

# Time Series Analysis on the Effect of Light Exposure on Sleep Quality

DSC 180 Capstone Report

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## I. ABSTRACT

The increase of artificial light exposure through the increased prevalence of technology has an affect on the sleep cycle and circadian rhythm of humans. The goal of this project is to determine how different colors and intensities of light exposure prior to sleep affects the quality of sleep through the classification of time series data.

## II. INTRODUCTION

### A. Background Information

As the world undergoes technological advancement on an unprecedented scale, artificial light from man-made sources are becoming ever more prevalent. The extent of this anthropogenic increase in artificial light has become a pollutant, with extensive research showing both ecological and medical consequences [1]. This is due to the importance of light from the sun on the survival and function of the majority of organisms and thus ecosystems on earth. These organisms have developed day/night cycles that cause physiological, behavioral, and metabolic changes which optimize function and are essential for survival. Artificial light interferes with these processes due to differences in wavelength, intensity, and timing from that of light with origins from the sun. A study of satellite images done in 2001, showed that artificial light at night (ALAN) affects 18.7% of global land area<sup>1</sup>, through

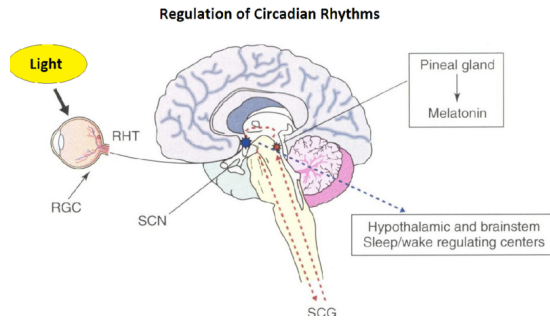
which roughly two thirds of the human population and 99% of humans living in the United States and the European Union, “live in areas where the night sky is above the threshold set for polluted status.” [2] The rapid development of technology and thus rapid increase in artificial light within the last two hundred years has undoubtedly had effects on the biological function of organisms around the world.

What is most concerning for the health of humans, however, is the ever increasing use of devices with light up displays such as phones, tv’s, and computers for entertainment, work, and communication. Currently, there are an estimated 16 billion mobile devices worldwide [3] with many individuals spending over five hours a day looking at a screen. One biological mechanism that is affected by this increased exposure to artificial light in human beings is the circadian rhythm, through which the body undergoes changes during the night in preparation for sleep and changes during the day in preparation for activity. The circadian rhythm plays major roles in many “physiological processes, such as body temperature, blood pressure, hormone secretion, gene expression, and immune functions” [4], which all have some reliance on diurnal light patterns from the sun and thus the optimized function of these human body processes are impacted by stimulus from artificial sources of light. When light enters the eyes and is picked up by photoreceptors, this information is then communicated to the suprachiasmatic nuclei of the hypothalamus, and then to other parts of the brain and body (*fig 1.*).

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<sup>1</sup> The actual percentage of global land area affected by artificial light is actually smaller due to this data being taken from satellite images and the measure of skyglow.

*fig 1.*



One result is that the brain experiences an increase in wakefulness and reduction in homeostatic sleep pressure in the presence of light [5] through the suppression of melatonin, a hormone released by the pineal gland which facilitates sleep and the circadian rhythm.

## B. Data

## III. METHODS

## IV. RESULTS

## V. CONCLUSION

## VI. REFERENCES

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