CE 3354 Engineering Hydrology
Exercise Set 6

Exercises

1. Estimate the monthly evapotranspiration depths for the San Angelo (Concho County) area using the Blaney-Criddle method.[1]

   ### Solution

   Figures 1 and 2 are the results of Google searches for temperature and location on the Earth.

U.S. climate data

Temperature - Precipitation - Sunshine - Snowfall

Home | United States | Texas

Monthly | Daily | History | Geo & Map | Weather Forecast

Climate San Angelo - Texas °C | °F

	Jan	Feb	Mar	Apr	May	Jun
Average high in °F:	60	64	71	80	87	92
Average low in °F:	33	37	44	52	62	69
Av. precipitation in inch:	0.94	1.34	1.5	1.42	2.83	2.6
Days with precipitation:	-	-	-	-	-	-
Hours of sunshine:	-	-	-	-	-	-
Average snowfall in inch:	1	0	0	0	0	0

	Jul	Aug	Sep	Oct	Nov	Dec
Average high in °F:	95	95	88	79	68	60
Average low in °F:	71	71	64	54	42	34
Av. precipitation in inch:	1.18	2.24	2.44	2.72	1.14	0.87
Days with precipitation:	-	-	-	-	-	-
Hours of sunshine:	-	-	-	-	-	-
Average snowfall in inch:	0	0	0	0	0	0

Figure 1: San Angelo climate record from Google

The Monthly temperature is supplied to the Blaney-Criddle Formula. They need to be converted into Celsius.

[1] A Google search should get you sufficient guidance to perform this exercise.

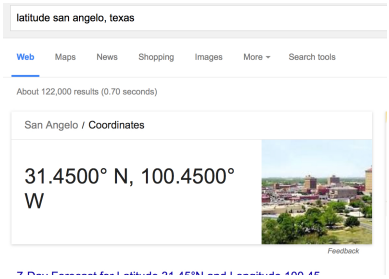
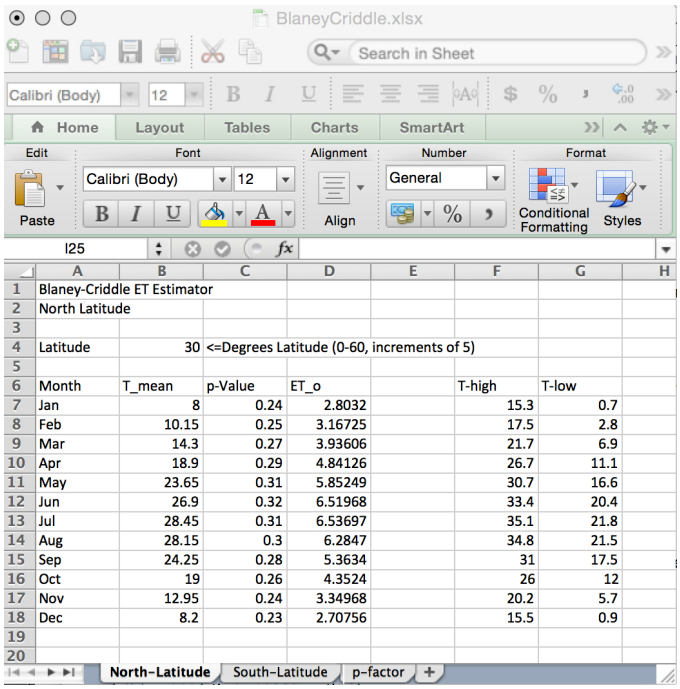


Figure 2: San Angelo coordinates (DDDMMSS from Google

The Latitude is also supplied to the Blaney-Criddle Formula. We need to tell the formula we are North of the equator.

Figure 3 is a screen capture of the completed spreadsheet using the average of the reported high and low temperatures in Celsius reported at the website pictured in Figure 1.



	A	B	C	D	E	F	G	H
1	Blaney-Criddle ET Estimator							
2	North Latitude							
3								
4	Latitude	30	<=Degrees Latitude (0-60, increments of 5)					
5								
6	Month	T_mean	p-Value	ET_o		T-high	T-low	
7	Jan	8	0.24	2.8032		15.3	0.7	
8	Feb	10.15	0.25	3.16725		17.5	2.8	
9	Mar	14.3	0.27	3.93606		21.7	6.9	
10	Apr	18.9	0.29	4.84126		26.7	11.1	
11	May	23.65	0.31	5.85249		30.7	16.6	
12	Jun	26.9	0.32	6.51968		33.4	20.4	
13	Jul	28.45	0.31	6.53697		35.1	21.8	
14	Aug	28.15	0.3	6.2847		34.8	21.5	
15	Sep	24.25	0.28	5.3634		31	17.5	
16	Oct	19	0.26	4.3524		26	12	
17	Nov	12.95	0.24	3.34968		20.2	5.7	
18	Dec	8.2	0.23	2.70756		15.5	0.9	
19								
20								

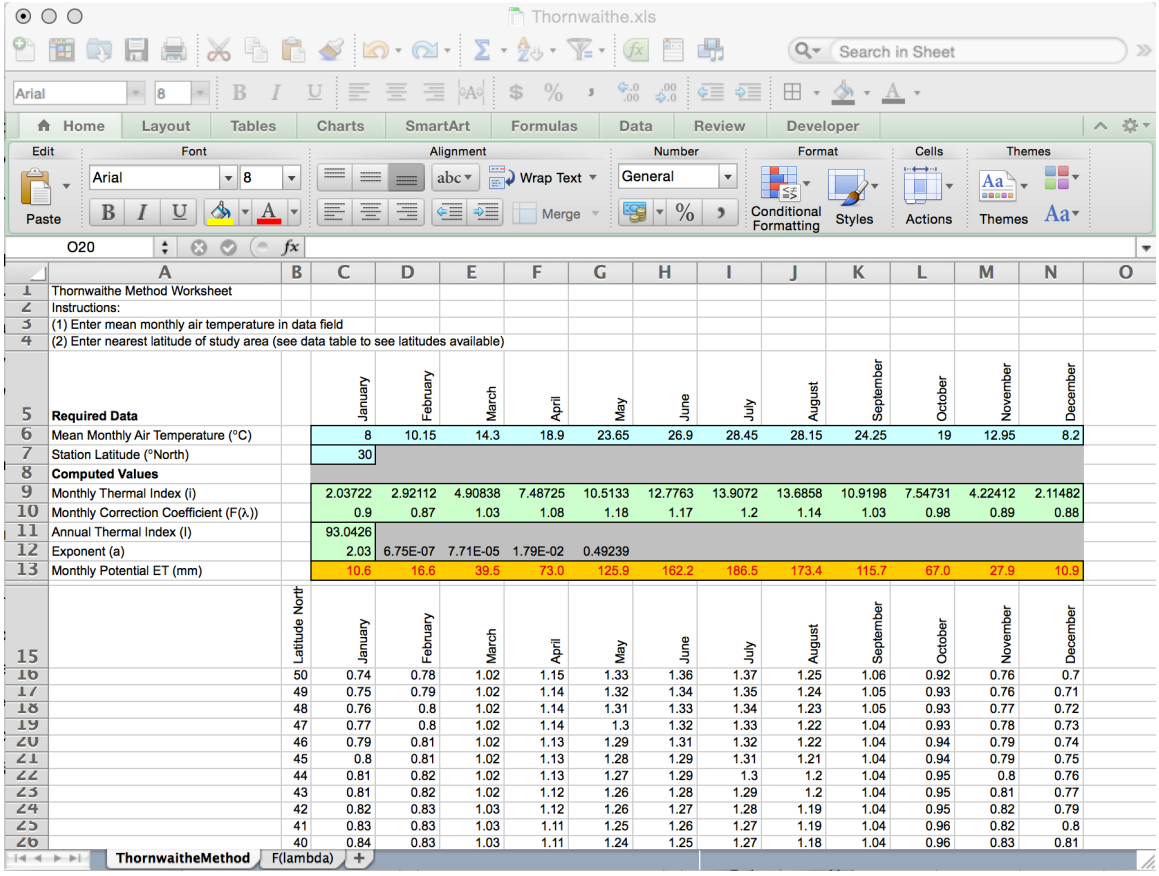
Figure 3: Blaney-Criddle calculations using spreadsheet supplied on class server.

The results indicate a high value of about 1/4 inch/day during the summer months, and about 1/10 inch per day in the winter months.

2. Estimate the monthly evapotranspiration depths for the San Angelo (Concho County) area using the Thornwaithe method.[2]

Solution

The Thornwaite method uses the same data from the previous problem. The Thornwaithe spreadsheet supplied on the class server is pictured in Figure 4.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Thornwaithe Method Worksheet														
2	Instructions:														
3	(1) Enter mean monthly air temperature in data field														
4	(2) Enter nearest latitude of study area (see data table to see latitudes available)														
5	**Required Data**		January	February	March	April	May	June	July	August	September	October	November	December	
6	Mean Monthly Air Temperature (°C)		8	10.15	14.3	18.9	23.65	26.9	28.45	28.15	24.25	19	12.95	8.2	
7	Station Latitude (°North)		30												
8	**Computed Values**														
9	Monthly Thermal Index (i)		2.03722	2.92112	4.90838	7.48725	10.5133	12.7763	13.9072	13.6858	10.9198	7.54731	4.22412	2.11482	
10	Monthly Correction Coefficient (F(λ))		0.9	0.87	1.03	1.08	1.18	1.17	1.2	1.14	1.03	0.98	0.89	0.88	
11	Annual Thermal Index (I)		93.0426												
12	Exponent (a)		2.03	6.75E-07	7.71E-05	1.79E-02	0.49239								
13	Monthly Potential ET (mm)		10.6	16.6	39.5	73.0	125.9	162.2	186.5	173.4	115.7	67.0	27.9	10.9	
15		Latitude North	January	February	March	April	May	June	July	August	September	October	November	December	
16		50	0.74	0.78	1.02	1.15	1.33	1.36	1.37	1.25	1.06	0.92	0.76	0.7	
17		49	0.75	0.79	1.02	1.14	1.32	1.34	1.35	1.24	1.05	0.93	0.76	0.71	
18		48	0.76	0.8	1.02	1.14	1.31	1.33	1.34	1.23	1.05	0.93	0.77	0.72	
19		47	0.77	0.8	1.02	1.14	1.3	1.32	1.33	1.22	1.04	0.93	0.78	0.73	
20		46	0.79	0.81	1.02	1.13	1.29	1.31	1.32	1.22	1.04	0.94	0.79	0.74	
21		45	0.8	0.81	1.02	1.13	1.28	1.29	1.31	1.21	1.04	0.94	0.79	0.75	
22		44	0.81	0.82	1.02	1.13	1.27	1.29	1.3	1.2	1.04	0.95	0.8	0.76	
23		43	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77	
24		42	0.82	0.83	1.03	1.12	1.26	1.27	1.28	1.19	1.04	0.95	0.82	0.79	
25		41	0.83	0.83	1.03	1.11	1.25	1.26	1.27	1.19	1.04	0.96	0.82	0.8	
26		40	0.84	0.83	1.03	1.11	1.24	1.25	1.27	1.18	1.04	0.96	0.83	0.81	

Figure 4: Thornwaithe method calculations using spreadsheet supplied on class server.

The results indicate a daily rate of about 1/4 inch/day per day in the summer months and about 0.01 inches per day in the winter months.

3. How important are these estimates in the drainage analysis project for a storm lasting 24-48 hours? Probably not terribly important for rainfall rates in excess of 1 inches per hour.

[2] A Google search should get you sufficient guidance to perform this exercise.