In this section we will examine the sensitivity of the air concentration calculation to the mixed layer depth. If you're continuing on from the previous section, then we will go back and use the original default case as a starting point. So you should go ahead and load, or retrieve rather, the original CONTROL file, and the original name list file for the base case, the optimized base case.

Now if you recall in the previous sections, the equations for mixing did have the mixed layer depth as one of the variables. So we want to examine how direct the change in mixed layer depth would be in terms of effect on the concentration. Now the default is for the meteorological model to provide the mixed layer depth already computed for HYSPLIT to use. And you can see this in the MESSAGE file for the WRF simulation. For instance the last one that you did, if you are continuing on, shows the variables that the model found in the meteorological data file. These are flagged with true or false and you can see that the mixed layer depth is true, which means that that field was available in the meteorological data file, as was the heat flux and the friction velocity. So when the turbulence parameters were computed the default of using the fluxes was valid because the flux fields were available.

So what we're going to do is redo the calculation, the base, the optimized base calculation, but this time instead of using the, we’re going to open menu seven again, instead of using the mixed layer depth from the meteorological model, we will compute the mixed layer depth from the temperature profile. And the way

HYSPLIT does that, is it looks at the potential temperature profile from the ground going upward and when potential temperature exceeds 2° from the ground level value, that height is assumed to be the height of the mixed layer depth. This is a very simplified approach, but it is quite effective because it is simple in that in a well mixed layer the potential temperature is approximately uniform with height, and then there is usually a large change or increase in potential temperature at the top of the mixed layer. So this approach eliminates sensitivity to small fluctuations in stability that may be found in observed data.

So go ahead and select from temperature profile, save, and run the model, and then display. Remember we're displaying the 1000 meter level only, we have the multiplier for picograms, we are setting the contours, and we are plotting the measured data as well. And this result looks very close to the original calculation; 33,000 is the peak in this case. If you don't remember the original calculation, it's actually saved here, this was the calculation for 31000, showing 31000. So the approach of using the temperature profile was comparable to that of the mixed layer depth from the WRF model.

Just to show the sensitivity, we can force a different value, but before I do that let's take a quick look at the mixing by opening up the MESSAGE file. And by looking at the mixing, what I mean is let's look at the profile, the vertical profile, and you can see that all the mass, all the particles were below 2500 m. So let's arbitrarily double the mixed layer depth. One of the options within HYSPLIT is that you can force a mixed layer depth. And we can force this mixed layer death by setting it is as a constant and we will put in the number, we will double the height, let's make it 5000, and then save, and run the model again. Notice there is a message here about puff splitting turned off. I will discuss that in just a moment.

Let's look at display, and you can see that the maximum concentration now is 16000, so it's approximately half and the contours also correspondingly show lower concentrations. So we have effectively created more mixing. Let's look at the MESSAGE file, and it's always a little of a trick for me to expand this window, and if you go down to the profile, you can see from the profile that the particles are almost uniformly all the way up to almost 6 km. So it was quite effective, directly effective in the sense that we doubled the mixed layer depth and halved the concentrations. And the reason we got the puff splitting message was because we have more levels that the puffs are being followed, being tracked. And remember puffs, and this is a Gaussian puff horizontal, particle vertical, calculation. The puffs will split in the horizontal, and we have now more levels at which puffs are splitting, and that makes the puff merging routines less effective, because the puffs have to be somewhat close to each other in the vertical for them to be merged. You can eliminate this message by just increasing the array size, that is puff splitting turned off, expand the MAXPAR. You can do this as a test and I think you will find that this has no effect upon the results.

And just briefly and let’s reduce the mixed layer to half this amount, and instead of the 5000, we will make it 1250, and save, save, and display, and you can see that the peak concentration is now 60,000, so we've essentially doubled the concentrations from the base case.

So the point of this is that although the mixed layer depth is used in the equations to compute the dispersion rates, the particle dispersion, or the puff growth rate, and the puff growth rates will be slightly different, depending upon the mixed player depth, it is a secondary effect, and the primary effect in this case, which is a well mixed case, this is an afternoon mixing situation, is that the mixed layer depth is directly proportional or indirectly proportional, in that when we doubled the mixed layer depth, we halved the concentrations.   So it's important in that respect.

The last point is the parameter that's being changed when you set this, if I can find it, here, is the KMIXD parameter, and normally if it is zero the model will use the mixed layer depth from the input data, if it’s one it computes it from the temperature profile, if it’s some other larger number it uses that for the mixed layer depth.

And this concludes the discussion of boundary layer depth.