Group Research Projects

The objective of the group research project (20% of course grade) is to expose you to the process of designing, planning, analyzing and presenting an experiment in urban climatology. In groups of three students, you will plan, implement and present your own project.

The projects are either based on simple field experiments (1 day), data analysis or on numerical models you can run on a PC/ laptop (also within 1 day). Your group will present your experiment with an emphasis on the experimental design, methods, and results in a 12-min presentation on March 28, March 30, April 2, and April 4, 2012 . You are also asked to prepare and distribute a hand-out (1 to 2 pages, including figures, photos) for your classmates at the date when you present your project.

A. SELECTING A RESEARCH PROJECT

Use the attached list of projects to identify your preferred projects. You can rank them from 1 (highest priority) to 12 (lowest priority). Starting immediately, you can **send a mail to your Instructor with preferred project ranks (by latest January 27, 2012** - after that deadline your will be attributed). Projects will be filled up based on at date/time of email). Groups will be posted at http://www.geog.ubc.ca/courses/geob401/projects.html
The following symbols assist you in selecting a project based on your schedule / preferences:

Involves field work.

Requires to be flexible in terms of weather conditions.

Involves outdoor work after sunset (evening, night).

Requires enhanced computing background (e.g. administroator rights, statistics).

B. CARRYING OUT YOUR PROJECT

Before the midterm break, you will be assigned a project, and you can pick-up your instrumentation / software. The next step - and most crucial one - is to carefully discuss the details of your experimental design (site, methods, times, who is where and when, data sources, methods) in your group and carefully plan the details of your field or numerical work. Projects are loosely defined, and a significant part of the grading is focussing on **how you have implemented, documented and planned your experiment** (50% of the grade). Carry out your research project soon - do not wait for the last day! Make use of office hours to discuss details or concerns. Act responsibly and do not carry out anything that endagers you or others (see equipment form).

C. PRESENTING YOUR PROJECT

All three group members must present their project in a 12-min presentation on the date assigned. You can use Power Point, Keynote, blackboard or traditional overhead slides. Do not exceed 12 minutes (+ 3 min questions). The presentation should include the objectives (given), experimental design, methods, and key results.

Group Projects Block 1
THE URBAN RADIATION BALANCE (Presentations: March 28, 2012)

1A - Diurnal course of the thermal anisotropy of a single building.

Objective: Quantify and discuss the diurnal (daytime) course of the thermal anisotropy of a single building.
Method: Select an accessible and detached building well exposed to the sun (try to avoid much shading by trees and other buildings). Over the course of a selected day (sunset to sunrise, ideally clear sky or little cloud cover) monitor the surface temperatures of all facets (walls, roof) 3-6 times using the infrared thermometer provided. Based on your readings describe, quantify and visualize the anisotropy of the building over the course of this day.

Instrumentation provided: 1 handheld infrared thermometer. *You bring:* Field book, camera

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1B - Thermal anisotropy of an urban canopy.

Objective: Quantify and discuss the statistically average thermal anisotropy of a large group of buildings for a given time of the day.
Method: Select a neighborhood of accessible and detached buildings, with simple surface materials, that are well exposed to the sun (try to avoid a neighborhood with many trees). For a chosen time of a clear, sunny day, monitor the surface temperatures of all facets (walls) using the infrared thermometer provided. Try to take as many measurements as possible within a short time (max. 2 hours). Based on your readings describe, quantify and visualize the anisotropy of the neighborhood at the selected time of the day.

Instrumentation provided: 2 handheld infrared thermometers. *You bring:* Field book, camera

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1C - How does urban geometry control the cooling rates in a street canyon?

Objective: Explore how long-wave radiation trapping and associated cooling rates differ for various facets and locations in an ideal street canyon at night and explain your results.
Method: Select a simple (vegetation-free), accessible, and safe street-canyon where you can do measurements just before and after sunset on a clear-sky evening. Use the infrared thermometer to measure a profile through a cross-section of the street-canyon (wall, road, wall) in regular time intervals. Use your measurements to discuss how the geometry affects the temperatures observed and cooling rates in different parts of the canyon.

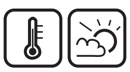
Instrumentation provided: 1 handheld infrared thermometer. *You bring:* Field book

Group Projects Block 2
URBAN SURFACE AND AIR TEMPERATURES (Presentations: March 30, 2012)

2A - The micro-scale distribution of minimum air temperature in an urban setting.

Objective: Map how the nocturnal minimum temperatures varies at ground level on the micro-scale (e.g. for a single property). Explain your map of minimum temperatures.
Method: Install several minimum-thermometers around a building you have access to - in locations of different sky-view factor and materials (e.g. lawn under trees, lawn close to walls, open concrete area, etc). Install all thermometers at exactly the same height (a few centimeters above the surface, you may use bricks, wooden blocks etc.). Run them over a clear-sky night and read off the minimum temperature the next morning. Map the micro-scale distribution of minimum temperatures. The exercise should include an appropriate comparison / test of the minimum thermometers prior to the field experiment.

Instrumentation provided: 5-10 minimum thermometers. *You bring:* Field book



2B - Microclimate of an urban park.

Objective: Design an experiment to measure and map daytime and evening (just after sunset) air temperatures, and humidity across and in the vicinity of a park embedded in a densely built-up urban area.
Method: Become familiar with the Kestrel data logger. Think about the scale, how big the park must be, and where you expect differences, and at how many locations you measure. Draw maps or sketches (a profile) of the temperature and humidity distribution and relate properties to urban surface properties (sky view factor etc.). Do not leave any equipment unattended.

Instrumentation provided: 2 Kestrel data logger. *You bring:* Field book.

2C - Subsurface temperatures in an open vs. a built-up area

Objective: Using small data loggers, measure subsurface temperatures continuously over at least 7 days along a gradient of an 'open' to a densely 'built-up' location characterized by a gradient of contrasting sky view factors.
Method: Become familiar with the HOBO data loggers and their software. Install the HOBO thermometer probes at exactly similar depth (5 - 10 cm). Run them over 7 days. Compare the subsurface climates at the selected locations and relate those to urban structure in the vicinity.

Instrumentation provided: data logger with thermometers, software, interface. *You bring:* Field book, PC

Group Projects Block 3
URBAN ENERGY AND WATER BALANCE (Presentations: April 2, 2012)

3A - Estimation of the storage heat flux density using the objective hysteresis model

Objective: Test the performance of the facet-individual objective hysteresis model (OHM, Lecture 9, slides 15 and 16) by calculating the storage heat flux (ΔQ_S) for a particular block in South-East Vancouver and comparing your results to ΔQ_S obtained from the residual method.
Method: Survey the block between Waverley Ave to the North, Inverness St. to the East, E 48th to the South, Ross St. to the West in Vancouver, BC. Use your survey data to construct a reasonable - but not too detailed - inventory of surface materials and surface fractions of different materials. The survey is possible from street and back-lanes. Use the facet-individual objective hysteresis model to calculate ΔQ_S of the whole block for a particular summer day where you will be provided with values of Q^*. Compare your results to the residual term approach for ΔQ_S obtained from energy balance measurements (tower data will be provided).

Instrumentation provided: Survey maps, data from tower with Q^*, Q_E *and* Q_H. *You bring:* Photo camera, field book, map, air photos (e.g. http://www.vancouver.ca/VanMap/ or GIC), spreadsheet software (e.g. Open Office, Excel).

3B - Variability of potential evaporation in urban areas.

Objective: Determine the micro-scale variability of potential evapotranspiration in an urban environment using mini-lysimeters. Discuss the driving parameters that affect evaporation.
Method: Fill all mini-lysimeters pans with saturated, wetted soil (same soil). Weigh them in using the high-precision scale provided. Deploy them carefully at locations with different exposure to microclimates (e.g. no vs. closed tree cover, different materials, parking lots, etc.) - but within 1 km from each other. After a few days collect them and measure their remaining weight. From the weight loss and their surface area calculate the potential evaporation. Hint: Preferable for the experiment are windy, clear days with a dry atmosphere - avoid days when there is precipitation forecasted.

Instrumentation provided: Mini-evaporation pans, scale. *You bring:* Field book, soil.

3C - Estimate the anthropogenic heat flux of different dwellings.
Objective: For 2-3 dwellings of your choice, estimate the per-capita anthropogenic heat flux released to the atmosphere for an entire year due to heating and cooling requirements, appliances, coocking and the human metabolism.
Method: As a starting point use your energy utility bills (electricity, gas, fuel). Do not take into account energy you use at work or during vacation, nor energy release due to transportation (as data is unavailable or challenging to gather). If you data comes from a multi-person household also provide a total and a per-capita estimate. Compare the dwellings and discuss any differences.

You bring: Computer with spreadsheet software (e.g. Open Office, Excel)

Group Projects Block 4
WIND AND PRECIPITATION IN URBAN ENVIRONMENTS (Presentations: April 4, 2012)

4A - Evidence of summertime precipitation enhancement downwind of a large urban area.

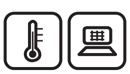
Objective: Use precipitation data provided on the web to analyze if there is any indication of precipitation enhancement downwind of a selected large city of your choice.
Method: Select a large city with simple topography (flat, no lakes or ocean), significant industry and best in a continental climate. Use summertime precipitation data provided for example by the National Climate Data and Information Archive / Environment Canada (http://www.climate.weatheroffice.ec.gc.ca/) or by NOAA (http://cdo.ncdc.noaa.gov/). Select urban and rural stations in the larger region of the city and analyze statistically if there is any indication of precipitation downwind of this city or not.

You bring: Terrain and land-use maps (e.g. http//maps.google.com/or GIC), computer with access to internet and statistical software (e.g. Open Office, Excel)

4B - Wind climate and pedestrian comfort around tall buildings.

Objective: For a windy day, map the observed wind at pedestrian level (mean wind, variability) within an urban block that contains high-rise buildings or around an isolated high-rise building.
Method: You will be equipped with hand held wind sensors, that can be used to read-off or log readings at predefined intervals. Select a day with strong, steady winds. Walk around the building / block of your choice and measure wind at pedestrian level, at representative locations. Carefully think about replications. Draw a map of the area and identify regions where pedestrians might encounter discomfort under observed wind situations. Explain why.

Instrumentation provided: Handheld anemometers, software, data download interface (USB). *You bring:* Field book, maps (e.g. http://www.vancouver.ca/VanMap/ or GIC)



4C - Wind comfort modeled in ENVI-met

Objective: Use a numerical model called ENVI-met developed for planners at the local-scale to assess wind flow around a building / block of your choice.
Method: Download and install the freeware ENVI-met (http://www.envi-met.com/). Use the software to set-up your environment and then calculate a single run with wind from a particular direction to visualize the flow field. Discuss the model results. Is the model useful for planners? Detailed technical instructions will be given in an office hour / by appointment. You can collaborate with group 4B.

Instrumentation provided: Software on CD. *You bring:* Computer with Windows, administrator rights, and at least 1 GByte RAM and 2 GHz CPU.