GEOG 272 Lab 3 Evaporative Heat Flux Density

Jordan Wang V00786970 October. 14th 2014

TA: Chris Krasowski A03

Theory:

1) Net All Wave Radiation (Q*)
   - The more net all wave radiation, the higher the amount of available energy and the greater the amount of evaporation.
   - The quantities typically covary:

$$\uparrow Q^* \rightarrow \uparrow Q_E$$

2) Ground Heat Flux (Q_G)
   - During the daytime, positive ground heat flux density takes energy away from the surface and less energy is left for evaporation.
   - A lower Q_G means more Q* can be used for Q_E therefore, a higher Q_E
   - A higher Q_G means less Q* can be used for Q_E therefore, a lower Q_E
3) H_2O
   - More available water gives greater evaporation
     e.g. wet surface, higher vapour pressure
     more $H_20 \rightarrow \uparrow Q_E$
4) Atmospheric Humidity
   - Water vapour (i.e. humidity) is the driving force of evaporation between the ground surface & the air.
   - Humidity is a control of the direction and magnitude of the vapour pressure gradient ($\triangle E$)
   - Lower vapour pressure, greater the gradient, and the greater the evaporation.

Data:

Net all wave radiation at waist height	1 (W/m^2)	2 (W/m^2)	3 (W/m^2)	4 (W/m^2)	5 (W/m^2)	Aver (W/m
Quad	234.8	227.67	224.18	226.03	234.13	229.3
Parking Lot	37.750	37.861	38.035	38.230	38.386	38.05

Net Pyrradiometer

Assman Psychrometer for Quad

Air Temperature at Waist Height	Wet Bulb	14.2℃
	Dry Bulb	18.2℃
Air Temperature at Ground Height	Wet Bulb	16.3℃
	Dry Bulb	17.9℃

Quad Ground temperature ℃ -> K	T at 2cm	17.35℃ -> 290.35K
	T at 10cm	16.269℃ -> 289.27K

Assman Psychrometer for Parking Lot

Air Temperature at Waist Height	Wet Bulb	13.1℃
	Dry Bulb	16.2℃
Air Temperature at Ground	Wet Bulb	12.1℃

Height	Dry Bulb	17.2℃

General Weather Condition for Quad:

- Slightly cloudy to North and has direct sunlight. Cloudy towards the West.
- The ground is muddy and wet

General Weather Condition for Parking Lot:

- Scattered thin clouds mostly.
- The ground is warm and dry

Case Study:

1) **Quad:** The Quad site is a big open grass field that has trees surrounding it (good distance away from the measuring site). However, the tree does not affect our data collection result and they are not obstacles in this situation. At this site, it is slightly cloudy to the North and has direct sunlight, radiating at this spot. It is also cloudy towards the West. All these clouds above this site are thin. The grassy ground is very damp and muddy. Based on the observation of the wetness of the ground, damp and muddy, I drew the conclusion of using 2 W/mK as the "C" unit in determining the ground heat flux density.
   Pavement Parking Lot: The parking lot site is a giant open pavement field full of parked cars. There are trees surrounding the parking lot and the shadows of these trees affected our data collection result by blocking the incoming solar radiation. The ground is very dry and quite warm. Refer to the calculation instruction on the lab manual, it stated that we can find Q_G by multiplying Q* by 0.3, therefore, the "C" value is 0.3
2) **Net All Wave Radiation (Q*):** The net all wave radiation for the Quad site is 229.36W/m^2 and the Pavement site has a net all wave radiation of 38.052W/m^2. There is a significantly large difference between these two sites. The Quad site has a really high net all wave radiation, therefore, the higher the amount of available energy the greater the amount of evaporation. At the parking lot site, there is a really small amount of net all wave radiation and therefore, lower the amount of evaporation. In conclusion, the Quad site has a higher evaporative heat flux density.
   Ground Heat Flux (Q_G): The ground heat flux for the Quad site is 27W/m^2 and for the Pavement site the ground heat flux is 11.42W/m^2. The Pavement site has a lower Q_G which means there are more Q* to be used for Q_E, therefore, a higher Q_E. The Quad site has a high Q_G in comparison, therefore a lower Q_E. Based on this theory, the Pavement site should have a higher Q_E.
   H_2O: The Quad site has a really moist and muddy ground, which means there's large amount of H_20 sitting on the surface. Large amount of water gives greater evaporation. In comparison, the Pavement site has a really dry and warm ground. The absence of water means there is no evaporation occurring. Therefore, the Quad site has a higher evaporative heat flux density.
   Atmospheric Humidity: The Quad site has a higher water vapour pressure than the Pavement site. This means at the Quad site the higher the water vapour pressure, the lower the evaporation going to be. For the Pavement site, there is low amount of water vapour pressure, which means greater the evaporation. In conclusion, based on the atmospheric humidity the Pavement site has a higher evaporative heat flux density.

Summary

The evaporative heat flux density (Q_E) at the Quad site is 208.62W/m^2 and the evaporative heat flux density for the Pavement site is 0W/m^2. The Q_E for the Pavement site is zero because if the pavement is dry, there are no available water to be evaporated, therefore, the Q_E is zero. The Quad site has a really high net all wave radiation in comparison to the Pavement site. Therefore, the higher the net all wave radiation, the more available energy there is to perform evaporation. At the pavement site there is a lower ground heat flux density meaning there is a higher heat flux density. However, there are no available water on the dry pavement ground to perform evaporation process. At the Quad site there is high Q_G and therefore a lower Q_E because the positive ground heat flux density takes energy away from the surface leaving less energy to evaporate. Therefore, the ground for the Quad site is muddy and wet. The muddy and wet ground for the Quad site also means there's a lot of H20 waiting to be evaporated. In comparison to the Pavement site, there is no available water to be evaporated from the ground. This means the Quad site has more available water to perform evaporation. Based on the Atmospheric Humidity theory, the Pavement site should have a higher evaporative heat flux density than the Quad site. This is because the Pavement site has a lower amount of water vapour pressure, which means the higher the evaporation. The Quad site has a higher atmospheric humidity, leading to a lower evaporation. However, the Pavement site has no available water to achieve the evaporation process. Therefore, the Quad site still has a higher Q_E than the Pavement site.