UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Mapping Campus Landscape Change Over Time

Nicholas Mantegna

University of British Columbia

VOL 400

Themes: Biodiversity, Climate, Community, Land

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31 August 2020

Purpose

This project used ArcGIS to create a data visualization of the change in building footprint area of the University of British Columbia (UBC) Vancouver campus landscape from the time period 1995-2020. The results were used to provide recommendations for urban biodiversity policy and planning on the UBC campus. A StoryMap is the preferred medium for communicating the data and arguments in this project. Please view the StoryMap through this link to learn about why biodiversity needs to be strengthened on the UBC campus: https://arcg.is/05jrf5

(If the link does not work on google chrome, please open on another web browser)

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Executive Summary

The University of British Columbia Vancouver campus has gone through numerous shifts in natural assets throughout recent history. Understanding how the green and grey infrastructure on campus has changed over time will help inform future biodiversity land use policy decisions. Urban forests on the UBC campus increase biodiversity by providing habitats for a rich array of flora and fauna. Buildings decrease in monetary value overtime, whereas an urban forest increases in value by providing more ecosystem services as the urban forest grows older. Many of the heritage trees on campus help protect the UBC community from the consequences of climate change. Trees can help mitigate climate change through ecosystem resilience, carbon sequestration and flood water mitigation. The urban forest at UBC also provides mental health benefits by lowering stress levels in students and increasing social wellbeing. Not only can urban forests mitigate and help us adapt to the impacts of climate change on the UBC campus, they also can restore and create a sense of community among UBC faculty and students.

Dry summers in Vancouver are becoming the new normal, therefore our trees are now more vulnerable to biotic and abiotic disturbances such as disease, pests and wind throw. We are at risk of losing many of the benefits that urban forests provide to the UBC community. We need to increase the resiliency of the UBC urban forest to disturbances by strengthening biodiversity locally on campus. This SEEDS report uses orthophotos of the campus landscape to measure the building footprint change overtime.

Methodologies

With the goal in mind of visualizing landscape change over time on the UBC campus, an orthoimage of the campus landscape from the year 1995 was imported into ArcGIS. Then polygons were drawn over all the buildings in the 1995 image. After this, an orthoimage of the UBC campus from the year 2020 was imported into ArcGIS, georeferenced, and polygons were drawn on all the buildings that sprung up between 1995-2020. The building completion dates were researched, then the building footprints were color coded from the 1995-2020 time period into five year intervals.

ArcGIS Workflow

1. Add 1995 orthophotos to ArcGIS data frame and project each orthophoto in NAD 1983 UTM zone 10N

2. Open the editor and draw polygons on all visible building footprints

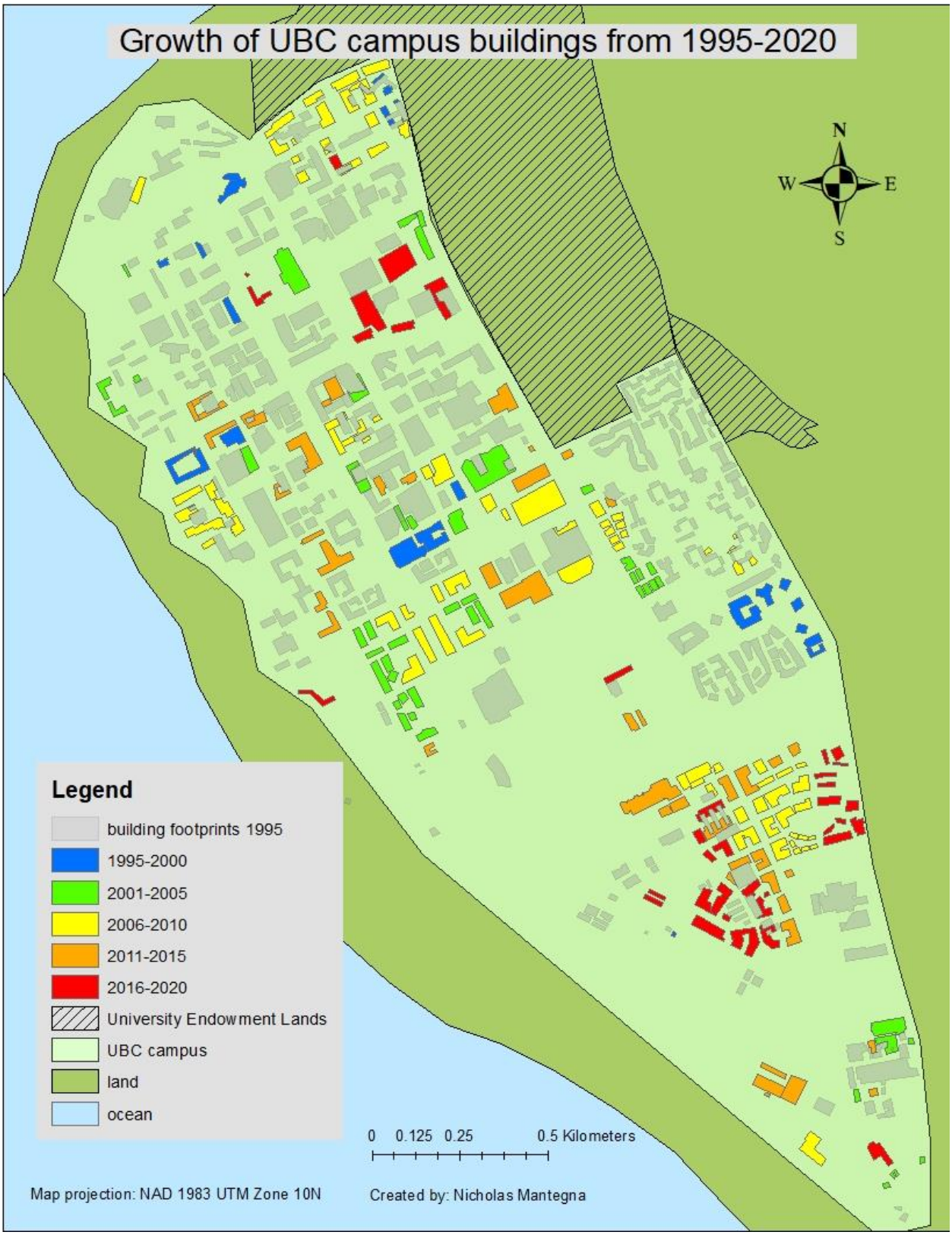
3. Add 2020 orthophotos to data frame and georeference the 2020 orthophotos to the 1995 orthophotos

4. Do not include buildings under construction, parking lots or roads, only map building footprints

5. Once the 2020 orthophotos are overlaid onto the 1995 orthophotos, draw polygons on building footprints in the 2020 image that did not exist in 1995.

6. Symbolize the additional 2020 building footprints in a different color than the 1995 footprints

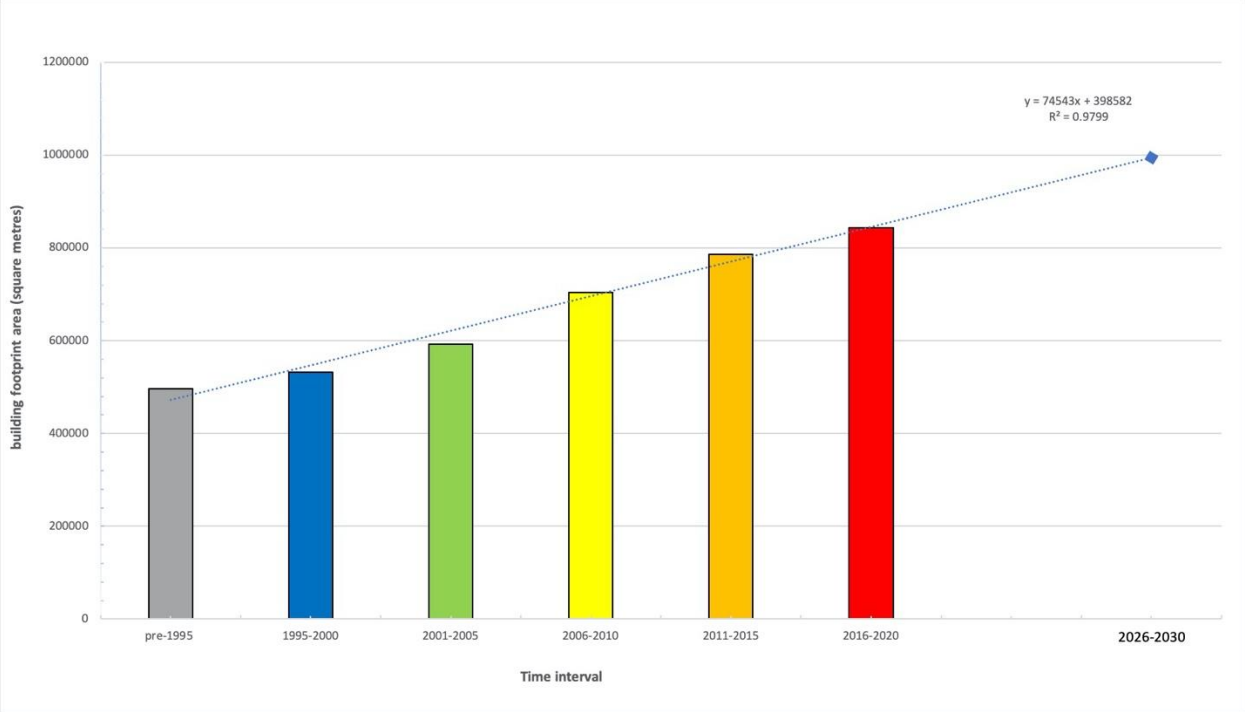
7. Open attribute table and ensure that the area of each polygon is being recorded for statistical analysis in Microsoft Excel


Growth of UBC campus buildings from 1995-2020
N
W
E
S
Legend
building footprints 1995
1995-2000
2001-2005
2006-2010
2011-2015
2016-2020
University Endowment Lands
UBC campus
land
ocean
0 0.125 0.25 0.5 Kilometers
Map projection: NAD 1983 UTM Zone 10N
Created by: Nicholas Mantegna

Results

The area, measured in square metres (m^2) of every building polygon drawn in ArcGIS was also being recorded. Using functions in Microsoft Excel, the total building footprint area on the UBC campus pre-1995 was ~497,002 m^2. The total building footprint area by 2020 was ~843,590 m^2.

The data was extrapolated with a trend line to make predictions about the projected building footprint area if UBC were to keep developing its building footprint area at the same rate it has been for the past 25 years. The diamond at the end of the trend line shows that UBC is projected to reach a total building area of ~1,000,000 m^2 by the time interval 2026-2030. The y-intercept of the trend line is 398,582 m^2. The R^2 value of the trend line is 0.9799. The slope of the trend line is 74,543 m^2 per 5 year time interval. Given the data gathered from ArcGIS of building cover area from the 1995-2020 timeframe, every 5 year interval the building cover area of UBC has been increasing by approximately 74,543 m^2.



UBC Land Use Plan 2015 and UBC Climate Action Plan 2020 Highlights

UBC Land Use Plan	UBC Climate Action Plan
One of the goals of the Greater Vancouver Regional District (GVRD) is “to protect and maintain the viability of the ‘Green Zone’.”	**2.1 Policy context and the case for action** "In 2010, UBC became the first Canadian university to announce bold greenhouse gas reduction targets putting it on course to be net zero emissions by 2050."
UBC is committed to “meet GVRD’s Livable Regional Strategic Plan and to help sustain UBC’s academic mission.”	**5.2 priority actions** Utilize existing space more efficiently. a. Increase intensity of space use as part of major renovations, where possible. b. Utilize occupancy data to enhance facilities planning and increase space utilization.
Regional Growth Strategy (RGS) goal number 1: "Create a compact Urban Area." Goal number 3: "Protect the environment and respond to climate change impacts.”	**5.8 complementary opportunities** Actions to reduce GHG emissions that UBC has little control over: Transportation to and from campus, business air travel for UBC staff and faculty, solid waste management, building lifecycle.

Recommendations to Inform Future Urban Biodiversity Policy and Planning

1. We need strict enforcement of Land Use Plan 2010 RGS goal numbers one and three. A strong emphasis on protecting green zones and utilizing space more efficiently will help prevent urban sprawl on campus.
2. An addition to section 5.8 of the Climate Action Plan 2030 could be, "Strengthening and protecting biodiversity on campus for climate change and ecological resiliency.” Or phrased differently, "Increasing the resiliency of the UBC urban forests to disturbances by strengthening biodiversity locally on campus." A method of fulfilling this recommendation is to adhere to section 5.2 of the Climate Action Plan 2020

3. UBC allocated financial funds in the past from private and corporate entities into the creation of more buildings on campus, fueling an increase in building footprint area overtime. UBC should instead reallocate said funds into replacing low density and energy inefficient buildings with high density energy efficient buildings wherever appropriate so that campus growth needs can be met on a smaller footprint. Not only will UBC reduce its building footprint area by replacing and retrofitting old buildings, the institution will also reduce its carbon footprint in the long run, therefore putting UBC on a better track to reach the net zero Green House Gas emission targets for the year 2050.

Key Mechanisms for Action

1. The Board of Governors Sustainability and Climate Action Committee is the most effective and needed tool to outfit UBC with a proper response to the climate emergency while simultaneously strengthening biodiversity locally on campus.
2. Action 14 of the 2018 Musqueam First Nation Comprehensive Community Plan is to "Exercise Land Management Jurisdiction." UBC needs to be listening and learning from Indigenous Land Use knowledge and practices through continuing the process of reconciliation between Musqueam First Nation and UBC.

Future SEEDS Project Ideas

This project did not touch on the increase in Green House Gas (GHG) emissions that will result from the expansion of the UBC campus in the near future. A SEEDS project could examine how GHG emissions have been correlated with building cover area over time on campus. The project could also examine what the projected increase in GHG emissions is on the UBC campus given the rate of building footprint change calculated in this SEEDS report.

The hardest part of this project was creating an informative method for visualizing campus landscape change overtime. This project did not directly measure canopy cover change. A SEEDS report could show the diversity and value of the UBC urban forest being removed over a period of time as a result of grey infrastructure development. The data visualizations in this project showed what is being added on the UBC campus (buildings), whereas a future SEEDS

project could use building footprint data to symbolize what is being removed (canopy cover/biodiversity).

Once the UBC Vancouver campus tree inventory is complete, many more variables of the entire UBC urban forest will be available for assessment such as: Diameter at Breast Height (DBH), tree height, crown width, species composition, etc... Empirical attempts of measuring biodiversity common among conservationists such as genetic diversity, species diversity, species abundance, alpha diversity, beta diversity and gamma diversity will also be available for analysis once the tree inventory is complete. There are endless methods for visualizing data in ArcGIS. A future SEEDS report could use UBC tree inventory data in ArcGIS to make predictions about the composition of the UBC urban forest in the past and future.

The COVID-19 pandemic will inevitably influence future land use policy. There could be a dramatic decrease in students that go to physical classes in the near future. A SEEDS report could examine how UBC land use policy has shifted in the past as a result of exogenous shocks to society such as WW1 or WW2. The project could use my visualizations of building cover area overtime to make predictions about what landscape changes may occur in the near future as a response to the pandemic.

Acknowledgements

1. I would like to thank Laura Arango, Emma Luker, Tara Moreau and Paul Pickell for overseeing and providing feedback for this project.
2. Research for this project was conducted on the traditional, ancestral and unceded territory of the xʷməθkʷəy̓əm (Musqueam) people.

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