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WEEK 5 – URBAN CLIMATE AND LIVABILITY II

Albedo

“Albedo, or *reflection coefficient*, derived from Latin *albedo* "whiteness" (or reflected sunlight) in turn from *albus* "white", is the diffuse reflectivity or reflecting power of a surface. It is the ratio of reflected radiation from the surface to incident radiation upon it. Its dimensionless nature lets it be expressed as a percentage and is measured on a scale from zero for no reflection of a perfectly black surface to 1 for perfect reflection of a white surface.

Albedo depends on the frequency of the radiation. When quoted unqualified, it usually refers to some appropriate average across the spectrum of visible light. In general, the albedo depends on the directional distribution of incident radiation, except for Lambertian surfaces, which scatter radiation in all directions according to a cosine function and therefore have an albedo that is independent of the incident distribution. In practice, a bidirectional reflectance distribution function (BRDF) may be required to accurately characterize the scattering properties of a surface, but albedo is very useful as a first approximation.

The albedo is an important concept in climatology, astronomy, and calculating reflectivity of surfaces in LEED sustainable-rating systems for buildings. The average overall albedo of Earth, its *planetary albedo*, is 30 to 35% because of cloud cover, but widely varies locally across the surface because of different geological and environmental features.”

Wikipedia. *Albedo* [online] < http://en.wikipedia.org/wiki/Albedo> [accessed at 8 June 2015]

Canopy-layer heat island

The canopy-layer heat island is found within the atmosphere below the tops of buildings and trees (that is in the urban canopy). A heat island peak is usually associated with the city center and lower values with more open areas, parks, and water surfaces. The diurnal variation of the canopy-layer heat island is very pronounced and the heat island intensity reaches a maximum sometime between a few hours after sunset and before sunrise. Given its accessibility and relevance to human activities, it is the most studied of all heat island types. It is commonly measured by a network of fixed air temperature sensors placed at screen-level height (that is about 2 meters above ground) or on cars traversing the city when the spatial variability is of interest *(Matthias Roth, 2015).*

Human thermal comfort

Human thermal comfort exists of the subjective sensation of the environment (how you feel) and the objective interaction with the environment (heat and mass transfer rates) (Martínez, 2015)

“Thermal comfort is the condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation. Thermal neutrality is maintained when the heat generated by human metabolism is allowed to dissipate, thus maintaining thermal equilibrium with the surroundings. The main factors that influence thermal comfort are those that determine heat gain and loss, namely metabolic rate, clothing insulation, air temperature, mean radiant temperature, air speed, and relative humidity. Psychological parameters such as individual expectations also affect thermal comfort.” (Wikipedia).

e.g.: “Thermal comfort for a person at rest or under light activity (e.g. office work) is best at air temperature of T=22±2 ºC, relative humidity of ϕ=50±20%, air speed. “ (Marínez, 2015)

Martínez, I. (2015) *Human Thermal Comfort*. [online] <http://webserver.dmt.upm.es/~isidoro/Env/Human%20thermal%20comfort.pdf> [accessed at 10 June 2015]

Wikipedia. *Thermal comfort*. [online] < http://en.wikipedia.org/wiki/Thermal_comfort> [accessed at 10 June 2015]

Surface urban heat island

The surface urban heat island is defined by the temperature of the actual surface that extends over its entire 3-D envelope and involves all urban facets (streets, vertical walls, roofs, trees, etc.). It is strongest during daytime when the response is dominated by exposed, horizontal surfaces such as roofs and pavements. The surface urban heat island is usually remotely-sensed by instruments mounted on aircrafts or satellites.

The surface urban heat island is a surface phenomenon that should not be set equal to its atmospheric counterpart whose magnitude is lower and largest during nighttime, which is the reverse of the surface temperature pattern *(Matthias Roth, 2015).*

Urban heat island

"An urban heat island (UHI) is a city or metropolitan area that is significantly warmer than its surrounding rural areas due to human activities. The phenomenon was first investigated and described by Luke Howard in the 1810s, although he was not the one to name the phenomenon. The temperature difference usually is larger at night than during the day, and is most apparent when winds are weak. UHI is most noticeable during the summer and winter. The main cause of the urban heat island effect is from the modification of land surfaces, which use materials that effectively store short-wave radiation. Waste heat generated by energy usage is a secondary contributor. As a population center grows, it tends to expand its area and increase its average temperature. The less-used term heat island refers to any area, populated or not, which is consistently hotter than the surrounding area.

Monthly rainfall is greater downwind of cities, partially due to the UHI. Increases in heat within urban centers increases the length of growing seasons, and decreases the occurrence of weak tornadoes. The UHI decreases air quality by increasing the production of pollutants such as ozone, and decreases water quality as warmer waters flow into area streams and put stress on their ecosystems.

Not all cities have a distinct urban heat island. Mitigation of the urban heat island effect can be accomplished through the use of green roofs and the use of lighter-colored surfaces in urban areas, which reflect more sunlight and absorb less heat. Despite concerns raised about its possible contribution to global warming, comparisons between urban and rural areas show that the urban heat island effects have little influence on global mean temperature trends."

Wikipedia. *Urban Heat Island*. [online] <http://en.wikipedia.org/wiki/Urban_heat_island> [accessed at 8 June 2015]