

Unit 16 Applications Physical Hydrometeorology

1. All students: Revisit our soil measurements of porosity. Recall we obtained the following values: $m(\text{container}) = 22\text{g}$, $m(\text{soil_dry}) = 76\text{g}$, $m(\text{soil+water}) = 316\text{g}$, $m(\text{water}) = 240\text{g}$, and calculated porosity = 0.76 for method Task #2a of Unit 10. We noted that such high porosity doesn't exist in mineral soils. The soil sample in the given example was peat, i.e. an organic soil. Such high values are also expected for pot soil as it contains more peat than mineral soil. For task #2b, the area of the container was $0.155\text{m} \times 0.113\text{m} = 0.0175\text{m}^2$, $m(\text{container}) = 22\text{g}$, $m(\text{water}) = 234\text{g}$, $m(\text{soil+water}) = 295\text{g}$, $m(\text{soil}) = 61\text{g}$, $h(\text{soil}) = 0.024\text{m}$, $V(\text{soil}) = 0.024\text{m} \times 0.0175\text{m}^2 = 0.00042\text{m}^3$. Calculated porosity was 0.55. After 14 days, the students weighted the soil samples again and found for the first container used in #2a $m(\text{soil+water}) = 290\text{g}$, and for the second container used in #2b $m(\text{soil+water}) = 280\text{g}$. Determine the total evaporation for both containers. What was the mean evaporation rate? What is the soil volumetric water content now? Give reasons why the evaporation rates differed.

2. Graduate students: The data in the table below are for a grass covered site. Emissivity and albedo of grass vary between 0.90 and 0.95 and between 0.16 and 0.26, respectively. At this site, observed monthly precipitation was zero. In the table below, $R_{\text{sd,accu}}$, v , v_{max} , T , T_{max} , T_{min} , RH , RH_{max} and RH_{min} are the sum of daily solar radiation, mean 10 m wind speed, maximum 10 m wind speed, mean, maximum and minimum temperature at 2 m, mean, maximum and minimum relative humidity at 2m height, respectively.
 - a. Estimate the free water evaporation one would have at a site with the conditions given in the table.
 - b. Use the range of data and discuss the uncertainty of your estimate.
 - c. Note that some data provided in this task are not needed. Argue why you do not use which data.
 - d. What are the shortcomings of the method you used?
 - e. What data would improve your calculations? Can you calculate the actual evaporation?
 - f. How would your results change if the surface wasn't grass but a water pan?

	$R_{\text{sd,accu}}$ (KW-hr/m ²)	v (m/s)	v_{max} (m/s)	T (°C)	T_{max} (°C)	T_{min} (°C)	RH (%)	RH_{max} (%)	RH_{min} (%)
Ave	5.23	0.1	2.7	12.2	17.4	5.7	66	90	41
Max	7.24	0.4	6.3	17.7	27.0	10.0	90	97	77
Min	2.20	0.0	0.0	6.5	9.0	0.0	36	62	15