GEOG 272 Lab 5 Air Temperature

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Theory: Controls of Air Temperature

1) Solar Irradiance
   - Provides energy that can be directly absorbed in the air.
   - Radiation must be absorbed by the air to increase internal temperature
   - The more solar radiation absorbed, the higher the internal energy content, and the higher the air temperature.
2) Total Long wave Radiation (LW)
   - Long wave radiation provides energy that be directly absorbed in the air to heat the air.
   - The more long wave radiation absorbed, the greater the air temperature.
3) Humidity
   - Water vapour is a good absorber of both long wave and solar radiation
   - The greater the humidity, the more absorbed radiation. The more absorption, the higher the internal energy content and higher air temperature.
   - More humidity (i.e. vapour pressure) means more energy absorption and therefore a higher temperature.
4) Convective Heat Flux Density
   - Convective heat flux density provides energy from surface to air
   - Therefore, the higher the convective heat flux density, the higher the internal energy content, and a higher air temperature
5) Advection
   - Air coming from a warm source, brings higher temperature
   - Air coming from a cold source, brings low temperature

Data:

Incoming total solar irradiance (W/m^2):

Site	1st	2nd	3rd	4th	5th	Average
Shaded site	10.535 W/m^2	10.195 W/m^2	10.875 W/m^2	11.215 W/m^2	10.877 W/m^2	10.739 W/m^2
Open Sky	18.021 W/m^2	17.681 W/m^2	17.341 W/m^2	17.341 W/m^2	17.001 W/m^2	17.477 W/m^2

Radiant temperatures for the ground surface:

Shaded Site				Open Sky		
13℃	14℃	13℃		15℃	14℃	15℃
13℃	13℃	12℃		14℃	14℃	14℃
12℃	11℃	11℃		13℃	13℃	13℃
Zenith: 9℃				Zenith: -1℃		

Dry and wet bulb temperature:

Shaded Site	Dry	Wet

Ground	13.5℃	12.2℃
Chest	14.2℃	13.8℃

Open Sky	Dry	Wet
Ground	13.1℃	12.1℃
Chest	13.2℃	12.8℃

Wind Speed:

Shaded Site	2.39m/s
Open Sky	1.06m/s

Height of mid chest:
135cm=1.35m

Shaded Site Observation	
Direction of Wind	Coming from North East direction, closer to East
Potential upwind surfaces	● Buildings such as Clearihu and the Library ● Tall trees along the side of Quadra ● The slope difference between UVIC and Cadboro Bay ● Ocean cold breeze coming from the bay
General weather conditions & ground surface	● Windy day ● Small light rain shower ● Raining on and off for every 5 minutes ● Fairly cloudy with scattered small blue sky patches ● Sky is dark, but sun peaking through South West ● Ground is damp and wet ● There are still leaves on the tree above

Open Sky Observation	
Direction of Wind	Coming from North East direction
Potential upwind surfaces	● Buildings such as Clearihu and the Library ● Tall trees along the side of Quadra ● The slope difference between UVIC and Cadboro Bay ● Ocean cold breeze coming from the bay
General weather conditions & ground surface	● Less windy ● Cleared up a bit, but still patchy cloud spread out the sky ● North and South still super cloudy ● Clouds moving in a fast pace ● The ground is damp but less muddy than previous site

Case Study:

1) a. Solar Irradiance: The solar irradiance for the Shaded Site is 10.739 W/$m^{2.}$ The Open Sky site is receiving solar irradiance of 17.477 W/$m^{2.}$ The Open Sky site is receiving more solar irradiance than the Shaded Site. Therefore, based on the theory, the Open Sky site has a higher air temperature than the Shaded site.
   b. Total Long-Wave Radiation: The Shaded site is receiving a total of 698.57W/ m^2 long-wave radiation. The total long-wave radiation received by the Open Sky site is 659.74 W/ m^2. In comparison, the Shaded site is receiving more long wave radiation than the Open Sky Site. There are more long-wave radiation being absorbed by the Shaded site, which leads to greater air temperature. Therefore, I expect the Shaded site to have a higher air temperature.
   c. Atmospheric Humidity: The Shaded site has an atmospheric humidity of 10.8mmHg. The atmospheric humidity at the Open sky site is 10.08mmHg. The Shaded site has a higher atmospheric humidity than the Open Sky. This means, more energy can be absorbed at the Shaded site by the atmospheric humidity and therefore, leading to a higher air temperature.
   d. Convective Heat Flux Density: The convective heat flux density at the Shaded site is -76.46 W/ $m^{2.}$ The Open Sky site has a convective heat flux density of 13.29 W/ $m^{2.}$ Based on these two calculated value from our collected data, the Open Sky has a higher convective heat flux density. Founded on the theory, the Open Sky site has a higher air temperature than the Shaded Site.
   e. Advection: The wind speed at the Shaded Site is 2.39m/s and it is coming from the North East direction, more closer towards the East. The wind at the Open Sky site is also coming from the North East direction, with a wind speed of 1.06m/s. The wind observed at these two sites is from the same general direction, coming from the Cadboro Bay. Therefore, the air coming from the cold bay water brings low temperature to the observed sites.
2) The Shaded site has an air temperature of 14.2℃. The Open Sky site has an air temperature of 13.2℃. Based on the collected air temperature for these two sites, the Shaded Site has a higher air temperature than the Open Sky.
   However, judging from the solar irradiance control, The Open Sky site is receiving more solar irradiance, which means higher the internal energy content in this site, and leads to higher air temperature. This is the case, because Open Sky site has no overhead tree to interference with the receiving solar irradiance.
   Based on the total long-wave radiation we collected. The Shaded Site is receiving more long- wave radiation than the Open Sky. This means that at the Shaded Site, more long-wave radiation provides energy that can be directly absorbed in the air to heat the air. The Open Sky site is receiving less long-wave radiation is because there are less available clouds present in the sky during that time. Less clouds at the Open Sky site than the Shaded site to act as a reemit agent.
   The Shaded site has a higher atmospheric humidity than the Open Sky. The greater the humidity, the more radiation can be absorbed, and the higher the air temperature. Humidity is a good absorber of long wave radiation, with that being said, the high amount of long-wave radiation received at the Shaded site is being used by the humidity to increase the air temperature. This means, the high atmospheric humidity and the large amount of long-wave radiation at the Shaded Site combined to create a higher air temperature than the Open Sky.
   Judging from the convective heat flux density control, the Open Sky site has a higher air temperature because it has a higher convective heat flux density than the Shaded Site. The high solar irradiance and the wet/damp ground at the Open Sky site combined to create the high convective heat flux density by the moisture preventing energy being absorbed by ground. Energy at the site is used as an evaporation agent, giving off heat.
   The advection control has a relatively small affect on the differences between these two observed sites. The wind observed at these two sites is coming from the North East direction. The possible source for this observed air is coming from the Cadboro Bay. The cloudy weather prevents the solar radiation to warm up the water surface,

which makes it a cold source. The air coming from the cold bay water source brings a low temperature to the two sites.
In conclusion, based on the theory and our results, the Shaded Site has a higher air temperature. However, the result differences are not that significant, due to similar weather and ground condition.