GLOBE at Night

2006 GLOBE at Night Analysis Summary

www.globe.gov/globeatnight

March 22-31, 2006

Analysis and Summary by Dennis Ward
Astronomer and Educational Technologist
UCAR Office of Education and Outreach

What do the GLOBE at Night data tell us?

The map below (Figure 1) shows about 4,000 of the observations made during March 22-31, 2006 for GLOBE at Night. Each observation is represented by a colored dot, with the darker dots representing darker skies (fewer lights at night) and the brighter dots representing brighter skies (more lights at night). As you can see, there are many more bright dots than dark ones. This would make us think that most of the observations were taken by people who live in areas with at least some light pollution. To astronomers, biologists, and other scientists who study light pollution, this is not surprising. One question that you might ask is, "What do the GLOBE at Night data tell us about the geographic location of the observations?" This is a very important question—it's so important that we'll look at three different ways of answering it.

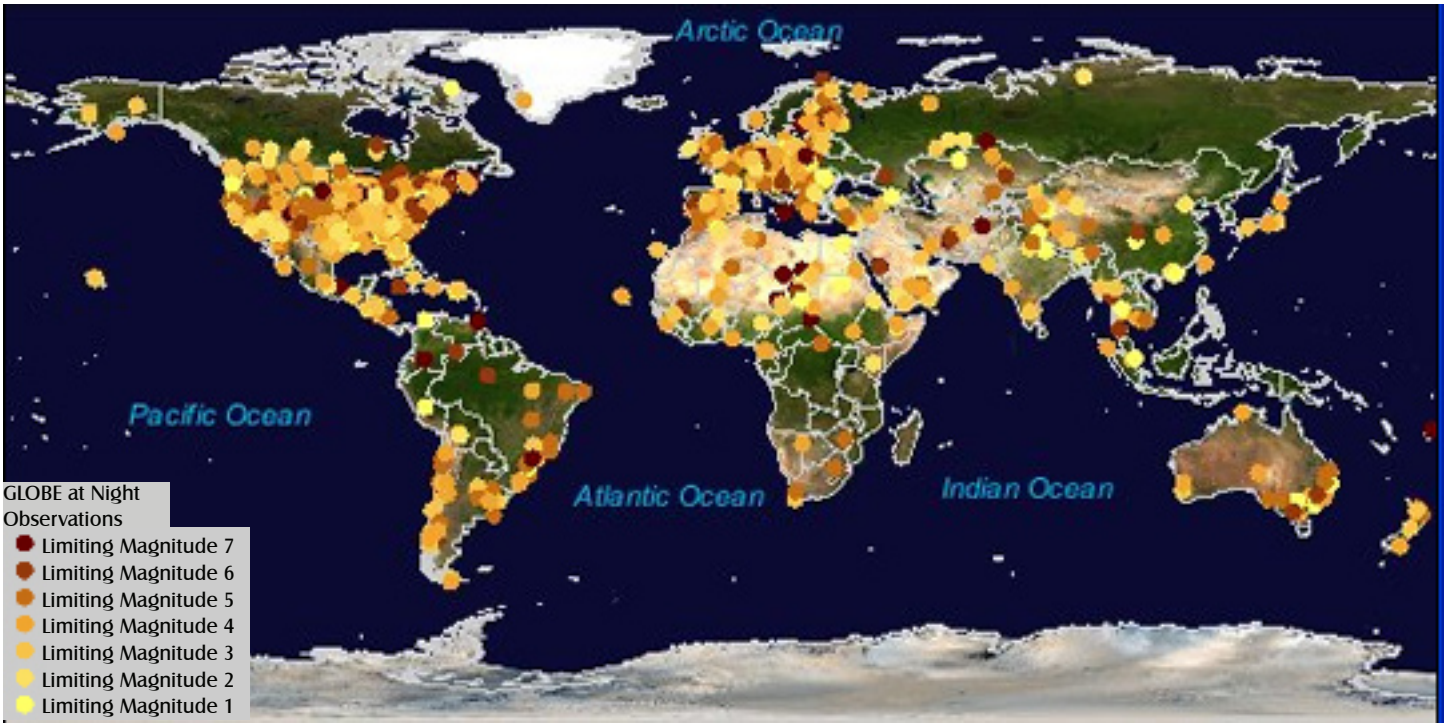

Figure 1. GLOBE at Night Observations for March 22-31, 2006

What do the GLOBE at Night data tell us? (continued)

The easiest way to answer the question is to count the number of observations that matched each limiting magnitude chart. Remember that magnitude is a term astronomers use to describe the brightness of an object. Magnitude 1 stars are brighter than magnitude 7 stars, so they can be seen even in light-polluted skies. By looking at the bar graph in Figure 2, you can see that 403 observations were made with a limiting magnitude of 1 (brightest skies) while only 126 were made with a limiting magnitude of 7 (darkest skies). According to Figure 2, most observations were made under limiting magnitude 3 and 4 skies. This tells us that most observations were taken in places with some light pollution. If you entered an observation, how does your location compare with others? Were your skies brighter or darker than most others?

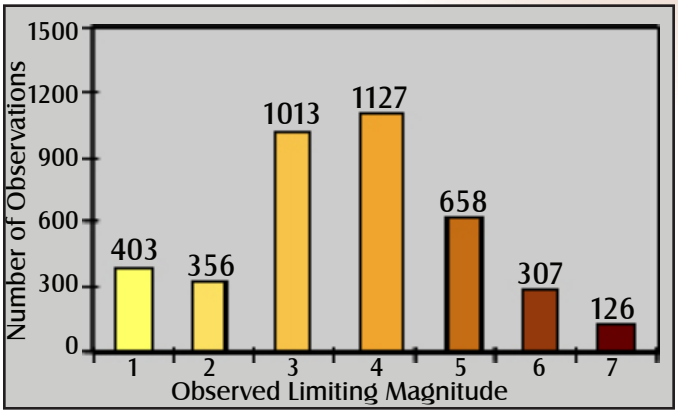

Figure 2. Number of Observations for each Limiting Magnitude

Another way of answering the question, "What do the GLOBE at Night data tell us about the geographic location of the observations?" is to compare each observation with how many people live at or near that location. The best way of doing this sort of comparison is to use a measurement known as "population density." Population density is defined as the number of people that live within a standard area, usually one square kilometer. The population density in a remote area might be just 3 or 4 people per square kilometer, while in the center of a large city there might be more than 10,000. The map in Figure 3 shows a portion of Finland as an example. The population density is shown by the shades of yellow in the background—darker colors are areas with more people per square kilometer. The GLOBE at Night observations are shown in different colors, shades of blue, so they don't get "lost" in the background.

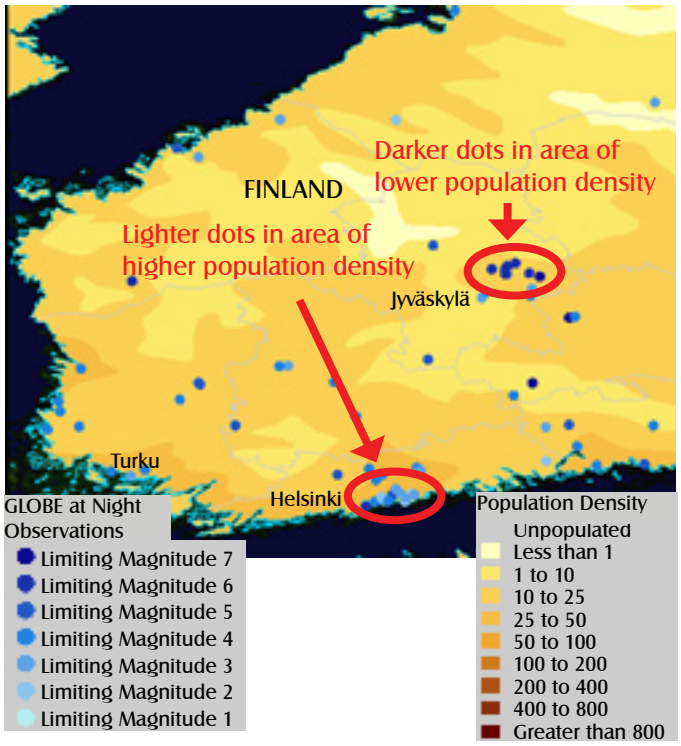

Figure 3. Comparison of GLOBE at Night with Population Density in Finland

Since light pollution is caused by the lights that people use, you might guess that areas of higher population density would have brighter skies and more light pollution. The GLOBE at Night scientists compared the GLOBE at Night data with the population density around the world and found that the brighter dots from GLOBE at Night are located in areas with higher population density.

What do the GLOBE at Night data tell us? (continued)

To double-check their results, the GLOBE at Night scientists used an image of the Earth that shows what it would look like if it were nighttime everywhere (no sunlight shining anywhere). Since the Sun always shines on half of the Earth, this image is made up of many individual images taken from satellites in space when they are over the Earth's night side. This "Earth at Night" image shows areas with more lights as bright dots. The GLOBE at Night scientists compared these two datasets, represented in Figure 4. Their comparison agreed with the previous population density comparison—the brighter dots from GLOBE at Night are near the lights in "Earth at Night."

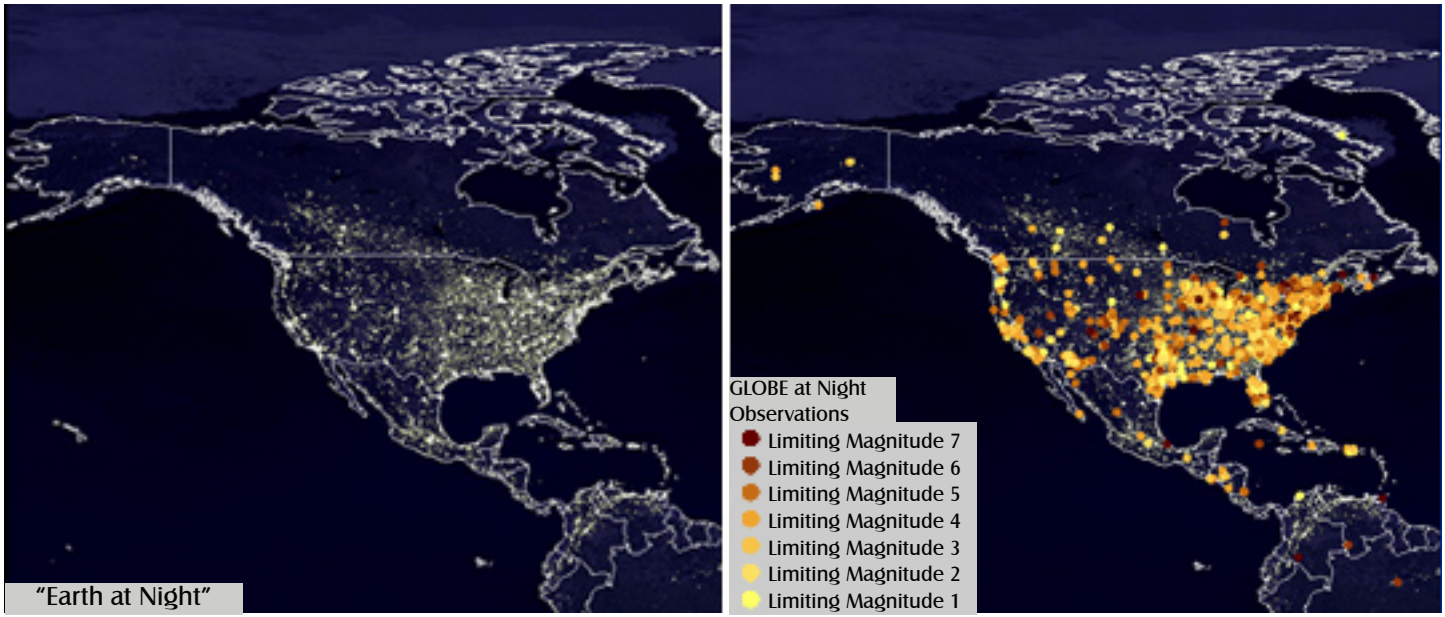

Figure 4. Comparison of "Earth at Night" in North America with GLOBE at Night
(C. Mayhew & R. Simmon (NASA/GSFC), NOAA/ NGDC, DMSP Digital Archive)

Scientists always look for ways to check their data and ideas. In this case, they had the population density data and the "Earth at Night" image taken from space, but no group of scientists could have traveled around the world and taken almost 4,000 useful observations in less than two weeks. Also, the GLOBE at Night observations provided measurements from the ground looking up, whereas the "Earth at Night" data is from the sky looking down. The similarity between the GLOBE at Night data and the "Earth at Night" image helps us to know that the satellite information is reliable in observing light pollution.

The summary of our analysis is that the GLOBE at Night data shows brighter skies in areas with more people. By submitting your observations to GLOBE at Night, you are helping scientists studying light pollution, population patterns, and energy usage. You have provided valuable information that would have otherwise been impossible to obtain.