

Hello, my name is Vishal Gaonkar and I'm the assistant professor of geography in Government, College of Arts, Science and Commerce, Khandola. So this particular program is for Bachelor of Arts and Science in the subject of geography and for the Semester 6 and the post code is GEC 106 and the title of the course is climatology and oceanography, so it is a unit two that is extreme events and climatic classification, the name of the module is classification of World climates That is, the schemes of Thornwaite's.

So the outline of this session is that we will going to discuss the concept of climate. Then we will go to learn the Thornwaite's 1931 classification followed by Thornwaite's 1948 classification, criticism, conclusion and references.

So through this session the students will be able to learn and understand the concept of climate and the basis for climatic classification, and they will also going to know about Thornwaite's climatic classification of 1931 and 1948.

So we will start with the climate. So what is climate? Climate is defined as the average weather conditions over a long period of time in a region. So on the basis of empiricism and genetics, the climate of the world is classified into various types. So empirical classification is based on statistics, experiments or physical characteristics related to climate and genetic classification is based on the causes or the genesis of climatic variations and these are the basis for climatic classification. And climatic classification is closely correlated with categorization of biomass as climate is the major influence on biotic life. And based on that we have different schemes with regards to climate classification, like we have Koppen's climatic classification. Then we have a Thornwaite's climatic classification and Trewartha's climatic classification.

For today's session we will be going to learn about the Thornwaite's climatic classification.

So Thornwaite's climate classification, Charles Warren Thornthwaite's, an American climatologist attempted classification of world climates in 1931. He later modified the

climatic classification and revised it in 1948. Thornthwaite's classification is an improved and modified form of Koppen's classification of climates. The classification of climates is based on the concept of potential evapotranspiration (PET) That is, the short form of potential evapotranspiration..

So now we will begin with the first one that is Thornwaite's 1931 classification.

In 1931 Thornwaite devised a complex and empirical classification which is very close to Koppen's scheme. He also considered natural vegetation of a region as the indicator of climate of that region. He accepted the concept that the amount of precipitation and temperature had paramount control on vegetation. As we all know that precipitation and temperature are very much necessary for the growth of vegetation. So He also pleaded for inclusion of evaporation as important factor of vegetation and climate. Thornwaite used two factors e.g. Precipitation effectiveness and Temperature effectiveness for delimitation of different climatic regions.

So first we will see about the precipitation effectiveness. It is also known as precipitation efficiency, and it refers to the amount of precipitation available for the growth of vegetation. He used P/E that is precipitation and evaporation ratio to calculate the amount of water available to vegetation. So P ratio is first calculated by dividing total monthly precipitation. Precipitation here means to rainfall by operation. It is derived by summing the PE ratio of 12 months. So on the basis of P/E index Thornwait identifies 5 humidity zones. So we're going to see it now. So climatic groups based on precipitation effectiveness. So we have five provinces that is humidity Provinces A is Wet, B is humid, C is sub humid, D is semiarid and E is Arid. These are the humidity provinces and vegetation and then you have the P/E index. So under vegetation we have rainforest, forest, grassland, steppe and desert. And these other P/E index values.

So on the basis of the seasonal distribution of precipitation, the humidity province were subdivided into the following, so they are starting with Ar So where r is rainfall adequate in all seasons and S is rainfall deficient in summer where W means rainfall deficient in

winter and d means the rainfall deficient in all season. Based on this, all this classification warm made.

So second, we have the temperature efficiency, the temperature efficiency relates to variation in temperature and its role in the growth of plants. So thermal or temperature efficiency index is calculated by sum of 12 months values of T/E ratio that is temperature efficiency. He divided the world into six temperature provinces on the basis of the index. So the main climatic groups based on thermal efficiency are.

So we have A that is tropical then we have B, Mesothermal, then C dash Microthermal. Then d Taiga E tundra, F Dash Frost and his other index values that is starting from 127 till last we have, the zero frost is almost zero. You all know that. So first on the basis of precipitation and thermal effectiveness and seasonal distribution of rainfall there exists 120 climatic types but Thornwaite has shown only 32 climatic types on the world map. So because of that he has faced certain criticism and certain demerits. So because of that he had given the second classification. That is, Thornwaite's 1948 classification.

So in 1948 Thornwaite proposed a new classification of climate which is his most valuable contribution and till today it is used by many of the climatologists or geographer. His second classification is based on the concept of potential evapotranspiration, which represents the amount of moisture that would be transferred to the atmosphere by evaporation of liquid or solid water plus transpiration from plants that is either from the land or from the Trees.

The potential evapotranspiration that is PE is calculated from the mean monthly temperature with respect to 30 day in a month that is 12 hour in days. Thornwaite developed four indices to determine boundaries of different climatic types e.g. Moisture index (Im), Potential evapotranspiration or thermal efficiency index (PE), Aridity and Humidity index, and Index of concentration of thermal efficiency or potential evapotranspiration.

So now we will see the all these indexes one by one. So first we have the moisture index. The short form is IM that is the symbol, It refers to moisture deficit or surplus and it is calculated by  $I_m = (100S - 60D)/PE$ . The sum of 12 monthly values of  $I_m$  gives the annual moisture index.

So this is the moisture or humidity promise. So Moisture index we have 100 and about till minus 102 -- 66.7 and these are the humidity provinces so that is a more humid be 4 humid be 3 humid be 2 humid then be one humid then we have C2 most submit then see One Drive submit D semiarid and east areas where rainfall is very much is less.

So then we have the second one. There is thermal efficiency index. It is simply the potential evapotranspiration express in centimeter. It is derived from the P values as it is a function of temperature. Then we have the third one that is Aridity and humidity index. It is used to determine their seasonal distribution of moisture adequacy. Aridity index means in moist climate water deficit taken as a percent of annual P becomes valid Index and humidity index interact limits Annual water supplies taken as a percent of annual P/E becomes humidity index, so we will see the Thermal efficiency index.

So we have this thermal efficiency index and thermal provinces, so it is starting from 114 and about till below 14.2..And Thermal provinces we have different types, that is A' is mega thermal till E' is Frost and these are the all thermal provinces.

On the basis of seasonal moisture adequacy two major and ten sub climatic types were identified. so humid climates r is no moisture deficit, s is summer deficit, W means winter deficit, S2 means summer deficit that is equipped and W 2 means winter deficit.

And these are the Aridity index starting from zero to 10 till less than 20. So this is another that is arid climate and humidity index. So D is water surplus negligible is water moisture surplus W means summer moisture surplus then S winter moisture surplus and W means summer moisture surplus.

So and these are the humidity index starting from zero to 16.7 till about 33.3 there is for last one there is some moisture surplus.

This is the last one with regards to 1948 classification of Thornwaite, we have the concentration of thermal efficiency, so it refers to the percentage of mean annual potential evapo transpiration so that it's PE that is the short form of potential evapo transpiration accumulating in three summer months. So on the basis of summer concentration of thermal efficiency, the world was further divided into 8 provinces. So we have eight provinces. That is, thermal efficiency in percent and we have the types. So starting from below 48.0 till about 8.0 and if you have different types that are a dash B dash etc so all are in small letters.

So the criticism of Thornwaites classification is as follows.

Thornwaite's classification has ignored the role of prevailing winds, relative humidity, air pressure and air masses. It is not satisfactory for tropical and semiarid areas. Availability of data for all the meteorological variables over time and space is a serious problem. Despite being an improved classification qualitatively, it is being less used and of limited application because of its complex nature because it is difficult to understand to some people.

So the conclusions Thornthwaite's classification of world climates is based on the precipitation and temperature indices to explain the vegetation. The classification provides an efficient way to describe biotic life of plants and animals through precipitation and temperature and their Seasonality.

The most valuable contribution of Thornthwaite's is his concept of evapotranspiration. It has helped in studying water balance in an applied sense. So these are the references you can follow for your study, thank you.