We’re going to start by looking at section 16, volcanic eruptions. This section is not so much about the volcano and how to configure HYSPLIT for that eruption as it is in terms of configuring a model for multiple particle sizes, with gravitational settling, and restarting the model from a PARDUMP file, as well as the assimilation of satellite data.

Let’s take a look at the eruption and how to configure HYSPLIT for it. We're going to work with the Eyjafjallajokull eruption that started on 14 of April 2010. So we're going to sort of follow the real-time scenario but we're not necessarily going to be faithful to it. So let's start by loading the preconfigured CONTROL and name list files. So open up the, well do a reset, and then open up the, or retrieve the menu from the tutorial/volcano directory, and you'll see both the CONTROL file and the name list file. I will go over the settings in each of these momentarily.

So let's go to the set up run menu, and the eruption started near zero hours UTC Greenwich time, and we're going to do these calculations in 12 hour segments, and you will see why moment. We're going to set up two starting locations, both of which have the same horizontal position, this is the latitude and longitude of the volcano, but they will start at different heights. When HYSPLIT sees the same starting location in two sequential locations, it is going to treat this as a line source, that is the particles will be emitted uniformly in the layer from 100 to 6000 m above ground level. And that is the basic configuration for a volcanic eruption, that we treat it as a vertical line source.

The second configuration we need to consider is the pollutant, and we are going to define four pollutants, and each one of these pollutants will have a different particle size. Now for the purposes of this calculation, we're assuming that the total release rate of ash is going to be 10,000 kT per hour. You can find different numbers in the literature for different types of volcanoes, with different types of eruptions. Or there are approaches where the density of the downwind material as seen in satellite photos is used to estimate the magnitude of the release rate.

So we're going to look at each of these species and the first one is going to be the particle diameter of .6 µm, so we give it a unique name just to be able to identify it. And what we're going to do is we are assuming for volcanic simulations that the total mass, this 10,000 kT per hour, is distributed over these four particle sizes, and that the smallest size only will contain 1% of the mass, or this number eight times 10 to the, 0.008×10^{16}, micrograms. So we have converted things to µg to give us an output directly in micrograms.

Let’s go back to this menu here. So that's where we enter these numbers and were going to emit for 12 hours from the start time of the simulation. And the same way each of the four species is defined, the two micrometer diameter containing this release rate, this represents 7% of the mass, and the 6 µm release rate representing 25%

of the mass, and finally the 20 µm release rate which represents 67% of the mass.

Now the concentration grid for the simulation, we defined the grid center along the Greenwich meridian at 45° N. We’re going to use a quarter of degree, about 25 km resolution grid, and we will cover the entire northern hemisphere, the part of the globe above the equator. So a 90° span centered at 45 degrees goes from essentially the equator to the pole. And we're going to only output one layer, this, we’re just going to look at the entire troposphere as a column. So what we would see in the output might be similar to what might be seen by the satellite, looking down over the entire atmospheric column. And we’re going to output a frame, six hour average concentrations, so two frames in this simulation.

And the last thing we need to define, the selling velocity for each of the four species. So they’re .6, 6 µm diameter, and they all will have a density of 2.5 g per cc, and they will all have a shape factor of one. And these particles are permitted to wet deposit and we will let the model compute the gravitational settling velocity, because this field is set to zero. And this is true then for each of the four species, the 2 µm, the 6, and finally the 20, and naturally this'll have the largest gravitational settling velocity.

And finally we will look at the name list. And the main thing in the name list is we are releasing 5000 particles over this 12 hour period. Again this is partly to keep the example calculation time reasonable for doing a demonstration. And, for now, going have the maximum particle number much higher, because as you will see, we will accumulate particles in subsequent steps. So save here.

And the last thing we want to do is open up menu number nine, and we will output a particle file after 12 hours. And that means after, essentially this is only a 12 hour simulation, so at the end of the simulation we will output the particle positions. Note that if a PARINIT file exists, the model will read the file at start up, but at this stage none exists. So now we can go ahead and close this and run model.

This goes very quickly and we can see, for instance from the MESSAGE file, that we are, after 12 hours we'll have released somewhat more than 5000 particles, because of the way the algorithm sets that up, the particle release rate.

But let’s take a look at the particle display and this is after 12 hours, we’re plotting all the particles and you can see that they are uniformly distributed from the near ground to 6000 m above ground level. And as we noted in some of the earlier sections, the particles that are aloft travel faster, in this case there is not much wind direction shear, and that regardless of the level, the downwind direction is approximately the same. But the particles aloft do travel much faster and as I noted, it is well mixed in the vertical, because it is treated as a vertical line source.

Note that if the volcano were of significant terrain elevation that height should be added to the base of the release, or the release sites could be defined in terms of above mean sea level rather than above ground level. But we're not doing that particular correction here.

And the last plot just for completeness, let’s take a look at the contour display, and we should probably, first of all select all pollutants, I don’t really care about them individually, the particle sizes, although you can look at that to see how the distribution changes, and we should probably force the contours to something simple, maybe 100+50+20+10. And that will be units of micrograms. And this is six hours and then 12 hours. So that goes along with the particle display and if we had some satellite data, we could compare this, and there is satellite, it's just not part of the discussion. I don't think we have it anyway.

Alright, that completes the configuration of HYSPLIT for a volcanic eruption. The next section we will show you how to restart the calculation from the particle file.