Revista Mexicana de Astronomía y Astrofísica Serie de Conferencias, 60, 19-21, (2026)

Proliferation of nighttime artificial lighting and light pollution in major urban areas of Latin America

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https://doi.org/10.22201/ia.14052059p.2026.60.12

Light pollution is a form of environmental degradation that is increasing worldwide and affecting the natural environment, flora, fauna, and various aspects of human life. Despite growing concern about this issue, its study is still limited in Latin America. In this research work, we conducted a comprehensive analysis of the expansion of artificial night light in major Latin American urban centers between 2012 and 2022. The study focused on the cities of Ciudad de Mexico, São Paulo, Bogota, Lima, Santiago, Buenos Aires, Rio de Janeiro, Caracas, San Jose, Havana, Quito, Asuncion, Montevideo, and La Paz. The data reveals a wide range of radiance growth rates across the surveyed cities. While Asuncion and Lima experience significant annual radiance increases (4.55 and 6.84, respectively), Caracas shows a notable decline (-2.28). This disparity suggests diverse trajectories in urban lighting practices. Cities like Santiago de Chile and Buenos Aires show substantial increases in the illuminated area (847 km^2 and 547 km^2, respectively). Conversely, cities like Caracas and La Habana demonstrate a reduction in illuminated areas. These findings provide valuable information on the growing threat of light pollution in Latin America and supports the need for action to help control associated environmental degradation. It is essential to raise awareness of the negative impacts of light pollution on the ecosystem, human health, and astronomical observations. Implementing lighting regulations, promoting energy-efficient lighting technologies, and incorporating light pollution considerations into urban planning are essential steps to mitigate the effects of light pollution and protect the natural environment in major Latin American urban centers.

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Towards a first sectro-photometric characterization of the Chilean night sky

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https://doi.org/10.22201/ia.14052059p.2026.60.13

Light pollution is widely recognized as a global issue that, like other forms of anthropogenic pollution, has significant impacts on ecosystems and adverse effects on living organisms. In recent years, it has emerged as a fertile field for interdisciplinary scientific research, socioeconomic studies, and wide-ranging cultural debates. Chile is widely known for its rich and distinctive ecosystems, and the superb quality of its northern skies has transformed it into one of the most important astronomical nodes in the world. Nevertheless, a coordinated scientific approach to characterize, quantify and monitor the effects of ALAN on the Chilean sky has only recently started. Our interdisciplinary research group on ALAN was born five years ago with the explicit purpose of filling this need, and aims at providing the international community with the first spectro-photometric characterization of one of the most pristine skies of planet Earth. Since 2019 we have been regularly monitoring more than twenty distinctive sites across the Coquimbo Region (also known as "Región Estrella"), including professional astronomical observatories, astrotourism centers, natural parks, and metropolitan areas. In this poster contribution we will introduce our research group by describing its raison d'être; stating its short, medium and long-term goals; and presenting the first results of our surveying campaigns. We further describe how our scientific projects and outreach initiatives, through a constant synergy with public and private institutions, contribute to heighten public awareness about the subtle but devastating effects of light pollution. Finally, we offer an example where our scientific conclusions have supported different public committees in taking more enlightened decisions to preserve the darkness of the Chilean sky, a natural and cultural heritage that is our scientific, moral and social obligation to protect and defend for all future generations.

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Research and development of sonification tools for astronomical and astrophysic data: the case of sonoUno

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https://doi.org/10.22201/ia.14052059p.2026.60.14

Data analysis in space sciences has been done exclusively visually for many years, even when there is evidence that more than one sensory style is possible (as is with sonification). Maintaining the data analysis exclusively visual not only limits the study of the unknown to the current resolution of the screens but also excludes a group of people who present different degrees of visual impairment. Considering those above and the fact that people with functional diversity experience a large number of barriers to achieving higher education and stable jobs, within the framework of my doctoral thesis, a new modality to access scientific data from the space sciences was investigated[1]. SonoUno is a product of this research that makes possible a multisensory display (use of more than one sense) of data files with two or more columns, taking into account the accessibility and inclusion of people with functional diversity from the beginning[2]. Based on the fact that multisensory perception can be a good complement to visual exploration for the understanding of complex scientific data and the exchange and feedback received from users over the past six years, sonoUno presents a framework focused on the user and is an application that can be used independently on the computer or through a web page. Additionally, the package presents different scripts for specific sonifications and use in bash. The work presented here maintains the next fundamental pillars: providing solutions and removing barriers (in education and scientific work, up to now); the use of free programming languages; and the design of infrastructure to improve inclusion.

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[1] https://arxiv.org/abs/2305.05635
[2] https://reinforce.sonouno.org.ar/

Massive photometric catalogs for S-PLUS: object classification and quasar photometric redshifts

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https://doi.org/10.22201/ia.14052059p.2026.60.15

The Southern Photometric Local Universe Survey (S-PLUS; Mendes de Oliveira et al. 2019) will cover 9300deg2 of the Southern Sky with an 80-cm telescope (T80S) located at Cerro Tololo Inter-American Observatory in Chile. The S-PLUS optical filter system includes five broad bands: u, g, r, i, z (similar to the SDSS filter system, except for the u band) and seven narrow-band filters: J0378, J0395, J0410, J0430, J0515, J0660 and J0861, centred on [OII], Ca H+K, Hγ, G-band, Mgb triplet, Hα and Ca triplet features, respectively. The latest public data release (DR4) covers 3000 squared degrees.

In this work we detailed the construction of two value-added catalogues for S-PLUS DR4: the star/quasar/galaxy classification and quasar photometric redshifts. The former was obtained by a Random Forest algorithm that classifies any S-PLUS observation in quasar, star or galaxy. A complete description of all tested feature spaces, metrics, cross-validation, and performances on S-PLUS DR2 can be found in Nakazono et al. (2021). For the quasar photometric redshifts we use data from S-PLUS DR4 in three machine learning methods: Random Forest, FlexCoDE, and Bayesian Mixture Density Network. FlexCoDE had the best performance with a precision of 0.042 and conditional density estimation loss of -2.84. Using the information from these two value-added catalogues, we then provide a catalogue of quasar candidates (Nakazono & Valença, submitted) containing 626 418, 220 177, and 131 376 quasar candidates with probabilities higher than 80%, 90%, and 95%, respectively.

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"XVII LARIM", Montevideo, Uruguay, November 27 - December 1, 2023.Volume Editors: Gonzalo Tancredi, Cecilia Mateu & Juan José Downes

Evaluation of the impact of artificial light on the nocturnal landscape and soundscape of Las Brujas (Canelones, Uruguay)

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https://doi.org/10.22201/ia.14052059p.2026.60.16

Increasing the emission of artificial light at night has well-documented negative effects on the quality of natural dark skies and changes the natural light/dark cycles, on which many species depend. Dark skies are relevant as natural values and for their cultural and heritage significance. This issue is just beginning to be perceived as a problem by decision makers and the civil society. The present work is a response to the concern of residents of Las Brujas (Canelones, Uruguay) regarding public lighting installation in July 2022. This research analyzes the nocturnal landscape before and after the placement of public lighting and its impact over the natural soundscape. Soundscapes are defined as the set of sounds generated by the elements that compose an environment. Through soundscape analysis, it is possible to estimate the response of organisms to anthropogenic pressures and to account for the structure and dynamics of the environment. For analyzing the nocturnal landscape, the sky brightness was measured at impact and control sites using an SQM photometer. From measurements obtained at 17 sampling points, sky brightness maps before and after the impact were made. For the analysis of the soundscapes, a Before-After, Control-Impact sampling design was implemented. A passive acoustic monitoring (PAM) was carried out, in which the soundscapes of 5 sites (1 impacted and 4 control sites) were recorded before and after the implementation of the new public lighting. By performing an analysis of variance, significant differences were found in the sky brightness before and after the public lighting was operational. However, the analyzed acoustic data shows that there are no significant variations in the acoustic landscape despite the alteration of the nocturnal landscape. Hypotheses that can explain this phenomenon are discussed and recommendations for the management of the socio-environmental problem are proposed.

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