In this section we will examine the revised dust emission algorithm that uses a variable threshold friction velocity. In this type of algorithm, the parameters are based on a climatology of satellite observations, satellite observations of the airborne dust, and these were compared with meteorological data at those grid cells that were showing a dust event. For details on this approach, we would refer you to a publication that is referenced in the tutorial section.

The equation is a simplified version of the original equation, in there are only three terms, well four terms, the threshold, the friction velocity, threshold friction velocity, the emission area, and a dust density, soil dust density that represents the capacity of the soil and that grid cell to emit dust. And the main difference between the approach, the constant threshold approach, and the variable threshold approach, is that in the CONTROL file, it's the same situation, we have two additional fields, but instead of the field being -1, this field represents the threshold friction velocity in that particular, or for that particular location, and it can vary according to the location. And the second term represents the product of the area of the grid cell times the soil dust density, and the area is fixed because it comes from the satellite observations. So this represents a fixed data set, you cannot change the area. Every emission grid cell represents a quarter of a degree resolution. And in the tutorial/dust directory we do provide you with a zip file that contains all the dust locations by month. So they vary by month, the dust emitting grid cells. There is a file for both the CONUS and for the global region. And what this file shows is simply, for instance for the Salt Lake City region, we extracted from the monthly file, that is for the month of March, all the dust emitting grid cells in, around the, around Salt Lake City region.

So the computer is set up the same way, that is the ICHEM parameter needs to be three, but when the code sees a non-negative number here in the social field event uses the new revised algorithm as seen here. So from this, we've already extracted, like I said, those 21 locations. Now in the previous section when we did that simulation, and the results are still here in the working directory. We actually identified from the half-degree land-use, we identified 26 locations in that region, that were defined as desert land-use. However, in the new approach, we only found 21 on the quarter degree resolution. So that is for that five-year climatology, only 21 locations showed some dust events. So just as a reminder, the statistical results that we had gotten with the fixed method, remember showed a correlation of only 0.5 and a factor of ten under-prediction.

So to configure the simulation, we go to the setup menu, and we will retrieve the CONTROL file from this case, it's called dust2, and we should do the same thing for the name list file. Well since we are continuing on, I’m going to do a reset and then retrieve, and it was setup_dust. I'm not going to review the parameter changes in these files, go to the discussion in the previous tutorial session on the changes that are required. This is all the same.

So now if you look at this, we have 21 locations defined here in this menu, with the starting location and the threshold velocity and so on, but we're not going to edit any of this. So these are the actual locations that came, possible potential dust locations that came from the satellite climatology.

Now to run the simulation, the only thing that is different is that we do not have to do special runs, because there is no preprocessor involved. The only thing the preprocessor does is identify the dust locations from the database, from the land-use database, for we have already done that, therefore all we need to do is run model. And otherwise, I didn't mention the name list was the same as in the previous fixed threshold simulation.

Now that the simulation has completed, we can go ahead and do the display again, and this time the output file is dust2 not dust0. And we're setting the contours, we're converting to µg, we don't need to define the measured data file and let’s execute. And you can see in the simulation that was even worse; the plumes did not go as far, the concentrations are much lower. To see things in the Salt Lake City region, we would have to lower the contours even further.

So we could do a statistics Convert to DATEM and we will select the measured data file, that is AirNow_dust in the tutorial directory, and we’re doing the conversion to µg and we will create the DATEM file, compute the statistics.
And if you recall in the previous plot of the fixed method,

we had a correlation of 0.5, so our correlation coefficient is increased, but the ratio of calculated to measured is, you can see here, it's probably a factor of 500 too low.

And same thing with the scatter plot, it just doesn't even show up. So even though our correlation was better, our bias was much worse. And the issue here is that this represents a climatology. So these locations that we looked at had dust events in the five-year period that was examined, but the conditions change. I mean there could've been flooding one year, or one year was drier than another, and certain regions might have less dust available to be emitted. I mean these things change from year to year. For example, if you had a wet year, a particularly wet year, there may be much more vegetation the following year, resulting in less potential dust emissions, or perhaps requiring a higher threshold friction velocity. So using a fixed data base to predict dust emissions is actually very difficult.

And before we wrap this up let me go back and just take a brief look at the working directory, and look at the MESSAGE file that we just created, because there was one unresolved item from the previous section that I wanted to mention, was you know we had a particle release rate of 50,000 and you can see here that as the calculation goes on, we're only releasing, in this case about 100, well the first time step 160 particles. So you can see that we never really approach the 50,000 mark for the particle maximum, 12,000 might be the largest number that we were seeing.

But if we had a lower, here you have 20,000, so if we had a lower number, instead of a hundred thousand as the particle emission rate, if we lowered it to 50,000 then these numbers would be half. So the maximum particle number we would be seeing might be only on the order of 10,000, just because the way the particle emission rate is computed.   It's based on the number of sources and the number of emission times.

So that the next thing that we want to do is let's take a look at, is there something that can be done to improve the dust calculation if we only have climatological data to work with.

So that concludes the discussion for the emissions using the revised algorithm.