

Earth-like Planet

A shader plugin for Cinema 4D

Introduction

The shader is intended principally to simulate an Earth-like world seen from outer space. As such, you wouldn't expect to see much surface height detail from such distances. In case you do want to see such details, you can use the shader in the bump or (better) displacement channel(s) of the material. For this, however, please see the appendices 'Using displacement' and 'How it works' which contain important information about using the shader in those channels.

Using the shader

Typically the shader would be applied to a Sphere object.

The shader parameters

The user interface looks like this:

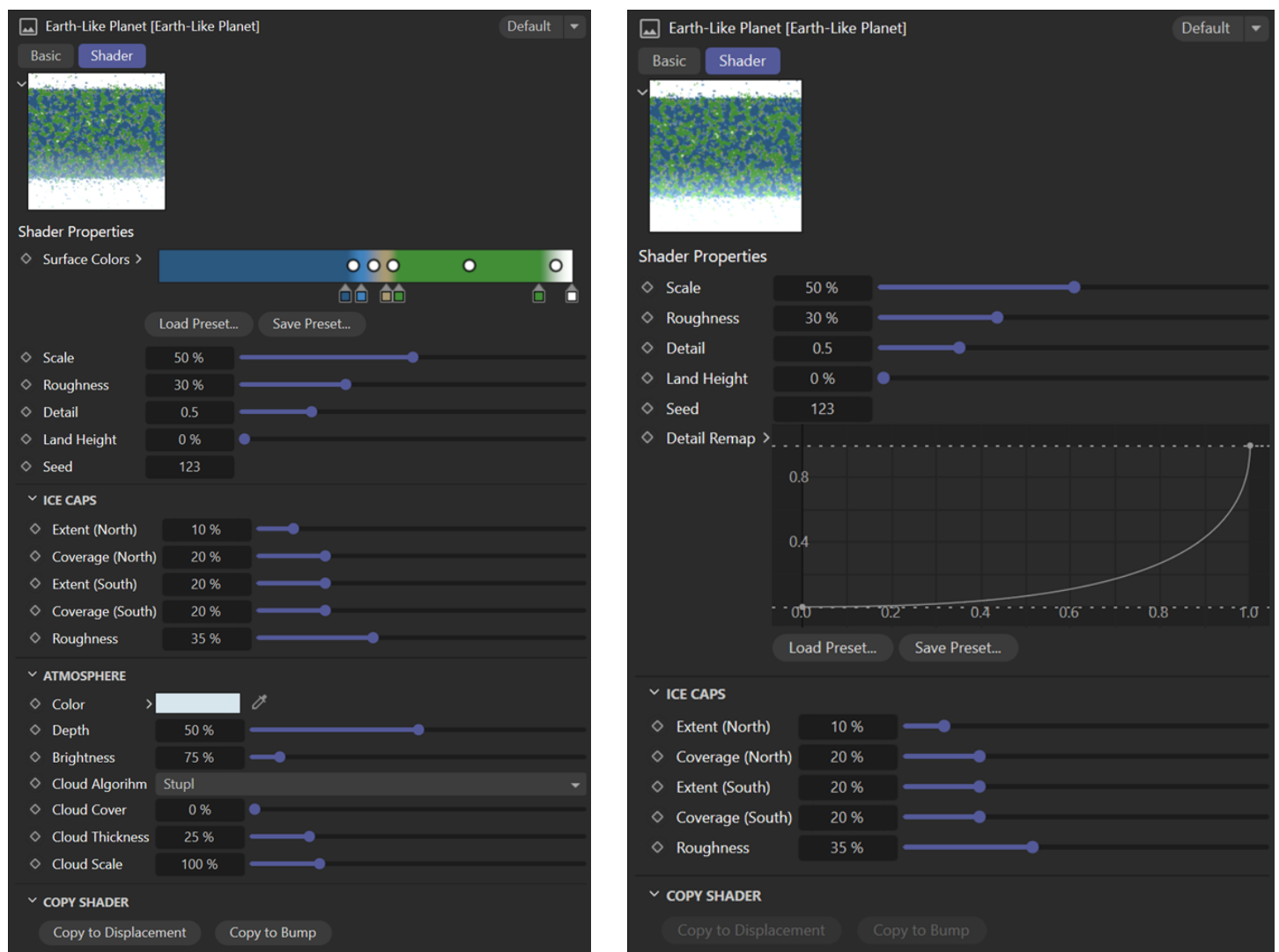


Figure 1. User interface in the colour channel (left) and in displacement or bump (right)

Settings

The following settings are available. Not all are used in all materials channels, so for each setting the available channels are shown if they are only used in certain channels.

Surface Colors (not bump or displacement channels)

This gradient gives the colours used on the object surface. For the reasons given in the 'How it works' appendix, these colours are not used in bump and displacement and cannot be edited in those channels.

Among other things, this gradient determines how much sea the planet has - assuming your planet has sea, of course. Simply alter the gradient by moving the knots to left or right to change the balance of sea and land, or the distribution of features such as coastal areas (sand-coloured in the default gradient) vs. green vegetation vs. white peaks. These three images demonstrate how moving the three leftmost knots in the gradient alter the amount of ocean:



Figure 2. Different amounts of sea, depending on the position of knots in the gradient

You are not restricted to this palette of colours. It doesn't even have to be an Earth-like planet. See this image, using a completely different gradient:

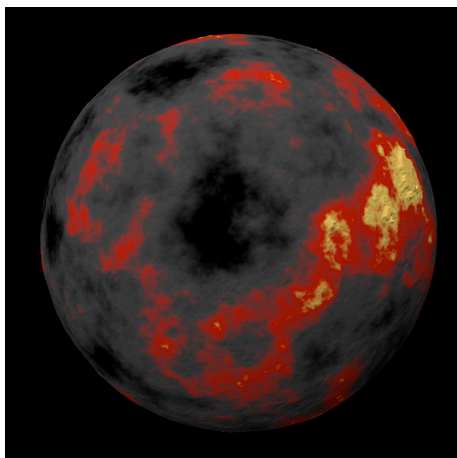


Figure 3. Lava planet, not at all Earth-like!

Scale

The scale of the land masses on the planet. Smaller scales will break them up into a myriad of small islands; large values give larger land masses.

However, note that the effect of the scale setting is also influenced by the size of the object being rendered. In Figure 4 below, the scale is set to 50% in both images but the sphere object has a radius of 100 scene units (left image) or 200 units (right image):

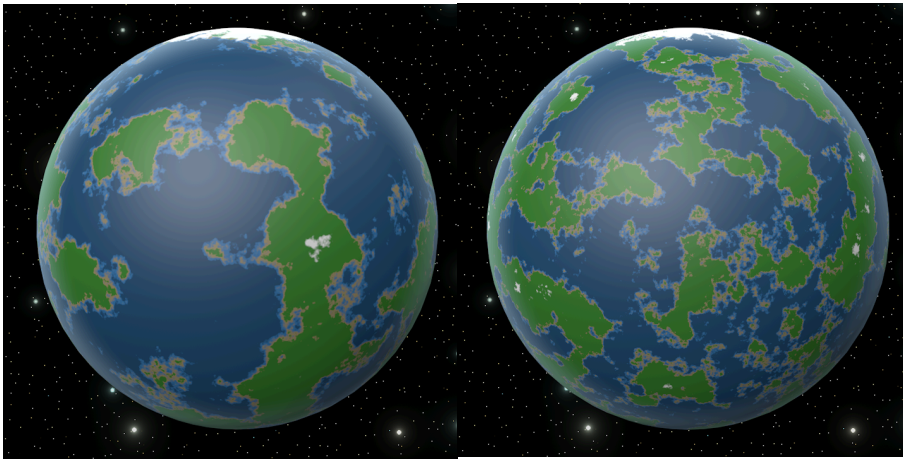


Figure 4. Scale set to 50% with a sphere of radius 100 scene units (left) and 200 scene units (right)

Increasing the scale to 100% for the second image gives a similar-sized pattern to 50% scale on the smaller sphere:

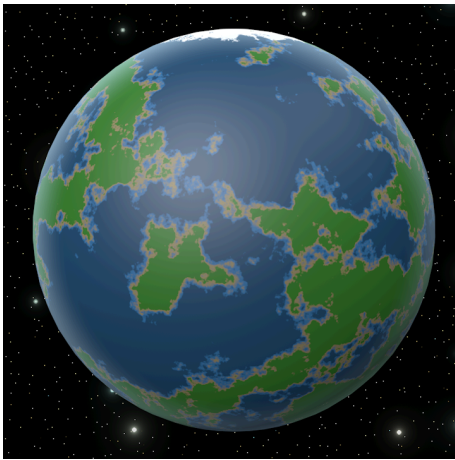


Figure 5. Sphere of radius 200 units with a Scale of 100%

Therefore, you may need to change the scale setting if you change the size of the rendered object in order to maintain the same size of pattern.

Roughness

This setting affects the roughness of the 'coastline' or more generally the border between different colours from the gradient. The default setting is 30% but a lower value is useful for scenes where the planet is seen at a great distance.

Detail

This has much the same effect as the Roughness setting but produces a different result. You can experiment with both to find the desired look.

Land Height

The default setting of zero gives a basic distribution of colours, and increasing the value of this setting will shift the colours towards the right of the gradient. If the colour on the left represents the sea colours and the others the land and that the right the highest areas (as in the default gradient), shifting the gradient to the right will give more land and more land will be at the colour representing the highest areas. In Figure 6 below this setting has values of 0% (the default), 150% and 300%:

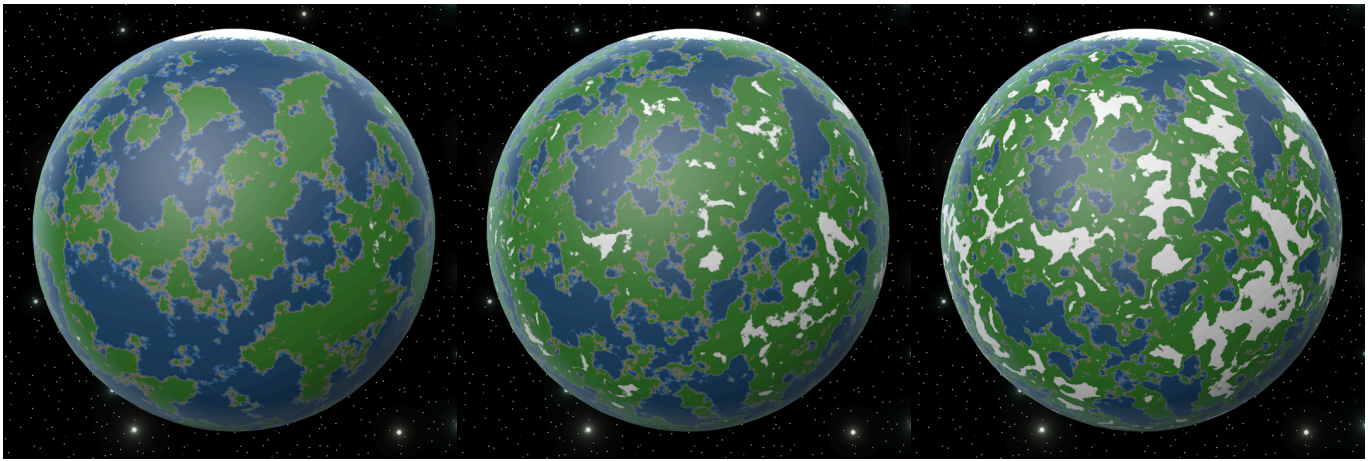


Figure 6. Land Height of 0%, 150% and 300%

Note that this setting will also affect bump and displacement.

Seed

The seed value used for the noise functions in the shader. Changing this will give different results. It is recommended (but not required) that if you are using bump and/or displacement in addition to the colour channel that the same seed is used in all channels. Otherwise you may get results which are not always desired, such as displacement in the middle of the sea, like this:

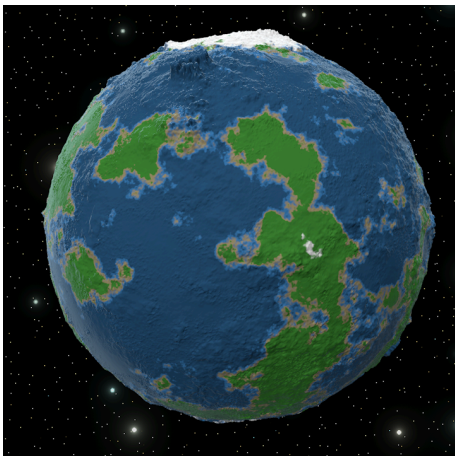


Figure 7. Displacement occurring in the wrong place due to differing seed values in colour and displacement

Ice Caps section

The ice caps on Earth can be simulated with this section. The settings are as follows:

Extent (North) and Extent (South)

These settings control how far the ice caps extend southwards or northwards, respectively. Set them to zero if you don't want any ice caps. The effects are shown in Figure 8 below (for the northern ice cap) using settings of 10%, 20% and 30% respectively.

By default the southern ice cap is larger than the northern one because that is the case on Earth.



Figure 8. Ice cap extent values of 10%, 20% and 30%

Coverage (North) and Coverage (South)

These controls don't affect the extent of the ice cap but they do affect how much of the land underneath them is covered. The more that is covered, the thicker the cap appears to be, as shown in these images which use coverage settings of 10%, 20% and 30% respectively:



Figure 9. Ice cap coverage values of 10%, 20% and 30%

Roughness

This parameter affects the irregularity at the edge of the ice cap. We wouldn't expect the edge of the cap to be a perfectly smooth line but to break up to some extent. This setting controls the edge roughness of both ice caps and the result is shown here using settings of 15%, 30% and 45% respectively::



Figure 10. Ice cap roughness values of 15%, 30% and 45%

If you also use the Red Planet shader from Microbion you will have noticed that these settings are identical to those in that shader.

Atmosphere section

This section is not available in the bump or displacement channels.

The first two settings simulate the reflection and scattering of light by the atmosphere which gives the appearance of a glow around the planet. To remove the atmosphere effect, set either Depth or Brightness to zero.

Important: although this effect produces a reasonable simulation of the atmospheric glow, you can get different results by using the Glow channel in the material, which produces a glow which extends outwards from the planet's surface. Be aware however, that this may lighten the planet's surface facing you, which this shader's effect will not, as it is a Fresnel effect.

Color

The colour of the atmospheric effect. By default this is a very pale blue, almost white, but you can change this to anything to match the other colours used. For example, here is a very un-earth-like planet with a bright yellow atmosphere (this image also uses the material Glow channel):

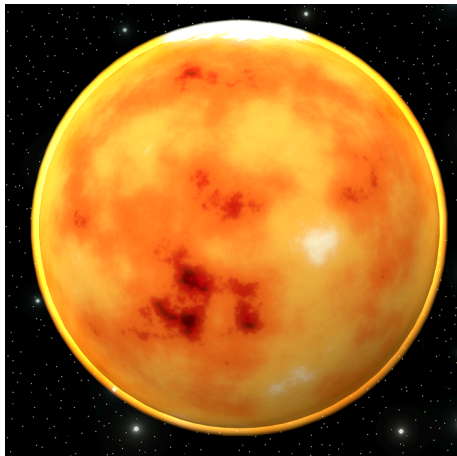


Figure 11. Planet with a toxic, yellow atmosphere

Depth

This is the depth, or thickness, of the atmosphere effect. By increasing it the atmosphere effect is more extensive and apparent. These images have depths of 30%, 50% (the default) and 70%:



Figure 12. Atmosphere depth values of 30%, 50% and 70%

Brightness

The brightness of the atmospheric effect. The default value produces a subtle result which can be increased with this setting. For a more pronounced effect, increase this setting.

Cloud Algorithm

Clouds are generated with another noise function, and here you can choose which one to use. These are, of course, a subset of the noise algorithms available in Cinema 4D, chosen because they will produce cloud-like results whereas the others do not. Choose the one which gives the appearance you prefer.

Note that even heavy black rain clouds seen from the surface are bright white when seen from space because the clouds reflect sunlight. On the ground, they appear dark because water vapour in the cloud disperses and absorbs the sunlight.

Cloud Cover

This controls amount of cloud cover. Note that 100% cover does not always mean that the surface detail is completely obscured; this also depends on the 'Cloud Thickness' setting.

Cloud Thickness

The thickness of the clouds - that is, to what extent the surface is hidden by the clouds. At 0%, there are no visible clouds even if Cloud Cover is set to maximum. At 100% the surface will be heavily obscured by the clouds, but higher values are possible if necessary. Setting cover and thickness to 100% will almost totally obscure the entire surface, rather like the planet Venus (though that is best simulated with the Gas Giant shader from Microbion).

Cloud Scale

This setting will change the size of the clouds, from many small clouds at low values to fewer but large clouds at high settings.

Setting specific to bump and displacement

Not all settings seen in the colour channel are available when the shader is used in the bump or displacement channels, but there is a setting in those channels which is not seen in the colour channel.

Detail Remap

In bump and/or displacement, the detail is provided by the base noise algorithm. The algorithm returns a value from zero to one, and in the colour channel is used to select a colour from the gradient. With the default gradient, this means that any value from zero to 0.45 will choose the blue 'sea' colour. This is fine but in bump or displacement the problem with doing this is that such values might produce a bump or displacement effect in areas where it is not desirable. This spline lets you adjust the detail strength for areas where it is not wanted.

The spline itself has the value from the surface noise algorithm on the horizontal axis, while the bump or displacement value is on the vertical axis. Therefore the default spline means that when the base noise value is very low, which is where the 'sea' area would be on an Earth-like planet, the bump or displacement is also very low. However, when the noise value is high, the amount of bump or displacement is much higher, producing peaks which correspond to the colour on the right side of the gradient.

You can adjust this spline to get whatever effect you need. For example, if you change the colour gradient to get more of the sea (for example) you will need to alter this spline so that sea areas are not bumpy.

Copy Shader section

There are two buttons in this section. 'Copy to Displacement' copies the shader from the colour (or other channel except bump or displacement) channel to the displacement channel. Note that this will completely replace the shader currently in the displacement channel (if any). This is simply a convenience function to ensure that the values in the two channels are the same.

The 'Copy to Bump' button does the same but copies the shader to the bump channel instead.

Appendix 1

Using displacement

At long distances from a planet you wouldn't expect to see much or any surface height detail on the surface, but when you got closer you would do so. Using displacement (much better than bump) will give you that extra detail. For best results, the following is recommended in the main displacement channel settings:

- the displacement type can be left at the default 'Intensity (Centered)'
- sub-polygon displacement should be on
- subdivision level of 3-5 is recommended
- round geometry must be on
- for a standard sphere of 100 scene units radius, a height of 2 units is usually fine

If the planet is a Sphere primitive, be sure to turn 'Render Perfect' off or no displacement will be seen. You can, of course, use bump instead of displacement; that will render much faster but won't look as good.

Appendix 2

How it works

It's very important to understand how this shader works, or it's possible to get very confused about what is happening. Please read this section so you know what to expect when you change something in the shader.

To start using it, you would normally add the shader to the colour channel of a material. On rendering, the shader uses a noise function (actually fBm, fractal Brownian motion) to generate the surface appearance. The value returned by the fBm function is then used to select a colour from the 'Surface Colors' gradient. A value of zero from returned from fBm will select the colour from the extreme left of the gradient; a value of one will select the colour at the extreme right. It is crucial to understand this when considering the use of the shader in the bump or displacement channels, as we shall see below.

For this we will use the 'Scheme 2' gradient preset supplied with Cinema, which is this simple gradient:



Figure 13. Simple gradient 'Scheme 2'

With the ice caps temporarily hidden the default render is shown in the left-hand image of Figure 14 below. With only five evenly-spaced colours in the gradient, we'd expect an even distribution of the various colours, which is more or less what we do see. If we change the gradient to a simple black to white gradient, you can see in the right-hand image of Figure 14 that the colours now show the actual value returned from the fBm function, where zero is black and one is white.

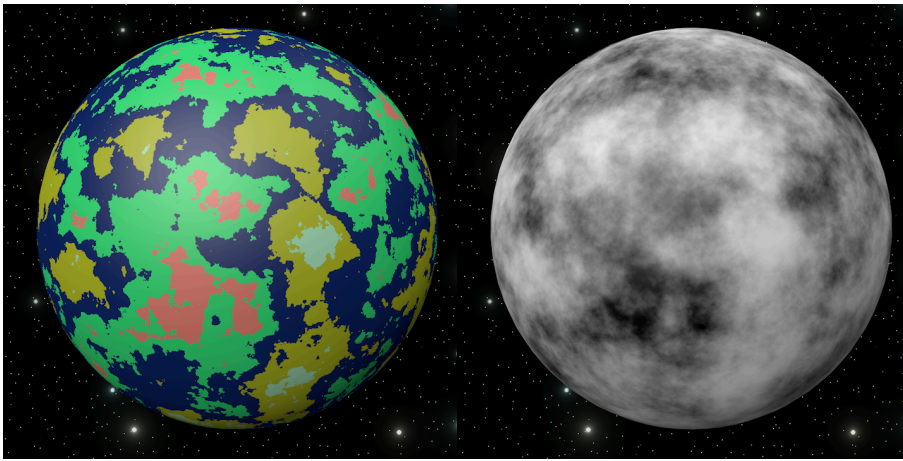


Figure 14. Colour and monochrome renders showing how the value returned by the noise function selects a colour from the gradient

Note that the underlying pattern is the same - the black areas are the pink zones in the colour image, the white areas are land, ranging from green through to white as the fBm value approaches one.

Why is this important? For the colour channel it has no other significance because only a surface colour is used. But if you add this shader to the bump or displacement channel, it is crucial. The vital point is that, in those channels, the colour you see in the shader preview is not used to produce the bump/displacement. The underlying value returned from the fBm function is used instead. You can still see the colours returned from the gradient in the shader preview, but they have no effect on the bump/displacement. This is the result:

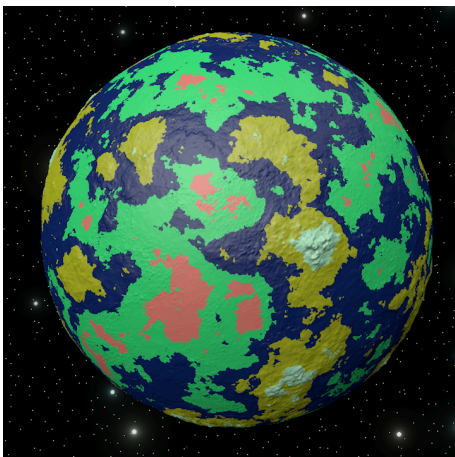


Figure 15. Same as Figure 14 (left) but with displacement enabled

As you can see, the areas of maximum displacement are those corresponding to the pale blue areas, but the amount of displacement has nothing to do with the colour; it could be a black colour but still get the same displacement.

Now look at Figure 16 below where we use a single colour in the gradient (green). For clarity, the atmosphere effect and the reflectance channel have been disabled. As expected, you see a plain green sphere. Now if we copy the shader from the colour channel to the displacement channel we might expect to see no displacement at all, because a solid uniform colour is used. What we actually see is shown in the right-hand image of Figure 16.

This is because - to repeat what was said earlier - the colour has no effect in the bump or displacement channels. The raw value returned from the fBm function is used to generate the displacement. If you use the 'Copy to Displacement' button in the colour channel to copy the shader to the displacement channel, you will see the same colour preview as in the colour channel; but you won't be able to edit the colour gradient because it would be very confusing to edit the gradient only to see have no effect!

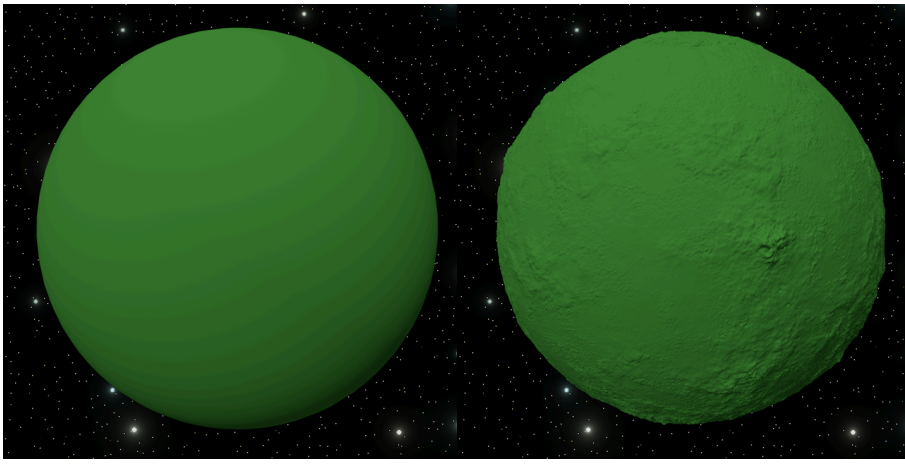


Figure 16. Colour only (left) with a single colour and colour plus displacement (right)

You can, of course, change the other settings in the displacement channel to those in the colour channel. One result of doing this is that the areas of greatest displacement don't correspond to where you might expect them to be, because of the colour. Whether or not this is an effect you want is for you to decide.

Just remember: the colours used have no effect in bump and displacement. Only the fBm values matter and these are changed by altering the parameters such as Scale, Roughness, Detail, Land Height and Seed.

And finally...

I hope you enjoy using the Earth-like Planet shader. You can get the latest version from my site at <https://microbion.co.uk/html/earthlike.htm> and if you have any comments (or find any bugs) you can contact me at <https://microbion.co.uk/html/contact.htm>.

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