
Climate Change & Cities: Urban Planning & Urban Design
New York City
Urban Design Climate Workshop
UDCW
New York Institute of Technology, 1855 Broadway
August 11, 2018

UCCRN Urban Design Climate Lab Workshops are underway worldwide with urban designers, urban planners, climatologists, policymakers, stakeholders and graduate students working side-by-side. The New York City Urban Design Climate Workshop (UDCW) was held on 11 August in New York City at the New York Institute of Technology, 1855 Broadway (at 61st Street). The UDCW in NYC drew its global experts from two simultaneous events:

1) The New York City launch by the Urban Climate Change Research Network (UCCRN) of the publication Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network (ARC3.2), Cambridge University Press 2018;

2) The International Association for Urban Climate (IAUC) conference in NYC (8/6-8/10), ICUC-10, that ran from August 6-10, 2018.

The New York City UDCW draws from a cross-disciplinary team of global urban climate experts from IAUC work with a NYC-based team to configure a prototype intervention for a strategic site in New York City: Baseline (business-as-usual) and Best Practices (climate-driven urban design). This approach would provide compelling evidence to NYC policymakers (and a wider audience) on the value proposition (financial/health/public realm co-benefits) from our evidence-based strategies.

The high-profile site for this workshop and panel is Sunnyside Yard in Queens, NY., which is under consideration for large-scale development. Sunnyside Yard site selection is based upon the expected population density increase through the year 2050, largely due to re-zoning or planned infrastructure improvements. In effect, more density increases urban heat stress as the urban climate gets hotter; and increases risk of flooding. This Sunnyside Yard site is the subject of the Urban Climate Lab at the New York Institute of Technology; so it benefits from graduate student prep work, expertise and a large physical model at the disposal of the UDCW.

The **NYIT Urban Climate Lab** used off-the-shelf Geographic Information Systems (ArcGIS) mapping and digital Parametric 3-D modeling tools (Rhinoceros, Grasshopper - with Ladybug plug-ins), drawing from Weather Data (EPW) files. The Planning and Design Intervention was generated by considering outputs from the "**2050 scenario**". Prior to the intervention, the design research includes 1) modeling and analyzing comparable districts of high density and low thermal stress; 2) developing evidence-based urban design guidelines that include climate factor diagrams and physical configurations. Elements of the qualitative guidelines were applied to the pilot site; 3) expected climatology modeling outcomes from peer-reviewed research. Students also made assumptions pertaining to density increase, based on projected population, planned housing and infrastructure development, and rezoning. That information is obtained from city agencies. The final urban design intervention has been configured through the articulation of design goals responding to the complexity of context, spatial scales and systems; pointing to coherent design strategies and outcomes. The preparation leading to the urban design workshop tested and refined the site intervention through micro-climate modelling at district scale for 2018 and 2050 projections.

Scenarios

The preparation leading to the Urban Design Climate Workshop tested and refined the urban design site intervention through the lens of micro-climate models and qualitative best practices. This urban design work was accomplished in a collaboration between the NYIT Graduate Urban Design students and the HOK NYC office Urban Design Group.

Baseline 2018: Site modeled as it is today, with the rail yard and surrounding areas.

Baseline 2050: Hypothetical scenario based on typical "market driven" decisions

Best Practice 2050: Based on climate adaptive development, considering the 4 climate factors (efficiency of urban systems, form and layout, heat resistant construction materials and vegetative coverage). This was developed by the NYIT Urban Climate Lab.

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Urban Micro-Climate Comparisons

Between 2018 and 2050 projections conducted at the urban district scale.

At the district scale, urban climate experts [UCCRN-Columbia University & NASA GISS and IAUC-University College Dublin] analyzed and projected 2050 land surface temperature estimates derived from satellite data. Summertime Landsat 8 imagery from 2017 to 2018 was also used to derive land surface temperature (LST) at the sites of interest for comparison. With average annual temperatures projected to rise by 4.1-5.7 °F by the 2050s from anthropogenic climate change, New York City can expect more frequent extreme heat conditions like those experienced in the summers of 2017 and 2018.This data is a proxy for urban heat island and urban microclimate that helps identify district-level "hot spots", zones of greatest heat intensity. Next, detailed urban climate software models were used to identify hot spots at a neighborhood level. The goal of this detailed "hot spot" analysis at the city block level was to evaluate urban thermal comfort, and better understand the potential physiological stress on local population based on their vulnerability. For evaluating urban outdoor thermal comfort, several metrics are available, including the Universal Thermal Climate Index (UTCI).

Urban Climate Software Models/Platforms

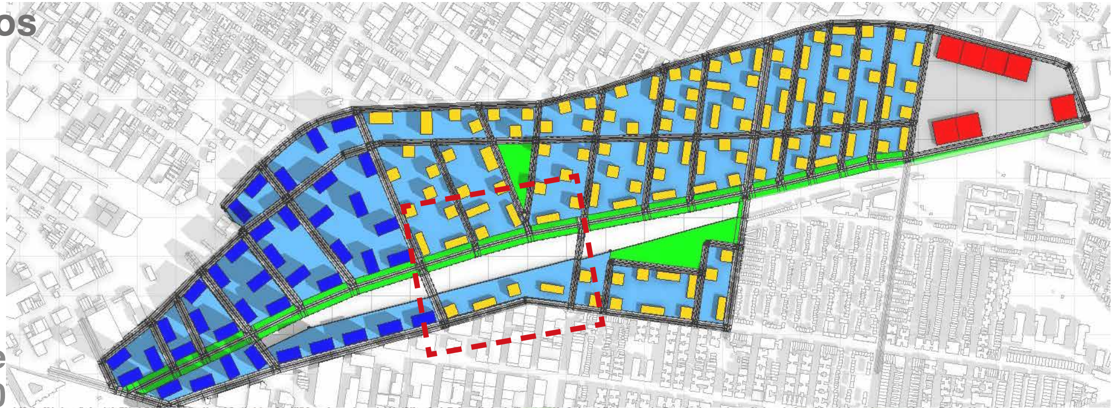
Three different Sunnyside Yard scenarios to be modeled using 4 urban climate software platforms:

1) **Earth Observations**; satellite images measuring radiant heat: UCCRN-Columbia University & NASA GISS
2) **Envi-met**; measuring human comfort: UCCRN-Columbia University & NASA GISS
3) **Solweig**; focused on temperature and vegetative cover: IAUC-University College Dublin*

Testing Strategic Locations: Once 3D morphological models were generated, the climate modeling teams identified key geo-specific locations in the Sunnyside Yard development to test more detailed/ granular outcomes; with energy/ financial; health/comfort outcomes specific to each.

* Gerald Mills (University College Dublin), Fredrik Lindberg (Goteborg University) -Solweig: https://gvc.gu.se/english/research/climate/urban-climate/software/solweig.

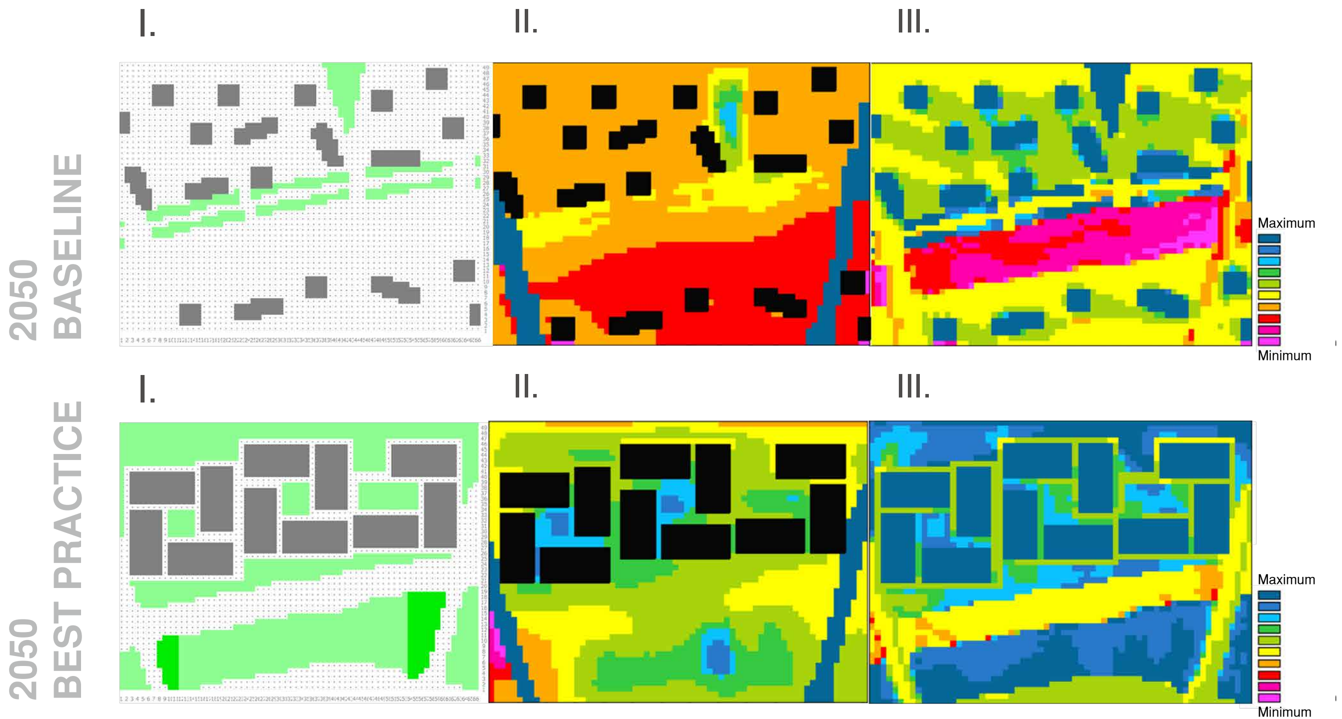
2050 Scenarios



Baseline 2050

Best Practice 2050

Scenario Comparison: Microclimates



ENVI-met Model

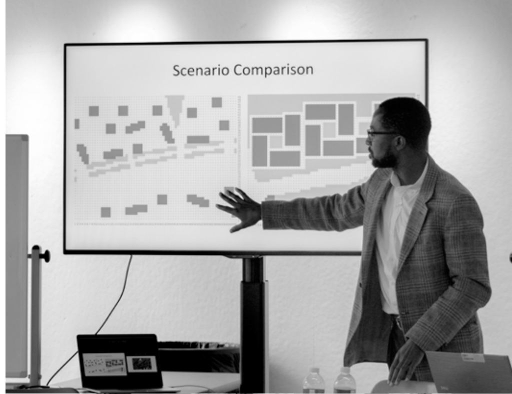
Credits: UCCRN, GISS Climate Impacts Group

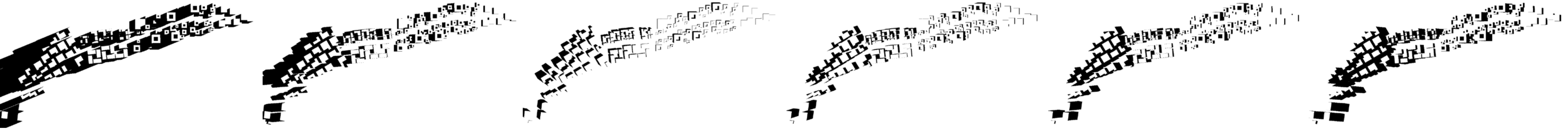
Climate Models: Baseline vs Best Practice

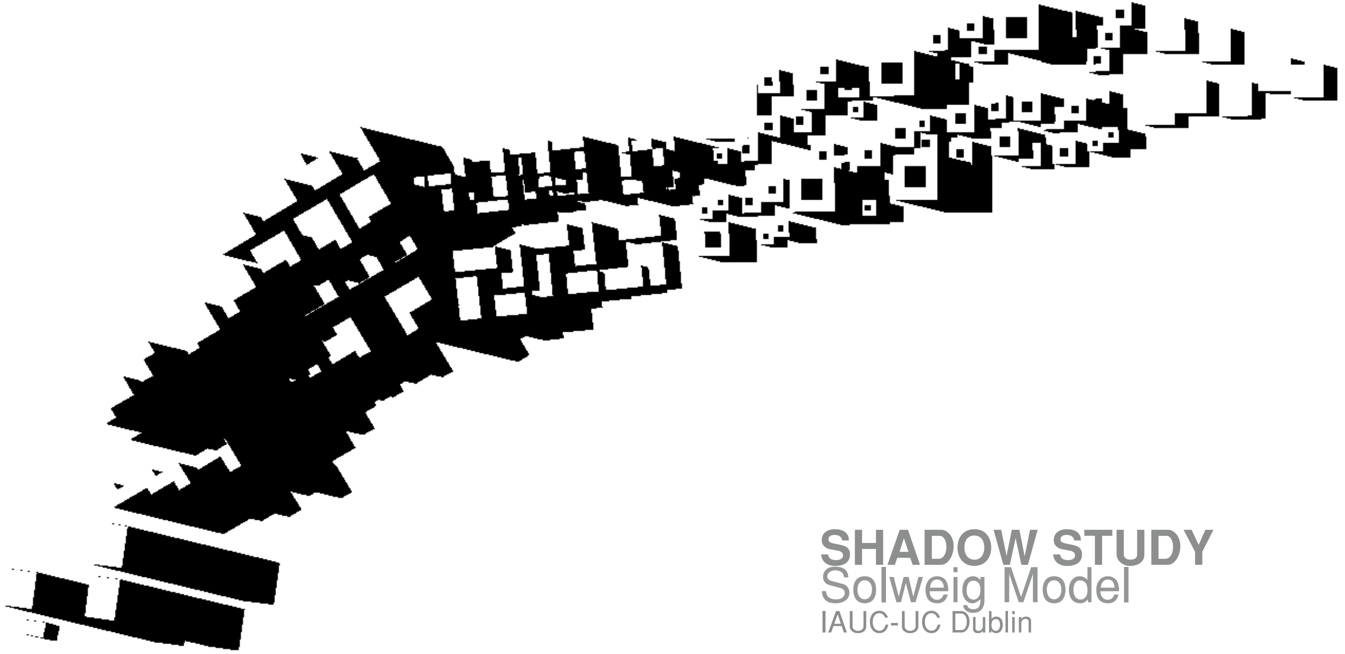
In order to assess the micro-climate outcomes from the 2050 Baseline and Best Practice urban designs, the microclimate model ENVI-met 4.0 was used to simulate air temperature and surface temperature differences. The model simulates surface-plant-air interactions and consists of a 1D boundary layer and three sub-models for atmosphere, soil and plants.

A strategic subdistrict of the 2050 Baseline (top row) and 2050 Best Practice (bottom row) is illustrated by the ENVI-met grid cells in columns I,II, and III. The micro-climate benefits of 2050 Best Practice urban design configuration is illustrated by these ENVI-met images taken at 6pm in July:

-Column II: Illustrates the variation in air temperature distribution across the sub-district.
-Column III: Shows the variation in surface temperature across he sub-district. Simulated surface temperatures range from 27 ˚C to 43 ˚C with significant surface cooling







SHADOW STUDY
Solweig Model
IAUC-UC Dublin

The primary impact of urban design at a neighbourhood scale is to modify the local climate, which is governed by a hierarchy of atmospheric influences. During heatwave events, strong solar irradiance, high air temperatures and low windspeed creates thermal discomfort, which can be alleviated by a design that does not obstruct airflow, generates shadows and uses cool surface materials.
In order to examine the microclimatic impact of different urban designs, the SOLWEIG* model was used to compare 2050 Sunnyside designs. SOLWEIG uses a three dimensional description of the urban landscape and of landcover to derive key drivers of climate at the ground. These drivers include the spatial distributions of direct solar radiation, shadow patterns and the sky view factor. Together, these can be used to estimate the distribution of the mean radiant temperature (MRT) of the urban surface and human comfort levels at selected locations. In the current experiment, the model was run using the 2050 designs and data for 1 June, 2018, which corresponded to a heatwave event in New York. In terms of the distribution of the MRT and human comfort values, the best practice design creates a more diverse shadow pattern and a greater area of relative comfort (by reducing MRT values). These images show the output of SOLWEIG over the course of the day.

*SOLWEIG is a component of the Urban Multi-scale Environmental Predictor (UMEP), which is freely available. See: Lindberg, F., Grimmond, C.S.B., Gabey, A., Huang, B., Kent, C.W., Sun, T., Theeuwes, N.E., J rvi, L., Ward, H.C., Capel-Timms, I. and Chang, Y., 2018. Urban Multi-scale Environmental Predictor (UMEP): An integrated tool for city-based climate services. Environmental Modelling & Software, 99, pp.70-87.

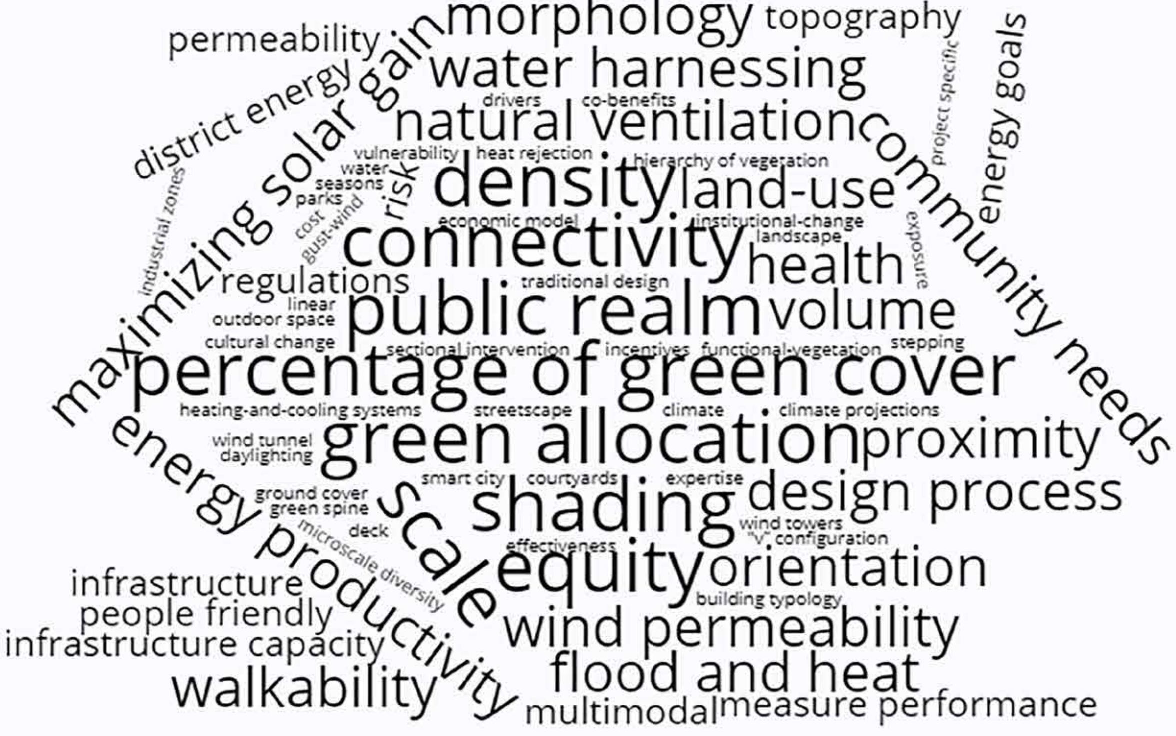
Round table discussion:
Common language; common strategies between:

-Urban Climate Scientists
-Urban Designers
-Public Policymakers

Sunnyside Yard through its four primary Land Uses (CBD; Transit Hub; Residential; Manufacturing) was a platform for discussion exchanges on the following:

-Micro-climate modeling outcomes (human comfort/stress) from "2050 scenario" baseline and best practice;
-Qualitative integration of evidence-based urban design guidelines;
-Policy implications related to the value proposition of co-benefits associated with public health and energy.
-Gap analysis: Current tools; missing tools; capacity limitations
-Measuring health and economic outcomes
-Role of design guidelines and work-around proxies

Common language; common strategies: WORD CLOUD



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