Revista Mexicana de Astronomía y Astrofísica Serie de Conferencias, 60, 11-12, (2026)

OPEN ACCESS https://doi.org/10.22201/ia.14052059p.2026.60.08

BOCOSUR: An all sky network for fireball detection in Uruguay

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Keywords: *H II regions, ISM: jets and outflows, stars: pre-main sequence, stars: mass-loss*

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We present the BOCOSUR network, a set of 20 stations widely spread across the entire territory of Uruguay, for automatic detection of fireballs.

Meteorites constitute relics of the early formation of the Solar System. A rapid recovery of fallen material is essential in retrieving a fresh and unweathered sample, which, together with the determination of the meteoroid's pre-atmospheric orbit, can significantly constrain the conditions on its origin. The most cost-effective way of rapidly retrieving such material is through the deployment of automated networks for the detection of fireballs.

The BOCOSUR network is an initiative driven by the Department of Astronomy of the Faculty of Sciences of the University of the Republic of Uruguay (UdelaR), and comprises 20 stations of all sky systems for automatic detection of fireballs, focused on very bright fireballs of asteroidal origin that may give rise to meteorites. Most of the stations are located in secondary schools. The reason for this is that the project is intended to have a strong citizen science profile, involving teachers and students in the operation of each station.

The acquisition system is based on a ZWO ASI 178MM (Mono) camera, which has a 1/1.8" CMOS sensor (IMX178) and a 14-bit ADC. The sensor's peak quantum efficiency (QE) is 81%, and the highest available video resolution is 2080x3096 pixels.

All of the applications and scripts for camera control, calibration, data acquisition, data transfer and post-processing have been locally developed in MATLAB (applications) and Python (scripts). The application for camera control, calibration and data acquisition runs locally on each PC, and enables to set the most relevant camera properties. Additionally, an application for post-processing detected events allows to perform both astrometric and photometric calibrations, and apply them to a fixed (e.g. Moon, planets, stars) or moving (meteor) body on the video stream.

We carried out a comparison between the astro- and photometric performances of the ZWO ASI camera versus a widely used, low resolution camera (Watec 902 H2). The reason is that the latter is still widely used in different meteor networks. The mean absolute error (MAE) of astrometric calibrations were 15' and 5', for Watec and ASI, respectively. As for the photometric results, a 30s integration of Watec data yields a limiting magnitude (SNR≥5) of +2.79, while a 10s integration of ASI data gives a limiting magnitude of +3.18.

The data processing pipeline was applied to a very bright event detected by five of the southeaster most cameras of the network, yielding a peak absolute magnitude of -9.0 mag. The computed geocentric radiant was coincident with that of the Northern Taurids, associated with the comet 2P/Encke.

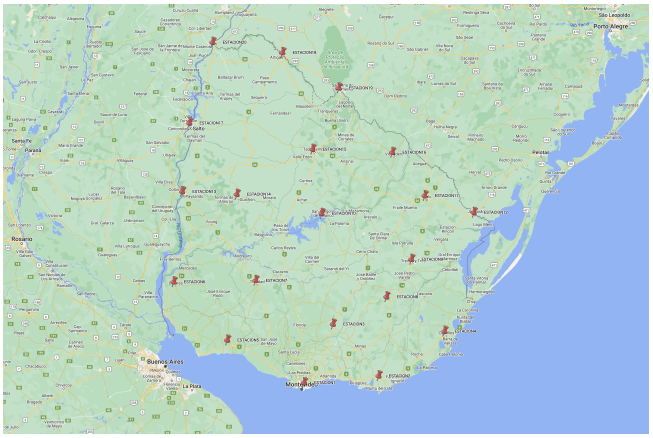

Figure 1. Location of the 20 stations that comprise the BOCOSUR network.

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In summary, we have succesfully deployed a nationwide network for automatic detection of fireballs, which contributes to unbias the geographical distribution of similar networks around the world. The data processing pipeline which has been developed enables to reconstruct the meteoroids pre-atmospheric orbit, and lays the ground for further developments which will enable to model the dark flight, essential to limit the search area of meteoric material.

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