In the previous section, we did backward dispersion calculations from multiple samplers to determine the characteristics of the source. In the next two sections, we will do a more complicated approach, we will use forward dispersion calculations from multiple potential source locations to multiple samplers, and then try to determine the optimum source based on multiple regression statistics.

To start this we are going to first introduce the source receptor matrix concept. This concept relies on the fact that, when we do a simulation from a source, for instance source number one, the concentration output grid that is generated can be treated as a series of receptors. Each grid point is a receptor. And then if we were to plot this on a map what we would have is the map of essentially air concentrations from the source. And we can do these simulations for multiple sources to get different air concentration maps for each source. That is what we've been doing up to this point. But we could for instance, lay this out in such a way that for each source simulation, we look at, for instance the same receptor or the same grid cell. And if we were to plot a map for instance for column B, for receptor one, what we would be showing would be the contribution of each source to that receptor. And you might consider this something like a source sensitivity map.

So that the sum of all the concentrations for receptor one from all sources, would be the total concentration at that point. You might look at this as, for instance each source

represents a different power plant and a receptor might be a downwind location like a city. If you sum all the values in the column from each source, you will get the total pollutant air concentration at that city. But you can, for instance, normalize it, and determine the percentage contribution for each power plant to that particular city's total concentration. So this in general is what I'm calling a source receptor matrix and we will use this concept to do some more complex calculations.

So to configure HYSPLIT to create a source receptor matrix, let's start with the CAPTEX configuration. First do a reset and then load the name list file that we have saved before, the setup file, and the CONTROL file. And as we did in the last example we will just work with the three-hour measured concentrations. Therefore, we only need to run the simulation for 19 hours, that would take us to 12 UTC on the 26th. The next step is identical to what we did when we computed a matrix of trajectories. We're going to set up the starting locations more than one, we're going to set up three starting locations, that represent the corners of a grid that will define the source locations. And location one will be the lower left corner at 38 and 85, and location two will define the upper right corner at 45 78, and the third location will define the resolution of the interior grid points, and this location three will be the first interior grid point at 38.5 and 84.5. So that means within the lower left and upper right corners, we will define multiple starting locations at half degree resolution.

The next step is, let's go into the pollutant deposition grids

menu, and we will do for this hypothetical calculation, a unit emission, that is we will emit one unit over the three hour release. Which means that the release rate needs to be one third of a unit, or 0.3333. This HYSPLIT calculation at this, for this version of the model, are all single precision, so it is unnecessary to go beyond six or seven significant digits. Also let's reduce the number of output frames, just to keep this example very simple, and let's do an output frame at the end of the 19 hour simulation, a one 3 hour period. Which means that the sampling should start on the 26th the 12, I'm sorry nine, which means we go from 9 to 12, and 12 on the 26th is the 19th hour of the simulation. And save and we can close the changes to the CONTROL file.

Now the, if we would have done the simulation at this point and just go, and I'm not asking you to do this, I'm just showing you, special runs, matrix. In a manner similar to the trajectory approach to matrix, there is a pre-processor program that will read the CONTROL file and generate a starting location in the CONTROL file for each of these grid points at a half a degree resolution. And if we were to do this run we would get one concentration output map that represents the sum of the contributions from all those sources within the domain. That is, however, not exactly what we want. Therefore we need to go to the advanced menu, and to menu number 10, conversion modules, and we need to select number two, the second item here, is that we want the HYSPLIT code to restructure the concentration grid to the source receptor format. And what that means is that instead of having one

concentration output grid, it will have a concentration output grid, an independent output concentration grid for each source location. Which means we can then generate that source receptor matrix, because we will then have for each a unique concentration grid. In other words you are defining an additional array element within the concentration grid to account for each source location. So save, and save, and then not run model, but special runs, matrix, using the setup file, and yes we have three sources configured for the matrix.

It notes that we have 214 sources in this potential grid, and if I were to look in the working directory, you could see in the CONTROL file that was created by the graphical user interface, each one of these there were 225 sources defined, but only 214 were within the domain of the meteorological data, the others were excluded. But otherwise, you can see the changes that we had made to the original CONTROL file, which by the way is called default_conc, so that is what we entered in the graphical user interface, but the preprocessor program turned this into 225 locations.

And the simulation is complete and now the next step is to extract the information from the matrix and that is done through a special menu tab, display, and of course source receptor, and view. Now what this program will do, it will look at the hysplit2.bin output file, which contains concentration arrays for each source location, it will generate a binary output file, and a display plot, based upon what we select in this menu. So for instance, and

there are two selection possibilities, source or receptor, I will not talk about normalization yet. So if we enter source, it will treat the location here as the source location. So if we were to put in Dayton at 39.9 and 84.22, what that would generate is a concentration map, in this case a normalized, a unit source map, that represents the, we extracted the concentrations from the source location, and plotted out the information at the 16 to 19 hours down wind, three hour, the last three hour period that we had selected.

The other option is to select a receptor location, and if we were to point at the same one we were looking at before in Ohio, that station 316, I believe the latitude was 41.3 and the longitude was 82.22, and we were to execute, we can give this a different name I suppose, it doesn't matter, let's just execute display, and now what you see is for this receptor location, which sources in the domain contributed to the values that were predicted here. And you can see that the largest contribution came from a grid cell was very close to the Dayton, Ohio, location. And so this can be used to do many of the kinds of calculations that you would do with a backward dispersion simulation, except there are none of the limitations of a backward dispersion calculations, because we are doing this all in the forward mode.

The normalization flag just divides the results by the total sum to give you a fraction, a fractional contribution. So now you would see that the maximum contribution from this area, that is 40%, 47% of the material predicted here

comes from this red square, and then you would have to look at the probabilities of the other regions, of course they go down as you get further away from that. So it's a way of assigning quantitative probabilities to particular source regions.

Before we exit this we should save the configuration so we can use it again, and let's go ahead and do a save as for the name list, and let's call it matrix_setup and also here, we'll call it matrix_control. In the next section, we will look at using the matrix approach to actually determine the source location in a more quantitative way using the measured data.

And this concludes the introductory discussion of source receptor matrices.