

GLOBE at Night: An update and look ahead to IYA2009

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Abstract

The ongoing loss of a dark night sky as a natural resource for much of the world's population is a growing, serious issue that not only impacts astronomical research, but also human health, ecology, safety, security, economics and energy conservation. "Star hunts" or "star counts" provide "citizen-scientists" with a fun, fast and no-frills way to acquire heightened awareness about light pollution through firsthand observations of the night sky. Over the last two years, the *GLOBE at Night* programme has enabled citizen-scientists around the world to contribute measurements on sky-brightness to a growing global database in two ways: simple unaided-eye observations that anyone can do and quantitative digital measurements through a handheld, well-calibrated sky-brightness meter. As discussed in this article, the *GLOBE at Night* programme will serve as a basis for the IYA2009 global Cornerstone Project on *Dark Skies Awareness*, as well as the central programme for the US IYA2009 *Dark Skies are a Universal Resource* theme.

Introduction: the challenge

We live in a world of urban constellations, unable to see the stellar constellations a moderately dark sky would provide. We should ask ourselves whether this is the legacy that we wish to leave our children. The ongoing loss of a dark night sky as a natural resource for much of the world's population is a growing concern in many countries of the world, as shown by recent "lights out" events in Australia, England, South Korea and the United States. These events and the growing success of various star-counting programmes show that dark-skies education efforts are most effective when they get people physically involved and when they develop a heightened awareness of light pollution as a global problem with a local solution.

A solution

"Star hunts" or "star counts" provide citizen-scientists with a fun, fast and no-frills way to acquire heightened awareness about light pollution through firsthand observations of the night sky. Past programmes have come from Greece, Austria, Canada, the International Dark-Sky Association and a pilot programme between NOAO-North in Tucson and NOAO-South in La Serena, Chile, among others. *GLOBE at Night* has built on these programmes to become an international citizen-science event to observe the night-time sky and learn more about light pollution around the world. *GLOBE at Night* brings together parents, students, and their communities for an engaging and fun science campaign.

GLOBE at Night

In March 2006, the National Optical Astronomy Observatory (NOAO) and the GLOBE project first conducted the *GLOBE at Night* programme to enable “citizen-scientists” around the world to contribute simple unaided-eye observations on sky brightness to a growing global database. Citizen-scientists recorded the brightness of the night sky by matching its appearance toward the constellation Orion with one of seven stellar maps of different limiting magnitude. Observations and their exact locations were submitted online. More than 18,000 people contributed 4,600 observations from 96 countries.

The *GLOBE at Night 2007* programme built upon the success of the inaugural campaign in 2006. The international star-hunting event returned from 8–21 March in two flavours: the classic *GLOBE at Night* activity incorporating unaided-eye observations toward Orion, and a new effort to obtain precise measurements of urban dark skies toward the zenith using digital sky-brightness meters. Both flavours of the programme were designed to heighten awareness 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 population. Participation increased to 8500 observations from 60 countries in the last event. In 2008, the dates for *GLOBE at Night* are 25 February – 8 March.

Five fun, fast, and no-frills steps to the classic GLOBE at Night programme

Participants are introduced to the five steps of the classic *GLOBE at Night* Programme that involve unaided eye observations toward Orion and the comparison of those observations to charts of limiting magnitudes. These steps are featured on the *GLOBE at Night* website¹.

Step #1: Find your latitude and longitude. There are tentative plans to build this feature into the *GLOBE at Night* web pages by IYA2009. Until then sources for acquiring latitude and longitude range from using Global Positioning Services (GPS) to inputting your address to a website⁷ to zooming in to your location with Google Earth maps to using topological maps. More information can be found online².

Step #2: Find Orion in the night sky. There are various ways given to find Orion³. You can also practice locating Orion by latitude using the interactive facility⁴. Or use an interactive slider to adjust both latitude and limiting magnitude⁵. There is also an online activity for the little citizen-scientists⁶.

Find Orion by going outside an hour after sunset (approximately between 7–10 pm local time). Determine the darkest area by moving to where most stars are visible in the sky toward Orion. If you have outside lights, be sure to turn them off. Wait 10 minutes for your eyes to adapt to the dark. Locate Orion in the sky using the tools in the paragraphs above.

¹ www.globe.gov/globeatnight/observe.html

² www.globe.gov/globeatnight/observe_latlong.html

³ www.globe.gov/globeatnight/learn_findorion.html

⁴ http://www.globe.gov/globeatnight/observe_finder.html

⁵ www.globe.gov/globeatnight/learn_orionsky.html

⁶ <http://www.globe.gov/globeatnight/GaN2007OrionAtFingertips.pdf>

⁷ <http://www.maporama.com>

Step #3: Match the night sky to one of the magnitude charts. Use either the teacher or family packets or the material on-line⁷. Estimate the cloud coverage. Fill out the observation sheet.

Step #4: Report your observations on-line⁸ anytime between 25 February and 20 March 2008. Try another set of observations from a different location!

Step #5: Compare your observations to thousands around the world⁹. Explore, zoom in and examine your data with the GLOBE at Night Map Viewer! *GLOBE at Night* is working to provide comparative data sets such as population density maps and night-time satellite imagery by IYA2009.

The Digital GLOBE at Night programme 2007

The digital *GLOBE at Night* programme was made possible by a small grant from the US National Science Foundation (NSF), which funded the purchase and distribution of 135 low-cost, handheld, well-calibrated sky quality meters (manufactured by Unihedron) called “SQMs”. (Repeatability of the device’s readings is +/- 0.1 magnitude/square arcsec according to Dr. Patrick Seitzer of U. Michigan.) Along with light-pollution teaching kits developed by NOAO, the meters were distributed to citizen-scientists in 21 US states plus Washington, DC, and in five countries, including Chile, where NOAO has major observatories. About 1,000 measurements were made. Initial results from 2007 show very good consistency, with obvious gradients in brightness from city centre to known dark areas. There was lots of creativity in the way measurements were made, such as via a Moon roof and with the car’s GPS unit. The prototype SQM shows great promise.

The citizen-scientists were teachers, their students, astronomers at local and national observatories, International Dark-Sky Association (IDA) members, staff from 19 science centres, members of advocacy groups and guide staff at the national parks.

At many of the sites where the SQMs were delivered, a local coordinator promoted dark-sky education using the educational kits and trained a number of teachers and amateur astronomers in using the meters. For each meter, citizen-scientists were asked to make measurements from different locations in their region and record their measurements online with their latitude and longitude at each location, using either a GPS unit or GIS-related website.

An illustration of the results can be found in an article by C.E. Walker et al. (2007). The SQM data for Tucson is plotted against population density in Figure 1 and against the intensity of night-time lights in Figure 2. There is high correlation between the values of the SQM measurements and those for population density and the intensity of night-time lights. The higher the population density or intensity of night-time lights, the brighter the SQM reading.

⁷ http://www.globe.gov/globeatnight/observe_magnitude.html

⁸ www.globe.gov/globeatnight/report.html

⁹ www.globe.gov/globeatnight/analyze.html

The easy to use SQM

The original Sky Quality Meter (SQM) has an angular field-of-view response of ± 40 degrees (80 degrees total) for a full cut-off at ± 60 degrees (120 degrees total). The new, improved model coming out in December 2008 (SQM-L) has a much narrower angular field-of-view response of ± 15 degrees (30 degrees total) for a full cut-off at ± 30 degrees (60 degrees total). The meter readings are somewhat temperature dependent. It is a good idea to leave the meter outside for 20 minutes before taking reliable measurements, depending on the temperature differential. Once you are ready, point the SQM directly above (at the zenith). The original model of the SQM has the sensor on the same side as the display. In the SQM-L model, the display is on the side and therefore easier to read. The SQM should be held above head level so that shadows or reflections from your body do not interfere with the reading. Avoid using the SQM in areas that are shaded by trees or buildings. For the original model in particular, be at least as far away from a structure as it is high. Pressing and holding the button a second time will display the outside temperature in $^{\circ}\text{C}$ and then $^{\circ}\text{F}$. Subsequently the model and serial numbers are displayed.

Data input

SQM data can be taken all year. The data input sought for the meters is its serial number, the date and local time, your latitude and longitude and the meter readings. During the *GLOBE at Night* campaign, include the unaided eye observations toward Orion. Optional input includes your name, outside temperature, what percentage of cloud coverage and illuminated Moon you have, and any comments on whether you are near a light, building, or tree, the current sky conditions, etc.

Plans for 2008

We will continue to build on the existing infrastructure of local coordinators and participants in *GLOBE at Night* to create a similar, but extended, US-based classic and digital programme. We will expand our collaboration with the International Dark-Sky Association¹⁰ and a local SQM citizen-science programme called Night Vision¹¹.

This effort will support ongoing student-teacher teams, as well as new participants, and build a more formal network of *GLOBE at Night* sites and coordinators. Funding permitting, people who commit to the programme will have access to sky-brightness meters as well as a kit with teaching materials on preserving dark skies. Participants will learn how to do the classic observations, use the meters, organise a meaningful campaign in their community, and teach with the kit. Interested participants will be offered the opportunity to continue SQM measurements all year.

NOAO and GLOBE are developing plans for web pages linked to the *Globe at Night* website¹² that will include information about SQMs, allow one to compare classic observations and digital measurements (discussing the importance of both) and instruct how to make an SQM measure-

¹⁰ www.darksky.org

¹¹ www.nightwise.org/nightvision.htm

¹² www.globe.gov/globeatnight

ment with the template provided. It will also provide a selection of different types of SQM measurement programmes – from grid surveys of one’s town on one night (repeatable every month), to seasonal surveys, to surveys every hour over a night at one or more location, to surveys of 8 cardinal directions along one’s horizon (concurrent with regular SQM measurements). Information on how to report an SQM measurement will also be provided.

Analysis of the maps will include a comparison with other data sets such as last year’s SQM data set, the limiting-magnitude unaided-eye observations, population density, regional environmental concerns (e.g., sea turtles in Florida), and satellite data on night-time lights (top view looking down versus the SQM’s bottom view looking up).

Plans for 2009 and summary

The outcome of the 2008 campaign will provide the basis for a quantitative global effort in 2009 as one of the major US IYA programmes. In addition, the US working group has come up with several related ideas (some existing, some new, some overlapping with other US IYA themes) that may extend to the global Cornerstone Project. The ideas include “Lights Out America; Dark Sky Teaching Sites”; “Astronomy Nights in the Park” (where national parks coordinate a dark sky night); light pollution discussed in documentaries and travelling exhibits (e.g. at libraries), a planetarium show, a video, articles, podcasts, public service announcements and MySpace; an art contest on “What does the night sky mean to you?”; a World Series of Astronomy (a competition for adults and kids to see how many objects in the sky they can identify – the darker the sky, the more objects); a “Return of the Sky” tour (a travelling programme of talks about the dark night sky); “Coming to a Dark Sky Near You” (a short drive to a dark site for a starparty) or Sidewalk Astronomy in cities; a tour of native American storytellers around the country; a booklet or website of poetic quotes about stars and the night sky; and an on-line star map with legends and stories (click on an object and hear stories).

The *GLOBE at Night* programme will also play a major role in the global IYA Cornerstone Project, Dark Skies Awareness. To facilitate the preservation and protection of the world’s cultural and natural heritage of dark night skies in places such as urban oases, national parks and astronomical sites, IAU will be collaborating with NOAO, the International Dark-Sky Association and other national and international partners in these dark-sky and environmental education efforts for IYA.

Reference

- Walker C.E., et al. (2007), Dark Skies as a Universal Resource, Citizen-Scientists, and the International Year of Astronomy. ASP Conference proceedings, 2007.