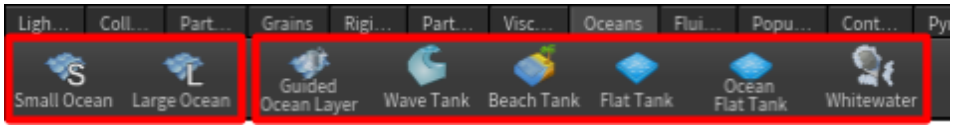
Houdini 16 Oceans

Introduction

Houdini's Ocean tools (formerly called Ocean FX) are a set of tools to help artists with oceans. These tools are broken down into 2 main categories:

1. Simulating the surface of an ocean
2. Fluid tanks (very similar to a FLIP Tank)

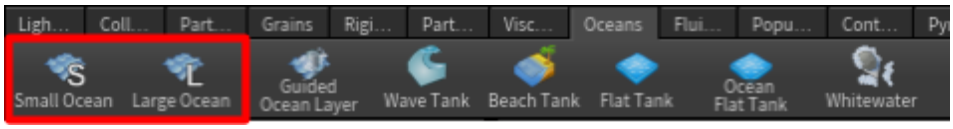
You can find them under the Oceans shelf.



NOTE: Not 100% sure if these tools are actually used by most artists. This part of Houdini could be similar to Maya's muscle system (in that no one uses it for anything).

Ocean Surface

You can simulate the surface of an ocean using the first 2 options in the Oceans shelf.

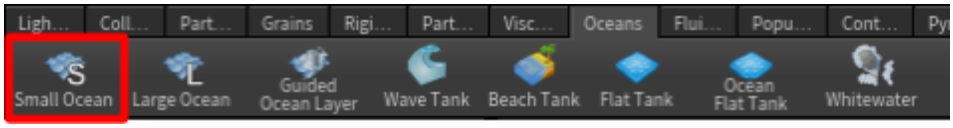


This part of the document will focus on the "Small Ocean" item, but the "Large Ocean" item is probably very similar.

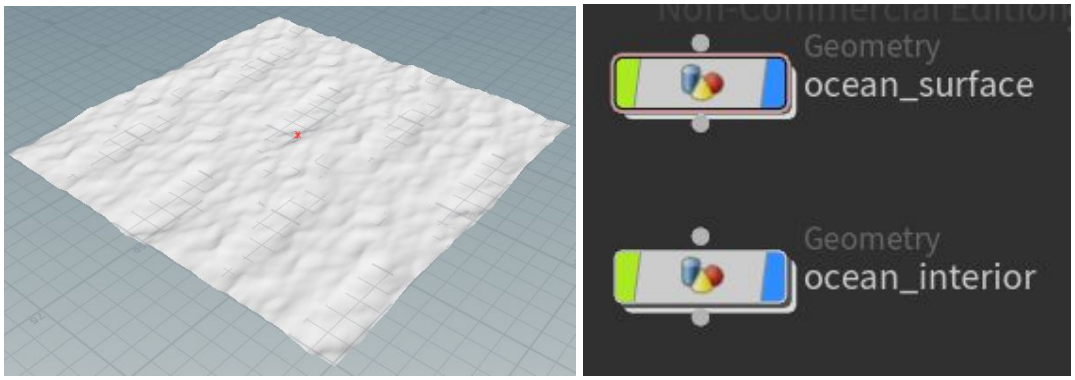
The surfaces generated here ARE NOT CONTROLLED BY A DOPs NETWORK! They are entirely simulated on their own, and they can't really interact with any other fluids or rigidbodies or anything else that requires a DOP setup.

Create

You can create a surface by using the Small Ocean item in the Oceans shelf.



Once you do, you'll end up getting what looks like a patch of terrain and 2 new nodes in your /obj context…



- ocean_surface is the surface of your ocean

- ocean_interior is the ‘inside’ of the ocean (essentially a volume extrude of the surface that’s hidden from the scene view but visible in renders)

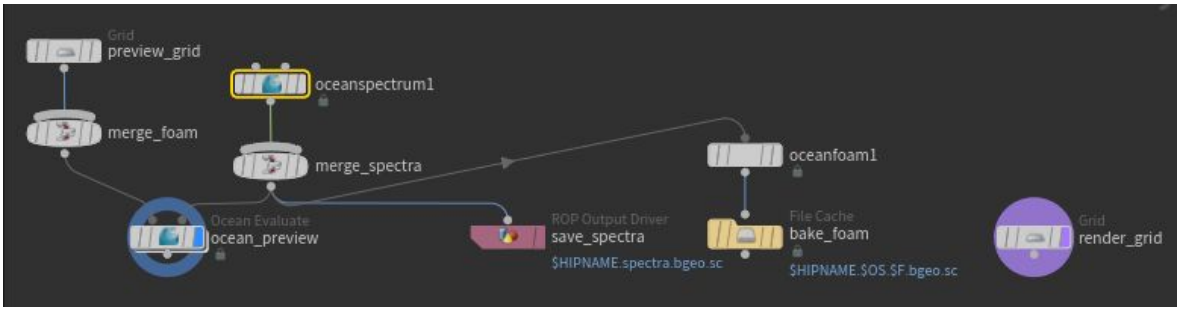
  NOTE: Notice how there’s no AutoDopNetwork here. This is independent of DOPs and can’t interact with other physics as if it were a FLIP fluid.

If you play your animation timeline now, you’ll see the ocean surface animating as if it were a real ocean’s surface.

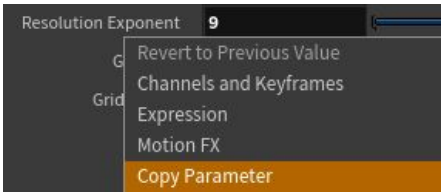
Setup Resolution

Once you’ve created your ocean, you need to do one extra thing: you need to make sure that the grid that makes up the surface has enough quads for our ocean surface's “resolution”...

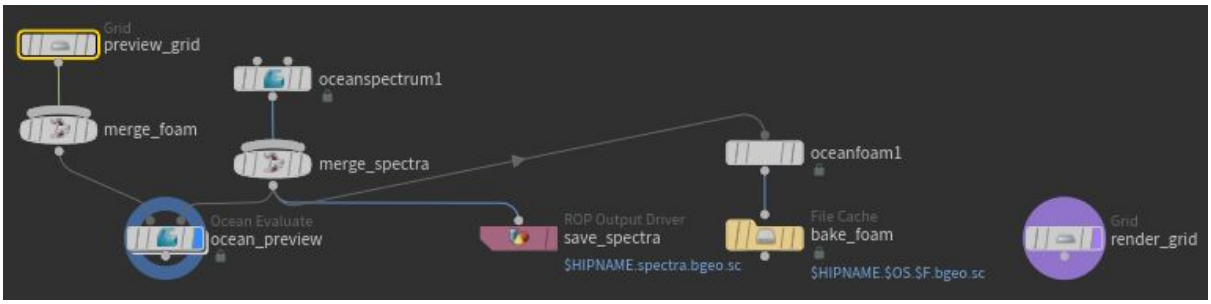
1. Go into the ocean_surface node...
2. Go to the oceanspectrum node (highlighted in image below)...



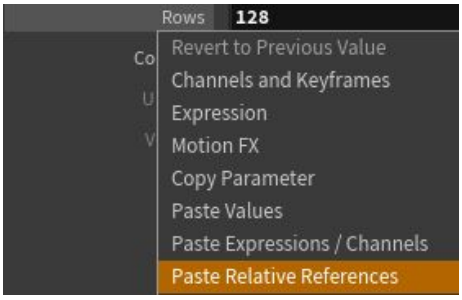
3. The first property you’ll see is Resolution Exponent. Right-click on the label and choose Copy Parameter...



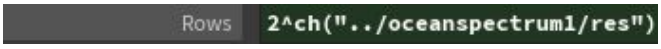
4. Go to the preview_grid node (highlighted in image below)...



5. Right-click on the label for Rows property and choose Paste Relative References...



6. The Rows property should now read ch("../oceanspectrum1/res"), change it to 2^ch("../oceanspectrum1/res")...



7. Repeat steps 5 and 6 for the Columns property

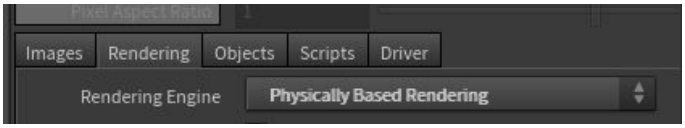
NOTE: It's unsure where the formula 2^exponentres came from, but that's what the lesson recommended. With this, we can now make sure that if we jack up the surface simulation's resolution, we'll jack up the number of faces in our grid that the surface gets mapped to (so we end up seeing the extra detail).

Setup Render

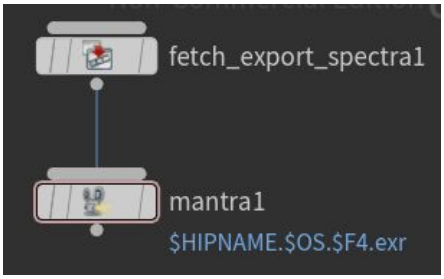
Once you've created your ocean, you need to do one extra thing to get it to render properly: you need to feed the displacement map generated for the ocean's surface into your render node so that you get a proper render.

1. Go to the /out context -- a node should have been added by the Ocean tool called fetch_export_spectra (it controls the displacement map for the ocean surface)…

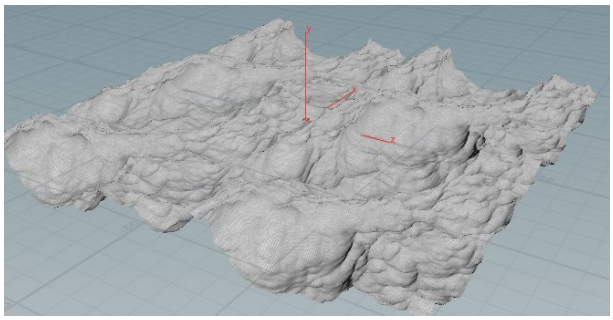
2. Create your mantra node if you don't have one already (make sure the renderer is set to Physically Based Rendering)...

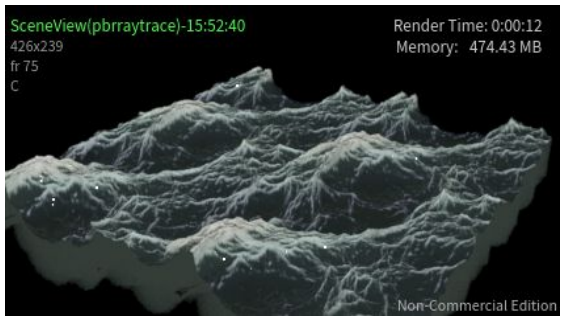


3. Hook the created node into your mantra node…



Once you do this, you'll get proper renders...

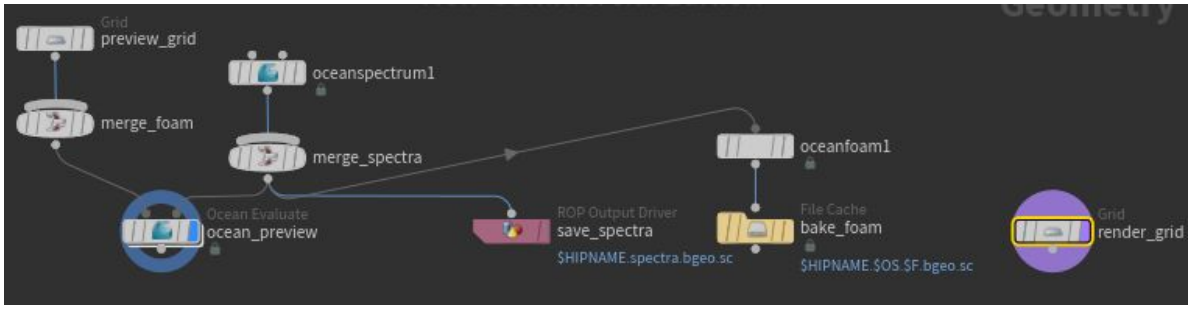




> **NOTE**: DO NOT USE THE RAY TRACE RENDERER. It seems to have problems and ends up dipping into the volume element that's underneath the surface.

Setup Size

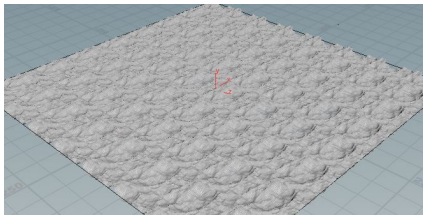
You can make the grid that makes up your ocean as large as you want. You can do so by going into your surface node (in the /obj context) and navigating to the render_grid node…



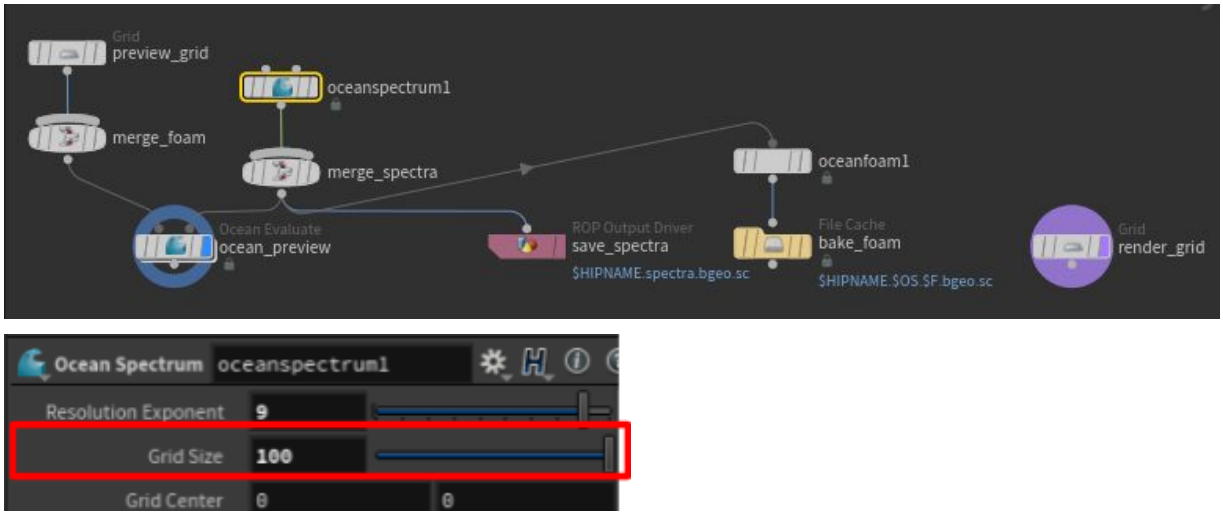
Change the size of this grid to however large you want your surface to be…

NOTE: Don't worry about this node that being connected to anything. Other nodes in this network have a channel reference to the size here, so everything will just magically work once you set the new size.

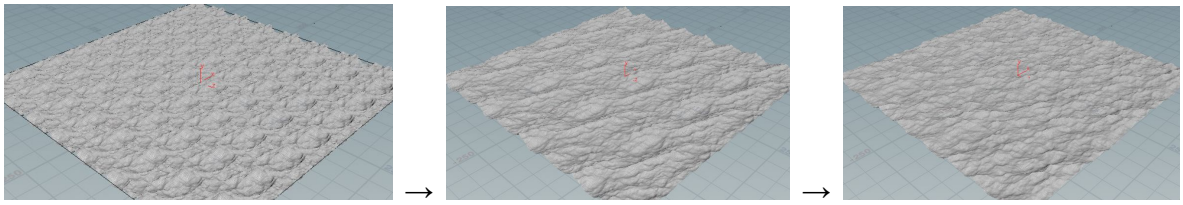
One thing you may notice after you do this… the waves are being tiled together (there's an obvious pattern)...



You can increase the size of the tile being generated (to make it less obvious) by going to the oceanspectrum node and increasing the Grid property…

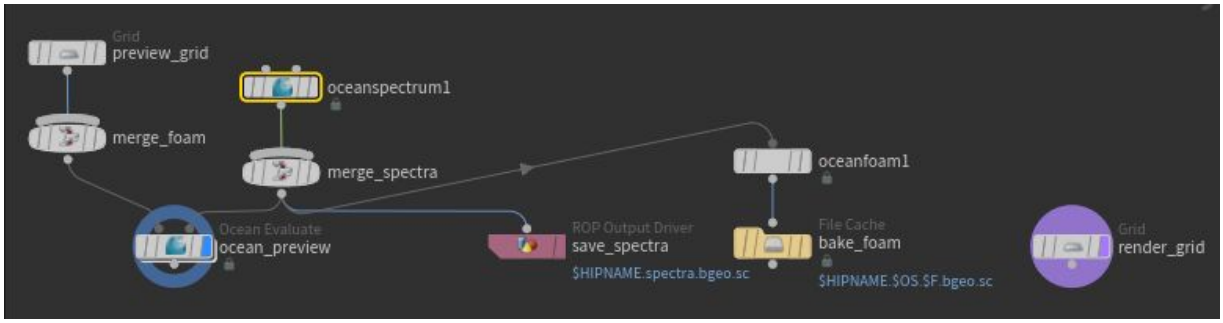


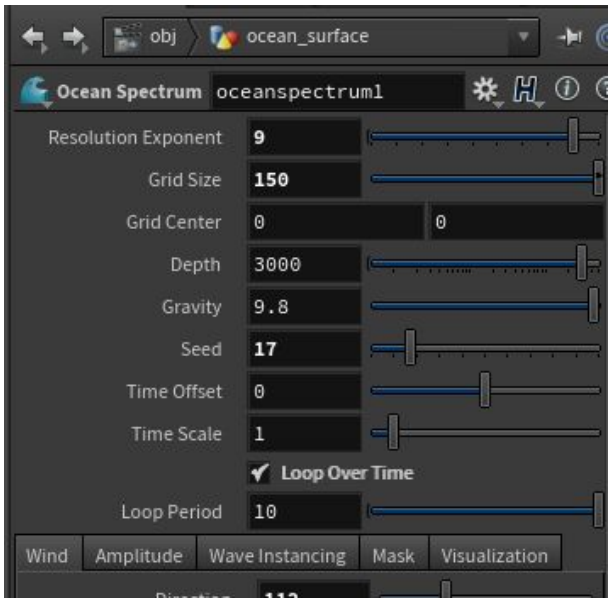
Here's an example with a Grid Size property of 50/100/150 (this is for a 400x400 grid plane).



Control

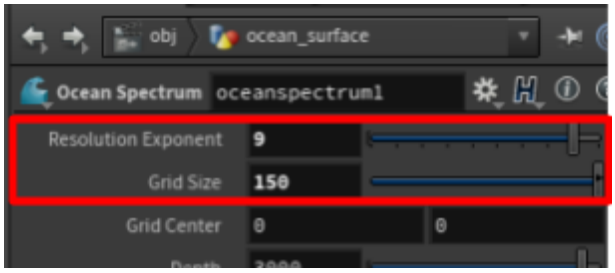
You can gain control over the surface of your water by going inside the ocean_surface node and to the oceanspectrum1 node. In here, you can find lots of options that reference real-world properties…





Resolution

As discussed in the Create section, you can jack up the resolution of your surface via the Resolution Exponent and Grid Size properties…



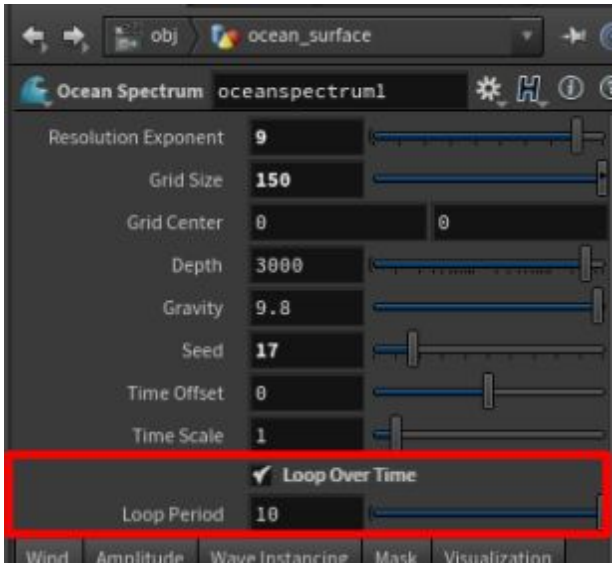
> **NOTE**: All of this is predicated on PROPER SETUP. See the Create section and make sure you did all the setup properly.

Resolution Exponent defines how detailed your surface is. The higher this number is, you can have smaller and smaller waves propagate over your surface, resulting in much finer/realistic detail.

Grid Size defines the tile size for the surface of your ocean. So if you set up your ocean to be super large, Grid Size will control how much repetitiveness there is on the surface of your ocean. See the Setup Size section for more information.

Perfect Loops

You can make it so that the animation on the surface of your ocean loops perfectly via the Loop Over Time and Loop Period properties...

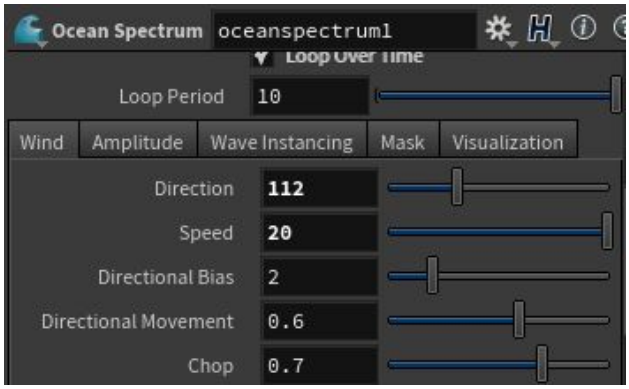


If you check Loop Over Time, you can fill in the Loop Period value. Loop Period is the number of seconds before the animation should loop.

So for example, if you have 240 frames in your animation and you set your FPS to 24 (these are the defaults), you want to set this to 10.

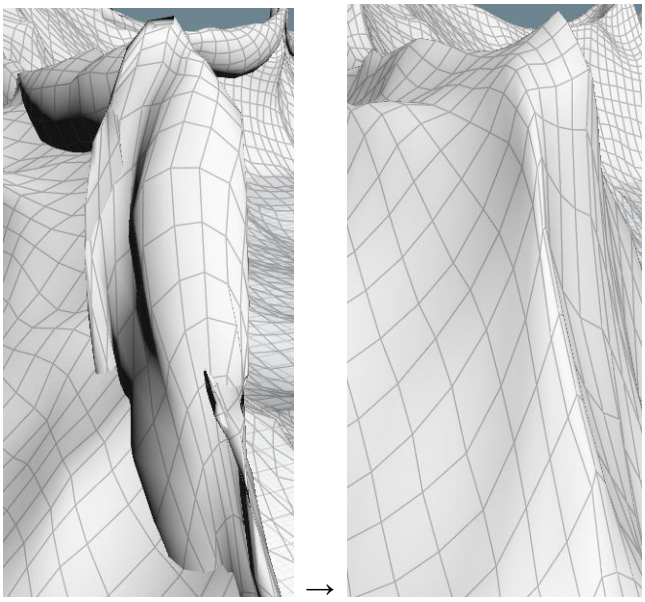
Wind

All wind related properties are under the Wind tab...



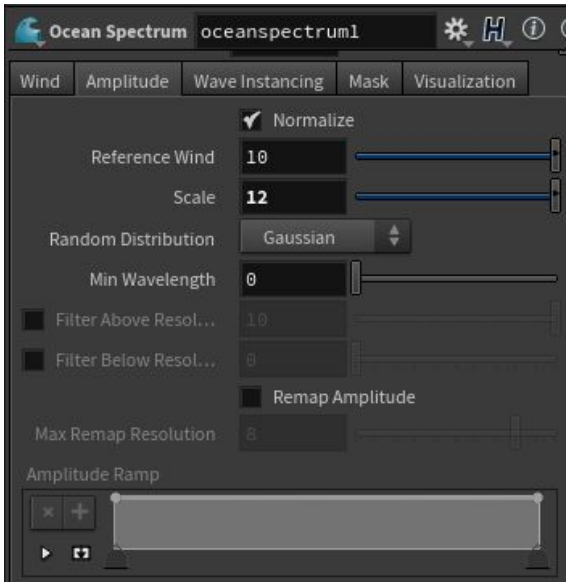
Most of the properties here should be self-explanatory…

- Direction and Speed refer to the wind being applied.
- Directional Bias controls the amount of waves that “align” with the wind direction... how many of the waves being generated for the surface follow the direction property -- if this value is zero, your ocean won’t have a direction? each wave goes in its own direction?
- Directional Movement dampens waves that are going against the wind -- 1.0 means all waves are going in the same direction, 0.0 means waves are going equally both in the direction of the wind and against the direction of the wind.
- Cusp controls how rounded the peaks of your wave are -- in certain cases you’ll need to round your peaks because your peaks will be so sharp and high that they’ll protrude through themselves… here’s an example of the same wave using a high cusp value vs a low cusp value



Waves

All wave related properties are under the Amplitude tab...

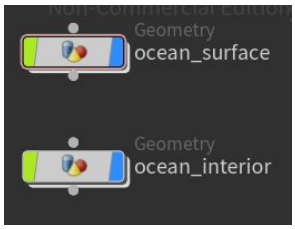


The big property here is Scale. The higher the scale is, the larger your waves will be. Don't bother touching anything else.

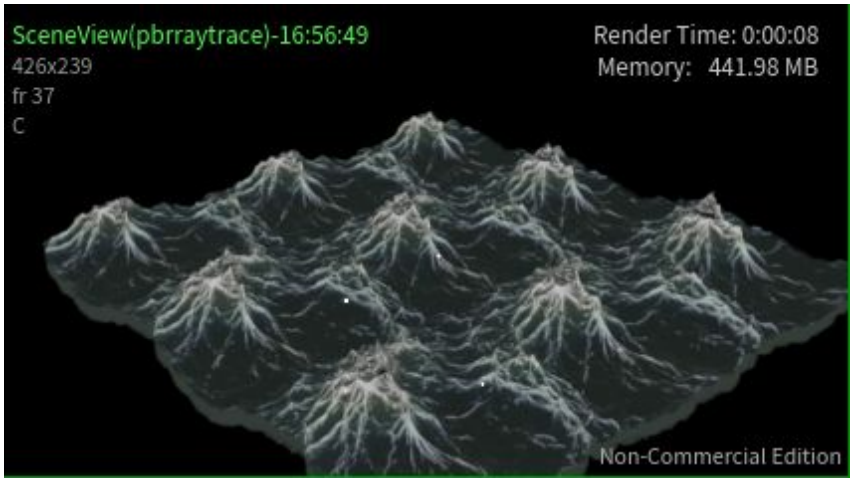
> **NOTE**: The Min Wavelength option takes out waves that are smaller than a certain size. It'll cause you to smooth out your water the higher it gets, almost as if you're dropping the Resolution Exponent value. Unsure why this would ever be used? Maybe to get a cartoonish look to water?

Shaders

Remember that 2 geometry nodes got created for your ocean surface…

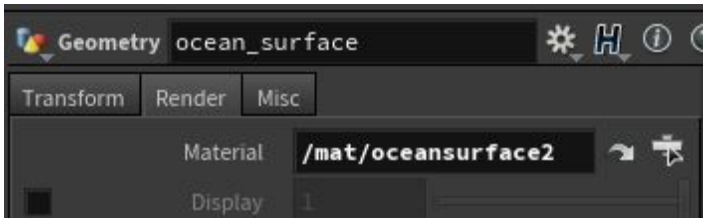


ocean_surface is the top of your ocean, while ocean_interior is a murky volume that protrudes slightly underneath it. You can see both if you do a render…

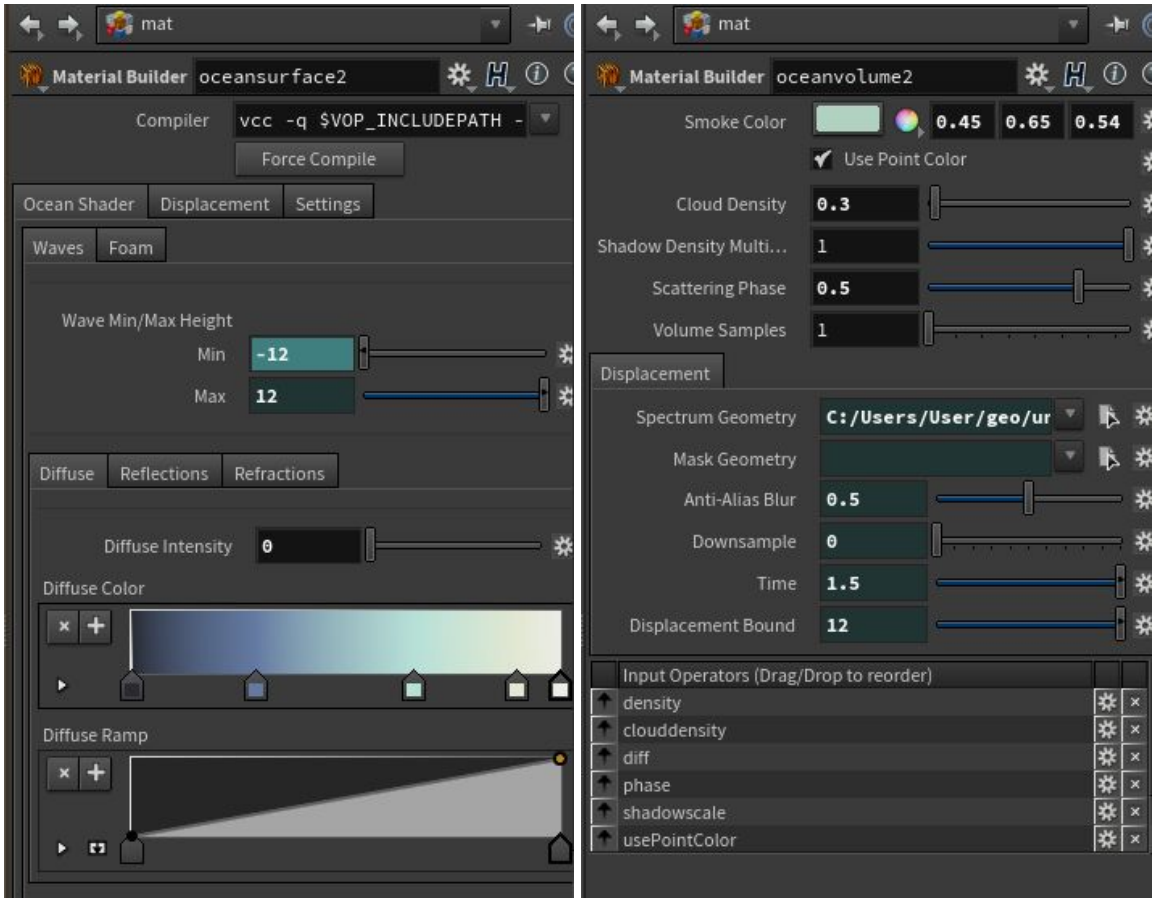


Each geometry node is controlled by a shader. You can use these shaders to customize how your water looks.

To see which shaders are being used, go to the geometry node's properties and check the Material property under the Render tab…



HINT: Clicking the little arrow on the right will take you to the material node.



The following is the material properties for the surface and interior.

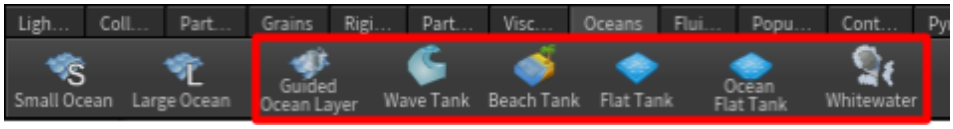
For oceansurface (the material for the surface geometry node), only stuff under Ocean Shader -> Waves seems to do something. Foam doesn't seem to do anything anymore -- it seems to be totally ignored.

For oceanvolume (the material for the interior geometry node), the Cloud Density property controls how murky the interior volume is.

Fluid Tanks

Fluid tanks are essentially FLIP Tanks (see the document on fluids) with some special stuff added to them such that they follow along with some animated object and create/sink particles as they move with that object.

Every shelf item highlighted below (except for Whitewater) is a variation of the Flat Tank option, so that's the one we'll be focusing on.

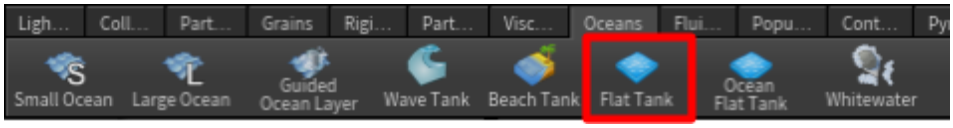


NOTE: Whitewater is used for generating realistic particles for foam/bubbles/etc.. as your object moves in the Flat tank.

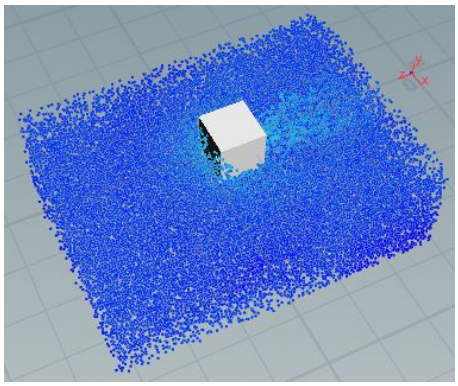
Create

First, make sure you have an animated object in your scene.

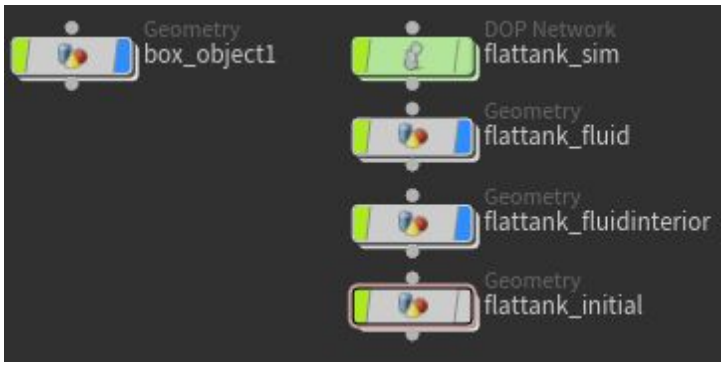
Select the object and choose the Flat Tank shelf item in the Oceans shelf…



A tank of water particles should surround your object now. If you play your animation, the tank will follow along with your object and the water particles will react as if it is actually moving…



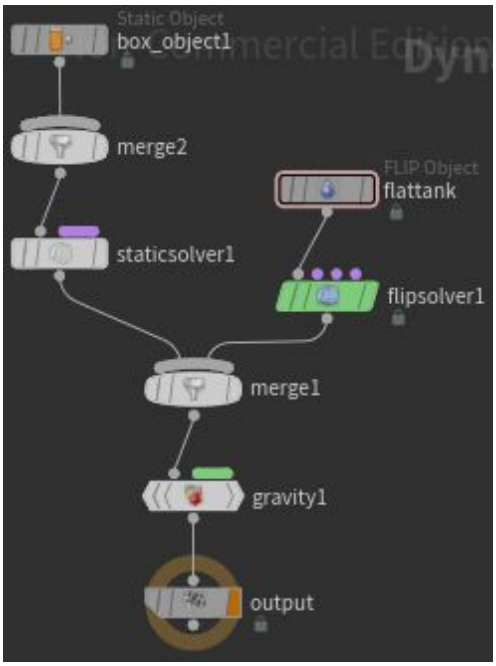
4 new nodes should be added to your /obj context…



- box_object1 is the original object the flat tank was added to.

- flattank_sim is the DOP network that handles the fluid physics.

  This exactly like an AutoDOPNetwork, except that it's focused entirely on the dynamics for the flattank and this object. Infact, if you go into this DOP network you'll see that all it does is add the object as a static object and feeds the flattank into a flipsolver as if you created a FLIP Tank. If you really wanted to you can just move these items into your other DOP network (if you had one)...



- flattank_fluid shows the particles in your scene view (exactly the same thing that happens when you create FLIP fluids from the Fluid Particles shelf)

- flattank_fluidinterior is for rendering the water in your final render (exactly the same thing that happens when you create FLIP fluids from the Fluid Particles shelf)

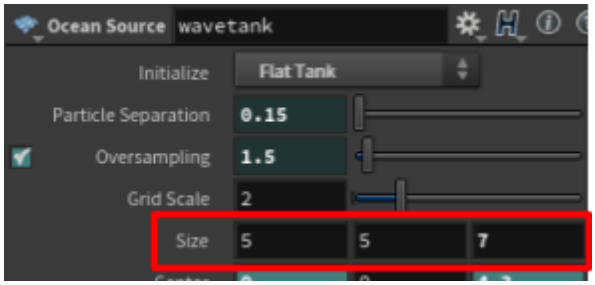
- flattank_initial contains the details of your tank

To set the details on your tank, step into the flattank_initial node and then to the wavetank node.

Setup Tank Size

First, step into the flattank_initial node and then to the wavetank node (see end of parent section for more details).

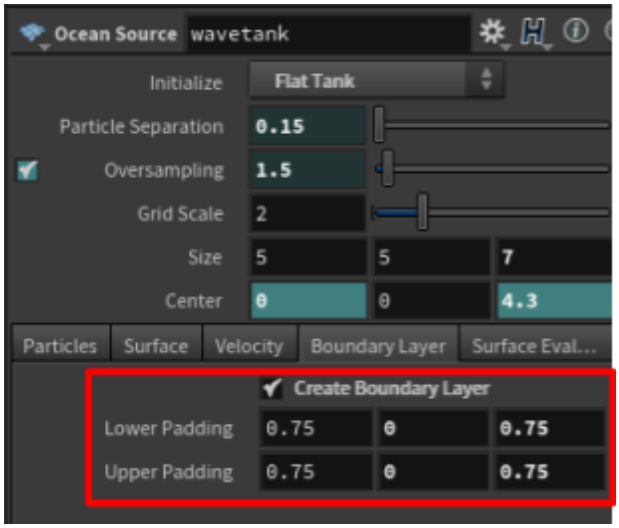
You can control your tank size by changing the Size property…

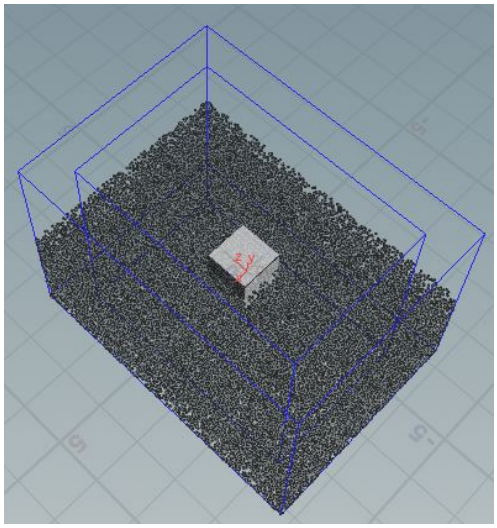


Setup Source/Sink Water Rate

First, step into the flattank_initial node and then to the wavetank node (see end of parent section for more details).

You can control how many water particles your tank creates/eats as it moves by setting the boundary around your tank. This is under the Boundary Layer tab...



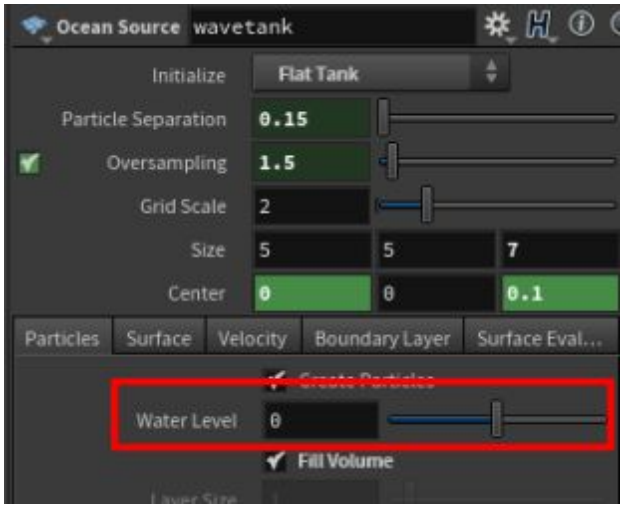


NOTE: The inner box is the water used for the simulation, the outer box is the water that's generated. You may need to increase the size of the outer box depending on how fast you're moving because you'll need to generate more water particles.

Setup Water Level

First, step into the flattank_initial node and then to the wavetank node (see end of parent section for more details).

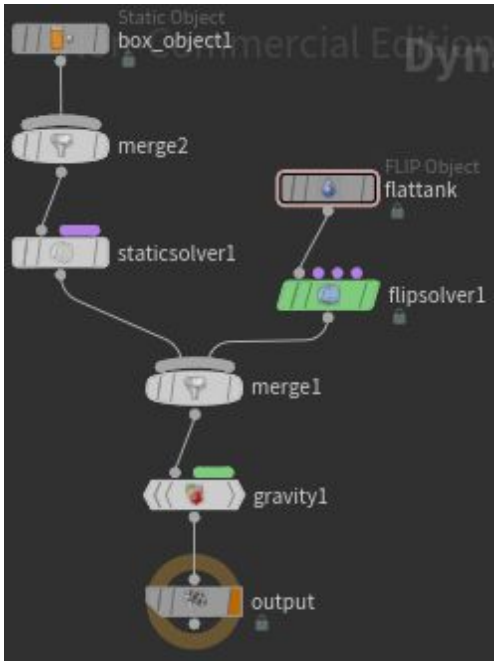
You can control how many water level in your tank by setting the Water Level property under the Particles tab..



NOTE: 0 means exactly the middle

Setup FLIP Fluid Details

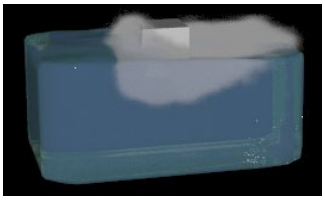
You can set the details on the FLIP fluid by going into the flattank_sim DOP network and fiddling with the FLIP object and flipsolver. This was covered extensively in the Fluids document.



Whitewater

Whitewater controls the dynamics/physics of a flat tank's foaming, spray, and bubbles as your object moves through it.

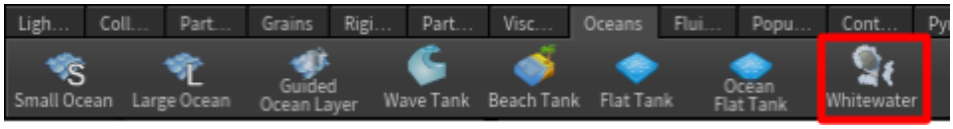
> **NOTE**: This only controls the movement of the particles. The actual shaders on those particles are myst sprites -- they look nothing like what they're suppose to.



Create

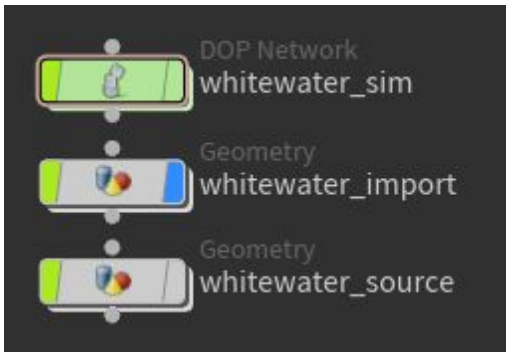
First, make sure you have an nothing select in your scene.

Select the object and choose the Whitewater shelf item in the Oceans shelf…



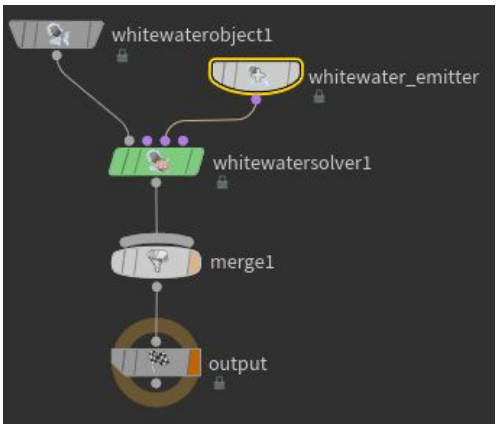
Select your flat tank in your scene and press Enter (or go into the flattank_sim node in /obj and select the FLIP Object for the flat tank that's being fed into the solver, then go back to your scene and press Enter).

3 new nodes should be added to your /obj context…



- whitewater_sim is the DOP network that handles the fluid physics.

  This exactly like an AutoDOPNetwork, except that it's focused entirely on the dynamics for the whitewater. If you really wanted to you can just move these items into your flat tank's DOP network (or maybe a larger DOP network if you had one). The only thing to be aware of is that THERE IS NO GRAVITY NODE HERE.

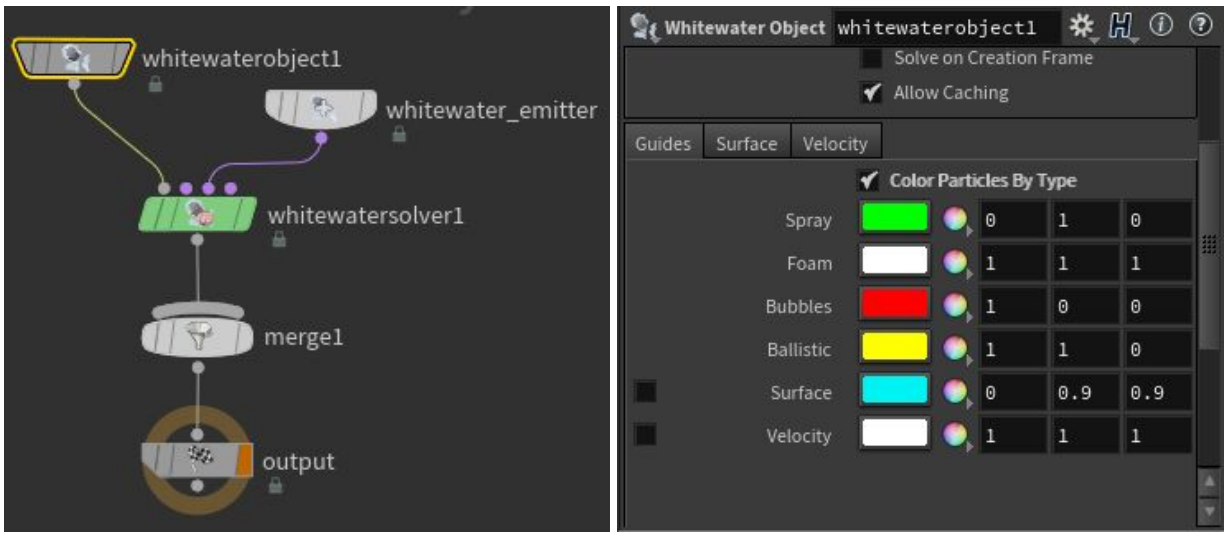
  

- whitewater_import shows the particles in your scene view (copied over from the whitewater_sim DOP network).

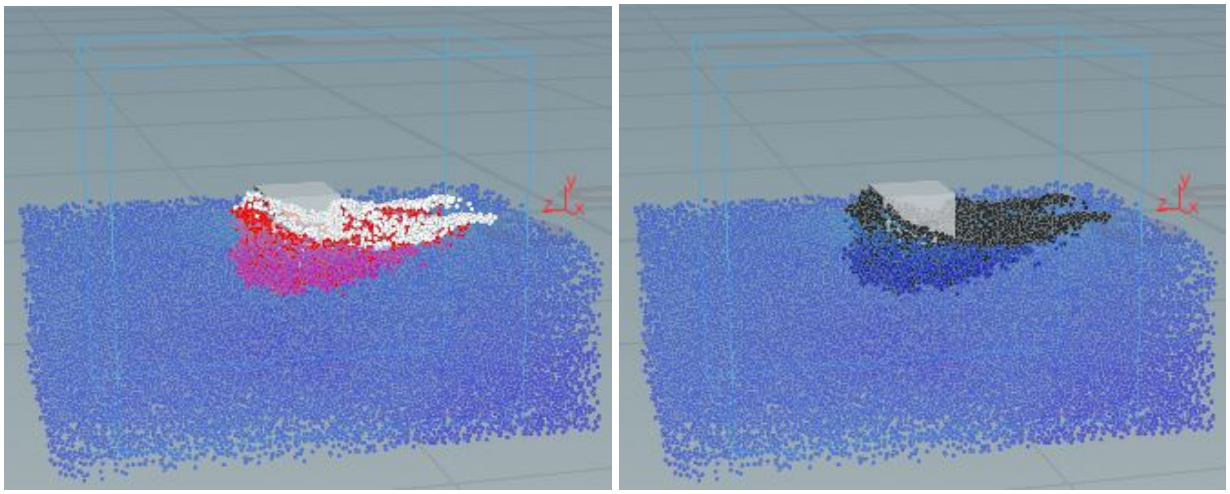
- whitewater_source is (I think) a copy of your flattank's details that eventually get fed into the whitewater_sim network.

Particle Guides

If you want to colorize each particle by type (e.g. spray should be green, bubbles should be red, etc..), you can go to the whitewaterobject node inside the whitewater_sim DOP network. There'll be a Guides tab with an option called Color Particles by Type…



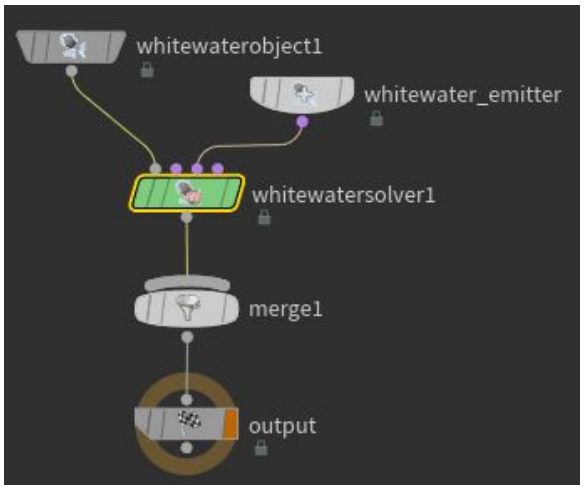
Here are colorized guides vs normal guides…

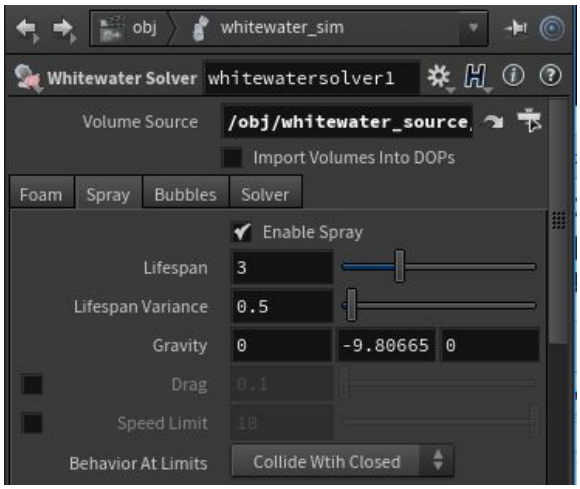


Essentially these colorized guides just give you a quick idea of how things will look in your final render.

Particle Properties

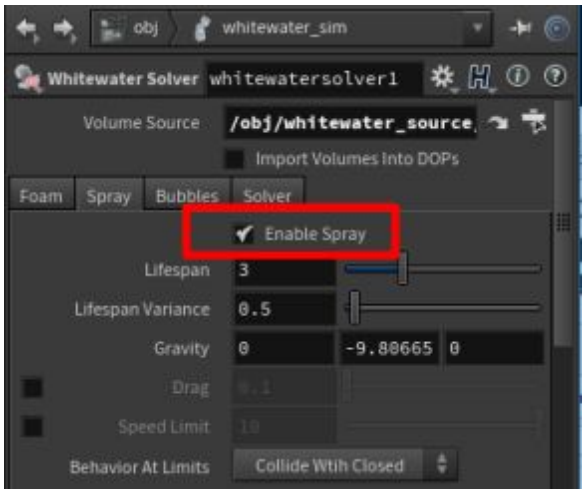
You can go to the whitewatersolver node inside the whitewater_sim DOP network and find 3 tabs that control the foam, spray, and bubble properties.





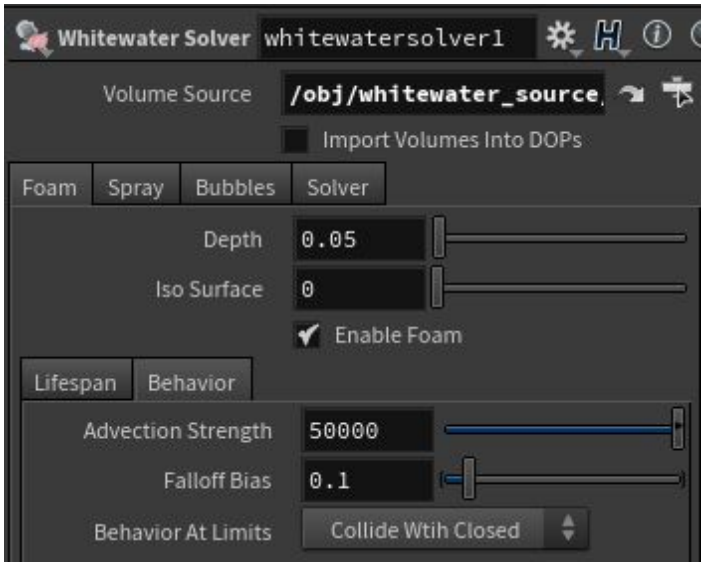
Enable/Disable

You can choose to enable or disable foam/spray/bubbles by going to the related tab and choosing the Enable (type) checkbox.



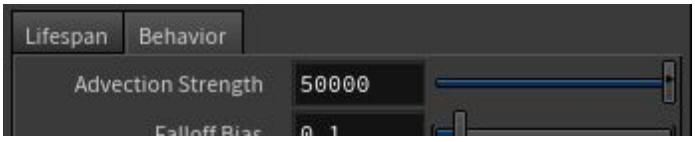
Foam

Foam particles sit on the surface of the fluid. Foam particles are primarily affected by the movement of the water and your object. You can control foam by going to the Foam tab…



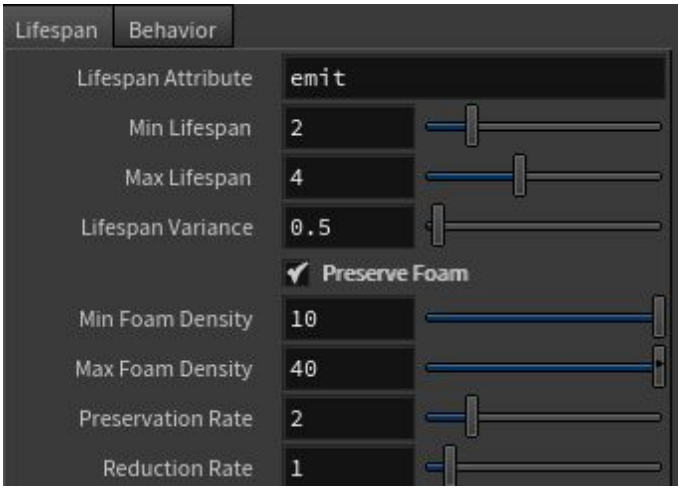
Obviously, stuff under the Lifespan tab controls the lifespan of the particles and stuff under the behaviour tab controls the behaviour of the particles.

There are 2 important attributes here…

1. Advection Strength (under Behaviour)
   This controls the motion of foam particles. The higher the advection strength, the more that the foam bubbles will move with the fluid.
   

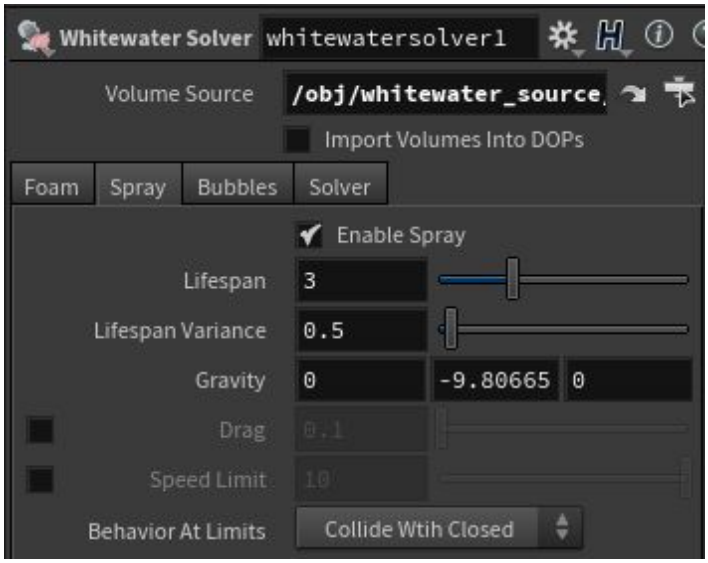
2. Preserve Foam (under Lifespan)
   This overrides the minimum lifespan you set in Min Lifespan if the foam is part of a large clump of foam. The size of the clump and how much time is added to the lifespan is

determined by the parameters below the Preserve Foam checkbox.



Spray

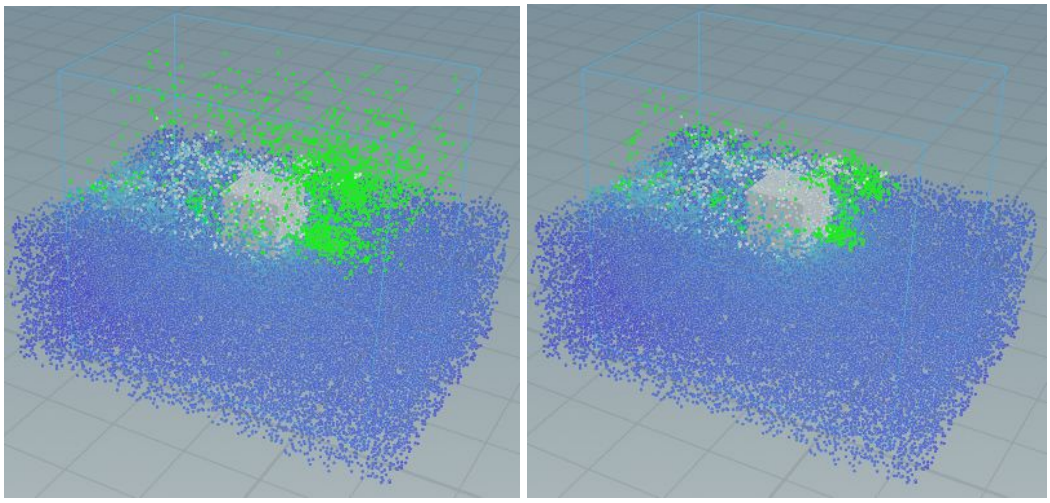
Spray particles live above the fluid. Spray particles are primarily affected by the force of gravity. You can control spray by going to the Spray tab…



Obviously, stuff lifespan attributes controls the lifespan of the gravity is the force of gravity.

> **NOTE**: This solver is not feeding into a gravity node. It's applying its own gravity locally. If you had this inside of a DOP network with gravity, you would likely need to make links between the gravity node and this.

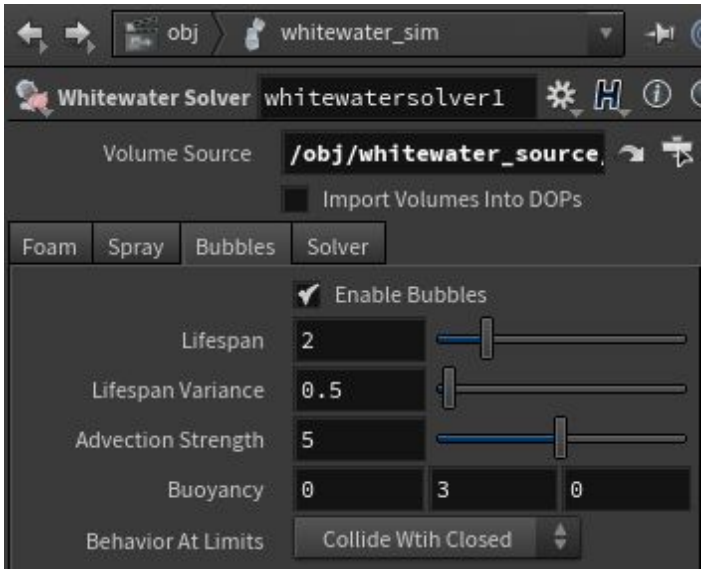
The important property here is Drag. The higher drag is set, the more narrowed those spray particles will be. Here's an example of 0 drag vs a drag of 2 for a relatively fast moving object…



It's almost as if the particles are being dragged back, which is I guess what you want. The spray particles are probably not taking into account how fast your object is moving since your object's movement is relative to the flat tank. The drag simulates the particles staying in place as your object is moving forward (instead what's happening is that the particles are being dragged back and your object is staying in place -- ultimately the end result is the same).

Bubbles

Bubble particles live below the fluid. Bubble particles are primarily affected by bouyance (this is a property you set on the solver). You can control bubbles by going to the Bubbles tab…



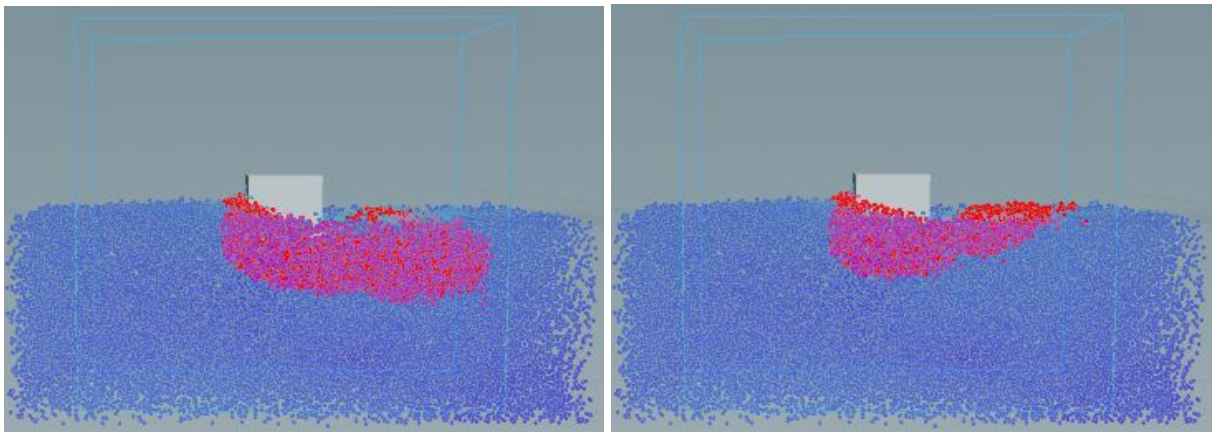
> **HINT**: Bubbles are only visible underneath the surface of the water. If you're going to have a murky style water shader (e.g. swamp?), you can save yourself some simulation time by disabling bubbles completely.

Obviously, lifespan attributes controls the lifespan.

The important properties here are Advection Strength and Buoyancy.

1. Advection strength controls how the bubbles move with the water (just like foam) -- the higher the advection strength, the more that the bubbles will move with the fluid instead of scattering.
2. Buoyancy is how fast the bubbles come up -- the higher the buoyancy, the faster they come up?

Here's an example of a buoyancy of 0,0,0 vs a buoyancy of 0,3,0…



NOTE: The actual amount of influence that buoyancy has diminishes significantly as the object moves faster and faster. The example above was a very slow moving object. For a fast moving object, I couldn't tell the difference between 0,3,0 and 3000,3000,3000.