Crater Density and Latitudinal Dependence: 10 km and 100 km Craters

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Introduction

The Moon's craters mostly come from two different time periods in which the moon was impacted by different groups of small bodies. The first period took place between about 4.1 billion years and 3.8 billion years ago. There was a cataclysmic heavy bombardment of material onto the surface of the Moon during that period. It lasted only a few hundred million years. The second period took place between 3.8 billion and 1.0 billion years ago, and is called Intermediate Cratering. These impacts continued at a steady pace during this time frame. Because the moon lacks of water, atmosphere or tectonic plates, there is not much erosion. As a result, the cratering record is extensive, and tells an interesting story of the geologic history of the Moon. We wanted to know more about the Moon's crater density and how the crater density might vary with latitude. We counted craters with a diameter of 10km and 100km in latitudes from 60 degrees south to 60 degrees north. We found out that there is an increase in the numbers of craters in the lower southern latitudes but a decrease when closer to the equator. We also found out that in some of the latitudes there is a small correlation between latitude and cratering density.

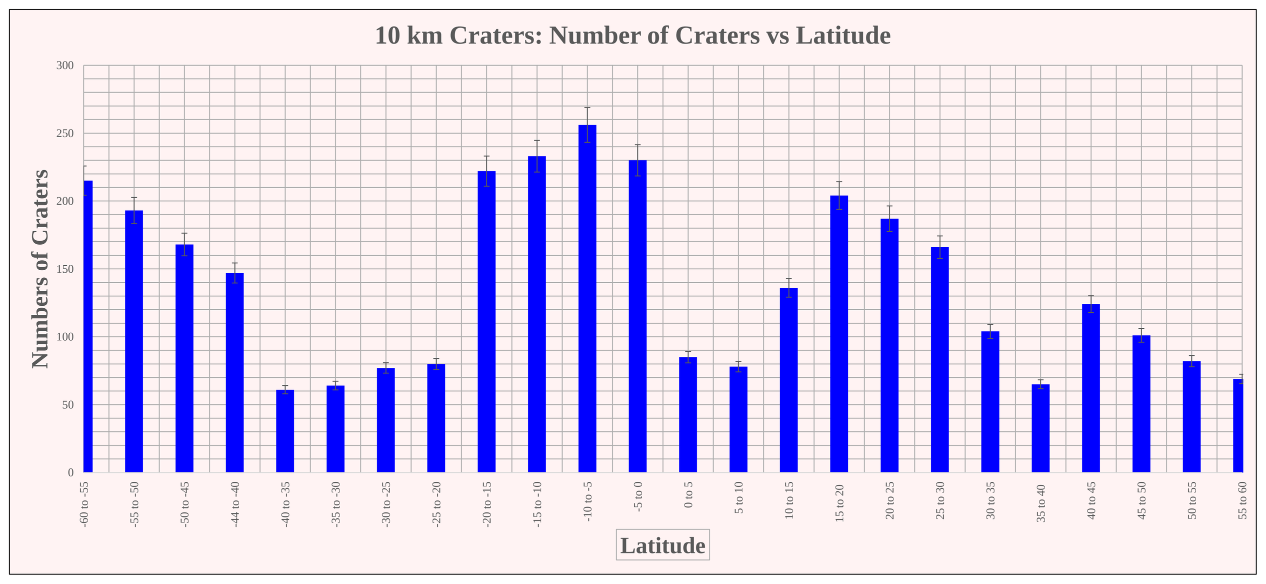
Methods and Materials

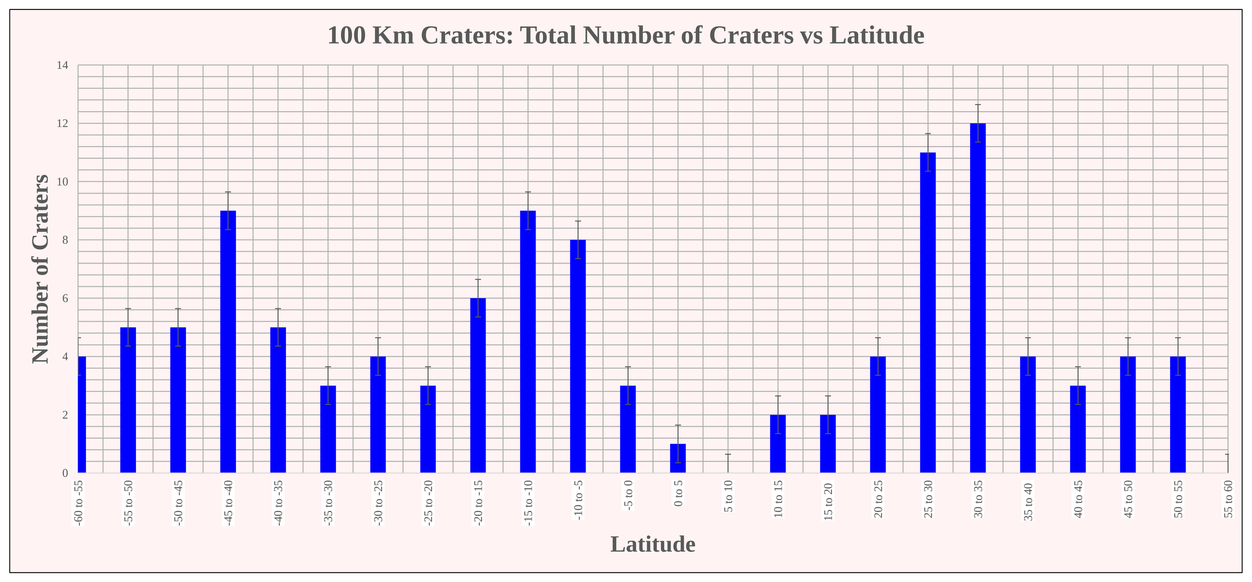
JMARS is a Geospatial Information System developed by ASU's Mars Space Flight Facility that is available to the public. We used JMARS to locate and measure lunar craters 10km and 100km in diameter. We used the LROC WAC Equatorial layer, the crater counting layer, and the latitude/longitude grid layer. The equatorial layer provided the best images for seeing the craters. The crater counting layer allowed us to mark every 10 km and 100 km crater we observed. We exported the data sets to Microsoft Excel. We kept track of latitude, longitude and the crater count. We used our findings to calculate the amount of each type of crater for every 5 degrees of latitude and the crater density (the numbers of craters per km^2) for every 5 degrees of latitude. The formula we used to calculate the area of each latitudinal band is:

Area = $2\pi R^2[\sin(\text{latitude1}) - \sin(\text{latitude2})]$

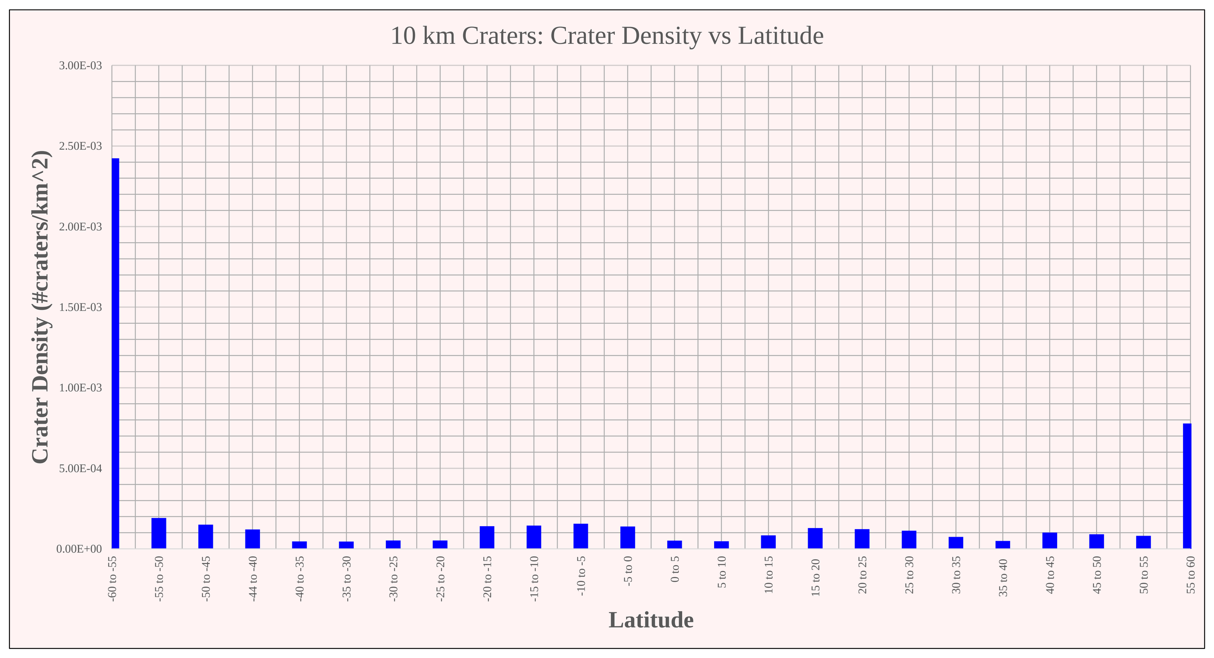
We used the mean radius of the moon = 1737.1 km.

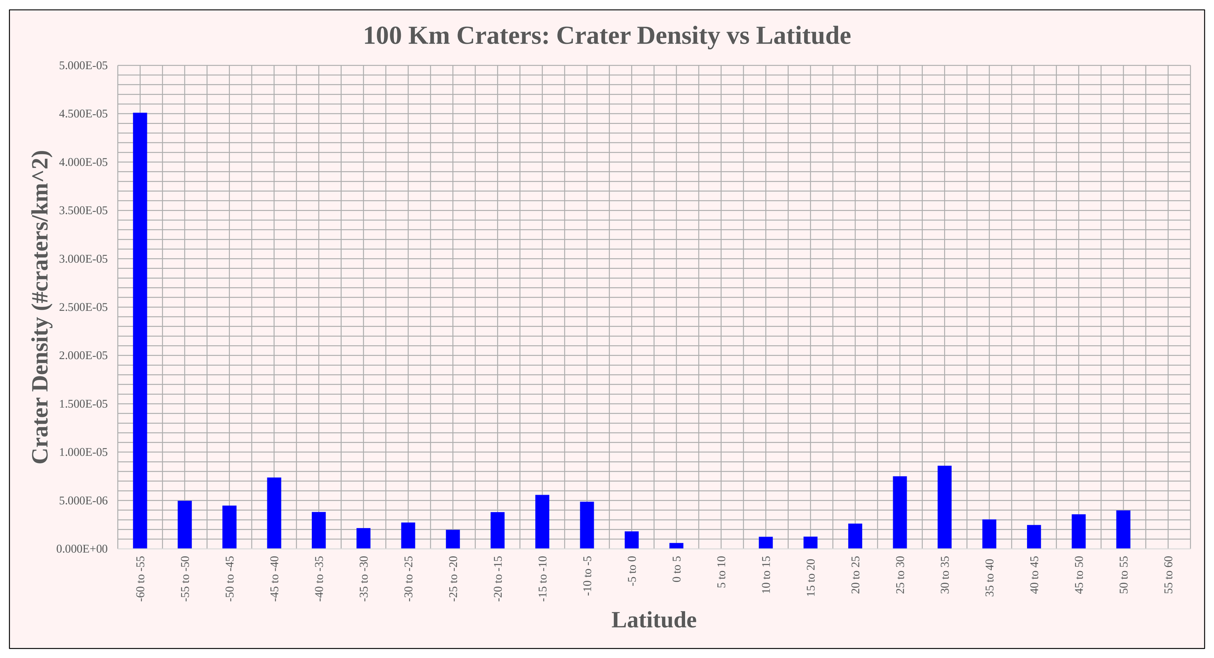
Data and Analysis





Data and Analysis (continued)

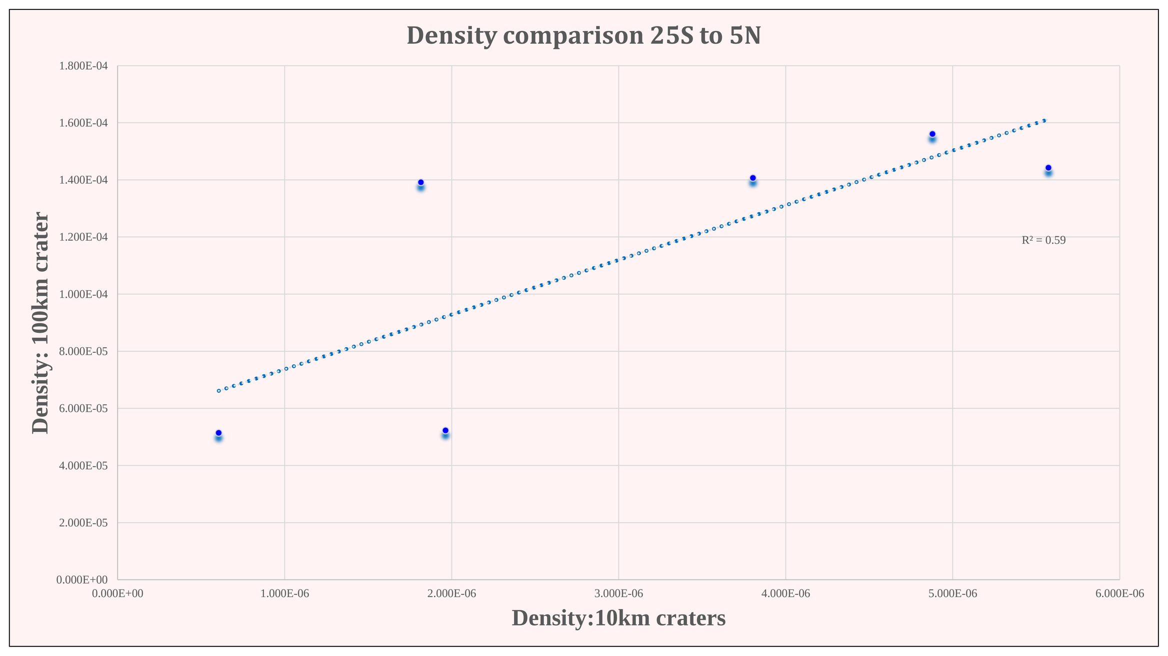




The first graph shows the number of 10 km craters that we counted between latitudes 60S and 60N. The second graph shows the number of 100 km craters counted in the same region. The counts were binned in 5 degree increments. We noticed that there seems to be a pattern in both graphs that show an increase in the numbers of craters in the lower southern latitudes, and then a decrease as one approaches the equator.

The third (10 km density) and fourth graphs (100 km density) show the crater density (number of craters/area of each 5 degree latitudinal band) for each size crater. The pattern seen in the first two graphs flattens out a bit due to accounting for the area of the latitudinal bands, but it is still noticeable.

Data and Analysis (continued)



We also looked at graphing the crater density of the 10 km craters vs the crater density of the 100 km craters. It appears, in some of the latitudes that there is a correlation between latitude and cratering density. For example, when looking at the crater density for both data sets between 25S and 15N, the densities of craters follow the same pattern of increasing-decreasing-increasing. We looked at the data sets - graphing from 55S to 55N and found the linear correlation (r-squared value) was equal to 0.13, which does not suggest a strong relationship. We left out the data from the highest latitudes as it skewed the correlation to look stronger than it is. When looking at only the densities between 25S to 15N, the linear correlation was stronger (r-squared = 0.59) but it is still not a very strong correlation to suggest that there is a relationship between cratering events and latitude, especially given that we are only looking at 2 sizes of craters.

Conclusion

We were hoping to find stronger patterns of cratering dependent on the latitude than we did. We would like to create a larger data set by counting more craters of a variety of sizes in order to determine if the small correlation we see is real. One other thing that we did note from the data set we do have is that if they are organized by longitude, the distribution of craters is very even. We counted close to 3400 10km craters, ~9.4 craters/degree of longitude, and if the data set is graphed the numbers/degree varies between 8-11/degree. The same evenness holds true for the 100km data set.

Thanks to Sean Lindsay for his mentoring advice; we appreciate it.