Noisy World v0.0

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15 November 2024

1 Introduction

Noisy World is a fictional world generator that creates procedurally generated worlds using various Perlin noise layers. These Perlin noise layers are combined to create a "base map" and then are altered using the following variables:

- Height modifier
- Continental-ness
- Erosion

The combination of these parameters is then capable of generating worlds such as Figure 1. The current iteration of Noisy World also features the ability to set a seed, which allows you to repeatedly generate the same world as you alter different parameters.

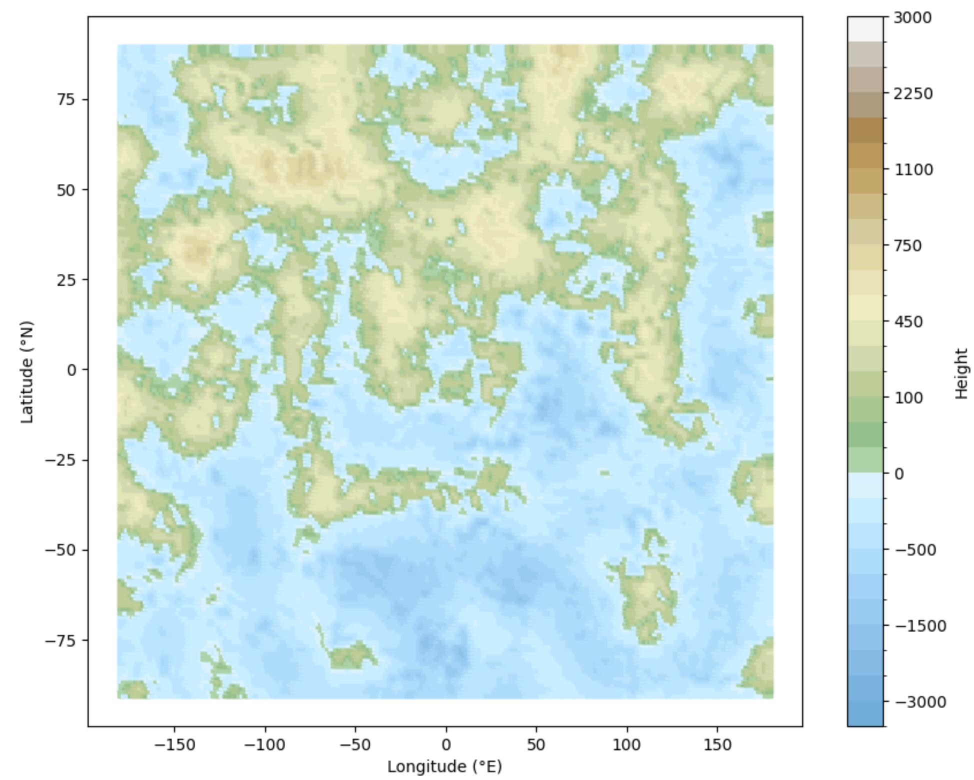

Figure 1: Example of a world generated using Noisy World v0.0 (seed = 2004)

2 Base map generation

The Noisy World base map is generated using a number of Perlin noise layers specified using a variable called "octave". The octave variable determines how many layers of Perlin noise are stacked together to generate the base map. The values generated by those layers are then incrementally increased using:

$$Value_{upper} = (x \times 2) + 5 \tag{1}$$

Thus the value range for a layer is between 1 and $Value_{upper}$. Therefore, if there are four layers the fourth layer will have a range of 1 - 51. The values used for this equation were selected as they space the layers in such a way that generates a world with a good amount of noise if the octave value is set to 4.

As the octave value is increased past 4 the world begins to appear too 'noisy' whilst a value that is less than four creates a world with too much of the Perlin noise shape. Thus the current optimal value for the number of Perlin noise layers is 4.

The base map generated via stacking the Perlin noise layers is then passed through another function called "rescale z" which changes the values generated by the Perlin noise stack. This is done by sorting the values into two different masks so that ocean and land cells can be edited using separate functions. Currently both subsets use the same function to alter the values.

$$\begin{aligned} df[mask] = df[mask] + (sin(2 \times df[mask]) + \\ sin(4 \times df[mask]) + sin(\frac{8 \times df[mask]}{4}) \\ + sin(\frac{16 \times df[mask]}{32})) \end{aligned} \tag{2}$$

With all the above in mind we can visualise what the base map of Noisy World looks like (Figure 2). We will apply 4 octaves, as this is an ideal level of noise for the effect we are trying to achieve, and we set the seed to be some integer, here we use 2004.

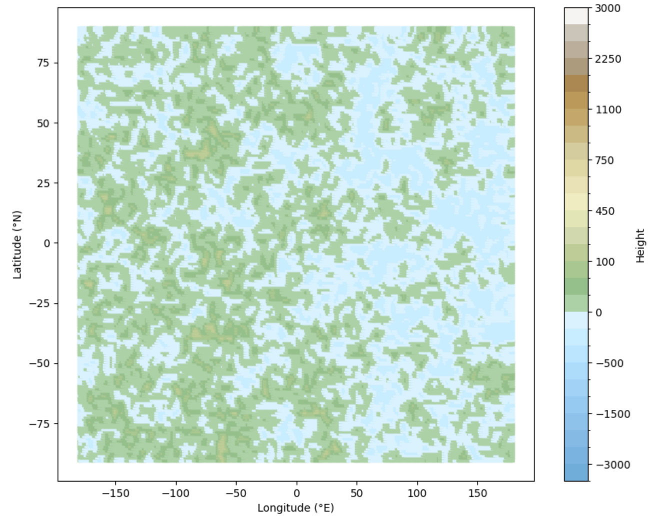

Figure 2: Base Map only enabled Noisy World (seed = 2004)

We can see that the Perlin noise has generated a random terrain within a small range of values using the functions mentioned above. However, this lacks any major height variation. With the base map only enabled we can create a "Dalmatian Coast" effect with lots of small islands, but this is not the desired effect hence we need the other parameters (Height modifier, Continental-ness, Erosion).

3 Height modifier

The height modifier is generated using the same process as the base map. However, the height modifier base map is generated using 2 less octaves. The height modifier is then multiplied by 1000 and then added to the world base map. The heigh map generation procedure can thus be shown as:

$$\begin{aligned} Heightmodifier = create_{d}ataframes(octaves - 2) \\ Worldmap = Basemap + (Heightmodifier \times 1000) \end{aligned} \tag{3}$$

This process leads to the output seen in Figure 3, with larger landmasses forming as the high level noise is "smoothed" out by the lower noise height modifier. The heigh map generated has hills and valleys, as well as mountains in some locations. The current application of the height modifier allows for the generation of islands as well as larger landmasses, it does also however for the generation of large lakes/interior oceans. In future versions of Noisy world the goal will be to minimise the presence of these large interior oceans and lakes, this will likely be handled by some form of filtering function that allows for a max lake size and a max amount of interior oceans, i.e., setting the interior ocean filter to 1 will allow for 1 Mediterranean size ocean to be present in the world.

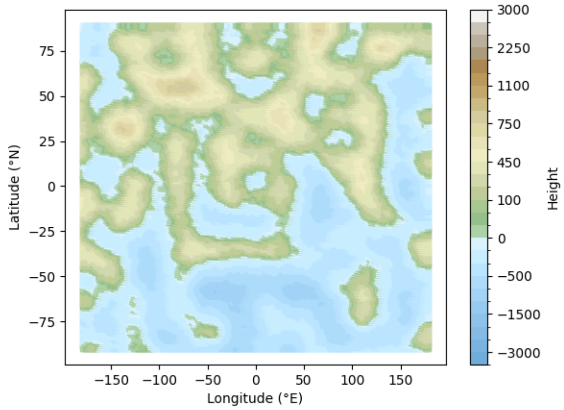

Figure 3: Base Map and Height map combined (seed = 2004)

Furthermore, the use of splines may be beneficial to set height maps for produce more "extreme" terrain. Under current conditions the height map does not generate heights greater 2500 m, which is roughly a third of the height of Mount Everest. Thus, the use of splines will enable the generation of terrain within typical ranges, but it will also enable the generation deep ocean trenches and tall mountains. Thus the next step within height modification part of terrain generation will be to impose boundary conditions to generate height distributions similar to those observed on Earth.

4 Continental-ness

The current implementation of the continental-ness parameter is as a factor that only adds to the height map. This is done by squaring the value produced from the Perlin noise stack. This ensures that all the values are positive as a square of a negative yields a positive value. This value is then multiplied by 100 to increase the values. A multiplier of 100 is chosen here as opposed to the 1000 in the height map generation as the values have been squared and thus already have a greater value than the noise stack used in the height map generation. The continental-ness values are then added to those of the previous world generation step.

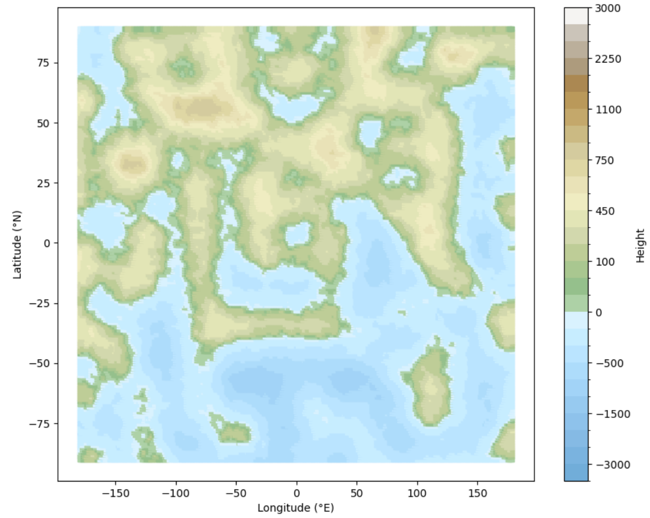

Figure 4: Base Map and Height map combined (seed = 2004)

As seen in Figure 4 the continental-ness variable does not have a great effect on the world map, however, it does have small effects on the overall terrain. The effect that this variable has is to slightly break up some of the larger features generated during the heigh modification portion of world generation. This can be best seen near the "L" shaped landmass where the bay that previously was in Figure 3 is no longer a bay in Figure 4 and has now become a lake. Inside of this lake what used to be one area of deep water has now also become separated into two different areas of deep water. Thus the main effect of the continental-ness variable in its current implementation is to slightly raise the overall world height to increase island size and break up areas that have similar heights.

5 Erosion

Erosion is applied as the inverse of the continental-ness parameter. This means that instead of adding the value product it is subtracted from the world map. Also in contrast to the method used for continental-ness the erosion parameter is multiplied by 500 so that it has a greater effect than continental-ness. The end product of this process is the world map seen in Figure 1.

This approach allows for the creation of islands near the coast of larger landmasses as well as the break up of some of the narrower landmasses into islands. The overall approach applied here leads to a height distribution that appears logical as landmasses and islands are surrounded by shallower waters with no regions of deep water occurring directly next to land. However, the current iteration of Noisy World leaves some things to desire, with these items being on the list for the next set of updates:

- Height ranges are insufficient, with a distribution of 700 - -300m not being representative of the real world.
- No way to control the formation and size of landmasses, ideally there should be a way to force denser groupings of land cells to create things that are more recognisable as continents.
- A way to make the map appear like it can wrap around a sphere and wrap around cleanly.