THE URBAN HEAT ISLAND EFFECT IN DENSELY POPULATED URBAN AREAS AND ITS IMPLICATIONS ON ECO-CITY PLANNING: INVESTIGATION OF VERTICAL TEMPERATURE PROFILES IN DOWNTOWN VANCOUVER

MAY, DANA; PETROV, OLGA; SACZUK, ERIC

The urban heat island (UHI) effect at the surface level of urban areas is influenced by the 3D characteristics of the local landscape, including vegetation cover and material types. Further research is needed, however, to understand the effect of these urban features on local vertical atmospheric temperature profiles within dense urban areas.

Methods: This study collected vertical temperature data with Remotely Piloted Aircraft Systems at four sites within downtown Vancouver, chosen to represent varying levels of urbanization and surface coverage. Data was collected in the morning and afternoon in two seasons: summer and winter. Temperature profiles were compared against site characteristics including percentage vegetation and tree canopy coverage, percentage impervious surface coverage, building heights, and material types.

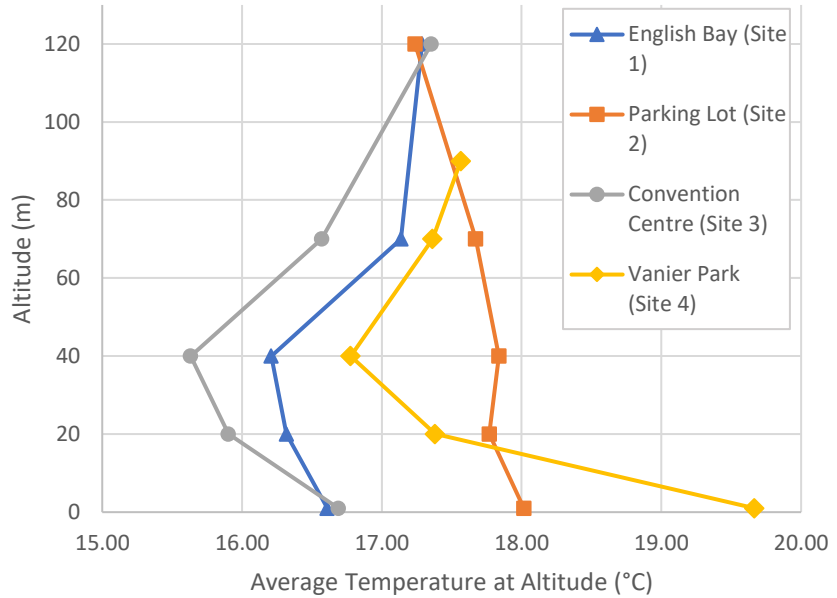
Site 1 – Mediumly urbanized
Site 2 – Highly urbanized
Site 3 – Urban with UHI mitigation features
Site 4 – Urban parkland

	Site 1	Site 2	Site 3	Site 4
% Tree Canopy	9	12	11	20
% Vegetation (all types)	21	16	29	49
% Impervious Surface	59	83	27	50
Number of Buildings	19	38	5	34

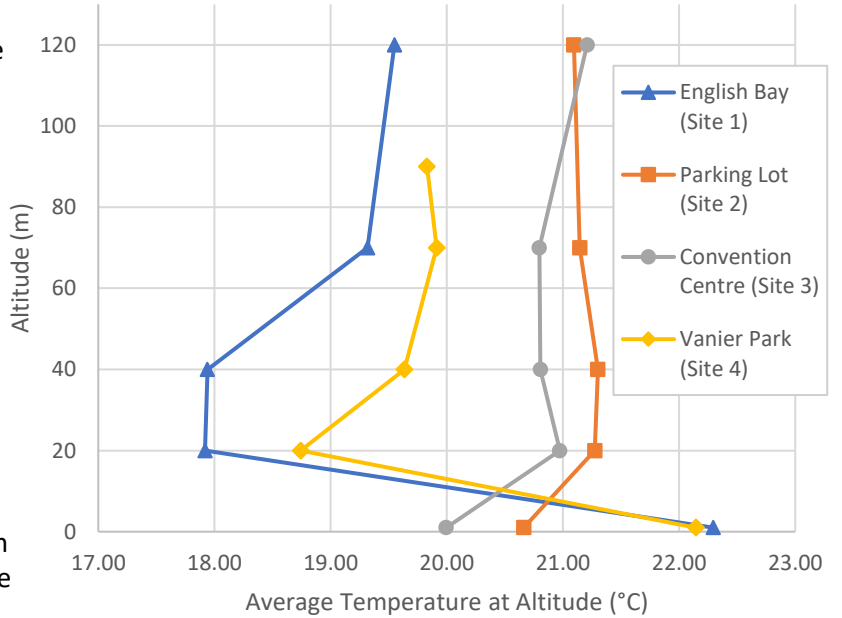
Conclusions: A significant difference was noted between the four sites in the summer (up to 4°C), but not in the winter. Summer results are shown in the figures to the right.

Results of this study supported existing theories such as the cooling effect of high proportions of vegetation and tree canopy coverage, the tendency for tall buildings to prevent night time cooling by insulating against heat loss, and that daytime surface temperatures are cooler in urban canyons shaded by tall buildings. It also showed that the height of local UHI effects increases over the course of the day as the surface gains heat.

Of interest, this study showed that the most urbanized site had localized warming of the air above, even when the surface temperature was cooler due to shading from buildings (Site 2). Results also suggested a cooling effect in the air above the park (Site 4), regardless of the warmer surface temperature. Finally, Sites 3 and 1 showed the impact of horizontal advection due to coastal land-sea breezes. Site 3, downwind of the downtown core, was warm despite local heat mitigation features (green roof), while Site 1, downwind of the inlet, was quite cool despite high imperviousness and low vegetation.



Combined vertical profiles at all sites, morning (10am), summer



Combined vertical profiles at all sites, afternoon (3pm), summer