

# Urban Observatory of Belgrade (UrbObsBel): Study of Light Pollution in Belgrade and at the Astronomical Station Vidojevica

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## Abstract

Urban Observatory of Belgrade (UrbObsBel) is a three-year project funded by the Science Fund of the Republic of Serbia started in January 2024. Several instruments aimed for the study of light pollution were mounted at the Astronomical Observatory of Belgrade (AOB) and at the Astronomical Station Vidojevica (ASV). In this study we present comprehensive findings on light pollution levels measured using Sky Quality Meter (SQM) devices designed to measure the luminance of the night sky, over an approximately one-year period. We also use the data obtained with the SQM device mounted in the downtown Belgrade at Kalemegdan provided by the Astronomical Society "Rudjer Bošković". Our analysis indicates that urban areas experience substantially higher levels of light pollution which increase over time compared to the dark area in southern Serbia where the ASV is situated. Our findings underscore the importance of mitigating excessive artificial lighting to preserve natural night skies. This research provides valuable insights for policymakers, urban planners, and environmentalists seeking to reduce the adverse effects of light pollution.

## Introduction

The Urban Observatory of Belgrade (UrbObsBel) is a three-year project, started in January 2024, funded by the Science Fund of the Republic of Serbia which takes place at the Astronomical Observatory of Belgrade (AOB). One of the main objectives of the project is to study the problem of light pollution. Light pollution is one of the least understood form of environmental degradation caused by human activities. We described the UrbObsBel project in the recently published Proceedings of the UrbObsBel Workshop held in Belgrade in June 2025 (Samurović 2026). Here, we note that light pollution refers to the excessive, inappropriate, or misdirected artificial light that disrupts natural light levels, causing adverse effects on the environment, human health, and astronomical observations.

The estimates of its changes vary: for example, using the observational data from 2011 to 2022, it was found that the sky brightness coming from the artificial light is increasing exponentially throughout the world with an average of 10% every year, meaning that it doubles in less than 8 years (Falchi & Bara 2023). However, some more recent estimates suggest that the artificial light is increasing at a slower rate, between 2.78 and 6.68% per year (Shah et al. 2025). In this contribution, we show our measurements of light pollution in Serbia at three different locations: the AOB, the Astronomical Station Vidojevica (ASV) run by the AOB and the Astronomical Society "Rudjer Bošković" (ASRB) in the Belgrade city center (Kalemegdan).

The following instruments have been mounted at the top of the Tower of the AOB, which is the highest point in the urban part of Belgrade and at the ASV (see Pavlović et al. 2025, Samurović 2026 for more details):

**All-sky camera Alcor OMEA 3C**, with a resolution of  $3100 \times 2100$  pixels, field of view  $180^\circ \times 180^\circ$  is mounted at the top of the Tower of the AOB and is used for comprehensive sky monitoring.

**Unihedron Sky Quality Meter (SQM), model SQM-LE** used for the measurement of night sky brightness. One device is mounted at the top of the Tower of the AOB and the other at the ASV.

**TESS-W photometer** is also mounted at the top of the Tower of the AOB and at the ASV.

**Two HyperSpectral Imaging (HSI) devices** constructed within the UrbObsBel project are mounted at the top of the Tower of the AOB.

Two **FLIR A700 thermal cameras** with an infrared resolution  $640 \times 480$  pixels, with wavelengths from 7.5 to 14.0 micrometers and field of view of  $14^\circ \times 10^\circ$  used for thermal characterization of sources and objects; both cameras are mounted at the top of the Tower of the AOB.

**Nikon Z7II camera** used for monitoring the sky in the visible part of spectrum. This camera mounted at the top of the Tower of the AOB is used with fisheye lens NIKKOR Z and has a resolution of  $8256 \times 5504$  pixels.

## Results

In Fig. 1 we show our SQM measurements of the night sky brightness for three locations: the AOB, the ASV and the ASRB.

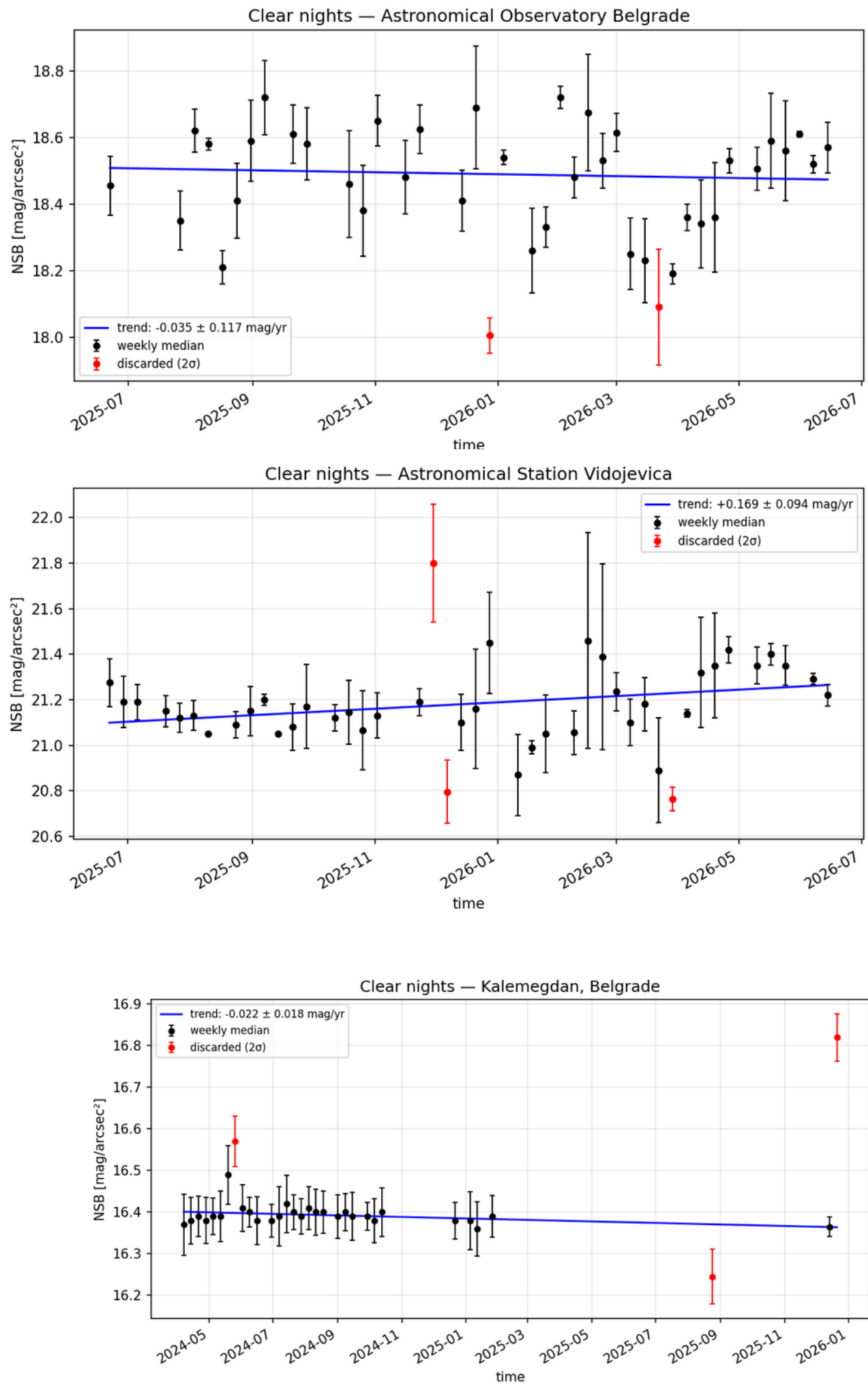


**Figure 1 (from top to bottom):** trend of clear nights for the AOB, the ASV and the ASRB. NSB denotes the night sky brightness.



## Conclusion

In Fig. 1 on the left we present our measurements of light pollution obtained using three SQM devices, mounted at the AOB, the ASV (the same period, mid-June 2025 to mid-June 2026) and also at the ASRB. In our analysis of the trends in light pollution we used the approach described by Shah et al. (2025). In Fig. 1 one sees two opposing trends: in the case of the AOB (and also the ASRB), i.e. the urban environment, the quality of the night sky has deteriorated because the sky brightness increased by 3.5% in one year (2.2% for the ASRB). On the other hand, at the ASV, which is a dark spot in the southern part of Serbia, the quality of the night sky has improved, because the sky brightness decreased by 16.9% in the same year. The details about the project, together with the data repository are available at the following address: <https://urbobsbel.aob.rs>.

## References

Falchi, F., Bara, S. (2023). Light pollution is skyrocketing, Science, Vol 379, Issue 6629, No 9, pp. 234-235.

Pavlović, R., Cvetković, Z., Bjelajac, D., Damljanović, G., Lukić, D., Rovčanin, B., Samurović, S., Simić, Z. (2025), The UrbObsBel Project: Instruments and Detectors, Publications of the Astronomical Observatory of Belgrade, vol. 107, pp. 129-134.

Samurović, S. (2026), Projekat Gradske opservatorije Beograda (UrbObsBel), Special Issues No. 5 of the Astronomical Observatory of Belgrade, pp. 1-14 (in Serbian).

Shah, F.R., Peletier, R.F., Noel-Storr, J. et al. (2025), Beyond the clouds: advanced data analysis of a Dutch sky quality meter network, Monthly Notices of the Royal Astronomical Society, vol. 542, pp. 272–292.

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