In this section we will examine an approach that we can use to determine absolute trajectory error.   Up to this point, our calculations on trajectory error in some ways were relative.   But the CAPTEX experiment also provides us some aircraft measurements of the tracer concentration. And we can use those aircraft measurements to do a backwards trajectory calculation and the closer that, or the distance that that trajectory, that backward trajectory, comes to the source location, which we know exactly, can provide us with a more absolute measure of the trajectory error.

So to start this, we will first examine the aircraft data.   In the tutorial/captex section you'll find files starting with the word flight, so the aircraft flight that was conducted for experiment number two at 914 m above sea level can be found there.   Aircraft data are usually referenced at a constant pressure level and this pressure level, that the aircraft flies at, is done usually referenced with respect to mean sea level.   So if you look at this sequence of measurements that were made aboard the aircraft, you can see the start of the sample time, the duration, and the position of the aircraft at the start of the sample collection. And I'm going to focus, in this case, on this last segment here, this segment here, where it appears that the aircraft flew through the plume, and where it is essentially zero at one end and zero at the other end. It essentially captured the entire width of the plume.   And we can see that the peak concentration occurred over this six minute period, very close to hour three.   So we will use this location as a starting point for the backwards trajectory calculation.

So let's go ahead and open up the trajectory menu for setup run. Now instead of starting at the 25th, and looking around, these, this aircraft measurement to the nearest hour, right at this point with meteorological data every three hours, and six minutes isn't going to make much difference here, so we will start the calculation on the 26th at 0300. And you need to start from the measurement location, which happens to be 41.09 and -82.52, and we know it was 914 m above mean sea level. All the data in this file were collected at that height. Now the other issue is the run duration, so if we want to go back to the start of the tracer release, that will be at 17 UTC the previous day, that will be 10 hours, backwards 10 hours, so we'll set this to 10 and click on backwards. So we can see the sign is now negative. And we should give the output file unique name. Let's use 0914 and we're going use the North American Regional Reanalysis data again, so let's clear this, and add the meteorology file, captex2_narr.

So now let's go ahead, and before we do the calculation, right, there's one other thing, we need to let the model know that the calculation is occurring at a height relative to mean sea level. So we need to go to the advanced tab, configuration setup, trajectory, and menu #2 here, where we define the MSL units. We will change this to be that the height, the input height in the CONTROL file, will be relative to mean sea level. Technically that means that the namelist variable KMSL is set to one, so we can save, and save.

And now we can go ahead and do trajectory run model. It's found the namelist file, which we just created, so we know that's what we want, so click on run using setup file. And the calculation finishes very quickly. And now we can go ahead and do the trajectory display. If I just do a simple display, you can see this back trajectory. But it would be nice to have a reference point. Where is the Dayton location? It would be illustrative to superimpose upon this the previous forward calculation that we did for mid boundary layer.

So we can at this point just do, you know, just plus the other filename, but I want to do something slightly different here, just for illustrative purposes. So if you go to the working directory, the hysplit4 /working directory and we're going to create a new file in this directory. And I want to create a new text file. And I'm going to call this file, let's say traj_files, traj underscore files. We're going to open this and I'm going to add the names of the trajectory files that I want to plot. So for instance, tdump_fwrd and tdump_ 0914 and now just do a save and exit. And so now we created a file of filenames and in the trajectory display program, if I were to start the output file here, the endpoints file that the plotting program will read, with a plus, then the plotting program interprets as a special file of filenames and it will plot all the data that are contained in the file with this particular file name. So now if I execute display, you'll see the two trajectories, the red is the 750 forward mid boundary layer trajectory from Dayton, and the blue is the backward trajectory that we just calculated from the aircraft peak sampling location.

And you can see that there is somewhat, let's call this absolute error here, but you also have to remember this this was a wide plume, and we just selected one point in this plume. And the distribution is not necessarily, you know we didn't get there in a uniform fashion, necessarily, because the wind directions vary with height, and so that the plume may be skewed to different directions at different heights. But you can use this to give you an approximate estimate of the absolute error of the calculation.

So just to wrap this up, since this worked, we're going to go ahead and save the, the control file, for instance so that you can use it for other examples. We'll call it traj_0914_control.txt and you should do the same thing with the advanced menu, the namelist file, do a save as traj_0914_setup txt. So you may want to go ahead on your own and try this with some other aircraft flights. There were flights that were made at different heights above mean sea level and at different locations downwind during the experiment. The 0914 MSL flights were the flights that were closest to the Dayton release point. There were are other flights that were made later on and further downwind, that might prove interesting to look at, but we will not do that here.

This concludes the absolute trajectory error discussion.