Numbers and types of light sources in urban areas

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Abstract

This talk presents first results from the campaigns using the *Nachtlichter* (night lights) app which took place in 36 regions (in 10 countries) during fall of 2021. The *Nachtlichter* app allows citizen scientists to count and classify outdoor light sources in publicly available spaces over very large areas (the methodology will be described in a separate presentation). In this presentation, we will provide more details about the areas in which *Nachtlichter* campaigns took part, and compare the distributions of light sources in different regions (e.g. small vs. large cities, and city centers vs. outlying residential areas).

Our results are consistent with earlier results showing that street and area lighting make up a relatively small fraction of all of the individual light sources (Figure 1). A striking finding is that in the early evening, lights from private windows make up a large fraction of the total number of light sources. This is likely important for skyglow modeling, as while windows typically have less luminous flux than streetlights, they radiate towards the horizon and often from higher elevation than the street level. Additionally, we show that the character of lighting differs between city centers and suburban areas, for example with many more luminous signs in urban areas.

We will also present the results of comparisons of the sum of lights in almost 200 Suomi NPP Day-Night Band pixels (based on the 15" grid of the Earth Observation Group) with the light sources observed by *Nachtlichter* participants in the same areas. We hope that it will be possible to use a linear model to estimate (to first order) the average contribution of the different light source types to the radiance observed from space. If this is the case, it would allow us to "translate" the DNB radiance observations from nW/cm^2sr into approximate numbers of light sources per square kilometer.

Looking toward the next decade, we hope that it will be possible to combine *Nachtlicher* results with 3D city modeling, in order to better understand the relationships between land use, light source type, and the blocking of light by obstacles, and how this affects skyglow.
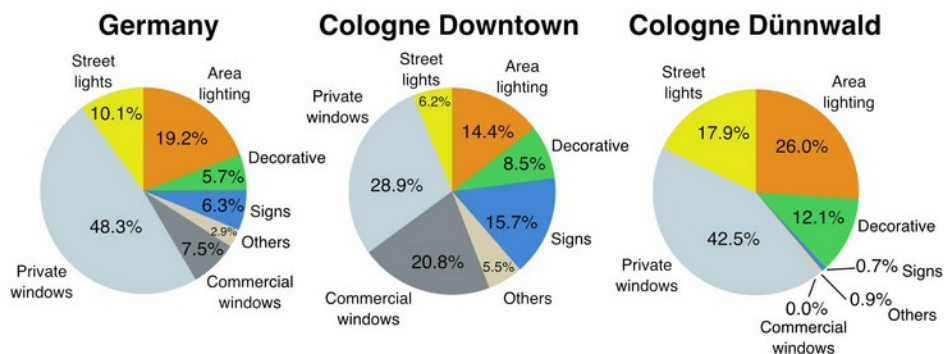
Figure 1: Comparison of light source types in all of Germany (left) to two areas of Cologne (city center at center, and an outlying residential area at right).