

Uncovering Relationships Between Climate Change and Quality of Life

T. Max Broekhuis

Introduction

The body of research investigating links between climate change and overall quality of life is lacking. To partially remedy this, I attempted to, through the creation of a novel method of determining climate, find links between changing climate and quality of life on a global scale. In doing so, I hope to reveal relationships between changes in quality of life and earlier climate change.

Data

- Subnational Human Development Index (SHDI)_[1] used for Quality of Life data.
- Global Summary of the Day (GSOD)_[2] used for weather data used to create climate data.

Harshness Index (HI)

A measure of climate habitability based on yearly average temperature and rainfall.

Creation

- 1) For each region:
 - 1) Find mean annual temperature (MAT) – average of all temperature measurements
 - 2) Find gross annual precipitation (GAP)
 - 3) Calculate and combine component indices

Component Indices

Precipitation Index (PI) compares GAP to the ideal range of 700 -1500mm of precipitation_[3]

$$PrecipIndex(GAP) = \begin{cases} 1 - \left(\frac{GAP}{700}\right)^3 & , GAP < 700 \\ \frac{1}{2} - \frac{GAP-100}{GAP+1300} & , GAP > 1500 \\ 0 & , otherwise \end{cases}$$

Temperature Index (TI) compares MAT to the ideal range of 11-15C_[3]

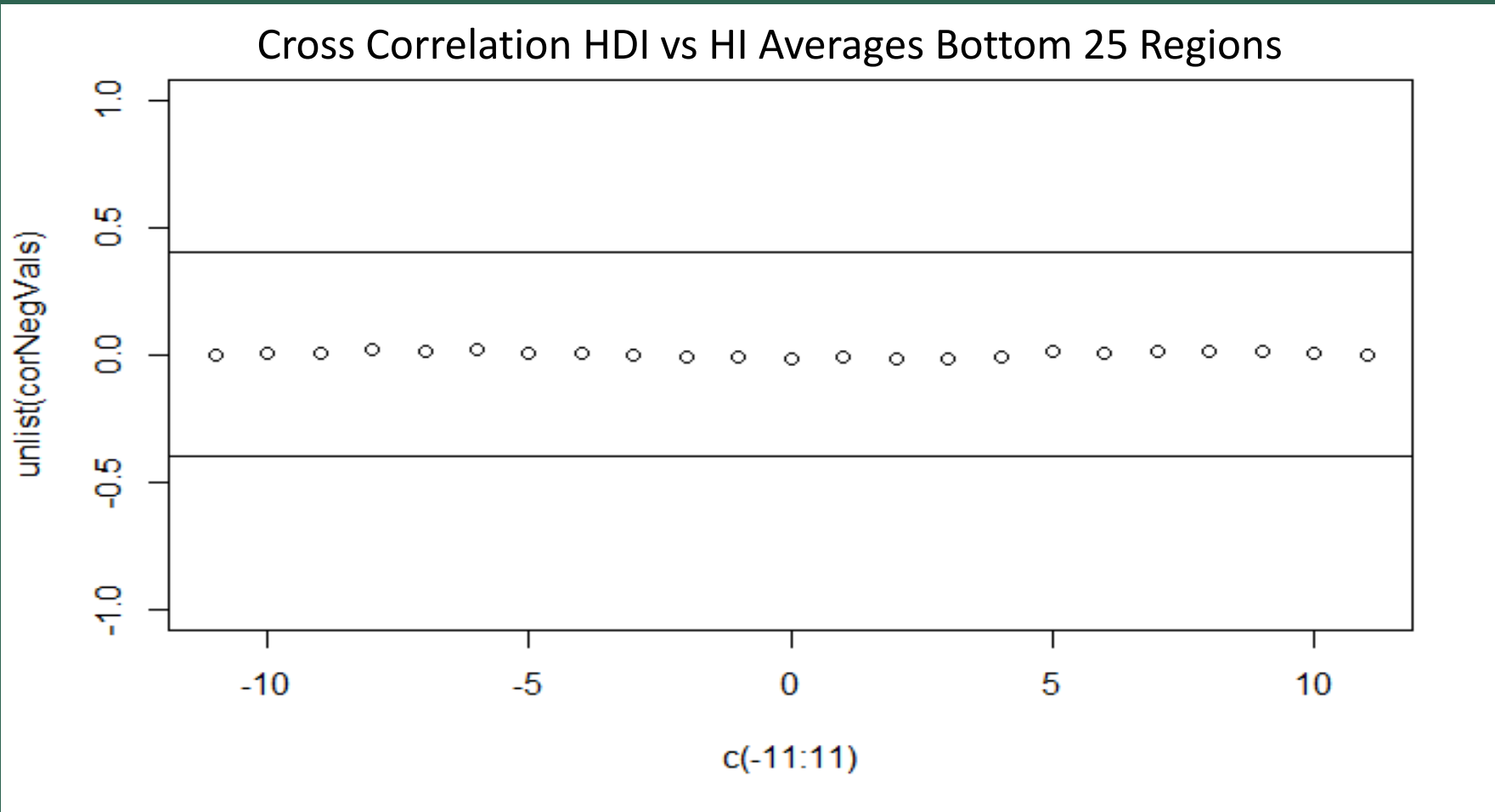
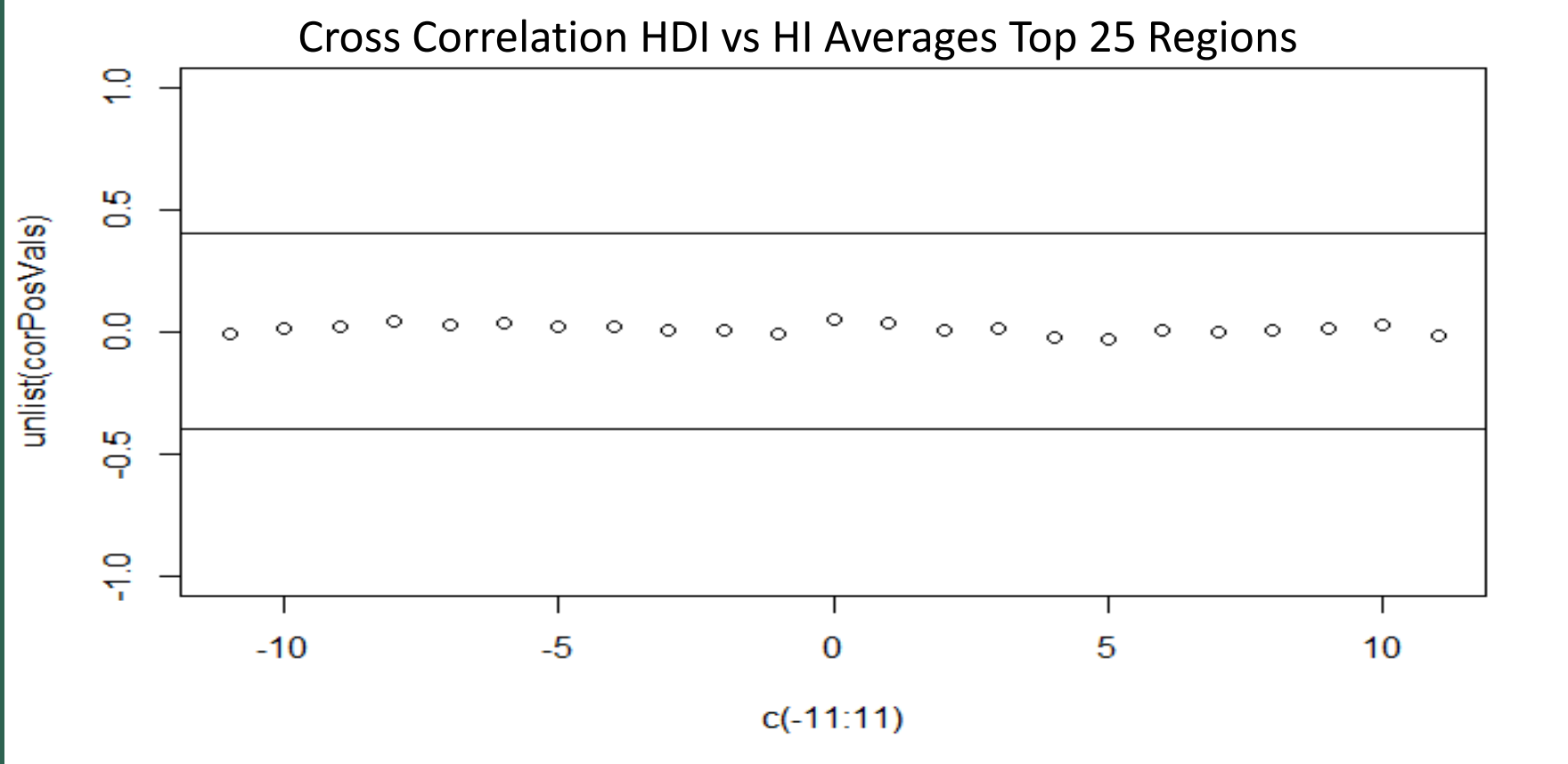
$$TempIndex(MAT) = \begin{cases} 1 & , MAT < 0 \\ \frac{11-MAT}{11} & , MAT < 11 \\ \frac{MAT-15}{50} & , MAT > 15 \\ 0 & , otherwise \end{cases}$$

Harshness Index

The Harshness Index combines the component indices, prioritizing temperature over precipitation. It is a weighted average of the two values, with temperature given a weight of 0.7 and precipitation a weight of 0.3

Results

Time-Delayed Cross Correlation revealed no significant correlations between change in harshness index and change in HDI. Not only were there seemingly no significant correlations, but the differences between regions with the largest positive and negative reveal no relationships of note.



Conclusions

Harshness Index, as a function solely of temperature and precipitation compared to the “ideal” values for each, is not a metric which can accurately predict relationships between quality of life and climate change in a short 30-year time period.

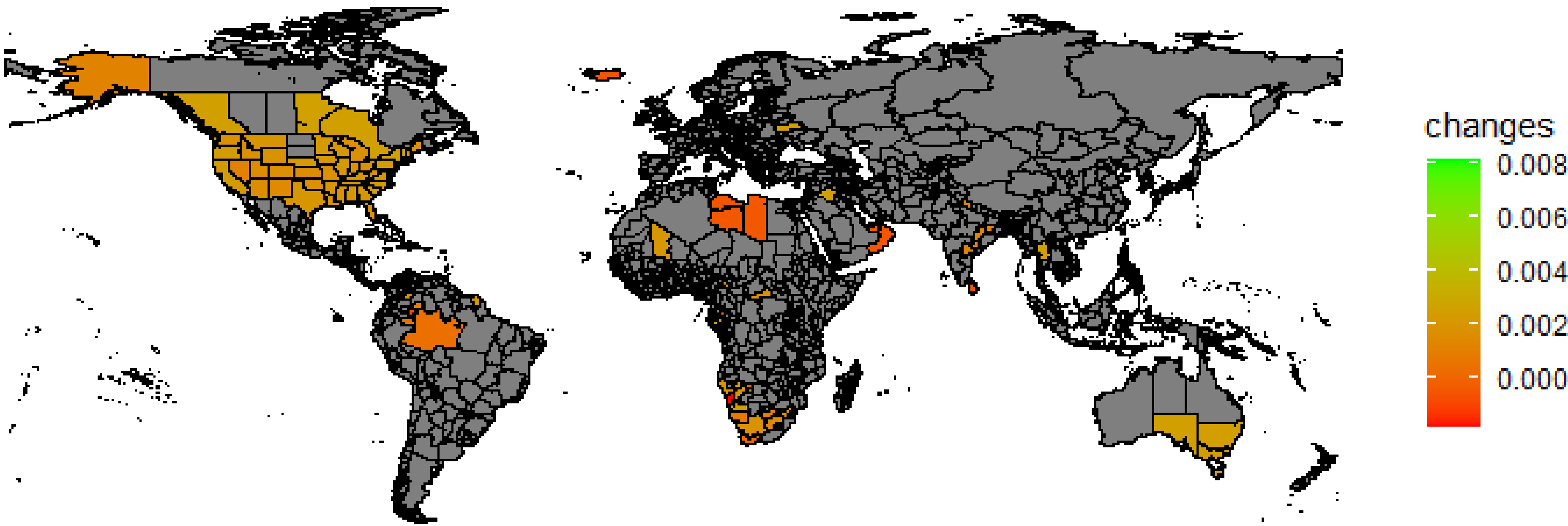
A better metric would take more factors into account, such as monthly, rather than yearly, temperature and precipitation, what form the precipitation is in, and air quality.

Although Harshness Index did not prove to be a metric of particular use, the map generated of the distribution of greatest and least improvements in quality of life over the past 30 years is intriguing and begs the question of what factors, socioeconomic, geopolitical, and regional, led to these different levels of improvement.

Methodology

- 1) Create Harshness Index to measure a region’s climate. Use a 5-year rolling average was to minimize effects of yearly fluctuations in weather and better approximate climate.
- 2) Calculate the yearly change in each region’s Harshness Index and Quality of Life. Quality of Life is measured using Human Development Index (HDI)
- 3) Perform a statistical analysis to find the presence or lack of correlations between Harshness Index and Quality of Life.
 - 1) Find the 50 regions with the most extreme regression slopes in change in HDI – 25 most negative, 25 most positive.
 - 2) Perform Time-Delayed Cross Correlation between change in HDI and change in Harshness Index. Compare differences.

Quality of Life Change in 30 years



Map Discussion

Although harshness index showed to be an inadequate metric when used to find correlations between changes in quality of life and climate, this research showed some interesting insights. To the left is a map displaying the regions with the top and bottom 10% slopes to quality of life.

English speaking nations, such as the United States, Canada, and Australia contain a large portion of the regions which were most improved, while historically exploited regions, such as those in South America, Africa, and South Asia all had relatively small increases to quality of life.

Sources

- [1]: DOC, et al. “Global Surface Summary of the Day - GSOD.” 16 Oct. 2020, <https://catalog.data.gov/dataset/global-surface-summary-of-the-day-gsod>. Accessed 19 Sept. 2021.
- [2]:Global Data Lab. “Human Development Indices (5.0).” June 2021, <https://globaldatalab.org/shdi/shdi/>. Accessed 12 Sept. 2021.
- [3]: Xu, Chi, et al. “Future of the Human Climate Niche.” Proceedings of the National Academy of Sciences, vol. 117, no. 21, 2020, pp. 11350–11355., <https://doi.org/10.1073/pnas.1910114117>.