In the previous sections on trajectory statistics, we looked at multiple trajectories from a single location.   In this case we're going to look at multiple trajectories, but all from different locations.   The typical application of this approach would be to identify source locations from multiple measurement sites at different places.   We call this source geolocation.   Fortunately, with the CAPTEX experiment we have measured data available and we can use those measured data to run backward trajectories and see if they converge over the source location.

To get started with this, let’s go ahead and open the trajectory menu tab, setup, and retrieve the forward CONTROL file, the mid boundary layer CONTROL file, which you all know by now is traj_fwrd_control.txt, where the trajectory will start on the 25th at 17 from the Dayton, Ohio, location, at 750 m, for 68 hours and in the forward direction. Let's simplify the output name and just make it tdump, because again, as previous examples, an identifier will be appended to the output file name, corresponding with each trajectory.   Now the reason we are setting up a forward trajectory is that the script will invoke, the graphical user interface, that is, will invoke a preprocessor program to generate backward direction CONTROL files for each sample and it uses the information from the forward trajectory to configure those backward trajectory calculations.

So go ahead and do a save and now go to the trajectory, special runs, geolocation tab, which opens up a menu that's really composed of only three steps. In the first step we need to identify the measured data file. Now this file is located, for the CAPTEX experiment, in the tutorial directory. Let's browse that and find it. So tutorial/captex, it's called captex2_meas.txt. So select that file. We'll leave things alone right now. Zero just defines what is considered zero for the purposes of these calculations, because we will only create backward trajectory calculations for samples, measured samples that are associated with concentrations above zero. Because there is some uncertainty about low-level concentrations, you may want to define a zero concentration at a higher level.

The next step is to create CONTROL files for each one of these measured samples, so let's execute that and we've completed creating CONTROL files. Well what actually happened? So let's quit this for a moment and open up file explorer and go to the hysplit4/working directory and you can see here that we created CONTROL files with a three digit appendix and there are 597 of these. If I were to take a look at the measured data, for instance, let's take a look at the first sample, the first nonzero sample, in capte2_meas.txt, and you can see here that this sample started at 1800 on the 25th. We had a duration of three hours and the value was 15 pg/m^3, 15.6 pg. If I were to go back and look at the CONTROL file that was created for that example, let me look at CONTROL file number one, that's the first nonzero one, and you can see that this one starts at 21 hours which is essentially the end of the sampling period. It starts at the location of the sample, this location. In this case it's mid-boundary layer and it's going to go back for four hours, which takes it to 17 UTC, which is the start of the tracer release. So the information that was generated here was obtained from the measured data file as well as the CONTROL file that we configured for the forward calculation. And for each sample, for each nonzero sample, three files will be created, three trajectory CONTROL files, one for the end of the sampling, one for the middle of the sampling period, and one for the beginning of the sampling period. And then the output file is appended according, the name is appended according to the station number, station number 316 this case, and the starting time of the backward trajectory. So when we did this execute, we executed a preprocessor program and the only thing that is left to do is run the trajectory calculations. And this runs a script that goes through each one of these trajectories, each CONTROL file to create the output files. So I'm going to select execute here, and you can see the message flashes as each calculation is completed and these files are of course written to the working directory, the tdump files with the appended name.

We can monitor their progress by just seeing how far the calculation has gone and we’re not quite halfway through yet. At this point you probably can go ahead and get a cup of coffee or tea while these complete. It probably will take another two minutes.

We're at 550 now, only about 40 calculations left.

And now it's completed. So click continue and we can actually close this menu and when you have multiple trajectory files, we can go ahead and do a frequency display. That is the easiest way to look at results. So open up the trajectory tab, display, frequency, and the base name will be tdump, that we will use as a wildcard to find all the files. So let's create the file of trajectory file names and that was done, and as before, let's confirm that, we're opening up the hysplit4/working directory, open INFILE in Notepad to make sure that there are no unwanted files. And as you can see we have a tdump file that was left over from another calculation, so we will eliminate that, and everything else seems fine, so we can save and exit. And let's make a slightly finer resolution output grid, half a degree, instead of a degree, and we'll leave the residence time and everything else as a default and let's go ahead and execute the display.

So we're done, exit, and that will open up the graphics. And the results are not as encouraging as one might like. The trajectories seem to, the highest frequency of trajectories, seem to be over the Great …, Lake Erie, not Lake Erie, but Lake Ontario and not near the source location, but there is some evidence that the highest frequency is toward the release location. And we know that this is the region where many of the trajectories passed, especially at the seven hundred fifty mid-boundary layer level. As an aside, and I'm not going to do that here, you may want to try redoing this calculation using a trajectory height of ten meters, which is the height at which the samples were collected. You will find that the results actually get more ambiguous because as we have from past examples most of the transport, the tracer transport, does not occur at 10 m, it actually occurs more mid-boundary layer, and mixing at different levels spreads the material in various directions. So a simple trajectory calculation is difficult to reproduce the characteristics of the flow.

Another point is that, this type of experiment where we have a single source and the measurement locations are all downwind in approximately the same direction, makes it difficult to use the measurement data to triangulate the source location, because all the trajectories really need to go in the same direction. For instance if we had a source that was located in the middle of our sampling network, then as the flow changes from day to day, and we collected different samples a different geographic locations about the source, it is much easier, computationally, to triangulate the source location with much less uncertainty.

We will look at other geolocation approaches in the concentration section. And this concludes the trajectory statistics, multiple trajectory discussions.