Kyba, C. (2016): Defense Meteorological Satellite Program data should no longer be used for epidemiological studies.- *Chronobiology International*, *33*, 8, pp. 943—945.

DOI: http://doi.org/10.1080/07420528.2016.1189432

Defense Meteorological Satellite Program data should no longer be used for epidemiological studies

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Abstract:

Recent years have seen major advances in imaging of artificial outdoor light at night from space. This data should reduce the correlation between light and other urban factors such as noise. As street lighting is generally changed on a decadal time scale, the advantages of the new data outweigh the need for environmental factors to be measured concurrently with study observations. Therefore, the newer datasets should always be used when investigating the epidemiological effects of light at night, even for retrospective studies.

Dear Editor,

I read with interest the investigation of Koo et al. (2016) into whether outdoor artificial light at night (ALAN) is associated with obesity and delayed sleep patterns, recently published in *Chronobiology International*. Koo et al. (2016) compared data from the Korea Genome and Epidemiology Study in 2001-2003 to an outdoor artificial light dataset acquired in 2001 and 2002 by the Defense Meteorological Satellite Program Operational Linescan System (DMSP). In recent years, DMSP data have been used in a number of epidemiological studies, such as the observation of Kloog et al. (2008) that outdoor ALAN is correlated with breast cancer, but not with lung cancer, in Israeli women. While I hope to continue to see studies investigating the relationships between outdoor ALAN and disease, I hope that Koo et al. (2016) will turn out to be the last one ever to use the DMSP as a data source.

Kyba and Aronson (2015) have previously asserted that epidemiological studies should make use of newly available satellite data, even in the case of retrospective studies performed before the satellites were launched. This may seem surprising, given that night light data taken concurrently with the patient study are available, so I would like to explain in more detail here why this is the case. The main reason is that the DMSP was not designed for scientific work, so its data cannot be considered equivalent to those from newly available instruments.

The DMSP has several serious deficits compared to more recent instruments. Most importantly, the spatial resolution of the DMSP data is approximately 5 km (Miller et al. 2013). Koo et al. (2016) appear to have mistakenly reported the ground sample distance in the reprojected global DMSP datasets (~930 m in South Korea) as the spatial resolution. In fact, the DMSP resolution makes it difficult to clearly identify features even as large as airports, so the DMSP data provide general information on the city district level, not individual bedroom exposure to outdoor ALAN. In addition, the DMSP data is uncalibrated, and saturation is common in city centers. In 50% of the study area considered by Koo et al (2016), the DMSP was saturated for many or most overpasses.

Koo et al. (2016) divided the study participants into two groups of high and low outdoor ALAN. The resolution of the DMSP data makes this similar to dividing the participants into urban and suburban groups. This is problematic, because other differences in urban and suburban living situations could be confounding factors (Kantermann & Roenneberg 2009). Noise may be particularly important for sleep (Zaharna & Guilleminault 2010), and it seems likely that the participants in Koo et al. (2016) were unintentionally divided into high and low ambient noise groups. Higher resolution light exposure data, especially the street-level information available from the International Space Station (Figure 1), reduces the correlation between measured light exposure and degree of urban-ness. If outdoor light is a true cause of disturbed sleep and obesity, then odds ratios should increase with higher resolution data. In contrast, odds ratios should decrease or disappear if the true underlying cause is another urban factor such as noise or chemical pollution.

Although artificial light use has grown rapidly over time (Hölker et al. 2010), street lighting tends to be stable for periods of decades. The political division of Berlin, for example, is still visible 25 years after German reunification, due to the differences in lamp technology in the former East and West Berlin (Kyba et al. 2015). For this reason, relative patterns in light use within a single city today are likely to be representative of the situation in the past, with one important caveat: cities worldwide are switching to LED street lamps, so retrospective studies should aim to find data taken before local LED transition was underway.

For epidemiological studies that cover areas larger than individual cities, satellite data is necessary. The Day Night Band (DNB) of the Visible Infrared Imaging Radiometer Suite sensor on the Suomi NPP has a spatial resolution of 750 meters, is sensitive to much lower light levels, and does not suffer from the saturation problems experienced by the DMSP (Miller et al. 2013). Since DNB has little sensitivity to the blue light emitted by many LEDs, retrospective studies should use the earliest DNB data available (Kyba et al. 2015).

Anecdotal complaints of stray light disturbing people preparing to sleep are common, so it is surely worth continued investigation into whether outdoor light is associated with delayed sleep. Such studies should be based on the best light exposure data possible, in the ideal case via bedside monitoring. For retrospective studies, the newly available imagery from space is the best available tool to test for correlations between outdoor ALAN, sleep, and health. If higher resolution data doesn’t strengthen the correlations, it would suggest that the observed correlations with DMSP data were due to an as yet unknown urban parameter.

Declaration of Interest: The author reports no conflicts of interest. The author alone is responsible for the content and writing of the paper.

References:

Hölker F et al. (2010) The dark side of light: a transdisciplinary research agenda for light pollution policy. *Ecol Soc* 15: 13 [online] URL: http://www.ecologyandsociety.org/vol15/iss4/art13/

Kantermann T, Roenneberg T. (2009). Is light-at-night a health risk factor or a health risk predictor? *Chronobiol Int* 26:1069-1072.

Kloog I, Haim A, Stevens RG, Barchana M, Portnov BA. (2008). Light at night co-distributes with incident breast but not lung cancer in the female population of Israel. *Chronobiol Int* 25:65–81.

Koo et al. (2016). Outdoor artificial light at night, obesity, and sleep health: Cross-sectional analysis in the KoGES study. *Chronobiol Int* 33:in press.

Kyba CCM, Aronson KJ. (2015) Assessing exposure to outdoor lighting and health risks. *Epidemiology* 26:e50.

Kyba CCM et al. (2015) High-resolution imagery of Earth at night: new sources, opportunities and challenges. *Remote Sens* 7:1-23.

Miller et al. (2013) Illuminating the capabilities of the Suomi National Polar-Orbiting Partnership (NPP) Visible Infrared Imaging Radiometer Suite (VIIRS) Day/Night Band. *Remote Sens* 5:6717-6766.

Sánchez de Miguel et al. (2014) Atlas of astronaut photos of Earth at night. *Astron Geophys* 55:4.36.

Zaharna M, Guilleminault C. (2010) Sleep, noise and health: Review. *Noise Health* 12: 64-69.

Figure 1: Photo of Seoul, South Korea, taken from the International Space Station on February 2, 2013. The city was identified as Seoul by citizen scientists in the Cities at Night project (Sánchez de Miguel et al. 2014), and the photo is available from NASA at http://eol.jsc.nasa.gov/SearchPhotos/photo.pl?mission=ISS034&roll=E&frame=38848)