Class- 3rd Sem
Paper - CC5

Date- 10-9-2020
Unit - II-8

Meteorology-5

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Topic Covered - Thornthwaite's Classification

C.W.Thornwaite:

Biography, Study, Works

- American Climatologist first published climatic map of USA in 1931
- Later, extended this to world basis on 1933
- Then further modified and revised second scheme in 1948

Base of the study

- In first Classification, like Koppen He also thought Natural Vegetation is an important parameter for the study
- He used “Precipitation effectiveness” and “Temperature effectiveness” term for classification

Precipitation Effectiveness

- Total precipitation available for vegetation growth
- Precipitation Efficiency Ratio (PE Ratio) = Total Monthly Precipitation/Total Monthly Evaporation
- PE Index = Summation of PE Ratio of consecutive 12 months

$$\text{P/E Ratio} = 11.5\,(r/t - 10)^{10/9}$$

$$\text{P/E Index} = \sum_{i=1}^{12} 11.5\,(r/t - 10)^{10/9}$$

Where:

r = mean monthly rainfall in inches

t = mean monthly temperature in °F

Division on the basis of P/E Index

Humidity Zone	Vegetation	P/E Index
A (Wet)	Rainforest	127
B (Humid)	Forest	64-127
C (Subhumid	Grassland	32-63
D (Semiarid)	Steppe	16-31
E (Arid)	Desert	<16

1. Ar	5. Br	9. Cr	13. Dr	17. Er
2. As	6. Bs	10. Cs	14. Ds	18. Es
3. Aw	7. Bw	11. Cw	15. Dw	19. Ew
4. Ad	8. Bd	12. Cd	16. Dd	20.Ed

where r = adequate rainfall in all seasons

s = rainfall deficient in summer

w = rainfall deficient in winter

d = rainfall deficient in all seasons

Thermal Effectiveness

Thermal Efficiency Ratio (T/E Ratio) = Mean Monthly Positive Temperature

T/E Index = 12 months T/E Ratio

1948 Thornthwaite Classification

- Bases are precipitation effectiveness, thermal efficiency and seasonal distribution of precipitation
- PE means Potential Evapotranspiration

PE (Potential Evapotranspiration)

PE (in cm) = 1.6(10t/I)^a

Where,

PE = Potential Evapotranspiration

I = The sum for 12 months of (t/5)^1.514

A = a further complex function of I

T = Temperature in degree celcisus

Four main indices

Moisture Index = (100S - 60D)/PE

S = monthly moisture surplus

D = monthly deficit of moisture

MI monthly = monthly Moisture Index

Annual Moisture Index = addition of 12 months of monthly moisture index

Other Indices

- Thermal Efficiency Index = it is same as PE
- Aridity and Humidity Indices =

In moist climate, annual water deficit taken as percentage of annual PE called as aridity index

In dry climate, annual water deficit taken as percentage of annual PE called as humidity index

- Concentration of Thermal Efficiency

Concentration of Thermal Efficiency refers to percentage of mean annual PE accumulating in 3 summer months

Classification on Moisture Index

Moisture Index	Humidity Province	Thermal Province
100 and above	Per humid	Megathermal
20—1 00	Humid	Mesothermal
0—20	Moist sub-humid	Microthermal
-33 — 0	Dry sub-humid	Tundra
-67— 34	Semi-arid	Dry Frost
-100– 68	Arid	

Classification on the basis of thermal efficiency

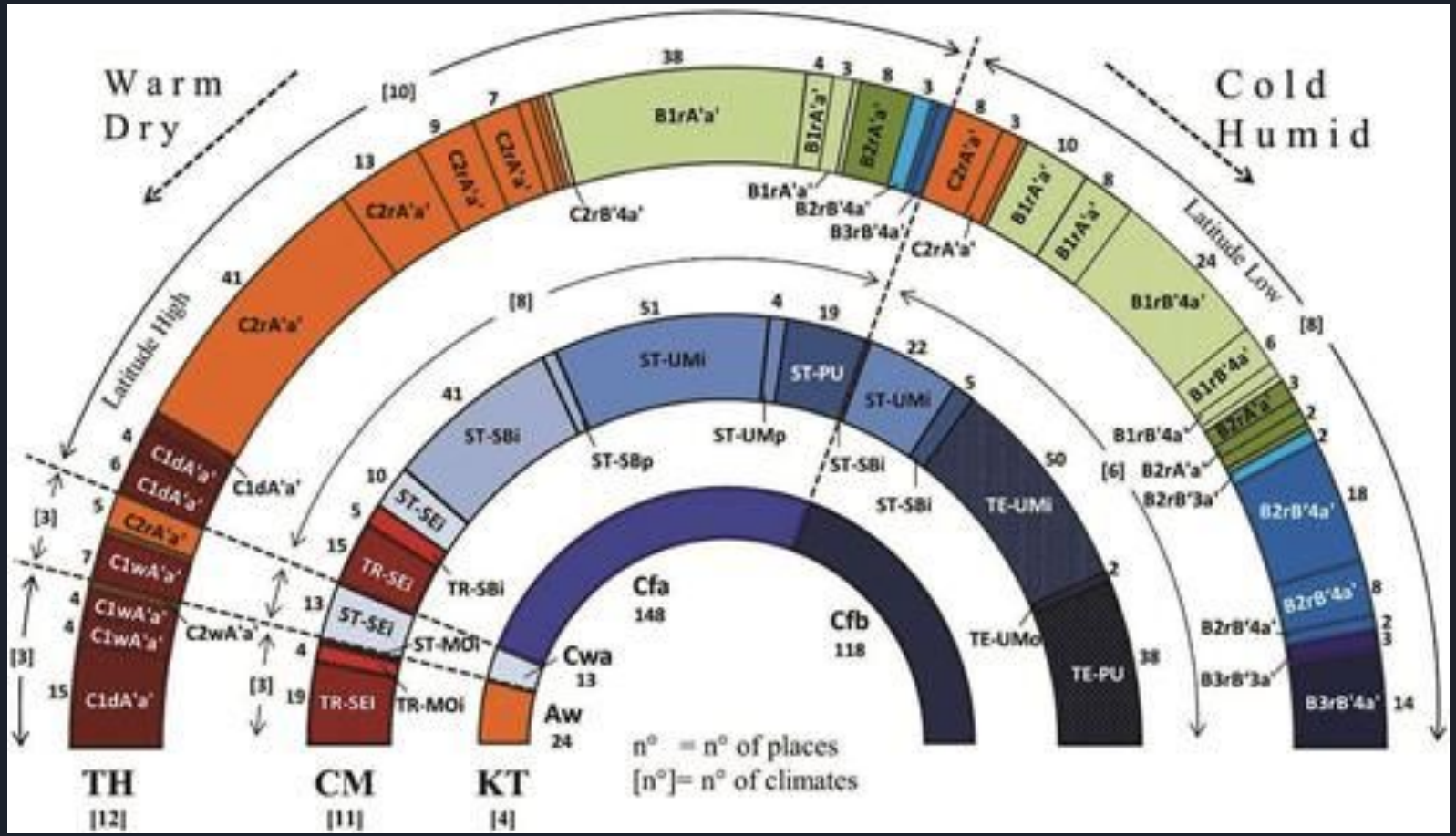
Thermal Efficiency Index (cm)		Thermal Province (Type)
(1) 114 and above	A'	Megathermal
(2) 99.7 to 114.0	B'_4	Mesothermal
(3) 85.5 to 99.7	B'_2	Mesothermal
(4) 71.2 to 85.5	B'_2	Mesothermal
(5) 57.0 to 71.2	B'_1	Mesothermal
(6) 42.7 to 57.0	C'_2	Microthermal
(7) 28.5 to 42.7	C'_1	Microthermal
(8) 14.2 to 28.5	D'	Tundra
(9) Below 14.2	E'	Frost

On the basis of summer concentration of thermal efficiency

Summer Concentration of Thermal Efficiency (%)	Type
(1) below 48.0	a'
(2) 48.0-51.9	b'
(3) 51.9-56.3	b'_3
(4) 56.3-61.6	b'_2
(5) 61.6-68.0	b'_1
(6) 68.0-76.3	c'_2
(7) 76.3-88.0	c'_1
(8) above 88.0	d'

Seasonal Moisture Adequacy

Moist Climates (A,B,C_2)		Aridity Index
(1) r	little or no water deficit	0 to 10
(2) s	moderate summer deficit	10 to 20
(3) w	moderate winter deficit	10 to 20
(4) s_2	large summer deficit	above 20
(5) w_2	large winter deficit	above 20
Dry Climates (C_1,D,E)		Humidity Index
(6) d	little or no water surplus	0 to 16.7
(7) s	moderate winter surplus	16.7 to 33.3
(8) w	moderate summer surplus	16.7 to 33.3
(9) s_2	large winter surplus	above 33.3
(10) w_2	large summer surpuls	above 33.3


Warm
Dry
Cold
Humid
Latitude High
Latitude Low
[10]
[8]
[8]
[3]
[3]
[3]
[6]
38
4
3
8
3
7
9
13
41
B1rA'a'
B1rA'a'
B2rA'a'
C2rA'a'
C2rA'a'
C2rA'a'
C2rA'a'
C2rB'4a'
B1rA'a'
B2rB'4a'
B3rB'4a'
C2rA'a'
8
3
10
8
24
B1rA'a'
B1rA'a'
B1rB'4a'
51
4
19
22
5
41
ST-UMi
ST-PU
ST-UMi
ST-SBi
ST-UMp
ST-SBp
ST-SBi
ST-SBi
50
10
5
15
13
4
19
ST-SEi
TR-SEi
ST-SEi
TR-SBi
ST-MOi
TR-SEi
TR-MOi
TE-UMi
TE-UMo
TE-PU
2
38
Cfa
148
Cfb
118
Cwa
13
Aw
24
4
6
5
7
4
4
15
C1dA'a'
C1dA'a'
C2rA'a'
C1wA'a'
C1wA'a'
C1wA'a'
C1dA'a'
C1dA'a'
C2wA'a'
B1rB'4a'
6
3
2
2
18
8
2
3
14
B1rB'4a'
B2rA'a'
B2rB'3a'
B2rA'a'
B2rB'4a'
B2rB'4a'
B2rB'4a'
B3rB'3a'
B3rB'4a'
n° = n° of places
[n°]= n° of climates
TH
[12]
CM
[11]
KT
[4]