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Measures for the Characterisation and protection of the SAAO Sutherland Observing Site

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Background

The South African Astronomical Observatory (SAAO) is the premier optical astronomy facility on the African continent and the national centre for optical and infrared astronomy in South Africa. The SAAO plays a significant role, not only nationally and in Africa, but also globally, conducting fundamental research in astronomy and providing optical and infrared astronomy facilities for use by national and international astronomers and other scientists.

The SAAO observing site near Sutherland is one of the observatories with the darkest night skies in the world, and it is relatively unpolluted (dust free). It is also recognised as one of the best sites for optical astronomy suitable for large telescope projects such as Southern African Large Telescope (SALT). The site is one of only three such sites in Africa (the other two being in Namibia). In order to preserve areas that are suitable for astronomy, as they are, or make them better, e.g. dark and dust free (for optical astronomy) and radio interference-free (for radio astronomy), a government legislation called Astronomy Geographic Advantage (AGA) Act, No. 21, of 2007, was enacted. Under the AGA Act, areas suitable for astronomy are declared as Astronomy Advantage Areas (AAAs). Declared AAAs can be protected under the AGA Act related protection regulations. Such protection regulations for Sutherland or optical astronomy were published in Government Gazette Number 42492, under Notice Numbers 805 and 806, on 29 May 2019, on astronomy protection regarding certain activities and prohibition on certain mining activities, respectively, within the Sutherland Central Astronomy Advantage Area (SCAAA).

Night sky brightness measurements are taken every night and monitored using All Sky Transmission MONitors (ASTMONs, Figure 1) at the SAAO observing plateau. The ASTMONs automatically monitor night sky brightness every night through B, V, R and I filters (see Aceituno et al., 2011, for a more detailed description of ASTMONs and how they operate). The ASTMON data are calibrated and converted to surface brightness in magnitude per arcsec ^{2} in each of the available filters/bands. In the protection regulations (Government Gazette, 2019), the established moonless sky brightness measurements, partly based on historical data over the past forty years collected with one of the SAAO small telescopes equipped with a photometer and partly on recent data taken with the ASTMONs at Sutherland (Sefako, et al., 2021, and Table 1) are quoted as U = 22.4, B = 22.7, V = 21.9, R = 21.1 and I = 19.8 magnitude per arcsec^2 at zenith, comparable to other very dark observatories (e.g. Benn & Ellison, 1998, and Leinert, et al., 1995). The regulations (Section 3(2) of the Protection Regulations) require that the abovementioned average moonless night sky brightness measurements must not be exceeded as a result of any artificial lighting located within the Sutherland Central Astronomy Advantage Area.

Figure 1: The ASTMONs (Sunrise and Sunset) at the SAAO observing plateau at Sutherland.

Table 1: Night sky brightness measurements in magnitude per arsec^2. The value for each year is a median/average number for all available clear and moonless night sky brightness measurements for that specific year.

Year / Filter	**B** (±0.3)	**V** (±0.2)	**R** (±0.2)	**I** (±0.2)
2020	23.0	21.8	21.0	19.8
2019	23.0	22.0	21.1	19.9
2018	22.8	22.0	21.1	19.7
2017	22.4	21.8	20.9	19.8
2016	22.5	21.9	20.9	19.8
Average (2016 – 2020)	**22.7**	**21.9**	**21.0**	**19.8**

Project Objectives

For the current project, we are interested in monitoring the night sky brightness and the extinction measures at the SAAO observing site in Sutherland and characterise how they change with seasons (if any), solar activities or with new developments around Sutherland or as a result of light and air pollution. The data from ASTMONs are available for the past six years.

The aim of the project is to use the existing data sets and generate time series and trends by an MSc student. The data is available from ASTMONs for the past 6 years, and continues to be taken nightly with Sunset. If necessary, these can be supplemented other available historical data collected with one of the decommissioned telescope (the 0.5m telescope).

The student will be expected to occasionally visit Sutherland and provide inputs on the operations of the monitoring instruments as well as other SAAO facilities at Sutherland.

Feasibility:

The data required to execute this project is already in hand at SAAO.

References

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