isbell, (NOAO North)
- Malcolm Smith, David Orellana, Hugo Ochoa (NOAO South and Centro de Apoyo a la Didáctica de la Astronomía (CADIAS) Chile
- Sandra Henderson (UCAR)
- Ed Geary and Craig Blurton (GLOBE Project Directors, past and present)

# The GLOBE Collaboration: NOAO plus

The Global Learning and Observations to Benefit the Environment (GLOBE) Program, Boulder, CO

Windows to the Universe/UCAR

Environmental Systems Research Institute, Inc. (ESRI)

Centro de Apoyo a la Didáctica de la Astronomía (CADIAS) in Chile

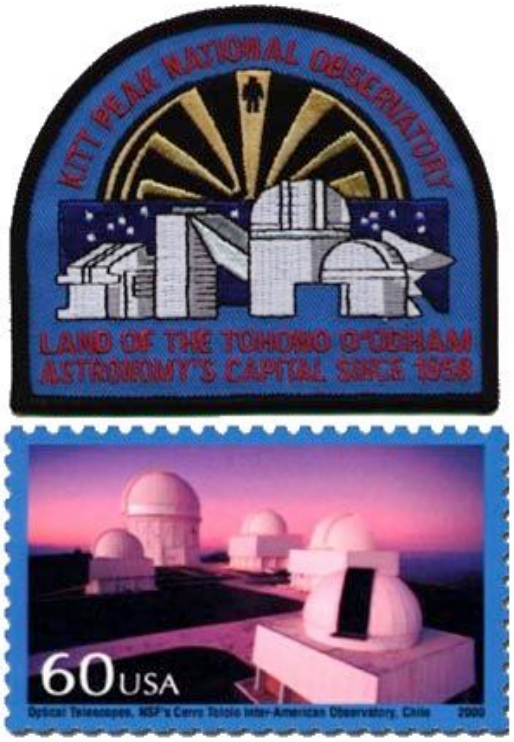
The International Dark-Sky Association (IDA)

# Lessons Learned (and Learning)

- Organization of Network (nature of branches)
- Differentiation of Audience (narrow or broad)
- Role of Authentic Science (versus other goals)
- Role of Kits/Importance of kits (time of task)
- Reporting Systems (all on the web?)
- Role of Follow-up and Analysis (doing real science)
- International Year of Astronomy (program expansion)

# NOAO Educational Programs:

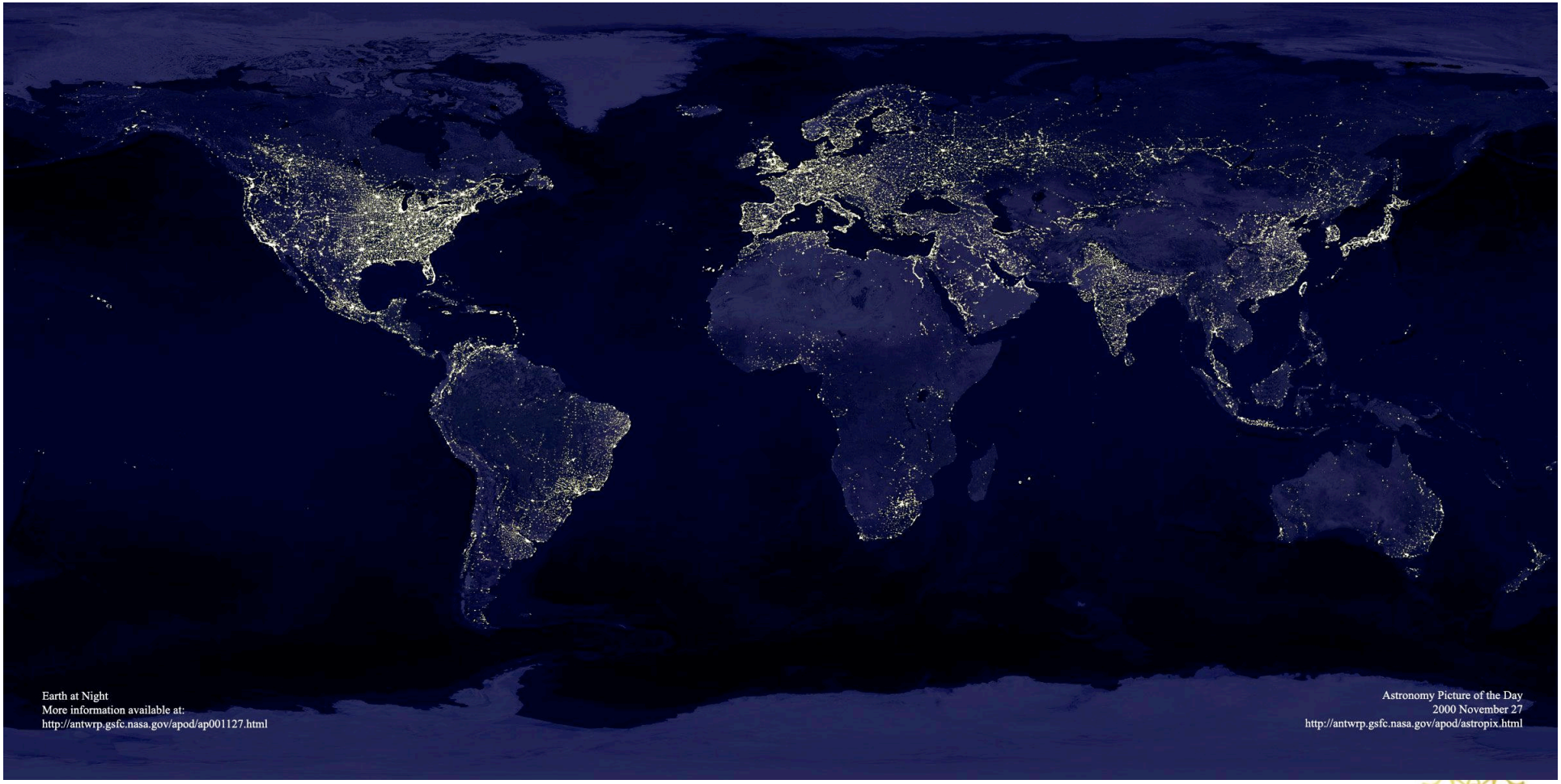
## Research Experiences, Formal, Informal, Communicating Astronomy (K-Gray)





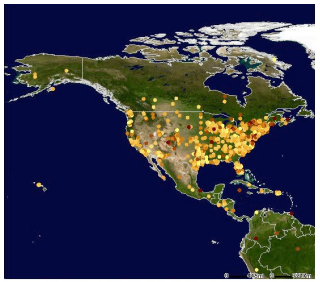
# Centro de Apoyo a la Didáctica de la Astronomía (CADIAS)

# Urban Constellations = Energy Wastage

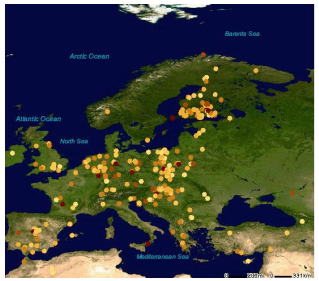


# The GLOBE at Night Program

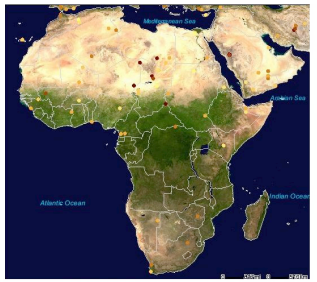
- Citizen-scientists recorded the brightness of the night sky by matching its appearance toward the constellation Orion with 1 of 7 stellar maps of different limiting magnitudes.
- Measurements have been submitted on-line and resulting maps of all observations have been created.
- March 2006: 18,000 citizen-scientists made 4600 observations from 96 countries the inaugural year!
- March 2007: An increase of 85% to 8500 observations

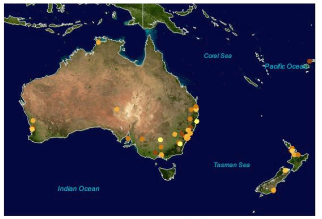

GLOBE at Night data in North America


GLOBE at Night data in South America


GLOBE at Night data in Europe

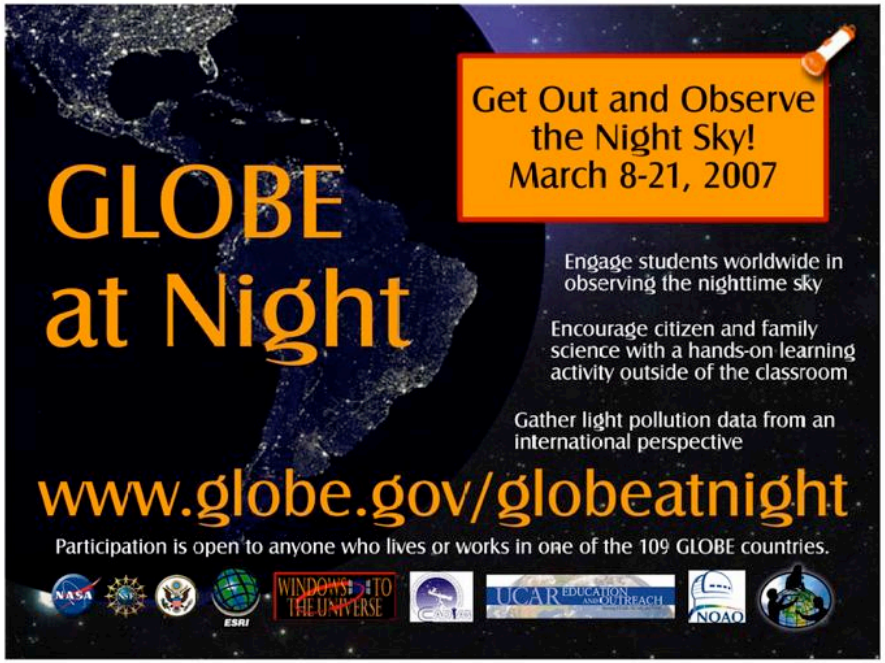

GLOBE at Night data in Asia


GLOBE at Night data in Africa


GLOBE at Night data in Oceania

# Built on Successful Programs

- Past programs from
  - Greece
  - Austria
  - International Dark-Sky Association
  - a pilot program between NOAO-North in the USA and NOAO-South in Chile.
- In 2006, a “star hunt” began for everyone all over the world. (NOAO & the GLOBE Project)




- Designed to aid teaching about the impact of artificial lighting on local environments, and the ongoing loss of a dark night sky as a natural resource for much of the world’s population as well as energy wastage.

# Two Flavors of GLOBE at Night

- The “classic” GLOBE at Night exercise that anyone can have fun doing with their unaided eyes. Low-tech, accessible.

- A new effort to obtain precise measurements of the night sky using digital sky-brightness meters, especially to identify and preserve urban dark-sky oases in urban areas. ‘Digital”

# 2007 Participants in GLOBE at Night

- Teachers and students (school and after-school programs)
- Astronomy Clubs (high school & amateur)
- Science and Technology Centers and Planetaria
- Observatories
- Int'l Dark Sky Association members
- National Parks (rangers and visitors)
- Anyone who found out about it!

# Teaching Kit Topics




GLOBE at Night
For Students
For Teachers
For Parents
Home
Learn
Observe!
Report
Map
...about observing stars and light pollution in your nighttime sky.
Magnitude of Stars | Finding Orion Interactive | Orion Mythology | Light Pollution Interactive | Light Pollution
What does your nighttime sky look like? Are you observing light pollution in your sky?* Also in Spanish.
Magnitude limit = 4
Drag the Magnitude slider left and right to make more (left) or less (right) light pollution. Drag the Latitude slider up and down to change the view of Orion to match the sky as seen from your location on Earth.
How does the amount of background light pollution affect your ability to see the fainter stars in the constellation Orion?
Latitude = 40 degrees N
Credits

Select the latitude closest to your location: 40 deg S | 20 deg S | Equator | 20 deg N | 40 deg N | 60 deg N

Cloudy Sky

Magnitude 1 Chart

Magnitude 2 Chart

Magnitude 3 Chart

Magnitude 4 Chart

Magnitude 5 Chart

Magnitude 6 Chart

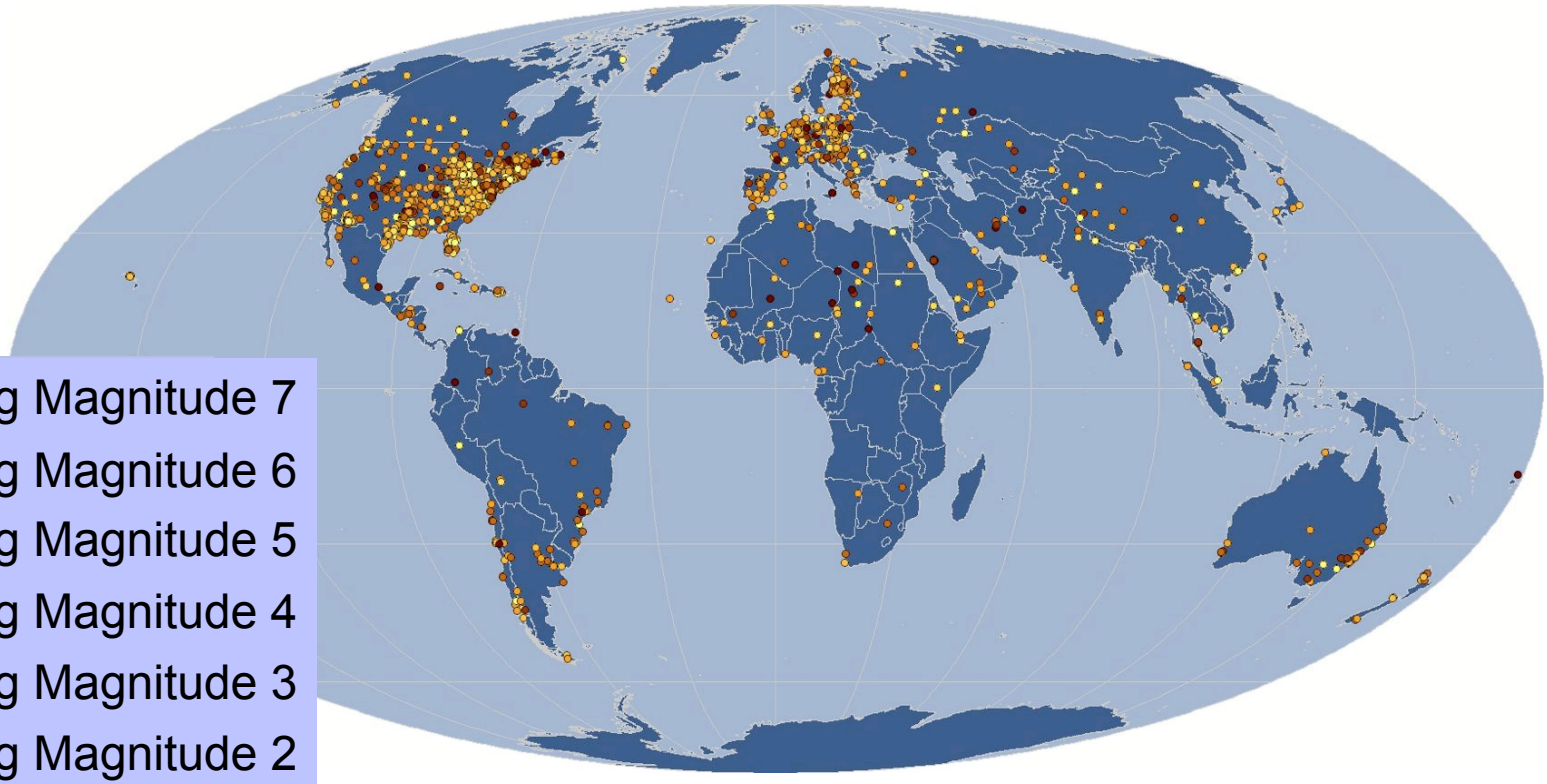
Magnitude 7 Chart

Match Night Sky to a Magnitude Chart.

Estimate cloud coverage.

Fill out the observation sheet.

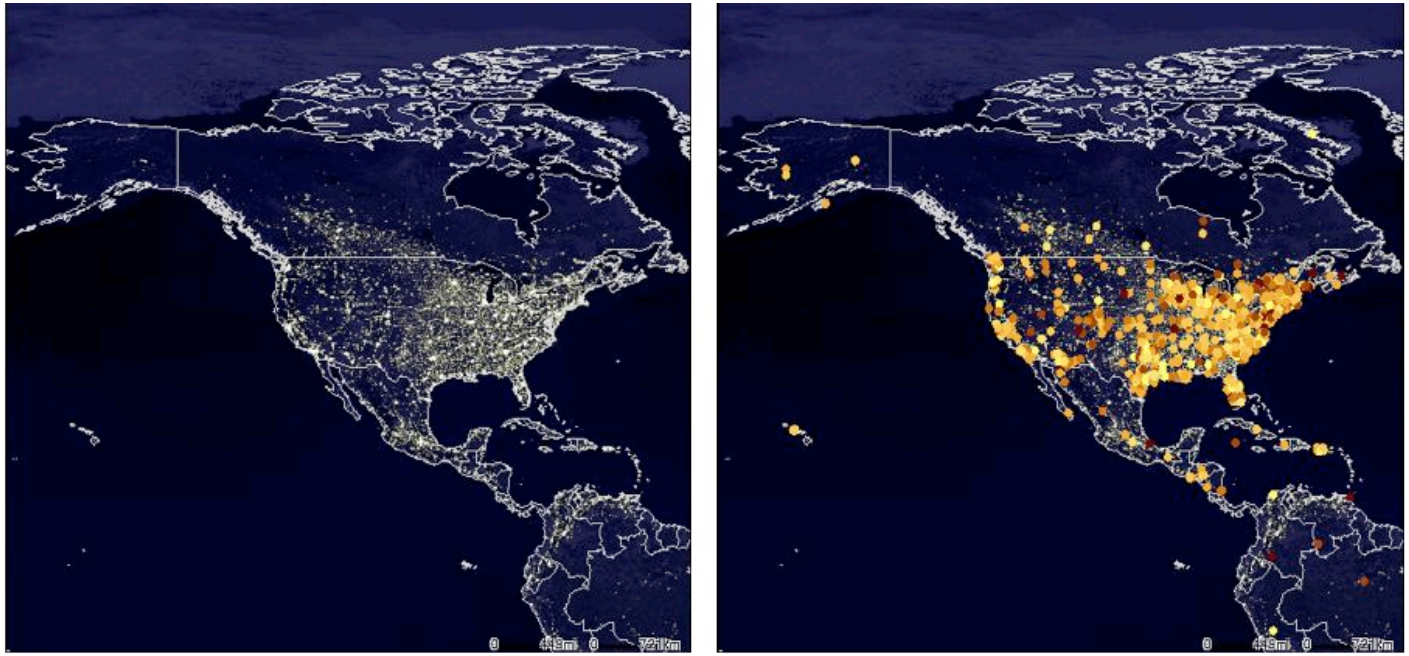
# Compare Your Observations to Thousands Around the World



- Limiting Magnitude 7
- Limiting Magnitude 6
- Limiting Magnitude 5
- Limiting Magnitude 4
- Limiting Magnitude 3
- Limiting Magnitude 2
- Limiting Magnitude 1

# Comparison of GLOBE at Night Data with Other Data Sets

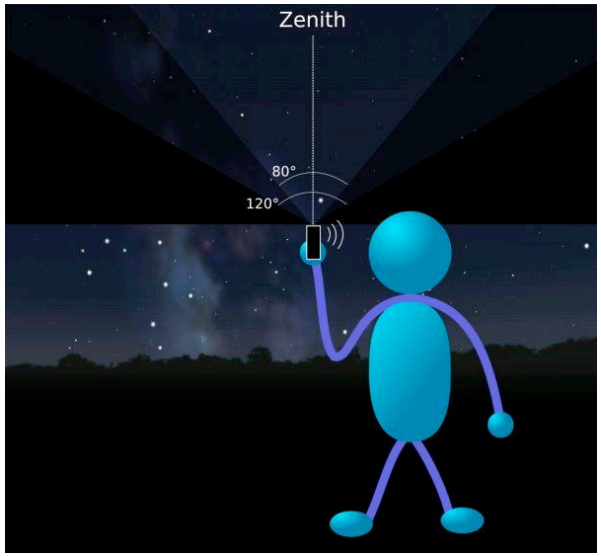
- Nighttime Satellite Imagery
- Population Density



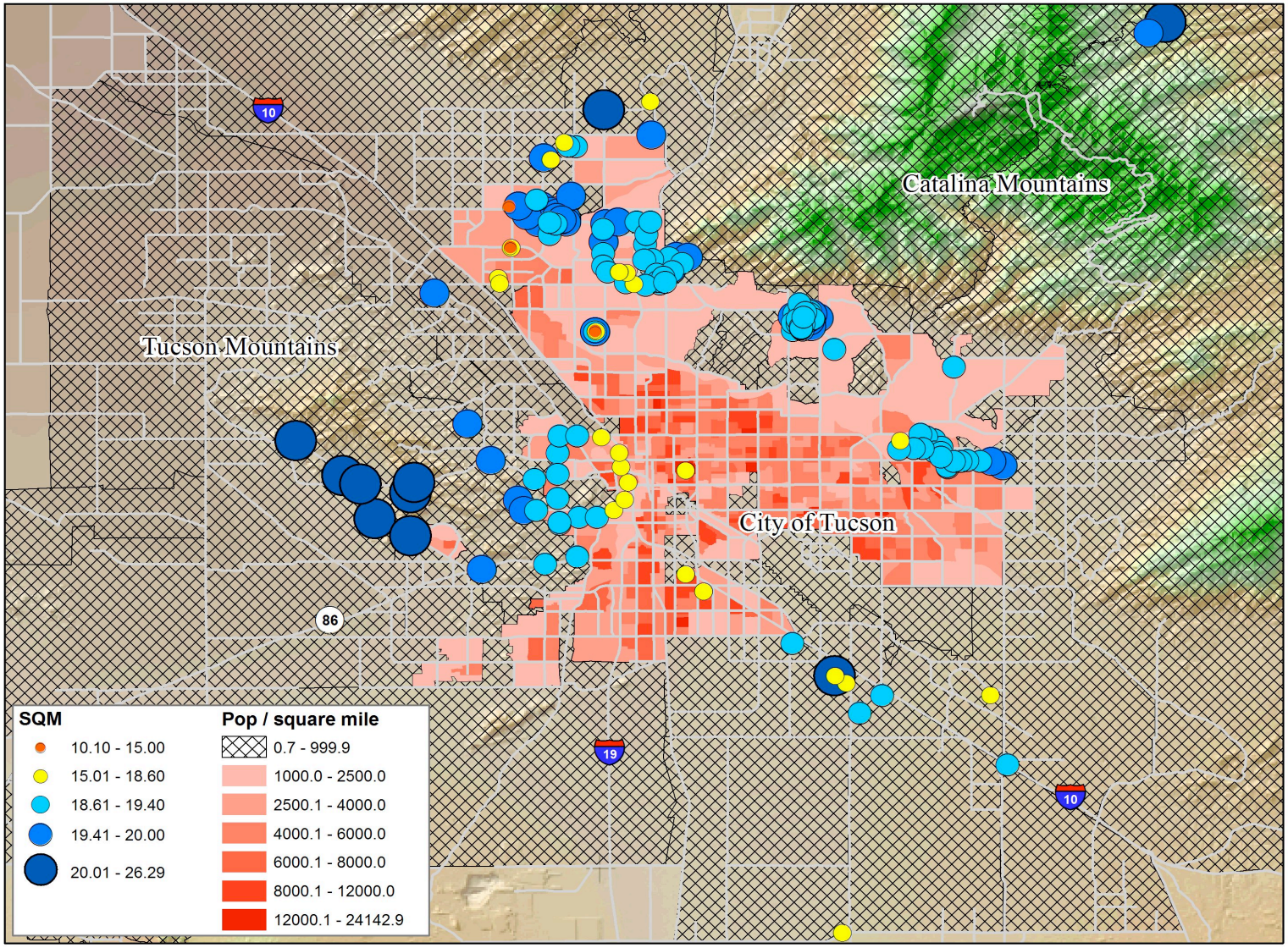
Comparison of "Earth at Night" in North America with GLOBE at Night
(C. Mayhew & R. Simmon [NASA/GSFC], NOAA/NGDC, DMSP Digital Archive)

# The Digital GLOBE at Night Project

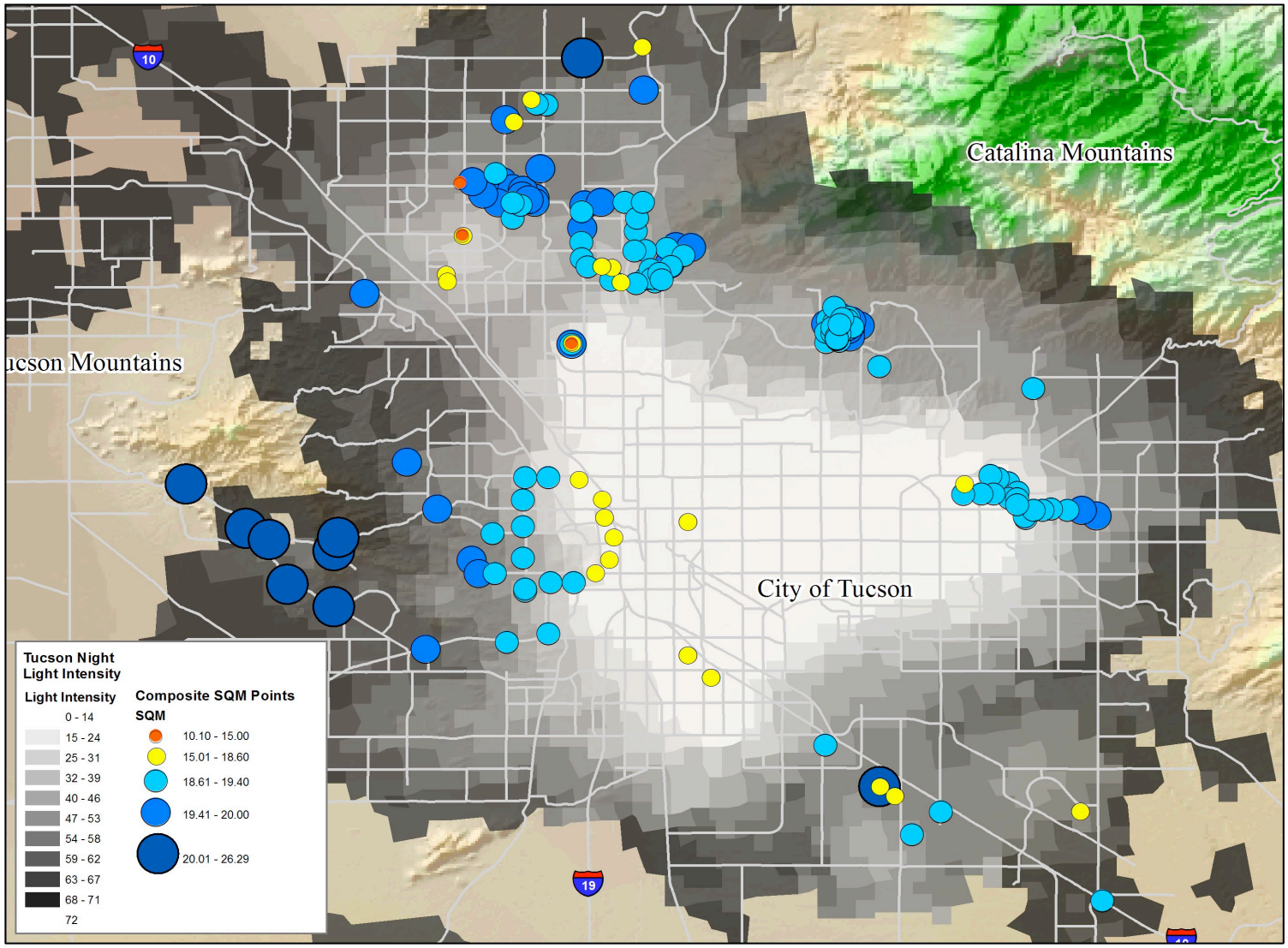
- Supported by a grant from the NSF Astronomy Division (for meters and kits)
- Sky-quality meters (SQMs) built by Unihedron in Ottawa, Canada
- Repeatability of the readings is +/- 0.1 magnitude/square arcsec.
- Meters allow for rapid and easy characterization of urban sky glow
- Narrow-beam version being tested, will be implemented for 2008.



# SQM Measurements vs Population Density
# Tucson, Arizona

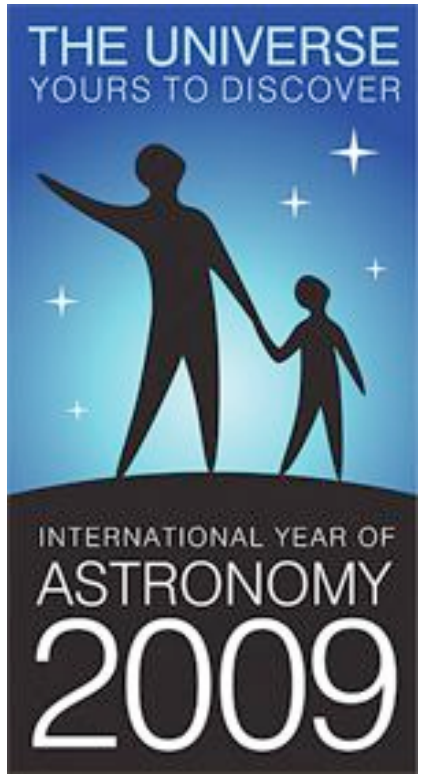


# SQM Measurements vs Nighttime Lights
# Tucson, Arizona



# The Future: 2009

- "Dark Skies are a Universal Resource":
  1 of 7 major US themes for IYA 2009
- "Dark Skies Awareness":
  1 of 10 Global Cornerstone Projects for IYA 2009
- Coordinate with International Astronomical Union Division XII, which includes
  - Commission 46
    (Astronomy Education & Development)
  - Commission 50
    (Protection of Existing & Potential Observatory Sites)
  - Commission 55
    (Communicating Astronomy with the Public)



# Proposed Activities for International Year of Astronomy GLOBE Campaign (from C. Walker, lead for IYA)

1. **Globe at Night** and Star Count Activities
   - Programs for Students, Families, and Individuals (activities that let people monitor the light pollution level and begin to appreciate the loss of the night)
2. More Sophisticated **Light Monitoring** Activities for Those with More Background and Equipment (**SQMs**)
3. A **Documentary** about Light Pollution
4. Booklet or Web Site of **Poetic Quotes** about Stars and the Night Sky
5. Tour of **Native American Storytellers** around the Country
6. Light Pollution **Exhibits** around the Country (e.g. at libraries)

# More Proposed Activities

7. Create an **On-line Star Map** With Legends and Stories (click on an object and hear stories)
8. Provide **Sky Story** Information and Activities for Teachers
9. Contact **Magazines and** Other **Media** about Doing Dark Sky and Light Pollution Stories for 2009
10. Do an **Art Contest** on "What Does the Night Sky Mean to You?"
11. Designate Certain Observatories as **Dark Sky Teaching Sites**
12. **"Return of the Sky" Tours** (traveling program of talks about the sky, sort of like a rock and roll music tour)
13. **World Series of Astronomy** (competitions for adults and kids to see how many objects in the sky they can identify)

# Summary of Design Choices We Made (but might revisit)

- Organization of Network (nature of branches)
- Differentiation of Audience (narrow or broad)
- Role of Authentic Science (versus other goals)
- Role of Kits/Importance of kits (time of task)
- Reporting Systems (all on the web?)
- Role of Follow-up and Analysis (doing real science)
- International Year of Astronomy (program expansion)

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http://www.globe.gov/globeatnight