Using JMARS for Crater Counting

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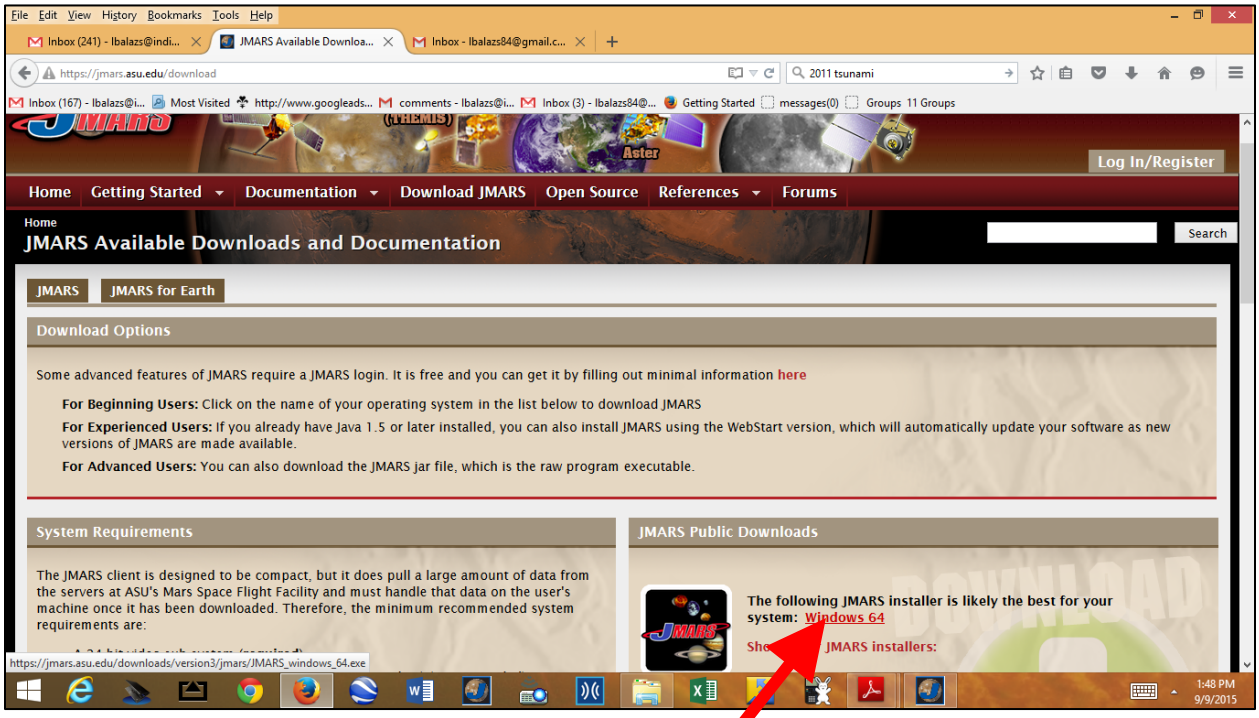
To begin, you will need to download JMARS. I have a Windows machine, so these directions may have to be adapted for a Mac or IMac.

https://jmars.asu.edu/download

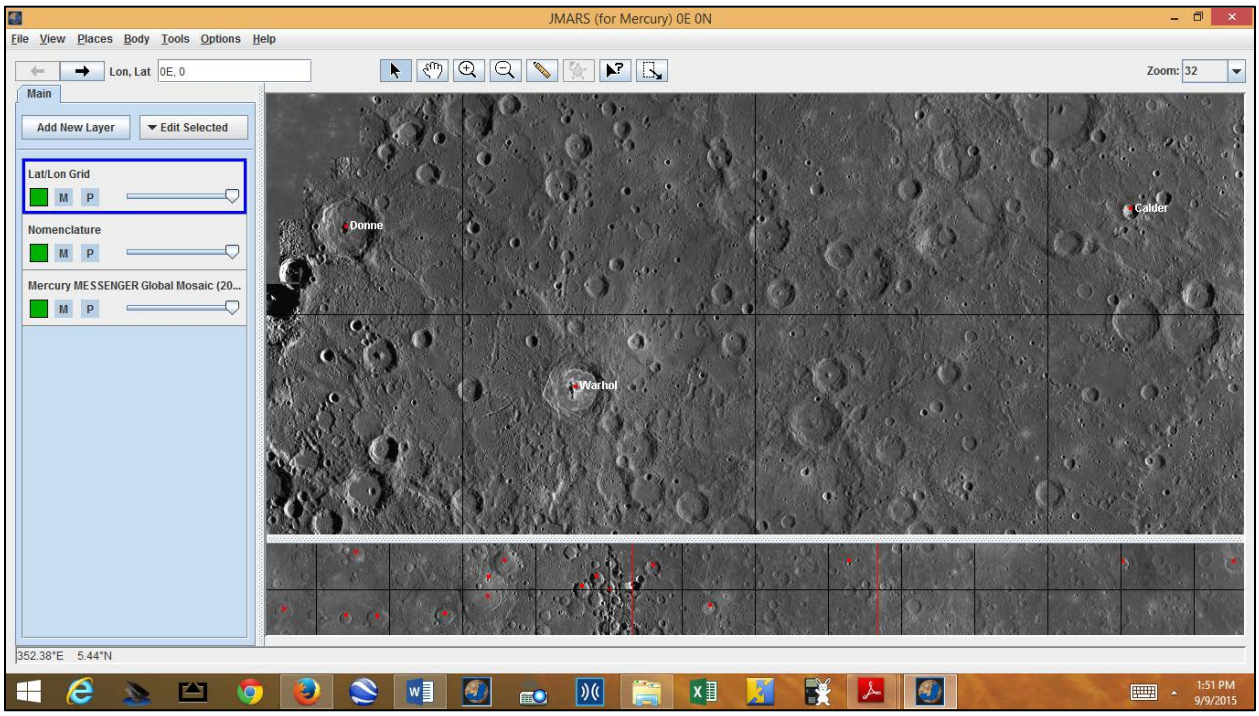
Save the file, and then click on it after it has downloaded to install it.

It will open up a small window that allows for a password and username to be entered. You can set that up, if you wish, or just “continue as guest”.



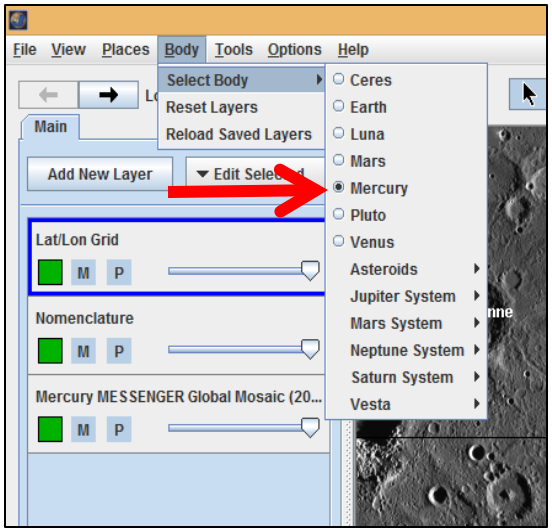
Click here to download----

Once you have “logged in” – the program will open and looks like this:



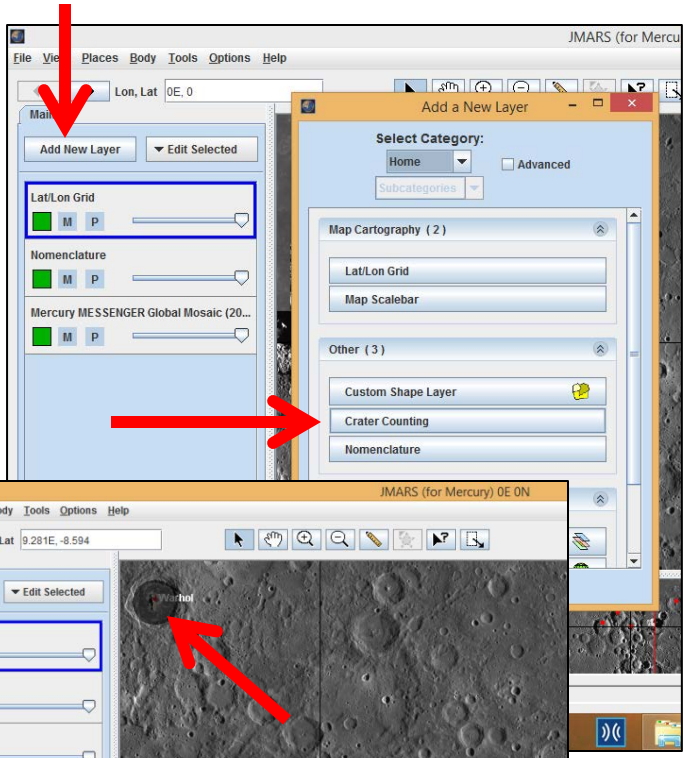
There are excellent tutorial videos available on the JMARS website (http://jmars.asu.edu/videotutorials) and it is worth the time to watch some and see what the capabilities are for this free tool.

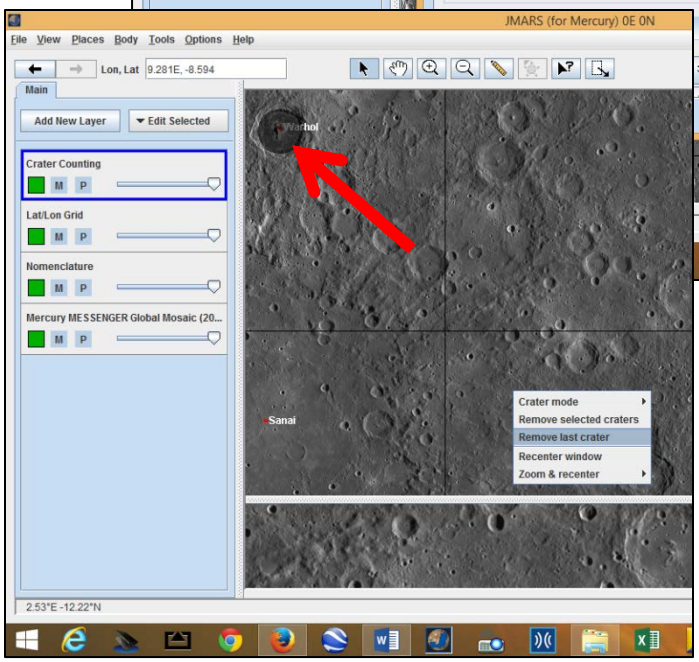
Here, we are going to focus on using it for crater counts – to help estimate the age of the planetary surface.



JMARS has layers for multiple bodies in the solar system. In the figure at the left, Mercury has been selected, but you can choose to look at many different planetary surfaces. We will use Mercury!

Click on “Add New Layer” (right). Select the “Crater Counting Layer.” You will notice that when you move the cursor onto the image, a circle marked “100 km” appears (right, below). To make the circle larger, use shift + key, and to make it smaller, use the – key. To mark a crater, move the cursor over the crater and left click. If you make a mistake, just right click and you will have the option to remove the last crater. You can also mark craters by using a different mode of marking 3 points on the crater. I have found this method works really well and is not at all frustrating.

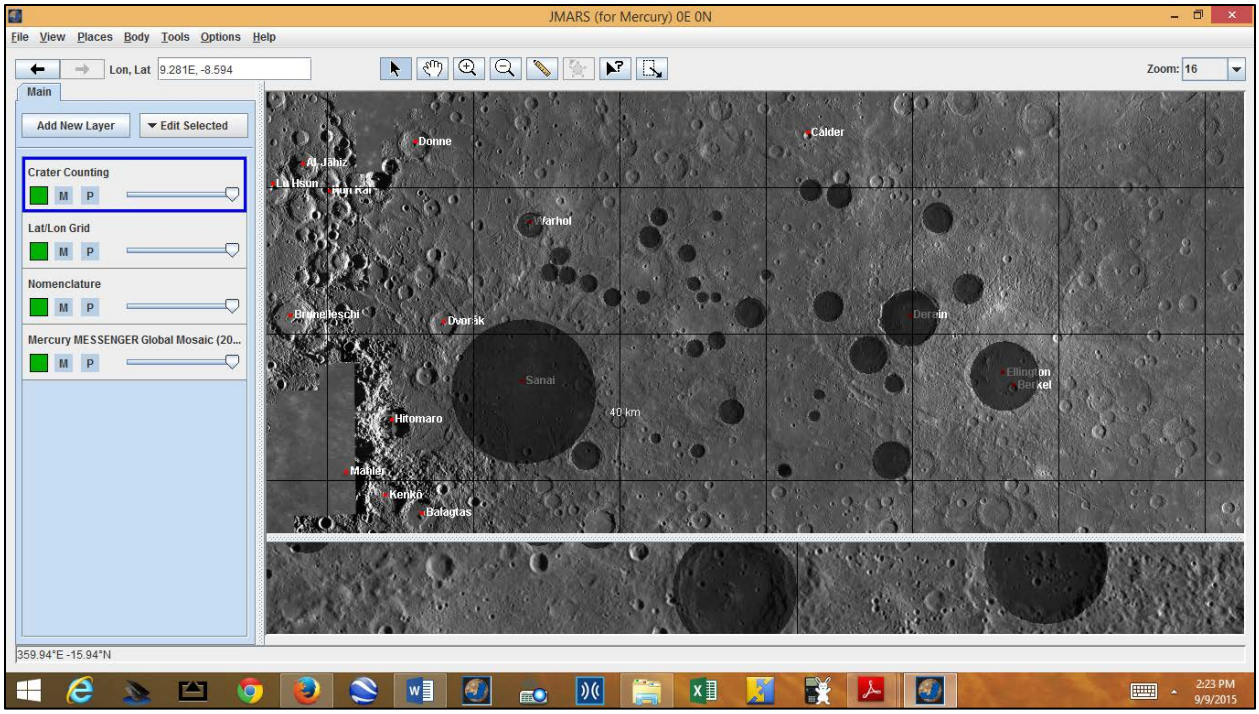




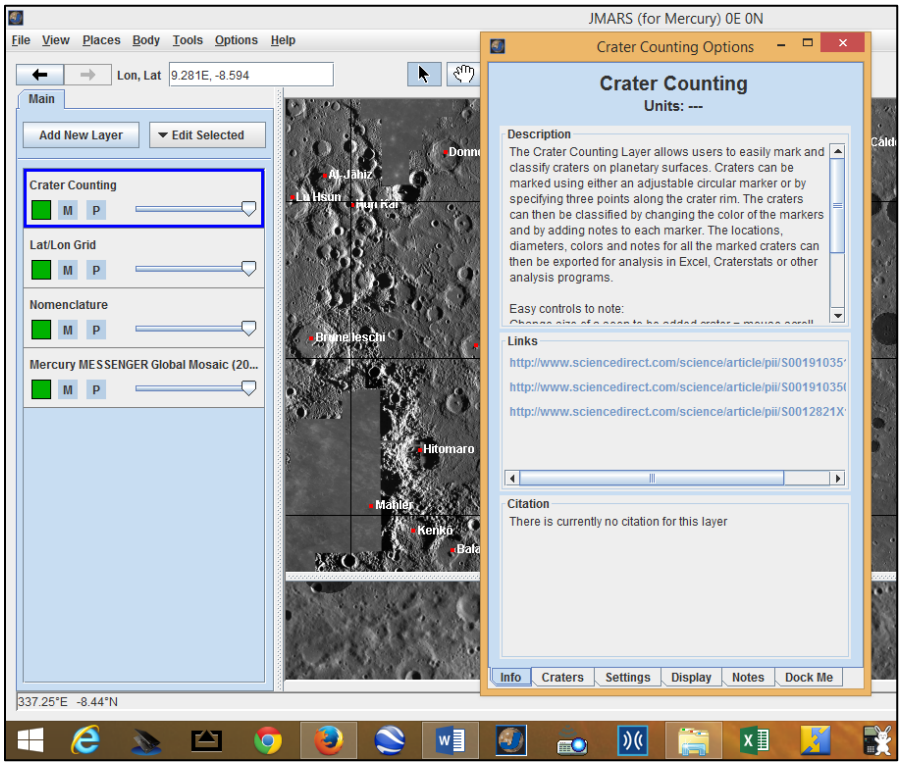
You can change the zoom on the image to show the smaller craters, just be careful as you will want to stay within some predetermined boundaries. Use the lat/lon lines on the diagram to help you.

It is important also, if you are planning on using this tool to determine surface age, that you determine how big the area is in which you are counting. For that, use the TOOLS tab and choose “Measure”. A pencil will pop up and you can measure how large each square is (look on the bottom bar to see the measurement). You will need to have the measure of the area in squared meters in order to calculate the surface age.

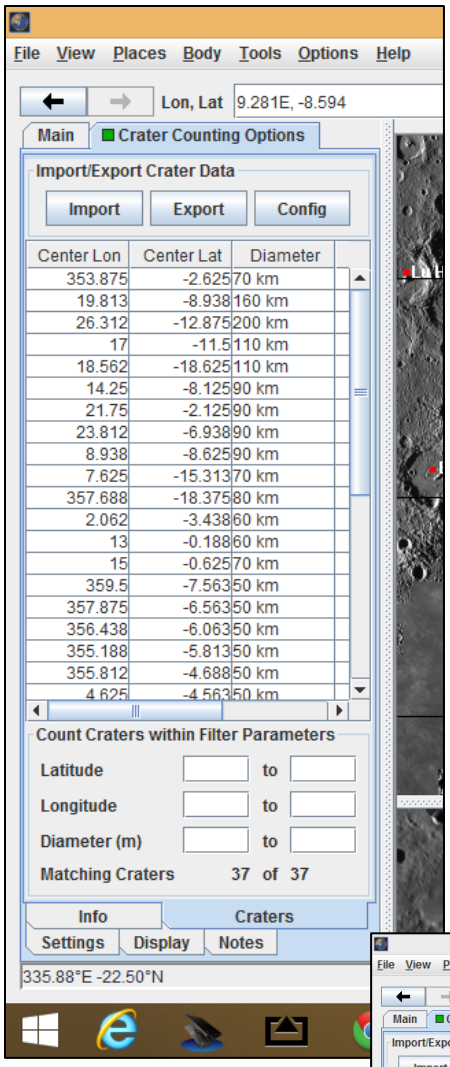
Once you are done marking craters, your image might look like this:



Click “Edit Selected,” then “Open” and a window pops up:



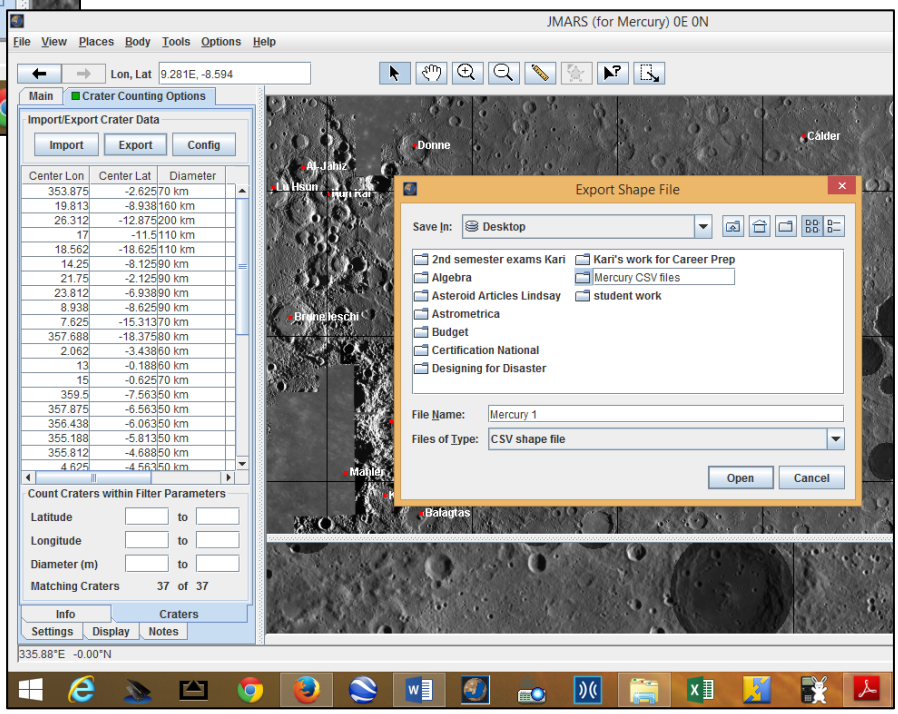
Choose the “Craters” tab and you will see this:

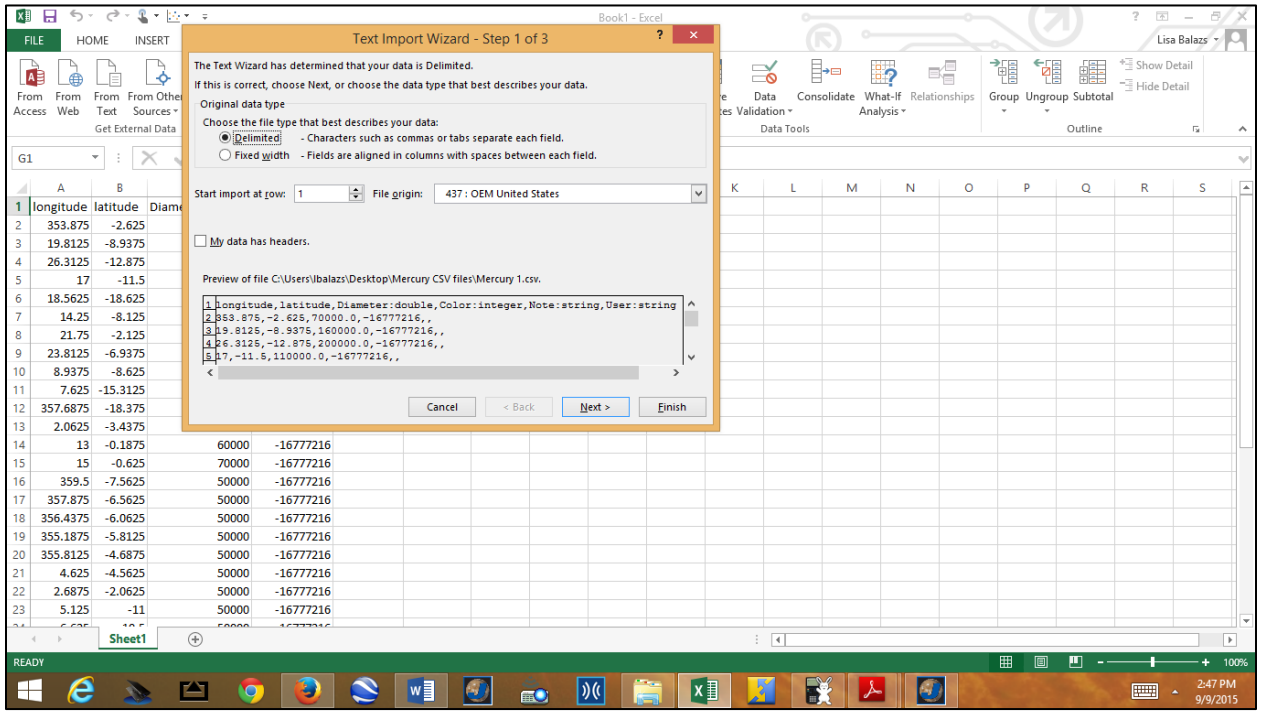


All the data is recorded and you can export this file to Excel! Click “Export” and save the file (below). It will save the data as a .csv file. I like to put them in a new folder on my desktop. If the data in the .csv file is not already separated in columns, it is helpful to make it so. To separate the data in its own columns, you will need to “delimit” the data:

- Open a new Excel workbook.
- Choose “Data” and “From Text”
- Choose your file and click “Open”

Another box will pop up (next page). Click “Next” and THEN, unclick “Tab” and choose “Comma” as your data is delimited by commas. You will see that, in the preview box, the data is now in neat columns and rows! Choose “next” and then “finish” and your data will be inserted into your table. You will have a column for Longitude, Latitude, Diameter and a couple of other random ones. The only one that matters is the Diameter column. Note that the diameter is now recorded in meters.

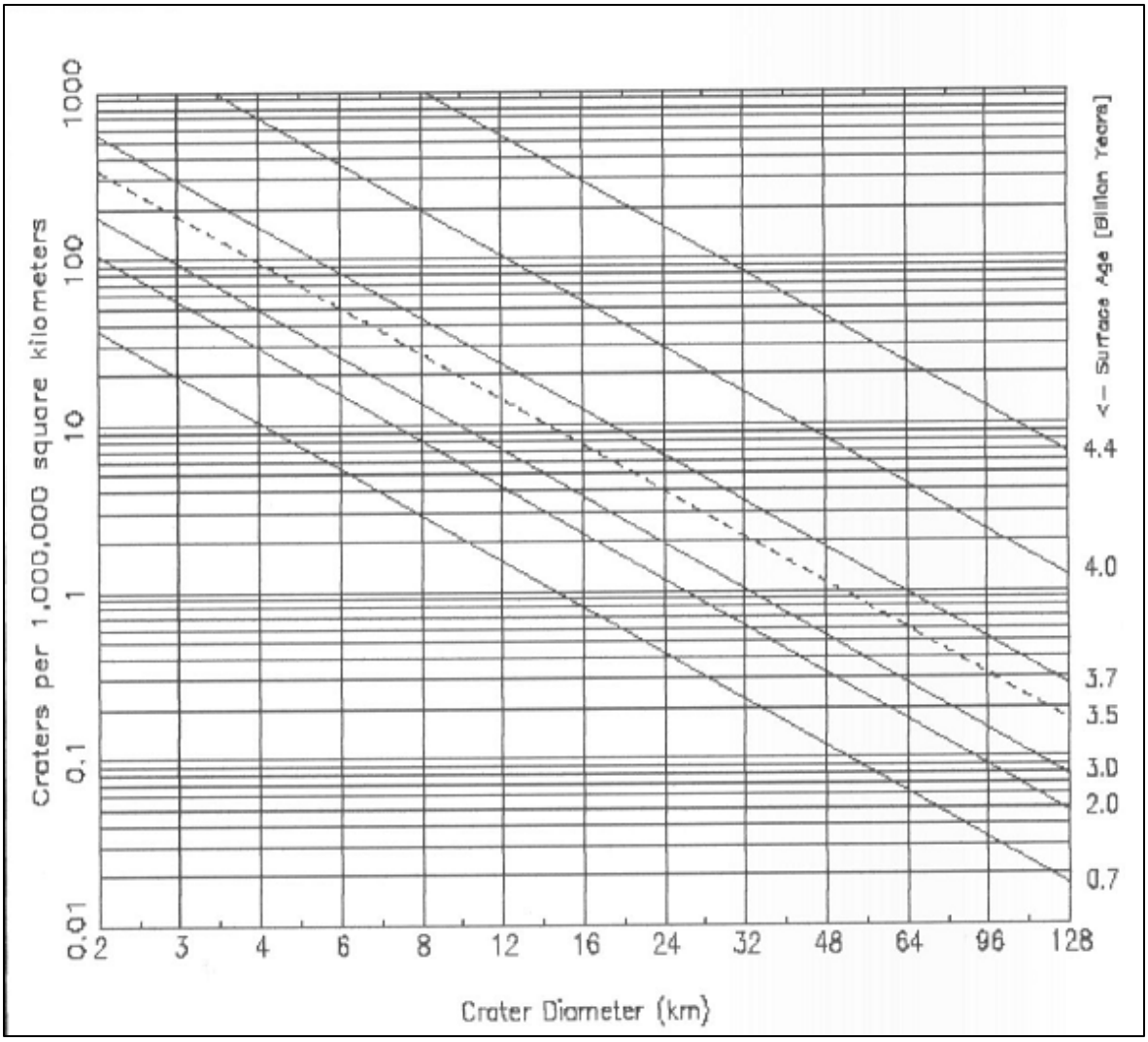




From here, you have 2 options. The first option is to use a graph to look at the average age of the surface. To use the graph you will need to "bin" the data. This means you need to count the number of craters of each bin size (for example: all craters that are between 0-8 km, 8-16 km, 16-32 km, 32-64 km and 64-128 km). Then you need to scale the number you have counted to a standard area of 1,000,000 km^2:

Number of craters per 1,000,000 km^2 = Number of craters × [1,000,000 km^2 / image area (km^2)]

Then, using the graph below, you can plot those numbers. Make sure to pay attention - this graph is a semi-log graph, so the y-axis (or number of counted craters) is marked in increments that are logarithmic. The lines that are diagonal on the graph are the surface average age lines.



While I like the graphing aspect of this, my preference is to use the Neukum Production Function instead. This requires some tricky use of a graphing calculator, but seems to work really well. The production function is a curve described by Neukum:

$$N(1) = 5.44 \times 10^{-14} \{\exp[6.93T] - 1\} + 8.38 \times 10^{-4}T$$

N(1) is the total number of craters greater than 1 km diameter/km^2 [so you will have to calculate that ratio - total number of craters/area of the region in which they occur in units of km^2]; *T* is the crater accumulation time (the average age of the surface) in gigayears. I have had good luck with using a graphing calculator and entering the Neukum function as $Y_1 = 5.44 \times 10^{-14} \{\exp[6.93T] - 1\} + 8.38 \times 10^{-4}T$ and $Y_2 = N(1)$. Then you can use the trace function and find the intersection of these two lines. The intersection is the age of the surface in gigayears (billions of years).