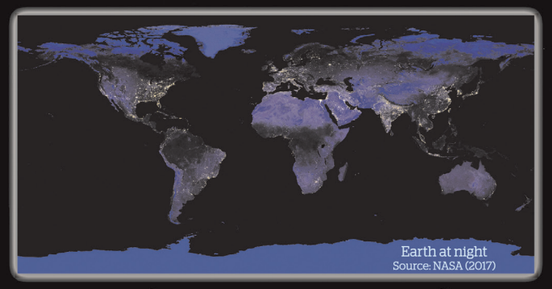

CARTOGRAMS

THE LIGHTER SIDE

BY BENJAMIN HENNIG

NASA's release of a new *Earth At Night* composite image is the first new global map of night light distribution since 2012 (featured in August 2015's *Geographical*). Since its previous release, NASA has worked on an improvement of the underlying algorithms that provide clearer and more accurate imagery from the raw satellite data.

The latest version (shown in the small inset map above) is not only the most accurate picture of light intensity around the globe, but the underlying data also allows a direct comparison of the changes that occurred between 2012 and 2016. To achieve this, the datasets of the two years were corrected for the changing light effects caused by the moon as well as 'seasonal vegetation, clouds, aerosols, snow and ice cover, and even faint atmospheric emissions (such as airglow and auroras) which change the way light is observed in different parts of the world.' Both datasets also cover the period of a full year in order to take seasonal changes into account.

The main cartogram above provides an insight into the changes in night light intensity between 2012 and 2016 by applying a geostatistical approach first described by ESRI cartographer John Nelson. Using night light imagery at a 3km resolution as a basis, a geospatial analysis of the differences between each area calculates how much the intensity has changed over time. The resulting data highlights where the intensity has declined (purple) or increased (blue) within the last four years and at what magnitude these changes were. Unchanged intensities remain black so that, unlike in the original *Earth At Night* map, here cities and other bright areas do not stand out unless they have seen a significant change in that period.

The cartogram transformation itself depicts an equal-population projection in which all areas are proportional to their total population. It therefore serves as a magnifying glass over the most densely populated areas and gives us an idea where changes to economic, social, political and other human activities have led to considerable differences in the distribution of light at night.

At a global level, the north of India stands out as a region where a huge increase in brightness has taken place in an area that is also heavily populated. Dense urbanisation and economic development are behind this region's prominence here. In contrast, the purple areas in the east of the Mediterranean, reaching from the coast inland like a band towards the south, mark the effects of war in Syria. Here large stretches of densely populated areas became darker in the past years, while neighbouring Lebanon and Israel along the coast have become brighter just like larger parts of the populated areas in Iraq towards the east.

In Europe, the picture resembles more of a patchwork of brighter, darker, but also many unchanged areas. In many cities across Europe, from London to Moscow, the ongoing effects of the cities spreading out and the suburban areas becoming brighter can be observed. Unchanged and dark in the change maps as well as in the night light map remains one outlier: Apart from Pyongyang, which has an overall decline in night lights, North Korea remains dark on the world map of light.

NASA's future plans for this project are an automation of its techniques to provide regular updates to night light data. The future availability of daily data or even almost instant access opens a wide range of possible applications that range from disaster response to tracking illegal fishing activities or monitoring sea ice movements for climate change research. Different insights into the data, such as cartographic distortions shown in this cartogram, can also contribute to gaining different insights into the underlying complex datasets.

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