

Stargazing in Maine: An Analysis of the Best Places for Colby Students to See the Stars

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Introduction

Stargazing is one of the most accessible ways for people to connect with nature. However, light pollution emanating from urban areas is severely damaging our view of the night sky. Maine, with its small population mostly concentrated around coastal areas, remains one of the premier locations to stargaze in the United States. Nonetheless, the quality of stargazing in Maine is highly variable, dependent on proximity to light sources, large water bodies, and elevation. This project will utilize a suitability model to locate the optimal locations to stargaze (with the naked eye), based on these parameters, within a 60 km radius of Waterville, ME. Convenience for Colby students will also be a consideration of my study. Least cost paths from Waterville to several viewing sites will be constructed through the analysis of roads and terrain. Ultimately the analysis seeks to answer the question: "What are the best places to stargaze around Colby, and how do you get there?"

Methods

I used ArcGIS software to perform my analysis. Satellite data for light pollution were obtained from The National Oceanic and Atmospheric Administration (NOAA). The satellites utilize visible near infrared emissions (VNIR) to detect radiation emanating from cities and small towns. The digital elevation model, hillshade image, land cover data and all other geodata were obtained from the Maine office of GIS. All data was projected using the NAD 1983, UTM Zone 18 coordinate system. Three parameters, effects of light pollution, elevation, and proximity to large bodies of water, were combined in a weighted model. Because of the dearth of scientific literature on the topic of stargazing with the naked eye, the weights assigned to each parameter were extrapolated from secondary stargazing literature and the experience of seasoned stargazers. The basis for the model is that areas of high elevation, low light pollution, and clean moist air provide the optimal conditions for seeing the stars. A 60 km radius was constructed around the City of Waterville, and 10 areas of high viewing quality were demarcated. From these 10 viewing locations, the highest quality point, the point closest to Waterville, and a point located on public land were selected for least cost path analysis. Three least cost paths were constructed based on slope and land cover. I generated an improved land cover layer for my analysis by mosaicking a reclassified land cover layer with a road raster layer. I generated a slope layer from the Maine DEM. Finally I conducted basic statistical analysis with my model in the ArcMap program. Conserved and non conserved land areas were clipped, and I calculated the mean and standard deviation viewing quality values. Finally, the land area of viewing sites deemed "superb" (viewing quality > 42) was also generated.

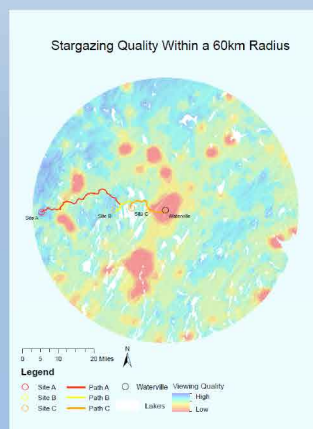


Figure D. Displays the model in a 60 km radius around Waterville, with view points and corresponding least cost paths. Site A is the highest quality viewing point. Site B is a public access viewing point. Site C is the closest "superb" quality point to the Waterville area.

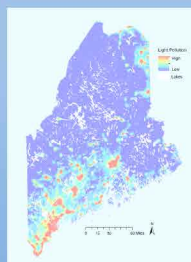


Figure A. Stable light pollution data and large standing water in Maine.



Figure B. Digital elevation model of Maine.

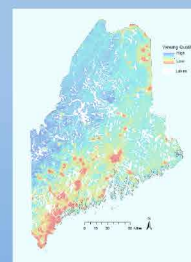


Figure C. Stargazing quality model for the state of Maine

Results

The model indicates a large area that can be considered to be of "superb" (>42) stargazing quality. The mean viewing quality for all of Maine was 37.2 ($\sigma = 6.23$). 9788 sq. km of land was designated "superb", corresponding to roughly 12% of the total land mass. Most of this area was located in the north eastern region, in Piscataquis, Franklin, and Somerset counties, which contain many of the state's mountainous, and unincorporated territory. Conserved land ($x = 40.10$, $\sigma = 4.17$) was found to be of higher viewing quality on average than non-conserved land ($x = 36.52$, $\sigma = 6.44$). Conserved lands encompass many of Maine's parks and public land. Meanwhile, the 60km disk surrounding Waterville displayed below average viewing ($x = 33.38$, $\sigma = 5.66$).

Discussion

Figure D displays the culmination of the stargazing suitability model and the least cost path analysis. The expanded model for the entire state of Maine can be seen in Figure C. The distribution of high quality viewing sites in Maine, and the high quality of star gazing over all supports previous expectations based on Maine's low population density, and relatively complex terrain. The model closely mirrors the NOAA light pollution data, in areas of high sky glow. However the model diverges from the satellite data in areas of low light pollution, where other inputs exert a greater influence. A major shortcoming of the model is lack of scientific robustness. Further study and observation are necessary to determine if some of the basic assumptions made by the model are genuine. The stars are not only valuable for their ability to inspire wonder. Star gazing quality is a great proxy for measuring human impact and tranquility. What's more, the damaging effects of light pollution are not limited to star gazing, and its effects on ecology and human biology are not well understood. Further research into this topic is recommended.

Conclusion

There are ample high quality stargazing sites available within the greater Waterville area. The model identifies low quality viewing with a high degree of reliability. Variability amongst areas that the model deems to be of a higher quality may be exaggerated as less scientifically robust parameters exert a higher influence.

Acknowledgements

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