In section 13 we're going to look at air concentration uncertainty. In the first section, we'll do a calculation that is very similar to what was done during the trajectory section. We will place a hypothetical cube about the starting location and run dispersion simulations using the meteorological data offset by the distance to each of the corners of the cube. As we had seen in that trajectory section, there would be 27 starting locations to account for offsets in the grid, in the meteorological grid, by one unit, positive and negative, in X, Y, and Z.

To start this calculation let's go back and retrieve the CAPTEX configuration for the surface concentrations, that is the CONTROL file and the name list file. Open up the menu, and let's go ahead and retrieve the CONTROL file and the name list file. Let me remind you, this is what we did with the trajectory calculation, the trajectory uncertainty, and that cube centered about the release point.

Now the next step would be to change the release location slightly and that is because this cube is offset also in the vertical direction as well as the horizontal direction, we need to raise the starting height to about one grid point, which is approximately 200 m above ground level. Therefore we will have a multiple variation in height. Also we do not need to run for the entire duration of the experiment, because we’re going to only be looking at some data that do not quite go all the way to the end, so we can save some computer time by only going 52 hours, and that will take us to approximately 21 UTC on the 27th.

We should probably change the name of the output, of the binary output file, so that we can keep track of things. Let’s just call this ensemble.   And again and we can reduce the number of output frames by maybe starting the output approximately 12 or so hours after the experiment, so let's say the 26th at 06. And I think that should be sufficient and let's save this configuration, as ensemble_control.

And we'll make one change to the name list, maybe two changes.   Let's reduce the particle number, again just because we’re going to be doing 27 simulations and this is going to take some time, so let's go down to 10,000.   And if you recall the basic simulation, the CAPTEX simulation also had particle file output, since you'll be running this 27 times, we don't really need to see the particle output; we don’t really need to see the particle files.   It will cut down on the time requirements, so make this zero for both fields, and therefore there will be no particle file output. And we can save this as also ensemble_setup, save, and then save.

The next step is simply to do the special runs ensemble. We are doing a meteorology ensemble in this case, and this calls a special executable that is designed to do the meteorological offsets, offsets in the data when doing the calculation.   All calculations are done from the Dayton, Ohio, release point, it's just that the meteorology is slightly offset, to provide you with some sense of the sensitivity of the calculations to gradients in the meteorological data fields. And we are starting the ensemble calculation. Yes. Now this may take approximately 10 minutes, so I would suggest you may take a break, and we will come back in a little while and look at the results.

As you can see we're almost complete, it is now doing the last simulation. In fact we're finished, and if you were to look in the working directory, you will see the output files, the binary concentration output files for each member, from one through 27. The next step is to display the results. So we open the display menu for concentration, but this time we go to ensemble, and we're going to go to view map. And the display, the ensemble display, invokes a post-processor, that will sort the output files, the 27 output files, ensemble.001 through 027, and sort them by concentration at each grid point. So there is a different sort at each grid point and it will then generate output files, binary output files that can be displayed through the normal concentration plotting program. So for now what we're going to select for the output, will be, and there are several selections possible, we're just going to look at the median concentration, the concentration at the 50% level. And simply at this point once you've made the selection, all you need to do is execute display. And the resulting output represents the median concentration, this PC 50 here is the label, at each three hour sampling period for those 27 members. So for instance, the grid cell here has been sorted, and this concentration, the $2x10^{-9}$ in grams per cubic meter, because we did not do any conversions, represents the median concentration, that is half of the members had higher concentrations and half the members had lower concentrations at this point. The member with the median concentration maybe quite different at this grid cell than the member with the median concentration at some adjacent grid cell. So, as I said, each grid cell is sorted independently over the, by ascending concentration for those 27 members.

So another way of looking at this is to look at a single point and look at a box and whisker plot map or a box plot map. And if we select a location here in the middle of the plume, we already know where it's going, so approximately I'm going to say around 42 N and maybe 79 W; somewhere around here. If we're going to select that location, maybe we can maybe look at a time series there, and that's got to be our next step. I will leave it to you to explore some of the other options here for doing plots. You can do a mean plot, member mean plot, or the variance among the members, or you could do the 90th percentile concentration map, which means that for the concentration that is shown, only 10% of the members would have a higher concentration than the concentration drawn on the map.

But let's quit this for now, and let's look at the other display option and that is the box plot display. So concentration display, ensemble, box plot. So we need to select a location and I said around 42 N, 79 W, and if we go to the CAPTEX report, we would find that location is the Little Valley New York station and we should enter that in here, and then we can execute and end up with two graphics. So this first graphic shows us the box plots for each sampling time at that location as the tracer, the computational tracer, moved through the domain and this represents the range of concentrations that would be predicted by those 27 members. Also, looking at this the bars here represent the 10% and the 90th percentile concentration, 10 to 90, the quartiles here are the 25th percentile to 75th, the line here is the median, this represents the mean, and then the 5% and 95th percentile concentrations. So for this particular one, the range of concentrations, if I look at the 10th or 90th percentile concentrations. So for this particular one, the range of concentrations, if I look at the 10th to 90th percentile, is approximately, at least in order of magnitude, and if we go on the 95th percentile, we're maybe a factor of 40 or 50. So there's quite a range and this range is strictly because we changed the meteorology by one grid point, so that represents the sensitivity to the gradients in the meteorology.

The second plot that's generated is, you can see which members contributed to those concentrations at the different percentiles, which member was closest to that value. And the last thing, which I'm not showing here is, we really can look at the concentrations for station 510, Little Valley New York, and we've separated them out here, these are actually are the measured concentrations. But unfortunately, the plotting program, the box plotting program, has no capability to put additional information on top of that. So just for your convenience, we did plot these measured values here, and you can see that, at least for the peak period, the peak concentrations, the measured values were very close to the predicted means, but the measured concentrations did persist longer than any of the ensemble simulations.

So the last point I want to make is that these ensemble members that you created, there is a table where you can find out what the offsets are. So, for instance, simulation run one has no offsets, so this is the base calculation, run number two has a one grid point offset in the Y direction and this information is found in the User's Guide. And also I should add that you can control the ensemble by going into the advanced menu number 11, and here you can change the defaults for the grid offset, the default being one for X and Y and .01 or about 200 m for the Z direction.

And this concludes the meteorological ensemble.