Assessing Socioeconomic Inequality in Green Space Distribution Across Toronto

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1 Introduction

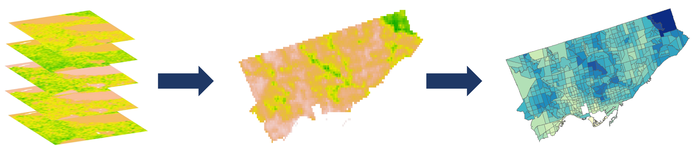
Urban green spaces provide benefits for both human health and the environment:[1]

However, these green spaces are distributed unevenly, with communities with low socioeconomic status often having less exposure to them, causing poorer health outcomes.[2,3]

It is therefore important to identify socioeconomic disparities in green space exposure to identify vulnerable communities and inform future planning.

2 Methods

Solar induced fluorescence (SIF) is the light that is emitted by chlorophyll when plants photosynthesize, with wavelengths falling in the range of 650–850 nm.[4] As a result, using satellites above the Earth to capture its emittance, SIF can be used as a proxy for vegetation productivity and greenness.

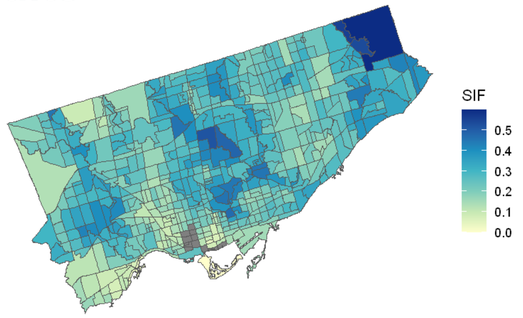


TROPOMI SIF was oversampled and downscaled to 500m resolution. The mean per pixel was calculated using values from June, July and August from 2018-2020. Then, pixel values were aggregated by census tract to obtain their mean SIF.

Data on income, visible minority populations, and education were obtained from the 2021 Canadian census.

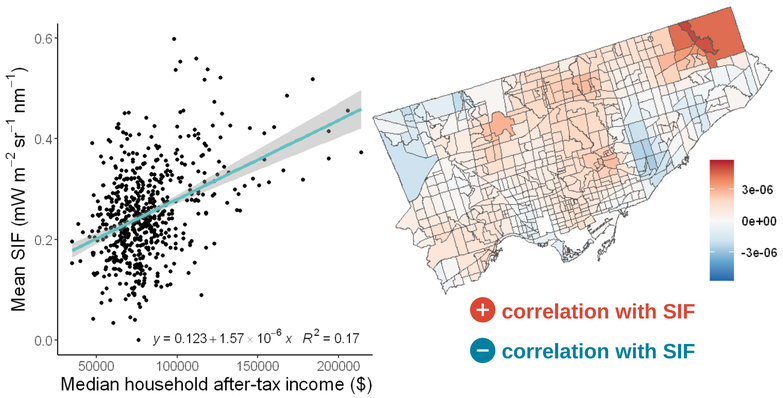
Regression models were used to determine the relationship between the socioeconomic variables and SIF.

3 Results



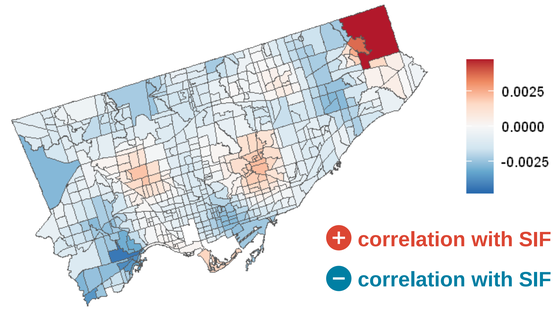
The mean SIF ($mWm^{-2}sr^{-1}nm^{-1}$) of each of Toronto's census tracts during the summer.

Household income



Linear regression of median household after-tax income in 2020 with mean SIF using all census tracts (left).
The regression coefficients ($mWm^{-2}sr^{-1}nm^{-1}\$^{-1}$) for each census tract, representing the influence of median after-tax household income on SIF (right).

Visible minority population



Regression coefficients ($mWm^{-2}sr^{-1}nm^{-1}$) representing the influence of the percentage of visible minorities in each census tract on SIF.

4 Discussion

Household income is positively correlated with SIF, suggesting that the greater income, the more likely it is for an individual to live in an area with greater amounts of vegetation. This trend is observed relatively consistently throughout the city, with a few areas exhibiting a negative correlation.

On the other hand, the percentage of individuals who identify as a member of a visible minority group in a census tract holds a negative relationship with SIF across a large part of Toronto. This suggests that visible minority groups may have less exposure to residential green spaces.

5 Conclusion

Communities with less household income and a greater percentage of visible minority groups are associated with less exposure to green space. Future steps include research on the effects of this disparity on outcomes such as mortality and heat exposure, as well as research on how green space in these communities can be improved.

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2. Kardan, Omid, et al. "Neighborhood Greenspace and Health in a Large Urban Center." Scientific Reports, vol. 5, no. 1, July 2015, p. 11610, https://doi.org/10.1038/srep11610.
3. Pinault, Lauren, et al. "Ethnocultural and socioeconomic disparities in exposure to residential greenness within urban Canada." Health Reports, vol. 32, no. 5, 2021, pp. 3-14, https://doi.org/10.25318/82-003-X202100500001-ENG.
4. Frankenberg, C., and J. Berry. "Solar Induced Chlorophyll Fluorescence: Origins, Relation to Photosynthesis and Retrieval." Comprehensive Remote Sensing, Elsevier, 2018, pp. 143–62, https://doi.org/10.1016/B978-0-12-409548-9.10632-3.