Climate Diagrams: Mini-Case Study

1. Climate diagrams are graphs that illustrate data for the two most important abiotic factors affecting terrestrial organisms, precipitation (including both rainfall and snow), and temperature. They usually show the average monthly precipitation and temperature over a year for a particular site, such as New York City, shown in Figure 1. Climate diagrams can vary in their set up (such as with bars instead of lines), but they show the same data. (If you are bit fuzzy on the metric system, remember that there are 25.4 mm to an inch and that water freezes at 0°C and that body temperature is about 37°C.)

 Figure 1. Climate diagram for New York City.

 Data are from the National Oceanic and Atmospheric

 Administration.

 

Temperature line

Precipitation line

Average temperature is on the left Y axis.

Average precipitation is on the right Y axis.

Months are shown on the X axis.

Questions:

A. According to Figure 1, in New York, which month on average is the coldest? January

B. Which month has the lowest precipitation? February

C. The biggest change in monthly precipitation is between February and March.

D. In New York, which month is hottest and most humid? (What affects humidity?) July

2. Climate diagrams provide a lot of data about particular parts of the world. Take a look at Figure 2, with a diagram for Perth, Australia.

 Figure 2. Climate diagram for Perth, Australia. Data

 from www.globalbioclimatics.org.

 

Precipitation

Temperature line

Questions:

A. Overall, is Perth wetter or drier than New York City? Drier

B. What are weather conditions (consider temperature and rainfall) like in December and January? Warm and dry.

C. Keeping in mind that Australia is in the southern hemisphere, when do you think “spring” is in Perth? September and October

D. Do you think the citizens of Perth have many opportunities to go sledding or ice skating? No

E. When do you think droughts are most common in Perth? Why? Droughts are most likely in summer (November to February) when temperatures are high and precipitation is low.

F. The “growing season” is the time of year when plants grow most quickly. When do you think the growing season is for Perth? Why? May through August. Even though this is the coldest time of year, it is not usually below freezing, and water is least limiting so plants will likely grow quickly.

3. Using data from your instructor, construct your own climate diagram. Things to keep in mind:

 A. Months belong on the X axis.

 B. Mean Temperature belongs on the left Y axis.

 C. Mean Precipitation goes on the right Y axis.

D. Use appropriate increments for the axes. Either use the graph paper below or a separate piece of paper. (For example, what should each tick mark on the temperature axis represent? A 5°C change or 10°C? What affects your decision?)

E. Remember to add a caption on the top of the graph.

Climate Data for Your Home

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Jan |  Feb |  Mar |  Apr |  May |  Jun |  Jul |  Aug |  Sep |  Oct |  Nov | Dec |
| Temp. |  |  |  |  |  |  |  |  |  |  |  |  |
| Prec. |  |  |  |  |  |  |  |  |  |  |  |  |

 

Climate Diagrams, Part 2

1. Imagine you are standing in a forest, and it begins to rain. Hard. What happens to the water?

Part of it runs off in streams and rivers, leading away from the forest. However, some of it *evaporates* back into the air after the sun comes back out, such as from the surface of the soil. And some of it is taken up by the roots of plants, moves up into the branches, then it exits through pores on the leaves. This process is called *transpiration*.

 *Evapotranspiration* is the sum of evaporation and transpiration from a site. Temperature is the most important factor affecting evapotranspiration. *Evapotranspiration rises as temperature rises*.

Questions

A. Besides the soil surface, evaporation happens from other surfaces in a forest. Name three:

Surfaces of ponds, lakes and streams. Surfaces of exposed rocks and the trunks of trees. The damp surfaces of leaves (evaporating from the surface, not through the pores.)

B. What are three other factors besides temperature that could affect evapotranspiration?

Humidity, wind speed, soil type, types of plants and water availability in the soil. (See <http://climate.ncsu.edu/edu/Evap> for a brief but nice listing.

2. Potential evapotranspiration (or PET) refers to the amount of evapotranspiration that would be expected to happen at a particular temperature. Since higher temperatures lead to higher levels of evapotranspiration, plants at a warmer site (or a warmer time of year) generally need more precipitation to thrive. An approximate “rule” is that for every 10°C increase in temperature, plants will need 20mm more of precipitation to avoid desiccation (or drying out).

 When a habitat, such as a forest, experiences a prolonged period without sufficient water to cover losses from PET, then a drought can occur. Fortunately, climate diagrams give us a handy way to see when drought may occur.

Figure 4. Climate diagram for New York City.

3. Take another look at the climate diagram for New York City below. Note how the intervals of the two Y axes (for mean temperature and mean precipitation) are set up. The numbers on the precipitation axis are TWICE the numbers on the temperature axis. So 20°C is opposite 40mm. This is intentional. Remember the rule of thumb that a 10°C increase in temperature requires 20mm more of precipitation for plants to avoid desiccation.

Temperature

Precipitation

Therefore to figure out the PET for a site for a particular temperature, just read the temperature curve against the precipitation axis (see Figure 4). For example, the PET in October for New York City is about 30mm, as indicated by the black arrow.

Questions:

A. What is the PET in July in New York City? ~50

B. In an average year, would we expect to see a drought in New York City? No

C. What happens to the rain, when the PET is less than the rainfall? The water runs off into streams or soaks into the soil.



4. Remember that PET is potential evapotranspiration. In a dry site, like a desert, the temperatures may be hot enough to evaporate a lot of water, but if it does not rain much, then there is not much to evaporate.

Precipitation

 Look at the month of December for the climate diagram for Perth. The temperature of 21.5°C leads to a PET of 43mm. But average precipitation is only 15mm. There is not enough precipitation to reach the PET. There is only 15mm of rain to evaporate. This is Actual Evapotranspiration (or AET).

Temperature

 When precipitation is below PET, then AET is just the available precipitation. When precipitation is above PET, then AET=PET.

Questions:

A. What is PET in July in Perth? ~25mm

B. What is the average precipitation in July in Perth? ~185mm

C. So what is AET? ~25mm

D. In January, what is PET? ~45mm What is AET? ~5mm

\*For more climate data, check out the National Oceanic and Atmospheric Administration’s website: www.ncdc.noaa.gov/cdo-web.