

# CLASSIC EROSION

## USER GUIDE

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# Introduction

Erosion is a natural process of wearing away rock, sand and soil by water, thermal stress and other natural forces. Erosion is responsible for the distinctive look of natural landscapes that is hard to get using only procedural noises.

Classic Erosion is a powerful plugin for Terragen 4, simulating realistic erosion right inside Terragen. It greatly streamlines workflow, allowing to generate, erode, and render landscape completely within Terragen without use of third-party external terrain editors.

Classic Erosion is a displacement shader, which takes uneroded terrain in its input and erodes it. Additionally, Classic Erosion provides erosion data maps for texturing purposes.

Classic Erosion provides three types of erosion: fluvial erosion – erosion by water flowing, thermal erosion – erosion by thermal stress, and rivers erosion – special sort of fluvial erosion.

## Installation

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Latest version can be found on the [Downloads](http://www.daniilkamperov.com/Downloads) page at [www.daniilkamperov.com](http://www.daniilkamperov.com). Download the installer for your version of Terragen. If you have any problems with .exe file downloading, download the compressed .zip-file and unzip it. Start the installer application.

## Use

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After installing, Classic Erosion shader can be found in the “Displacement Shader” category of Terragen shaders.

To add Classic Erosion to the scene:

- In the node list: click “Add Terrain”, then select “Displacement shader” => “(Daniil Kamperov) Classic Erosion”.
- In the network view: right click on desired shader, representing uneroded terrain, then select “Displacement shader” => “(Daniil Kamperov) Classic Erosion”.
- In the network view (alternatively): right click on empty space, then select “Create Shader” => “Displacement shader” => “(Daniil Kamperov) Classic Erosion”. Connect uneroded terrain to the main input of Classic Erosion shader.

Multiple instances of Classic Erosion shader can be used, allowing serial processing to erode terrain again using different settings, and parallel processing to erode different areas of terrain, for example, main shader for the main scene, and additional for background landscape.

# User Interface

## Global parameters

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Classic Erosion uses tabbed user interface, where different parameters are grouped and placed into different tabs. Global parameters are located outside of any tab and always visible.

### Enable

Enables/disables Classic Erosion shader. When Classic Erosion is disabled, uneroded landscape is rendered.

### Seed

Sets the seed of random number generator. Erosion process is affected by many random factors, and Seed determines the random numbers sequence.

Note: Classic Erosion algorithm isn't fully deterministic. This means that erosion results can be slightly different even if the same Seed is used. Large-scale erosion features remain the same, only small details can differ.

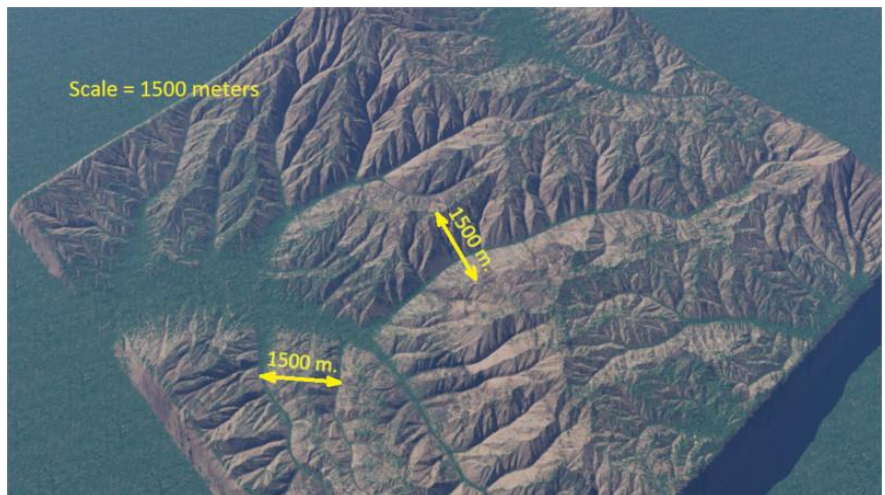
### Erosion duration

Determines the duration of erosion simulation. This parameter can be set to higher value than 1.0, but note that even default 0.15 is quite large value, resulting in prominent erosion effect. Low duration values, such as 0.1, 0.05 and lesser, can be useful for adding erosion details while keeping the main original landscape features unchanged.

### Erosion scale

Determines the lateral size of the largest erosion features in meters: width of largest valleys and ridges between them.

Note: actual size of these features can be different as it also depends on uneroded terrain which affects water flows.



## Auto calculate

When enabled, forces erosion recalculation on start of render process if any erosion parameter or uneroded landscape was changed. Classic Erosion parameters that don't affect the erosion (for example, those on the Render tab) won't retrigger erosion recalculation if changed.

Note: It is better to disable this parameter if you are satisfied with eroded terrain to prevent erosion recalculation on accidental change of some erosion parameter or uneroded terrain.

## Erode

This button starts landscape sampling and erosion calculating.

Note: landscape sampling is started only if needed, for example, if original landscape was changed since last sampling. The same is for erosion process: it is started only if original landscape or erosion parameters were changed.

## About

Shows number of installed version of Classic Erosion and registration information. If Classic Erosion is unregistered, this button also launches registration dialogue.

# Heightmap tab

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This tab contains parameters, related to heightmap, used for erosion simulation.

## Heightmap position

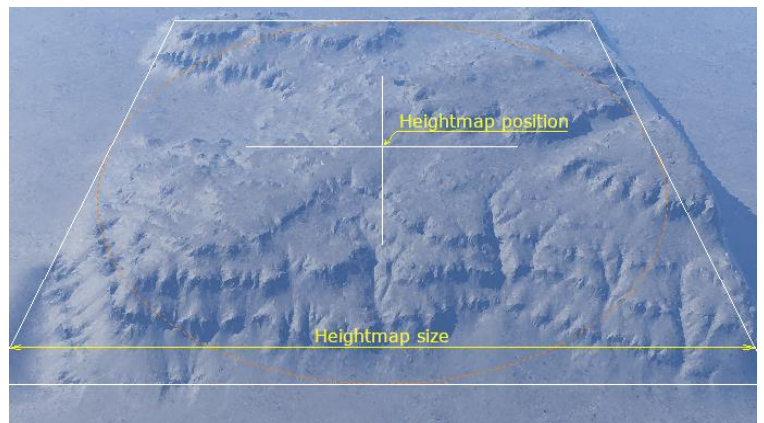
Sets the coordinates of the center of heightmap in the world.

## Heightmap size

Sets the size of heightmap

## Heightmap resolution

Sets the resolution of heightmap. Higher resolution results in finer detail, but also increases calculation time.



# Fluvial tab

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This tab contains parameters, controlling fluvial erosion.

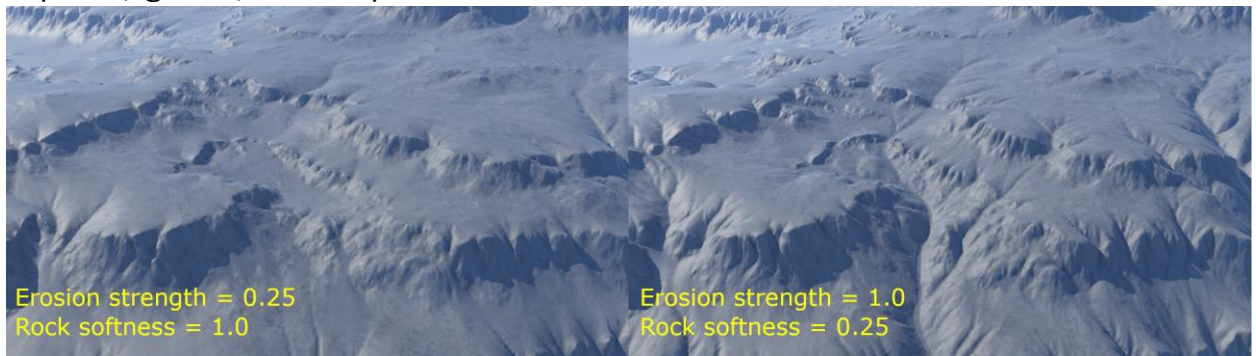
## Fluvial erosion strength

Sets the strength of fluvial erosion. This parameter controls the sediment transport capacity, that is how much of dissolved minerals water can carry. This parameter can be set to value that is higher than 1.0, this can speed up the erosion process, but also can result in lesser erosion quality, especially if erosion softness value is high too. Also setting this parameter to 0.0 allows to fully disable fluvial erosion, for example, if just thermal erosion is needed.

## Rock softness

Controls the softness of rock material. The softer rock is, the faster is erosion process.

Both “Fluvial erosion strength” and “Rock softness” parameters affect the aggressiveness of erosion, and effect from increasing of one can be similar to the effect of increasing other, but there is still the difference, derived from the definition of these parameters. Lesser strength means dissolved soil will be dropped earlier because of lower water transport capacity, and lesser softness means that the rock will be eroded slower but dissolved sediment will be dropped farther. This results in different distribution of deposits, gullies, and shapes of erosion features.



## Downcutting

This parameter controls the amount of downcutting, or vertical erosion. This is additional erosion mechanics, allowing water to transport sediments beyond the fluvial capacity by dragging and moving undissolved materials. This results in deeper gullies, and can be useful for getting mountain ranges.

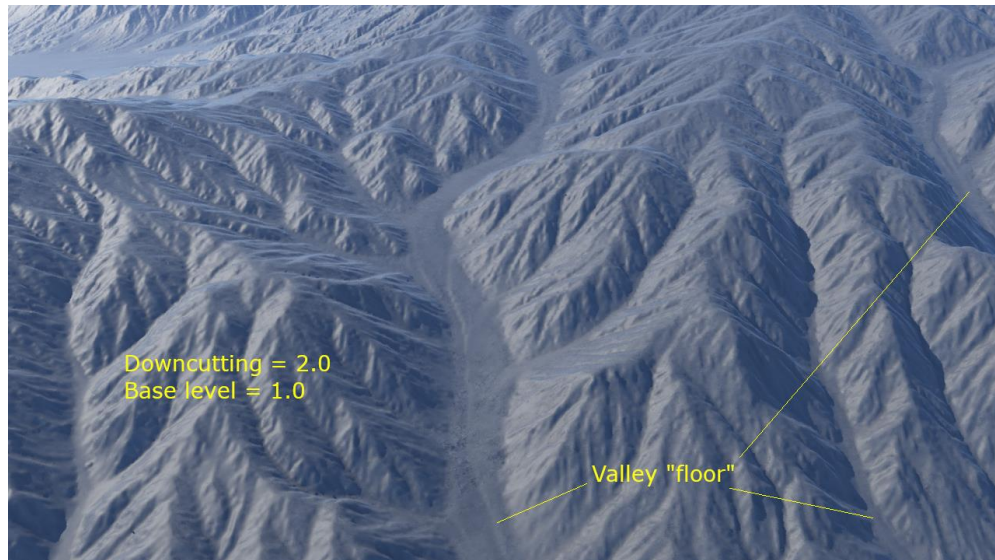
Downcutting effectively transports sediment far away from its origin. If shorter transport distance is desired, for example, for faster alternating between erosion/deposition, set this parameter to 0.0, or set “Retardation of downcutting” to higher values.

“Downcutting” parameter can be set to any value higher than 1.0. Even extreme values like 10.0, 20.0 or higher can be useful at some scenarios.

## Base level

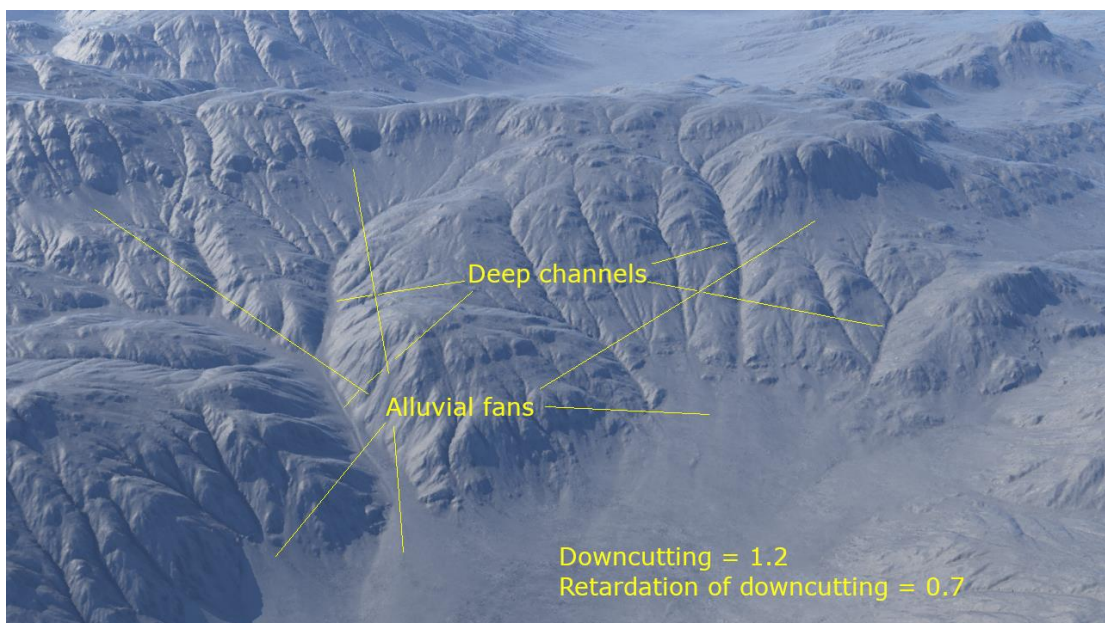
Controls the base level for the vertical erosion process, this is the lowest elevation that downcutting process can erode until it stops and begins to drop sediment. This elevation is different across the whole terrain, and depends on the terrain slopes, relative altitudes, stream velocity and other factors. This parameter can be useful for filling the largest valleys with deposit material, forming valley floors. “Base level” can be set to any value higher than 1.0 if needed.





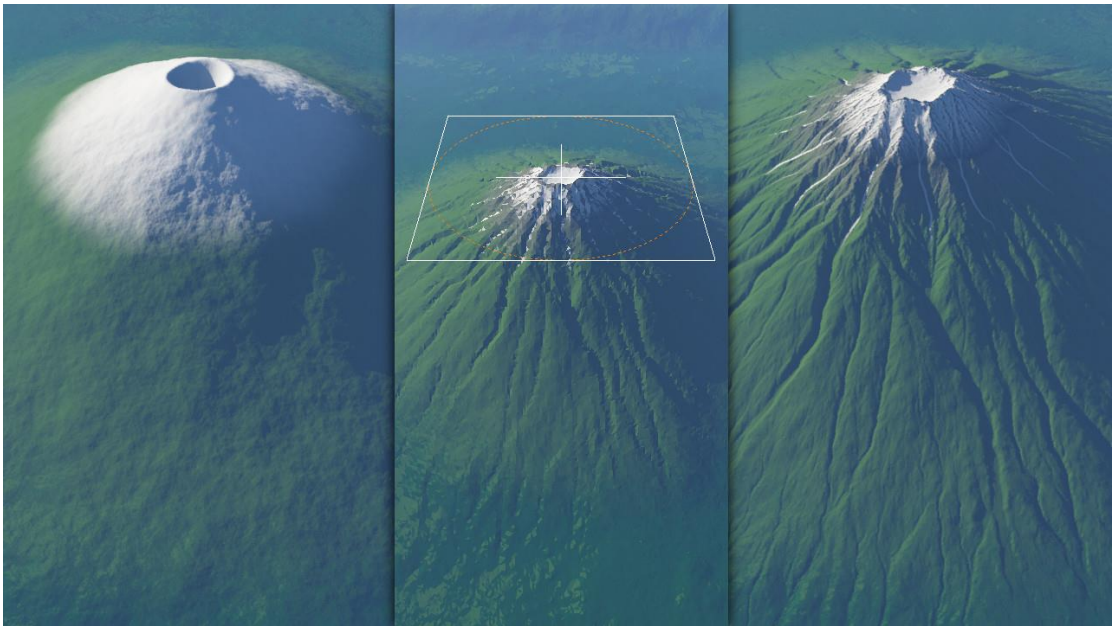
### Retardation of downcutting

This parameter controls special mechanics, adding additional restraints for downcutting. It determines how undissolved sediments are slowed down by already dropped sediments, causing downcutting to stop and drop its load. This allows to combine both variants of erosion, with and without downcutting, resulting at deep channels at some areas and alluvial fans in other areas.



## Random sedimentation

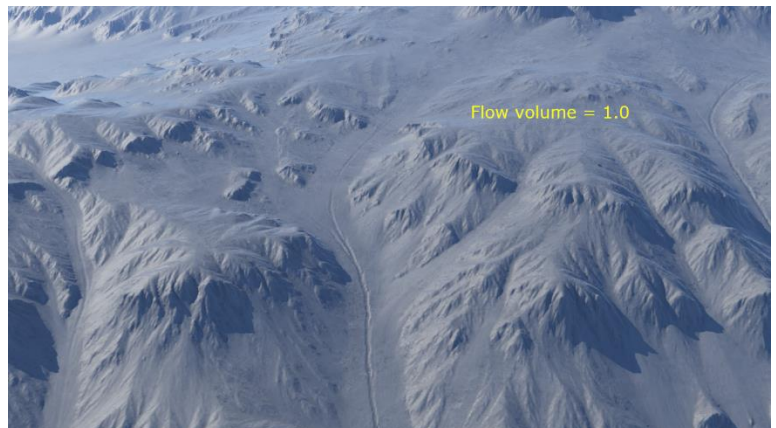
This parameter controls randomization of sedimentation process. In the cases of usual, uniform erosion it rarely has effect because multiple flows, dropping sediments randomly, results in uniform deposition field, thus cancelling random sedimentation effect. This parameter is for some non-standard scenarios, for example, masked precipitation, where precipitation occurs at some areas only. This picture shows the example of masked precipitation, where precipitation (controlled by Simple Shape Shader) is occurs only at the top of volcano. Random sedimentation, along with rough volcano surface, causes channels to change direction chaotically.



Other use of this parameter is for rivers erosion, where it makes rivers flow more random.

## Flow volume

This is another special parameter, which alters erosion physics, treating water flows as volumetric objects, affecting each other, causing higher water levels during simulation, which results in wider channels, filled with more deposits. This is another way to get valley “floor”, and it works without downcutting.





## Laminar flow

This parameter disables standard turbulent flow of water, used during simulation and makes it laminar. This results in less random channels with parallel flows, which is visible on flow- and streamline- maps and can be used for some texture effects, like steady longitudinal glacier lines.



# Thermal tab

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This tab contains parameters, controlling thermal erosion.

## Enable thermal erosion

Enables thermal erosion

Thermal erosion is simulated during the fluvial erosion simulation, and both types of erosion affect each other. If just thermal erosion is needed, set the “Fluvial erosion strength” parameter to 0.0.

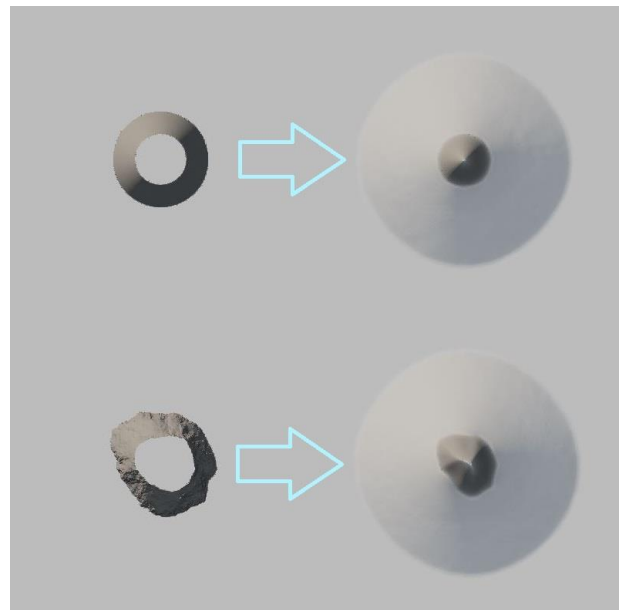
## Thermal erosion model

Sets the model of thermal erosion used in simulation.

Model A: old thermal erosion model, kept for compatibility with old scenes. Not recommended for use.

Model B: this thermal erosion model applies thermal stress uniformly to the rock. Resulting rock has similar look to uneroded, retaining its shape as long as possible. Of course, if high “Thermal erosion strength” or long “Duration” is used, resulting rock will lost resemblance to original. This model can be helpful for imitating erosion that often occurs in a dry climate.

Model C: This model simulates non-uniform thermal stress, which takes into account the shape of eroded terrain. For example, eroding of perfectly rounded truncated cone will results in a perfectly round cone with a nice "skirt" of talus beneath it. But if the original cone is distorted, its irregularity will drive and control the erosion process, resulting in a complex shape. This gives distinctive "mountain" look to the terrain, and sometimes just thermal erosion is enough to get good mountain-like landscape.



## Thermal erosion strength

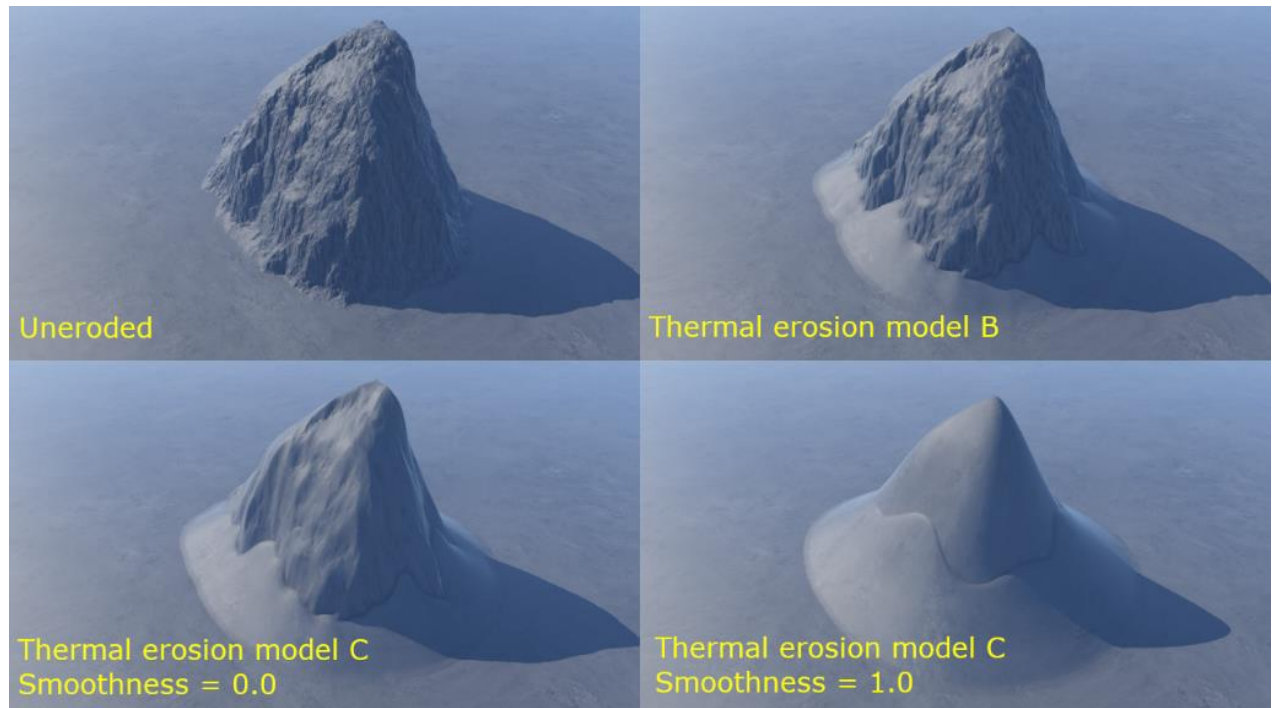
Controls the amount of thermal stress, applied to rock. Thermal erosion strength can be set higher than 1.0 up to quite high values (10 or may be more), but usually this isn't needed. Moreover, in many cases (for example, if thermal erosion is combined with fluvial erosion) it is better to set Thermal erosion strength to quite low values, sometimes even less than 0.1.

## Thermal erosion size

Set the maximum size of rock fragments, subjected to thermal stress. Higher size can result in faster erosion and simplified shapes. Usually it isn't required to tweak this parameter.

## Smoothness

This parameter is available for the “C” model. It controls the thermal stress, applied to convex parts of rock: the rock pieces that are raised. The higher is smoothness, the higher



is probability of destruction and falling down of these rock pieces. Combining with mild fluvial erosion this can be helpful for getting mountain shapes that often exist in a cold climate.

## Min angle effected

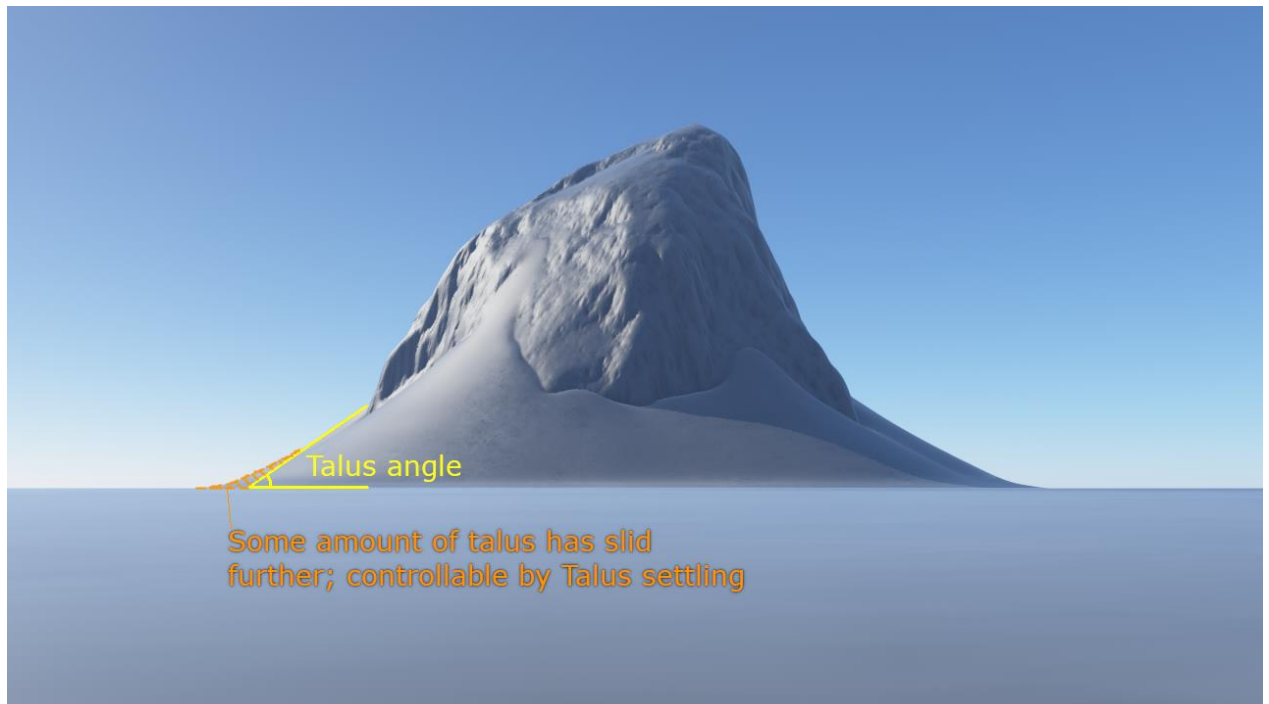
Legacy parameter, used in “Model A” model. Sets the minimum angle of surface that is affected by thermal stress.

## Talus angle

Controls the angle of repose of deposited material. Fallen rock fragments form a pile beneath of eroded rock, sliding down until this angle will be achieved, then sliding stops.

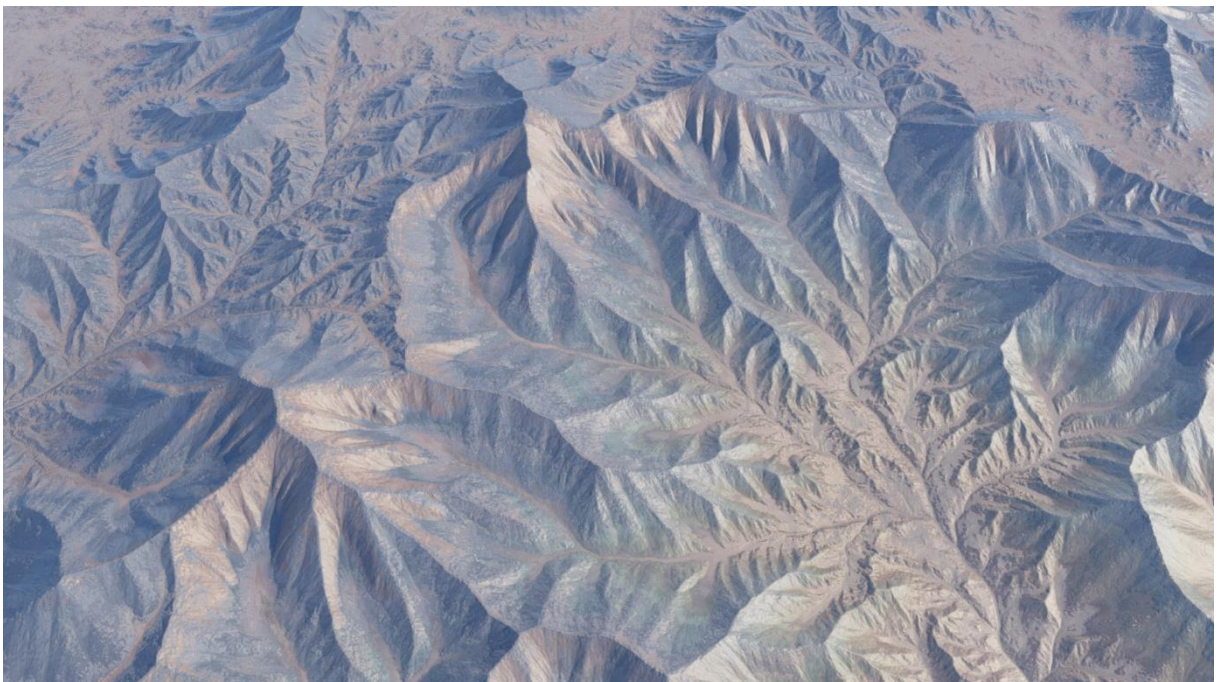
## Talus settling

Allows some fallen rock fragments to slide further, forming smooth transitions between talus and terrain. This results in not so perfectly slanted talus.



## Talus washing away

This parameter controls the extra amount of talus sediments, carried away by water flows. If fluvial erosion is evaluated simultaneously with thermal erosion, some of talus will be dissolved and transported away. But often this isn't enough, so, if there is too much of talus in the valleys, this parameter will help to get rid of it. Can be useful for mountain ranges. Example picture: fluvial erosion with aggressive downcutting, simultaneous thermal erosion (model "C"), some of talus is washed away.





# Rivers tab

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This tab contains parameters, controlling rivers.

## Rivers mode

Enables rivers mode. This is exclusive mode, disabling other erosion types. Internally it uses fluvial erosion in a special mode with special settings. So, if multiple erosion types are needed besides rivers, they can be get using other Classic Erosion instances.

Rivers are especially sensitive to a non-deterministic nature of Classic Erosion algorithm, so it is recommended to save erosion data to HDD and use it later.

Another peculiarity of this algorithm is that it may give different results at different resolutions, although it still tries to be resolution-independent. Probably, the best results can be achieved at 1536, 2048, 3072 and 4096 resolutions, if this isn't enough to get a good terrain details, it is possible to use "Render original hf details" option on "Render" tab, rivers mode works fine with this option. Example: picture with river, built using heightmap with resolution 2048, rendered with "Render original hf details" enabled, all fine landscape details are original terrain features.



## Headwaters density

Sets the number of headwaters on a terrain per square kilometer. Headwaters are placed randomly.

## Max rivers depth

Sets the maximum depth of river channels

## Rivers width

Adjust the width of river channels

Additionally rivers can be controlled using "Random sedimentation" and "Base level" parameters on the "Fluvial" tab. Random sedimentation adds some more meandering, and Base level adds more braiding.



# Render tab

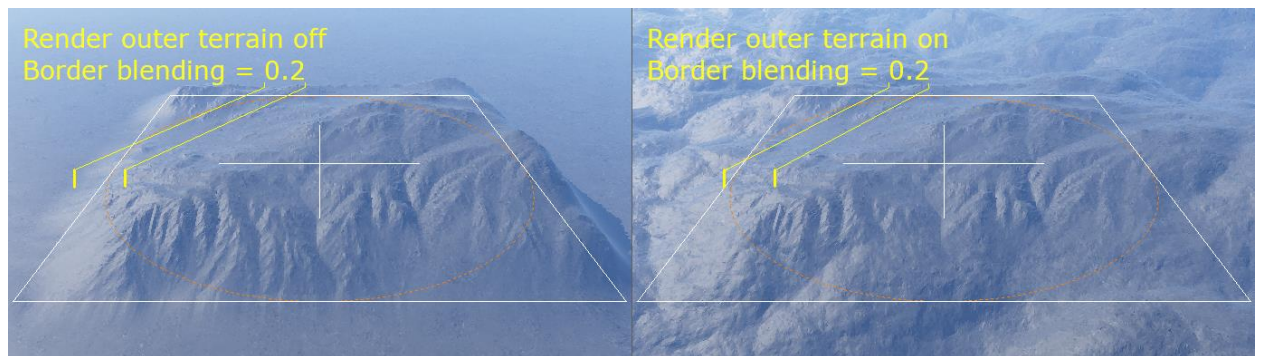
This tab controls parameters, controlling rendering of eroded heightmap.

## Border blending

Sets the width of smooth transition between outer terrain and Classic Erosion heightmap. This blending looks differently depending on the “Render outer terrain” option: if outer terrain isn’t rendered, then transition occurs partly outside of heightmap, and partly inside, and, if outer terrain is rendered, then blending occurs entirely inside the heightmap.

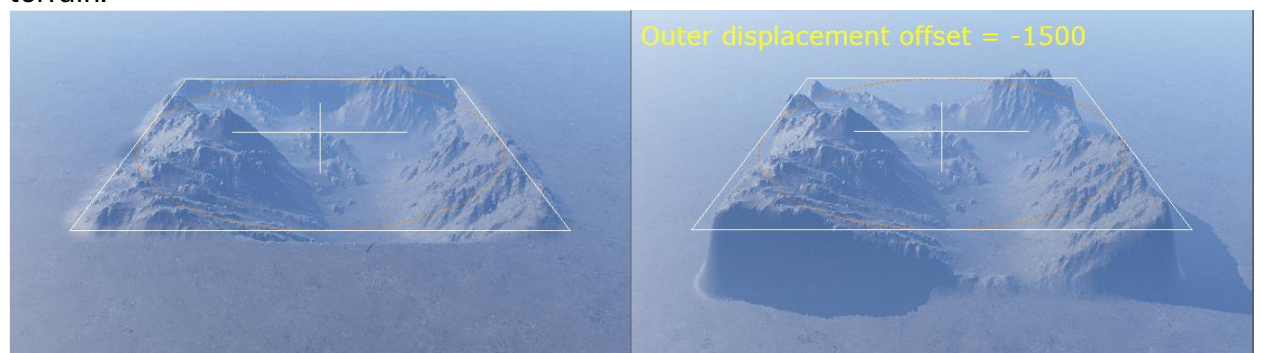
## Render outer terrain

This option allows to disable the rendering of outer terrain, saving computational resources. When it is disabled, just base object (usually planet) without displacement is rendered outside the heightmap. If the scene is located entirely inside the erosion heightmap, and outer landscape should not be visible, this is a good idea to disable this option, and, vice versa, if erosion heightfield is just part of entire landscape, enabling this option will render outer landscape. Sometimes this may be a good idea to use several Classic Erosion shaders, located at different places with this option enabled, for example, one high-resolution heightmap for the main scene, and some lower resolution heightmaps, placed on the background landscape for eroding distant mountains.



## Outer displacement offset

This parameter adds displacement to the outer terrain if “Render outer terrain” option is disabled. This can be useful when uneroded landscape has negative displacement, so there can be steep uplifting “walls” at the border of heightmap after eroding. This parameter allows to pull down outer flat terrain, adding negative displacement to this terrain.



## Render original hf details

This parameters allows to bring original fine terrain features back. “HF” stands for “High frequency”. Sampled terrain can’t represent fine details that are less than heightmap cell, they have too high spectral frequency to be sampled. Classic erosion allows to blend these features with heightmap, adding fine details that were in original terrain. This blending is controlled by flowmap and deposition map (banks map in rivers mode), allowing to not add these details on deposition fields or inside erosion channels.

This option allows to use low resolution heightmap and still have a good visual quality and detailed terrain. Other, more complex way, is to add procedural details manually after Classic Erosion shader using other shaders, for example, Powerfractal shader, and blend these details using maps output of Classic Erosion as mask. This is usually better way, but “Render original hf details” is simpler way and is often enough to get decent results.

## Mask by deposition

Controls blending of original fine details by deposition, keeping deposition field smooth.

## Mask by flows

Controls blending of original fine details flow map, keeping erosion channel beds smooth.

## Mask by banks

Controls blending of original fine details by river banks.



## Render water surface

This option is available in Rivers mode. It allows to render a water surface instead of dry river channel. Note that it doesn’t render transparent water surface. If transparent surface is needed, it can be get by adding additional layer in Terragen, for example, additional sphere object with the same size and position as the main planet object, and should get the same displacement. Then additional displacement should be applied to the planet object, based on the “Water depth” map to get river bed. Then this additional layer can be rendered using water shader or other transparent shader.

## Water level adjust

Allows to lower water level for “Render water surface” option.

## Maps tab

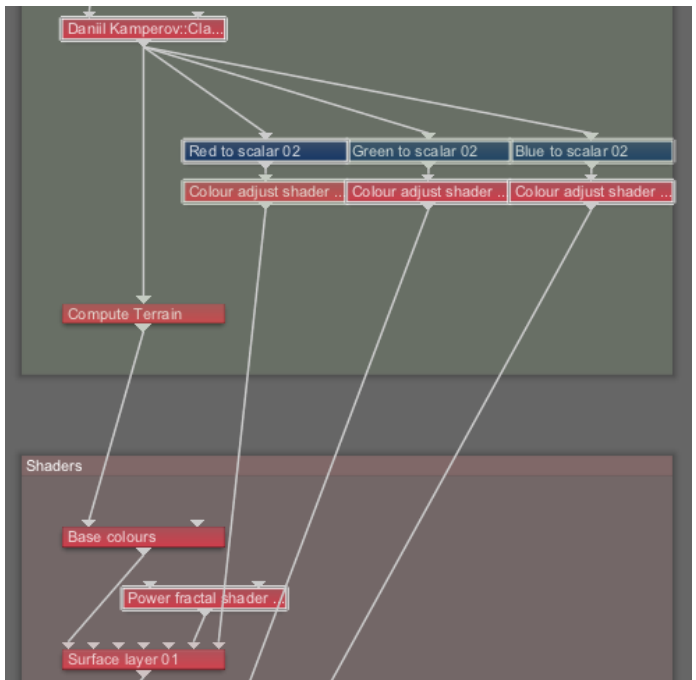
This tab contains parameters, allowing to use some erosion information outside of Classic Erosion shader. This information can be useful for landscape texturing, for example, marking deposition fields. Classic Erosion shader uses main color output of Terragen nodes for passing erosion maps, by coding red, green and blue color channels.

### Enable maps

This parameter enables color output.

### Red, Green, Blue

These parameters allow to select required erosion maps and assign it to desired color channel. If just a single map is required, it may be a good idea to assign it to all color channels, this will allow to get this map right out of Classic Erosion's color output. If different maps are assigned to different color channels, then decoding is required. This can be done using "Red to scalar", "Green to scalar" and "Blue to scalar" function nodes.



These erosion data maps are available:

- Deposition map – displays the deposited sediments;
- Flow map – displays areas where water flowed during simulation;
- Wear map – displays where rock was worn;
- Streamline map – displays directions of water flow; somewhat similar to flowmap;
- Banks map – displays river banks;
- Water depth map – displays depth of river channels (in meters).

### Normalize wear map

Normalizes wear map, converting it to 0...1 range. If not normalized, it represents wear data in meters

### Normalize deposition map

Normalizes deposition map, converting it to 0...1 range. If not normalized, it represents deposition data in meters

## Mask tab

This tab contains parameters, controlling erosion masking. Any color shader, connected to the "Mask" input of Classic Erosion shader can be used as mask. Some shaders that can be useful for mask, are: Simple Shape shader, allowing to place mask exactly to desired area, Distribution shader, allowing to select area by altitude and/or by slope, Power fractal to select area randomly.

## Mask by shader

This parameter allows to enable masking and to select a shader which will be used as mask.

## Invert mask

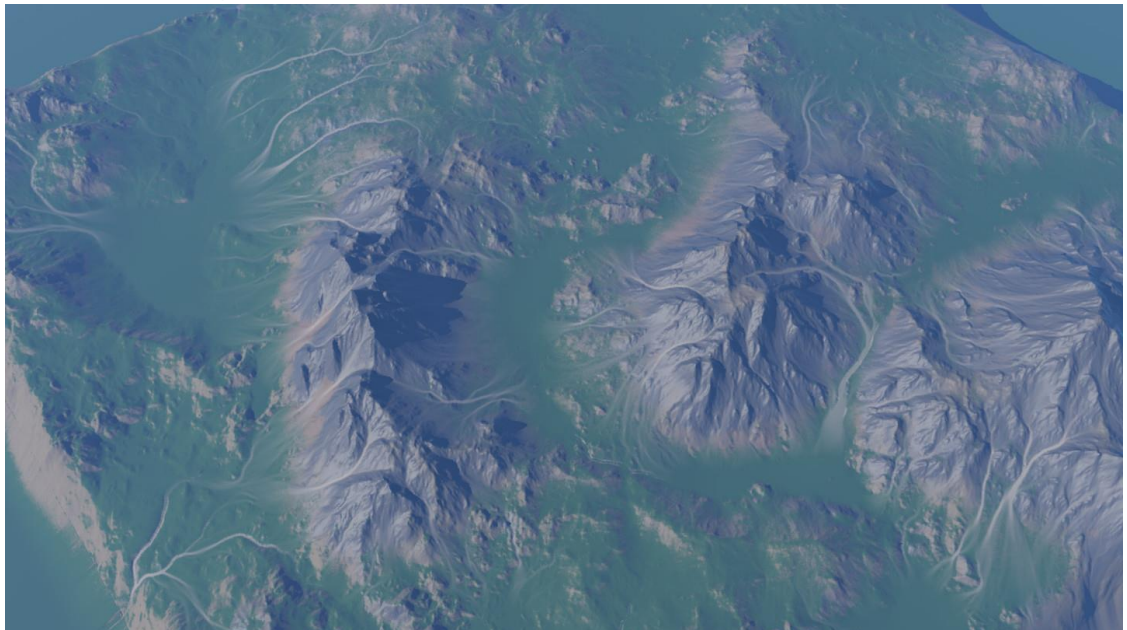
Inverts mask when enabled.

## Masking mode

Sets the mode of masking.

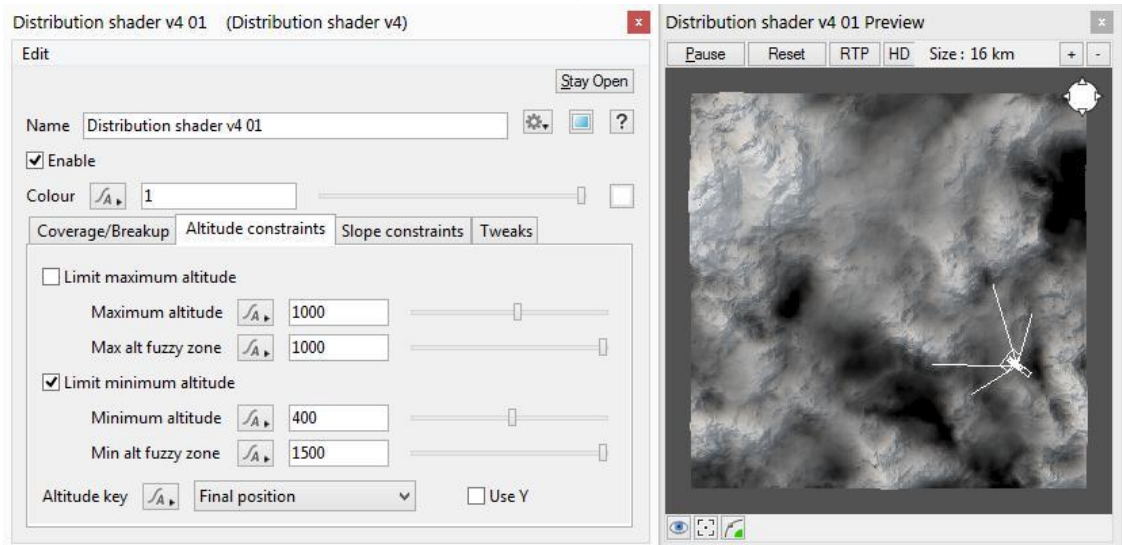
Several modes are available:

- “Mask as blend”. In this mode uneroded terrain is blended with eroded, mask controls blend ratio: black mask means uneroded terrain, white mask means eroded, intermediate grey shades are supported.
- “Mask as erosion strength”. In this mode mask controls the “Erosion strength” parameter.
- “Mask as rock softness”. In this mode mask controls the “Rock softness” parameter.
- “Mask as precipitation amount”. Probably the most interesting mode. In this mode mask controls rained areas, allowing to drop water only to some regions. The brighter mask is, the more water is rained. This masking mode allows to avoid boring look of uniformly eroded terrain. One of good scenarios is to apply this mask high altitude areas using Distribution shader: the higher altitude is, the brighter is mask. This allows to erode high mountains more than low areas, making erosion more interesting. Next picture shows how such erosion looks like.





This is how Distribution shader was configured to get this look:



Thermal erosion was enabled here too, with “Mask as thermal erosion strength” parameter on.

## Mask as thermal erosion strength

This parameter allows to apply mask to thermal erosion too. When enabled, mask controls thermal erosion strength.

## HDD tab

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This tab contains tools for saving erosion data and exporting maps. Saving erosion data is useful for loading it later. This allows to not recalculate it every time when Terragen scene is loaded, also it guaranteed exactly the same look of erosion, this is especially important for rivers.

### Erosion data file

This parameter sets the erosion data file name and writes erosion data immediately.

### Read erosion data on project loading

When enabled, forces Classic erosion to load erosion data on Terragen scene loading. Erosion data file string should be set to correct file name for this (it is set automatically on saving erosion data file), and this file should exist.

### Read now

Sometimes manual loading of data file may be needed. This parameter lets to select and load erosion data file immediately.

### Export maps

This parameter allows to export erosion maps as 16-bit .png images (streamline map is stored to 8-bit). All maps are exported at once, adding the name of erosion map to filename automatically.