



INTRODUCTION

This work aims to choose potential astronomical sites that can be candidates for a new astronomical optical observatory in Ethiopia in addition to the Entoto Observatory and Lalibela sites. For our primary investigation, the six basic criteria, namely the altitude of the mountains, artificial light pollution, cloud coverage, humidity, wind speed, and wind direction, were taken into account. Consequently, using the multi-criteria statistical analysis (MCSA) techniques, 21 high-potential places are selected and presented for further investigation out of 367 mountains. Those selected mountains are mapped and presented to study the future of the astronomical seeing effect. This study may contribute to the protection of those potential astronomical sites and their dark skies and the development of astrotourism for the sustainable development of modern astronomy in Ethiopia and in the East African region.

METHODS

- **Ethiopia** referred to as the roof of Africa has an advantageous location near the equator, which can have access to see the north and south sky at the same time and its expansive plateaus, towering up to 4,550 metres above sea level, combined with its prevailing dry weather, establish it as an exceptional region for premier astronomical observation sites on a global scale.
- Ethiopia has two sites ongoing, namely Entoto Mountain and the Lalibela site. However, due to the expansion of Addis Ababa (the Capital of Ethiopia) and Sullulta cities, Entoto Observatory has been extremely affected by artificial light pollution.
- In the current project of searching for tests of astronomical sites under the Ethiopian Space Science and Geospatial Institute, we highlighted the importance of reserving the best astronomical place for an optical observatory in addition to the Entoto observatory and Lalibela sites by setting 11 standard criteria [1, 2, 3] and employing the multi-criteria decision analysis technique (MCDA) and detailed statistical analysis.
- In the meantime, we have successfully identified 21 promising locations as preliminary results based on six fundamental criteria: altitude, cloud cover, city light pollution, humidity, wind speed and direction, and slope.
- In this work, we also take into account multiple factors, such as atmospheric conditions, weather patterns, dark skies, altitude, and geographic positioning, to ensure that the selected mountains have good sustainability for the observatory establishment.

METHODS CONTINUED...

- This research project combines multi-criteria decision analysis (MCDA) and statistical analytics, utilising eleven key criteria to assess potential optical observatory sites.
- Reliable data are collected from primary and secondary sources, including meteorological satellite data, on-site measurements, and astronomical surveys.
- NASA's comprehensive and user-friendly data (<https://power.larc.nasa.gov/dataaccess-viewer/>) has been specifically chosen as a valuable resource for the project due to its long-term records and diverse parameters.
- In the future, this work aims to improve the site selection process by incorporating additional parameters, such as seismic vulnerability, aerosol optical concentration, availability of infrastructure, diurnal temperature, and perceptible water vapour (PWV).
- Astronomical seeing [3, ?], which is the most important assessment of the astronomical observatory, will be implemented for each selected mountain in the next phase of the work. The significance of these chosen areas for the astronomy community is profound, offering valuable resources for research and presenting enticing prospects for astronomical tourism in addition to sustainable scientific development.
- Data sources: NASA <https://power.larc.nasa.gov/data-access-viewer/>, FAO <https://www.fao.org/aquastat/en/geospatial-information/climate-information>.

EXISTED SITE PLACES IN ETHIOPIA: ENTOTO OBSERVATORY AND LALIBELA SITE



Figure 1: Entoto Observatory

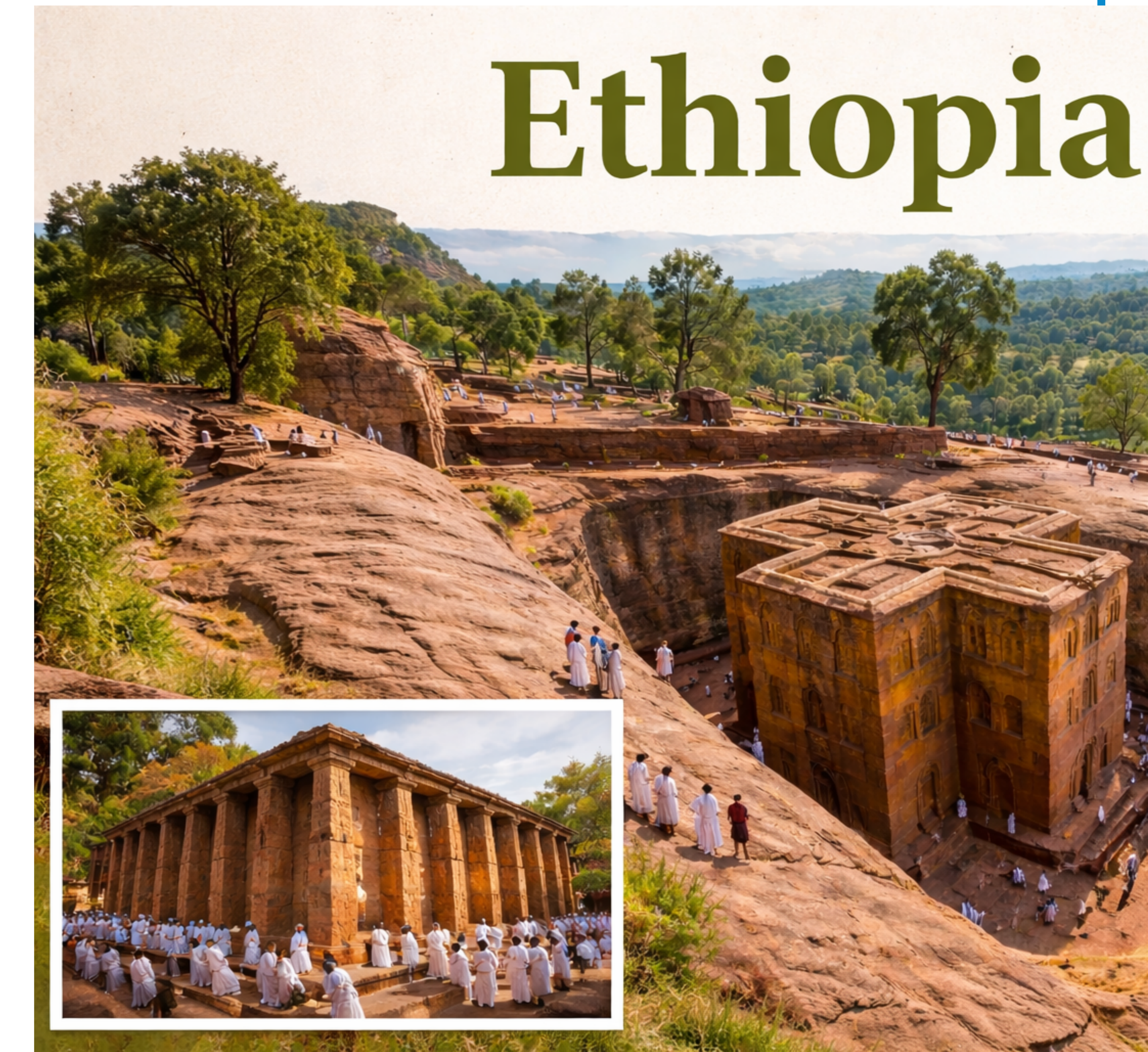


Figure 2: Lalibela

21 SELECTED PLACES

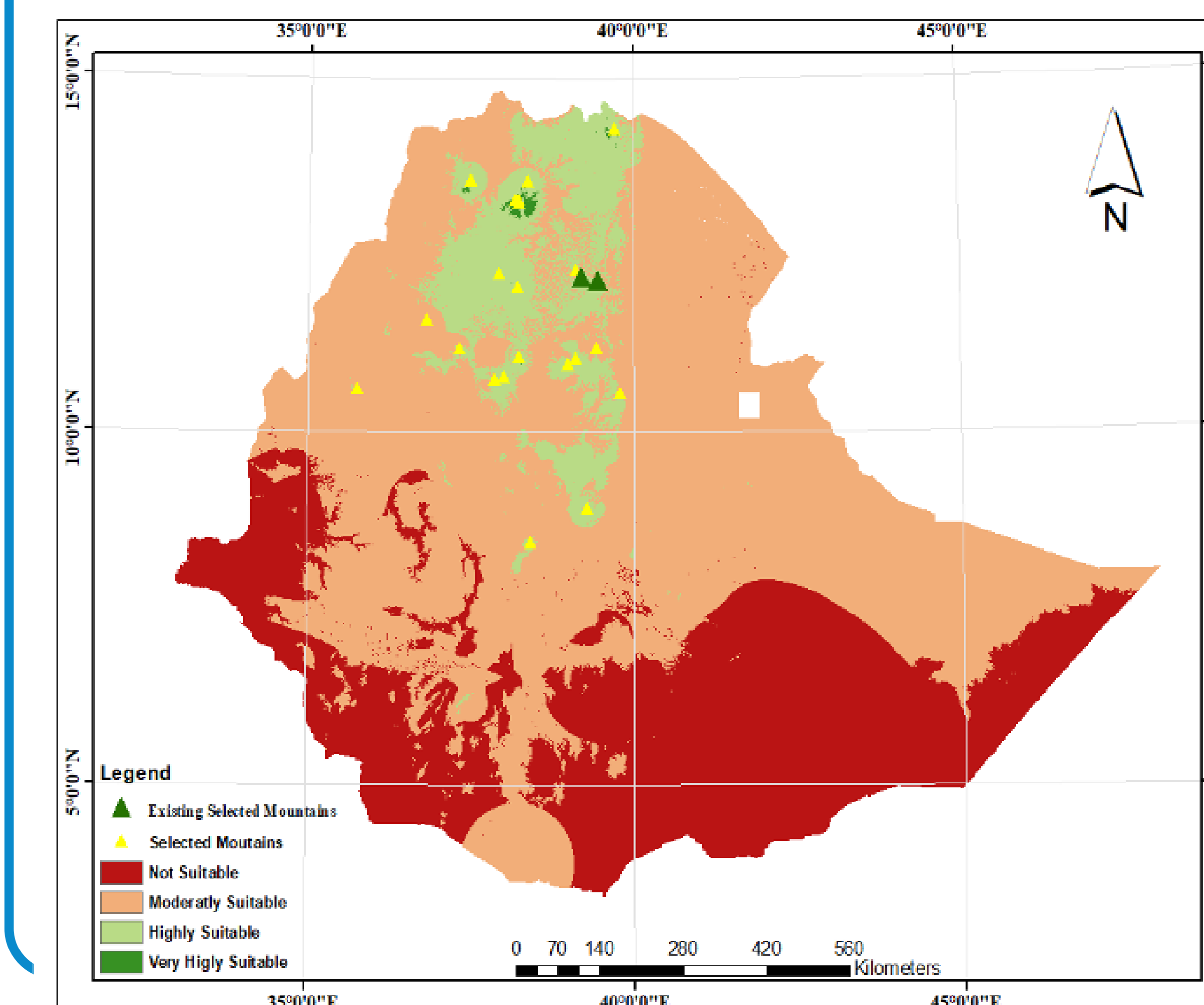


Figure 3: 21 selected Astronomical site places

- Weather Spark <https://weatherspark.com/>, and SRTM <https://www.earthdata.nasa.gov/sensors/srtm>) and NMA <http://www.ethiomet.gov.et/> including astronomical surveys, satellite data, meteorological data, and on-site observations.
- Both primary and secondary data sources were used in the research; the data sources for each criterion. Weather trends at the possible location are tracked and predicted using meteorological satellite data, while on-site observations yield information about infrastructure and light pollution.

REFERENCES

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- [2] Legesse W Kebede. Astronomy in ethiopia. In *Observational Aspects of Pulsating B-and A Stars*, volume 256, page 279, 2002.
- [3] Jean Vernin and Casiana Munoz-Tunon. Measuring astronomical seeing: the da/iac dimm. *Publications of the Astronomical Society of the Pacific*, 107(709):265, 1995.

CONCLUSION

- In this work, 21 suitable astronomical palaces, along with the two existing sites (Entoto Observatory and Lalibela), are presented, with their names listed <https://arxiv.org/abs/2512.15669>
- As mentioned earlier, we consider only the six essential criteria from the eleven stan-

dard criteria. Including the astronomical seeing, other important criteria, namely: Seismic variability, precipitable water vapor, seismic risk, aerosol concentration, and infrastructural accessibility, will be considered in the next phase of the work for future investigation.