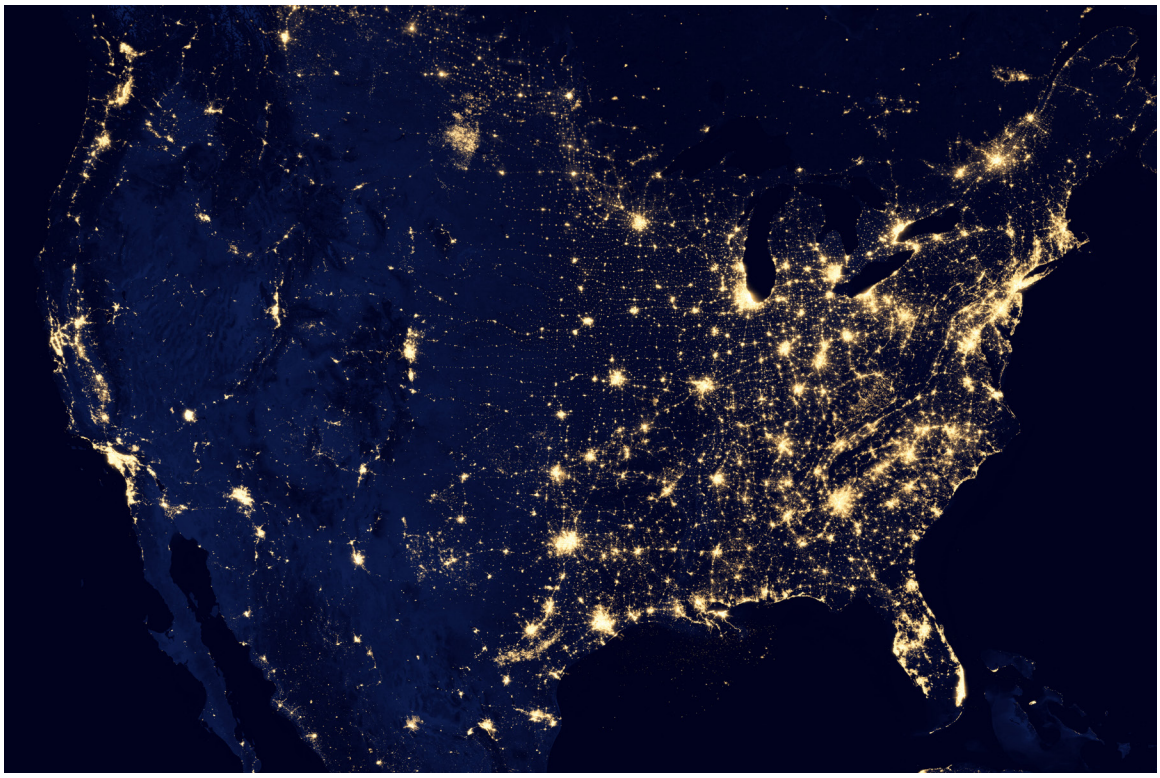
Nighttime Lights



The Nighttime Lights products of the Earth Observation Group (EOG) within the Solar-Terrestrial Physics (STP) Division of the National Geophysical Data Center (NGDC) represent the epitome of data reuse. The original data come from the Air Force's Defense Meteorological Satellite Program (DMSP), a series of polar-orbiting satellites intended to collect weather data for the Department of Defense. The EOG has used that data, sent to them by the Air Force Weather Agency (AFWA) for archiving, to build an ongoing data base of stable and ephemeral light sources, from which they continue to derive an amazing array of products – from the nighttime lights posters to a study for the World Bank, quantifying for the first time the amount of global gas flaring.

The DMSP has been collecting data since 1972, data which was initially collected on film and upon being declassified after 72 hours, ended up being archived at the Federal Records Center. NGDC began to speculate on the potential usefulness of the data for purposes beyond its original targeted role, and when the Air Force transitioned to digital data, which would be destined for the bit bucket upon declassification, NGDC stepped in and requested that they provide an archive for the data.

That archiving began in 1992 and continues to the present, with a current flux of data of the order of 8.5 Gigabytes (GB) per day. These data are analyzed for patterns of light that both match and contrast with previous establish patterns. This provides a continual pattern of changing lights, analyzed for stability and classification.

The original intent was to generate a mask of stable light that was present consistently from night to night in order to detect the ephemeral lights, lights that appeared and disappeared, which might be fires. However, when the mask was generated, the

pattern of stable nighttime lights was stunning and made for a delightful graphic presentation, which has now graced a number of media and posters.

However, among the stable lights were some peculiar anomalies to what was expected: lights at sea, in the midst of the Sahara desert, or off in Siberia. These were eventually sorted out to be fishermen, using intensely bright lights to attract fish or squid into nets and gas flaring from petroleum production areas, both onshore and offshore. Additionally the analysts were able to detect fires as anticipated in the original intent of the project.

Additionally, with the appropriate calibrations, the nighttime lights proved to be an effective proxy for population, energy consumption, carbon production, economic vigor, etc. By building a time-series database of lighting patterns, change analysis can be applied to look at socio-economic and environmental change, trends and disruptions. To expand on this latter aspect of change analysis, the EOG is now going back and digitizing the old film archives of DMSP data to extend the digital record back in time to establish a longer baseline for change analysis.

With this data we have been able to quantify, for the first time, the total, global amount of gas flaring at over 150 billion cubic meters per year, worth US $60 billion in today's prices, and sending 400 million tons of carbon dioxide directly into the atmosphere. In another interesting twist on using the data, if we know where the lights are normally on, we can detect where the lights have gone out. Now we can detect widespread power outages, as seen on the left with analysis products for the passage of Hurricane Katrina across the Gulf Coast.

These data have been enhanced by the Air Force, allowing us to vary the gain on the instruments to permit the capture of calibrated radiance, not just the presence or absence of light. There was, however, one city in the entire world that still saturated the instrument, despite the gain being at its lowest setting. It was not Paris, The City of Lights, nor London or New York. Viva Las Vegas!

So what was originally data for weather analysis and prediction, good for three days, has become a source of information about socioeconomic trends, fishing, fires, gas flaring and power outages as an aid to emergency response. All this information coming from what was once regarded as digital discards. But one man's garbage is another man's gold.