

BIOME PLACEMENT FOR FANTASY WORLDS

A continuation of: The Köppen–Geiger Climate
Classification Made Simpler, by Azelor.

BY MBARTELSM

OVERVIEW

While Azelor's tutorial goes in great depth into the climates of a world, it barely touches the surface when it comes to biomes (which are affected by, but not are not the same as, climates). So, I decided that maybe I could expand on this small gap left of that wonderful guide.

After some research, Holdridge Lize Zones seemed like the best fit for the job, it divides biomes based on three different variables, of which only two are needed to make it work.

The first of the three variables was potential evotranspiration ratio, just from the name I knew that was out.

The second was annual precipitation, which was easy to extrapolate from the precipitation maps made during Azelor's tutorial.

The final variable was biotemperature, that is, the sum of all monthly average temperatures that fall

between 0° and 30°C divided by 12. The problem is, we only have two maps for two months.

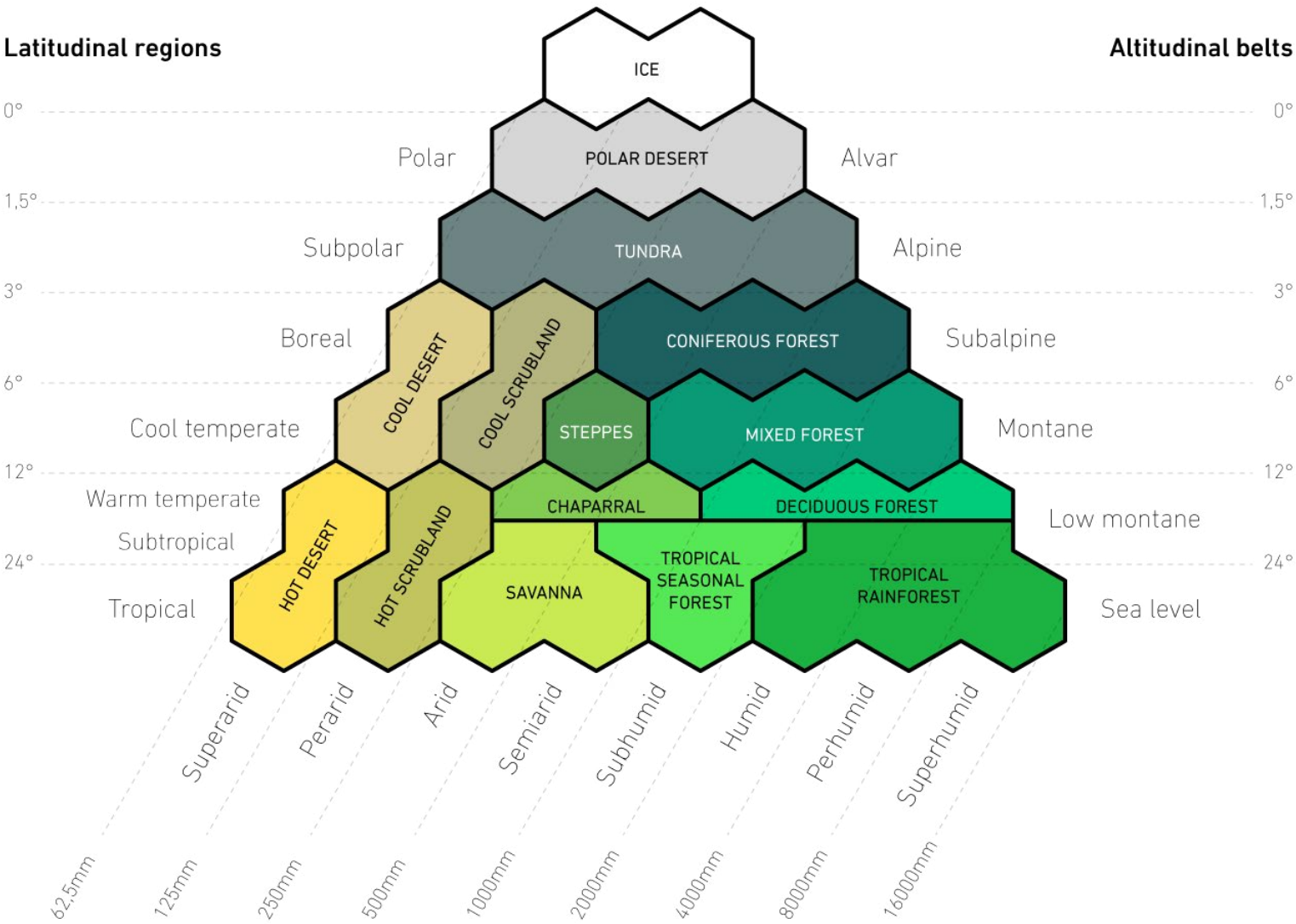
The solution is to expand those two months into a full year by assuming a regular sine wave pattern in temperatures, and that one of the months is the maximum yearly temperature while the other is the minimum.

Under those assumptions, a excel table was made with all the temp combinations, each with a full year of extrapolated temperature values from which the average biotemperature is extracted.

It isn't perfect, but for all intents and purposes, it works.

The classification system was then simplified in order to make the reading and using the resulting map much easier.

The proposed model divides the world into 15 biomes:



■ Coniferous Forest

Coniferous forests consist mostly of conifers, trees that grow needles instead of leaves, and cones instead of flowers. Conifers tend to be evergreen, that is, they bear needles all year long. These adaptations help conifers survive in areas that are very cold or dry. Some of the more common conifers are spruces, pines, and firs.

High latitude coniferous forests have explosive plant growth during the summer due to the long days and the melting of winter snow.



■ Mixed Forest

As climates get hotter, deciduous and evergreen broadleaf trees (such as certain species of oak) start to grow among the conifer trees. Giving way for mixed forests. This biome has less extreme winters and warmer summers.



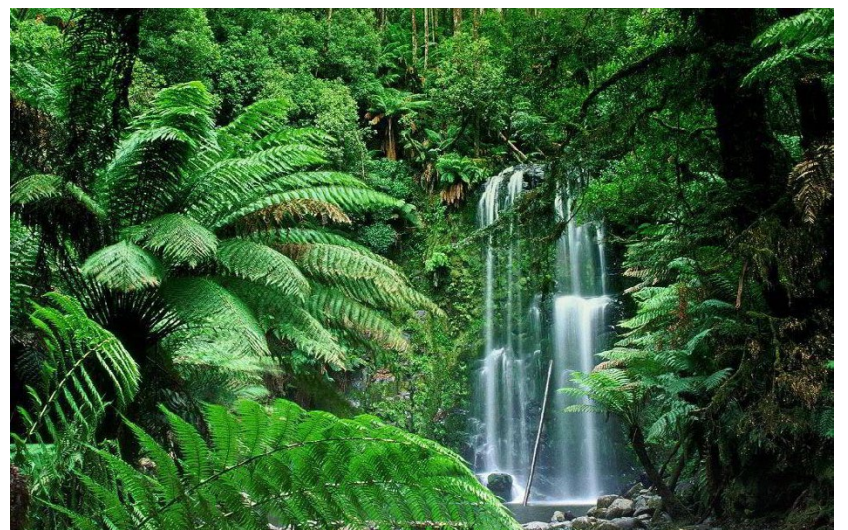
■ Deciduous Forest

Deciduous forests are comprised of trees that shed their leaves during winter. These trees do that in order to be able to withstand the cold winters. Soil tends to be very rich in nutrients and there is usually a wide range of animals living in the region, some of which hibernate during winter.



■ Tropical Rainforest

The tropical rainforest is earth's most complex biome in terms of both structure and species diversity. It occurs under optimal growing conditions: abundant precipitation and year round warmth (mostly corresponding to Af climates). There is no annual rhythm to the forest; rather each species has evolved its own flowering and fruiting seasons. Sunlight is a major limiting factor.



■ Tropical Seasonal Forest

The tropical seasonal forest is a biome with a more or less dense growth of trees. This biome has marked wet and dry seasons (Am, As and Aw climates). During the rainy season, trees can easily maintain leaves and productivity is high. During the dry season(s), evaporation from the leaves is too high for the tree to sustain, so the leaves are dropped, much the way temperate deciduous forest plants lose their leaves in the winter.



■ Savanna

Tropical grasslands are dominated by grasses, often 3 to 6 feet tall at maturity. They may have some drought-resistant, fire-resistant or browse-resistant trees, or they may have an open shrub layer. They develop in regions where forest would normally be expected, but seasonal droughts, fires and soil conditions make it impossible.

Because of this, savanna and tropical seasonal forest biomes tend to overlap and mix.



■ Chaparral

The chaparral biome has a precipitation pattern similar to that of savanna, with a long dry season and a very wet short season. The main difference is that chaparral is colder than savanna and is able to sustain taller layer of vegetation which consists of dry bushes and occasional trees rather than grasses.

Plants in chaparral biomes also have a tendency to develop thorns to defend themselves from foraging.



■ Steppe

The Steppe biome is a dry, cold, biome characterized by grassland plains without trees apart from those near rivers and lakes. Steppes have a poor soil, so people who live in them mostly rely on animals for their sustain.



■ Hot Scrubland

■ Cool Scrubland

Scrublands get slightly more rain throughout the year than deserts, this allows them to sustain a greater density of well adapted vegetation.

Cold scrublands are prone to very low temperatures during winter.



■ Hot Desert

■ Cool Desert

Deserts are very arid biomes where almost no vegetation grows and the plants that do grow are specially adapted to the environment. Due to the lack of humidity, deserts are very prone to temperature changes.

Cool deserts are characterized by having lower temperatures and oftentimes brutal winters.



■ Tundra

Tundra is a biome where the tree growth is hindered by the fact that the soil is frozen most of the year and only thaws during the very short summer periods. In tundra, the vegetation is composed of dwarf shrubs, sedges and grasses, mosses, and lichens. Scattered trees grow in some tundra regions. Plants and animals in this biome have adapted to withstanding snow during most of the year.



■ Polar Desert

Polar deserts are biomes that are covered in snow most of the year but are not cold enough to be permanently frozen. Polar deserts have virtually no vegetation with the exception of moss, lichens and a few very well adapted flowers.



TROPICAL ALTITUDINAL BELTS

The altitudinal belts classification is pretty accurate for mid and high latitudes as the climates in higher regions tends to correspond to that of a higher latitude.

But for tropical regions, where there are no seasons to speak of, altitudinal belt biomes are different from those of the rest of the world.

■ Montane rainforest

Very similar to the tropical rainforest, albeit somewhat colder. Montane rainforests have less dense vegetation and a much shorter canopy.



■ Cloud forest

A cloud forest is a evergreen, montane, moist forest characterized by a persistent, frequent or seasonal low-level cloud cover. Cloud forests often exhibit an abundance of mosses covering the ground and vegetation, especially in the saddles of mountains where humidity is more easily retained. In cloud forests, much of the moisture available to plants arrives in the form of fog drip, where fog condenses on tree leaves and then drips onto the ground below.



■ Paramo

The paramo is a variety of the alpine tundra biomes characterized by being overall very humid and having a daily freeze-thaw cycle (rather than seasonal) caused by strong temperature variations between night and day being described as "summer every day and winter every night". Humidity, temperature, precipitation level, soil water-holding capacity, and nutrient content all go down as height increases.

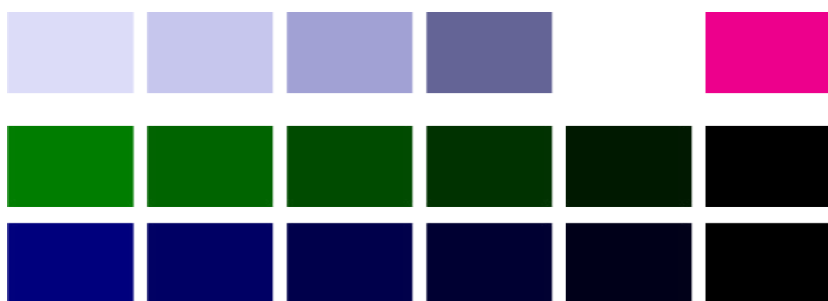


THE GUIDE

Step 1: Repainting

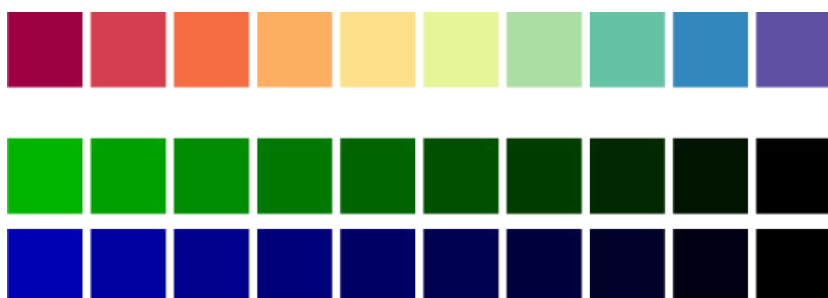
Take your precipitation and temperature maps and recolor them according to the key below. It doesn't matter if you paint summer green or blue, as long as it's not the same as winter otherwise we will get some odd overlap because color scales are linear and the scales used for the holdrige life zones are logarithmic.

Precipitation



<http://imgur.com/4g2ijvo>

Temperature



<http://imgur.com/NWZTVsN>

How to recolor them? paste these images into a new layer below the others but visible (can also be above but you won't see your progress). Select the paint bucket tool and enable "All layers" and disable "Contiguous". Now just pick the new color from the image and fill over the old color right next to it. **And remember to have the layer you want to paint selected!** it doesn't have to be the original one, it also works on empty layers.

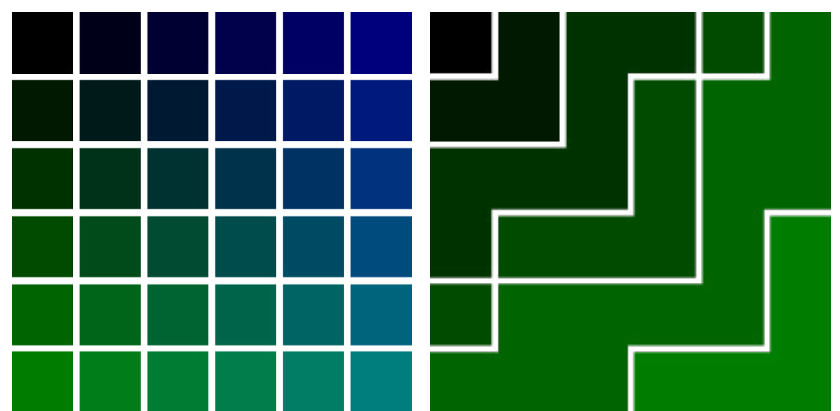
Do this for all four layers.

Step 2: Defining areas

Now select the top temperature layer and the top precipitation layer, set their blending mode to Linear dodge (add) and merge (you can duplicate the layers to keep the originals).

Once merged, we start merging colors to define the different levels of biotemperature and precipitation. This is done the same way as the previous step.

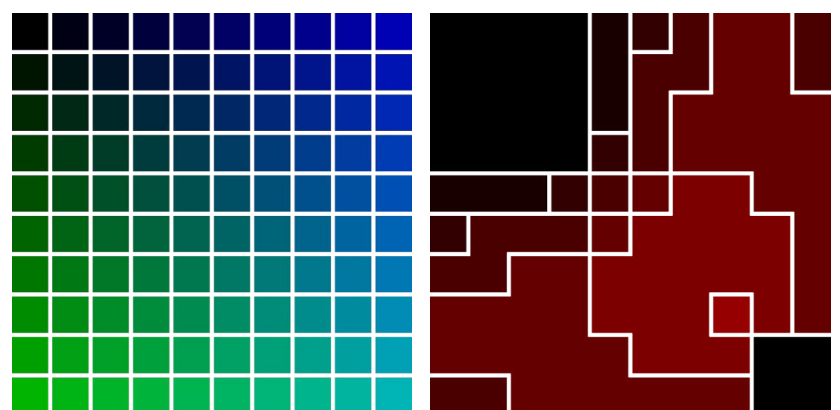
Precipitation



<http://imgur.com/Jh268Nn>

<http://imgur.com/ECdQBbs>

Temperature



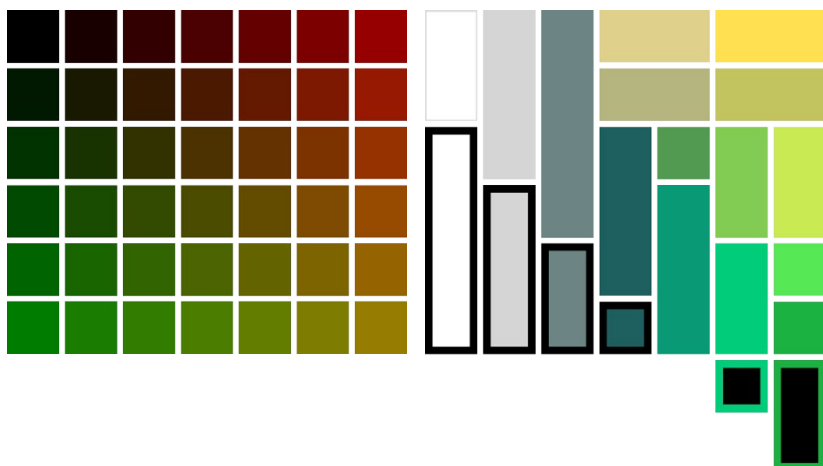
<http://imgur.com/UlkgxCt>

<http://imgur.com/v8TEKM7>

Step 3: Defining biomes

Once that is done you select the top layer, set it's blending mode to linear dodge once more and merge it down.

We are gonna do the same that we did on the last step with the following images







<http://imgur.com/JKM2Wor>

<http://imgur.com/x2llPF8>

The colors surrounded by black are biomes outside of Holdridge Life Zones (too much precipitation) but they are colors you will likely get. The colors with a black interior are biomes that are covered by Holdridge's system but that we can't define because we don't have enough precipitation levels.

Step 4: 'Fixing' tropical biomes

There's one last step we need to do, and that is fix the tropical biomes because they are currently too small. We do this by using our Koppen climate map.

Make visible the climate map and select with the wand Af climates (deep dark green if you are using the original colors). Now go back to your biome map and with the paint bucket tool paint over your deciduous forest biome  with tropical rainforest . We do it again, this time we select with the wand our As Aw and Am climates and paint over our deciduous forest  with tropical seasonal rainforest  and we are done!