

Thornthwaite Climatic Classification

C. W. Thornthwaite, an American climatologist, presented his first scheme of classification of climates of North America **in 1931** when he published the **climatic map of North America**.

Later **he extended his scheme of climatic classification for world climates** and presented his full scheme **in 1933**.

He further modified his scheme and presented the revised second scheme of classification of world climates **in 1948**. In his 1948 concept; gave the **potential evapotranspiration concept**. His scheme is complex and empirical in nature.

In 1931, his classification looked similar to Koeppen. **Like Koeppen, Thornthwaite also thought that vegetation is the indicator of climate type**.

Two basic features of this classification are

- 1. Precipitation Effectiveness; (P/E , where P is the total monthly precipitation and E is the total monthly evaporation)**
- 2. Temperature Efficiency.**

On the basis of these two indicators, **Thornthwaite divided the world into five humidity regions**.



The modified Thornthwaite system (1948) is based on the **concept of potential evapotranspiration (Potential ET)**, which **approximates the water use of plants with an unlimited water supply.**

Though **he again used previously devised three indices of precipitation effectiveness, thermal efficiency, and seasonal distribution of precipitation** in his second classification **but in a different way.**

Instead of vegetation, as done in 1931 classification, **he based his new scheme of climatic classification on the concept of potential evapotranspiration (PE).**

Which is in fact an **index of thermal efficiency** and **water loss** because it represents the amount of transfer of both moisture and heat to the atmosphere from soils and vegetation (evaporation of liquid or solid water, and transpiration from living plant leaves) and thus is a function of energy received from the sun.

Index in modified method

- **Aridity Index (Ia)**
- **Humidity Index (Ih)**
- **Soil Moisture Index (Im)**

if: **PET > Precipitation = Soil Moisture 0/-ve**

if: **Precipitation > PET = Soil Moisture +ve**



- **A: Very Humid Rain Forest**
- **B: Humid Forest**
- **C: Semi Humid Grassland**
- **D: Semi-Dry Steppe**
- **E: Dry Desert**

Each region had its own special type of vegetation as shown in the table below:

| Sr. No. | Humidity Region | Special type of Vegetation |
|----------------|------------------------|-----------------------------------|
| A | Very Humid | Rain Forest |
| B | Humid | Forest |
| C | Semi Humid | Grassland |
| D | Semi Dry | Steppe |
| E | Dry | Desert |

Design of Thornthwaite Climatic Classification

Thornthwaite's design of climate classification is a combination of **three letter alphabets**.

- 1. The first** alphabet used in the major climatic classification is any one of the **English capital letters from A to E**.
- 2. The second** letter used in the climatic classification is also an **English capital alphabet superscript with a dash**. It denotes thermal provinces

3. The third letter in a combination of alphabets is denoted by a set of 8 small English alphabets.

Precipitation effectiveness

- Plants' growth is not only dependent on precipitation but precipitation effectiveness.
- Precipitation effectiveness P/E ratio = total monthly precipitation / Evapotranspiration
 P/E index = sum of 12 month P/E ratio.
- **Based on the P/E index, Thornthwaite classified five humidity region:**
 - **A:** (P/E index >128) – Wet-Rainforest.
 - **B:** (P/E Index 64 to 127) – Humid-Forest
 - **C:** (P/E index 32 to 63) – Subhumid-Grassland.
 - **D:** (P/E index 16-32) – Semi Arid-Steppe
 - **E:** (P/E index less than 16) – Arid-Desert

On the basis of precipitation effectiveness, thermal efficiency, and seasonal distribution of rainfall **there may be 120 probable combinations and hence climatic types on the theoretical ground but he depicted only 22 climatic types on the world**



- **On the basis of the distribution of seasonal rainfall** the above types of humidity regions were further divided into the following subdivisions:
 - **r** = Heavy rainfall in all seasons
 - **s** = Scarcity of rainfall in the summer season
 - **w** = Scarcity of rainfall in the winter season
 - **d** = Scarcity of rainfall in all seasons
 - **Aridity index for humid climates**
 - Moisture deficit acute during winter = w2
 - Moisture deficit acute during summer = s2
 - **Humidity index for arid climates**
 - Moisture surplus abundant during winter = s2
 - Moisture surplus abundant during summer = w2

Temperature efficiency

- Temperature efficiency is calculated **mean average temperature** of through years.
- Based on Temperature efficiency – Thornthwaite has divided the world into **six thermal provinces**. They are expressed as:
 - **A'** — tropical: (T/E index more than 128).
 - **B'** — Subtropical: (T/E index 64-127).
 - **C'** — Temperate: (T/E index 32 – 63)
 - **D'** — Taiga: (T/E index 16-31)
 - **E'** — Tundra: (T/E index 1-15).
 - **F'** — Frost: (T/E index 0).

Thornthwait was being criticized for making climatic classification complex. To make it simple, Thornthwait gave the **evapotranspiration concept to derive a climatic region in 1948.**

Evapotranspiration: *Combined, evaporation from the soil and transpiration from vegetation is called Evapotranspiration.*

