



A Study of Meteorite Impact Data

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Questions and Goals

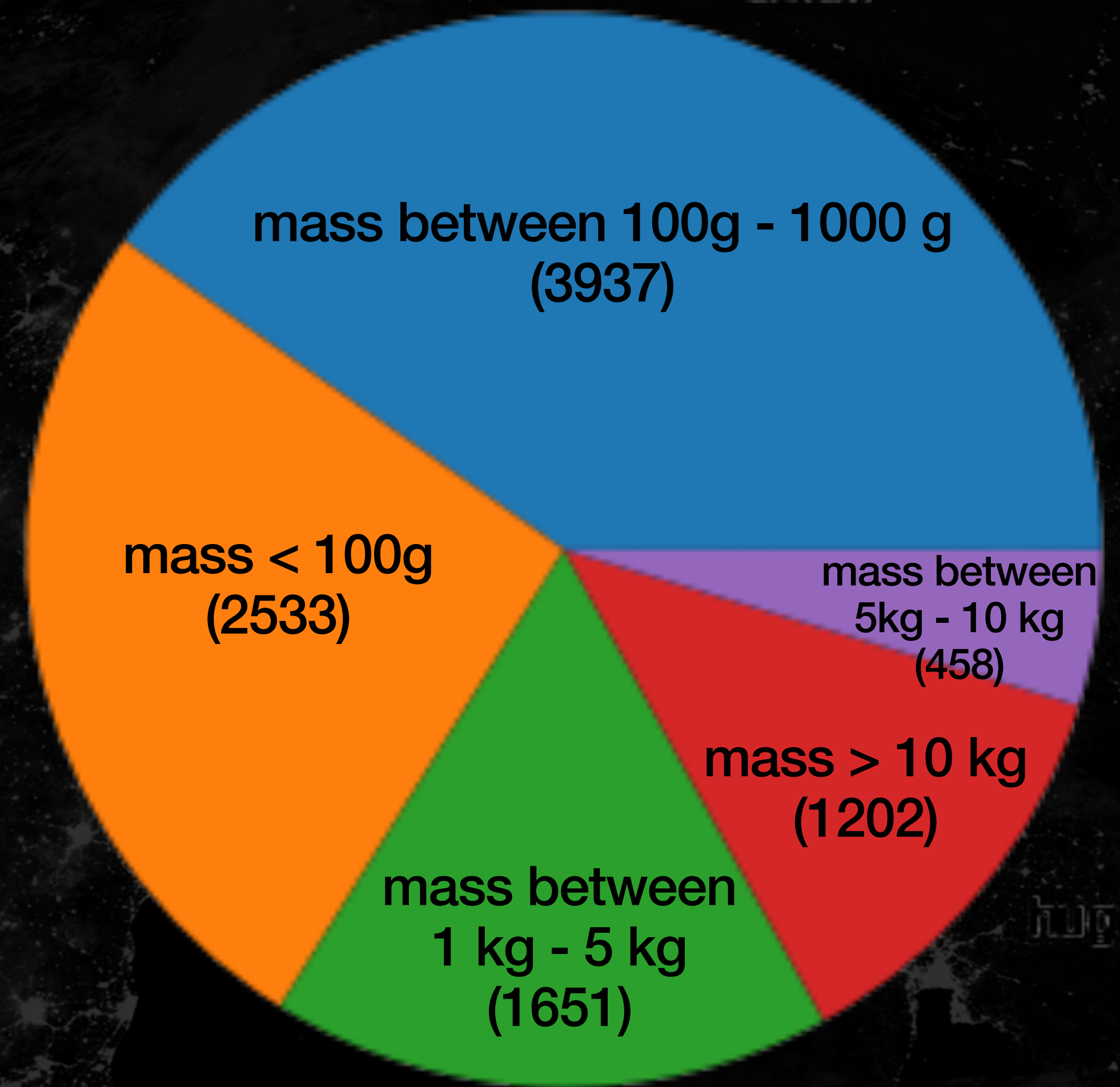
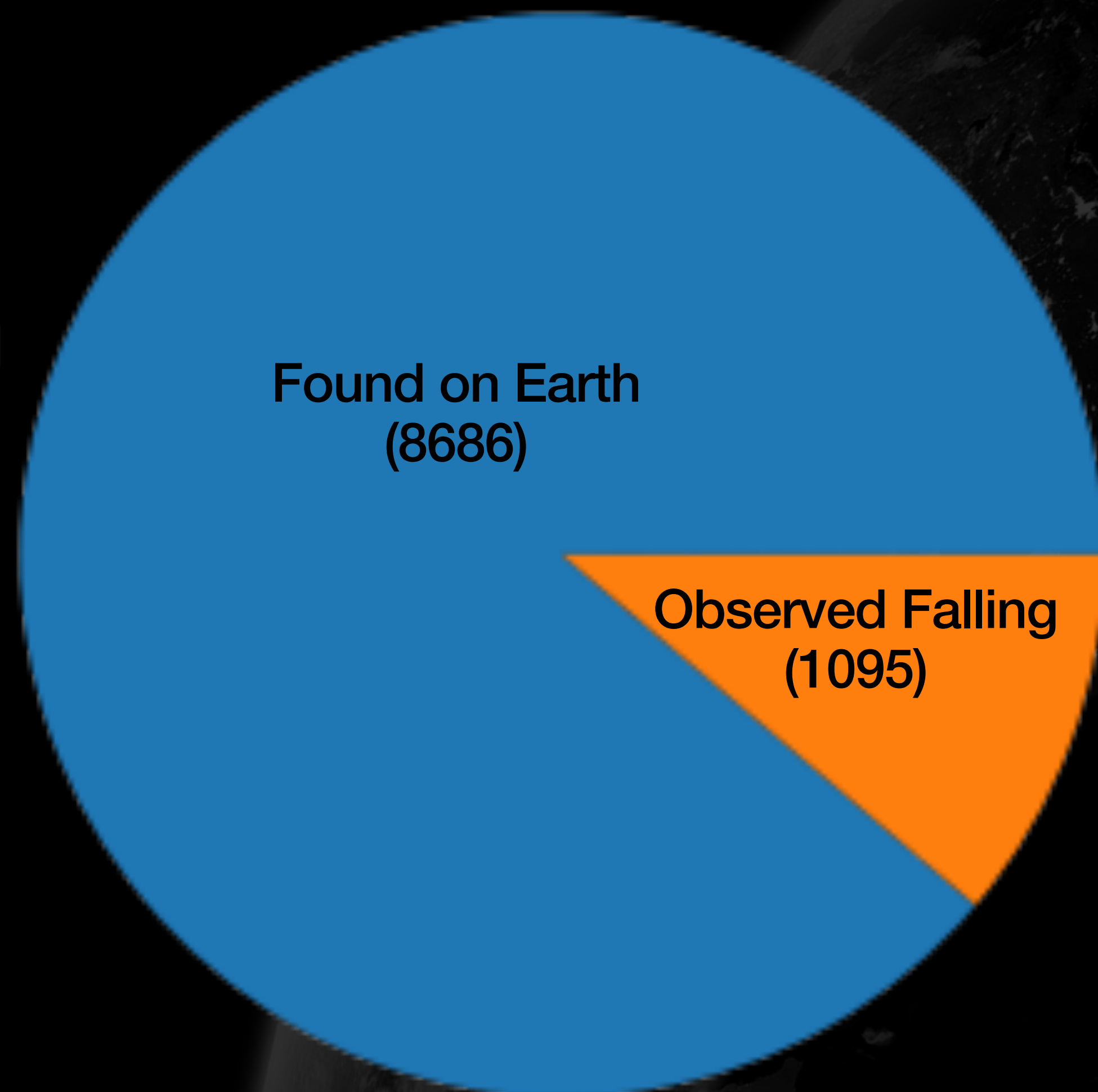
- Entered this study with five questions to answer:
 - Are the numbers of meteorite falls consistent over history or are they changing?
 - Are there trends between meteorites that have been observed hitting the ground and the ones that are found?
 - Is there any correlation between impacts and human population?
 - Do meteorites fall at random, or are there patterns to their impact locations?
 - Can predictions be made about future meteorite impacts by studying past impact events?

Data Suitability and Preparation

- Began with a single dataset, from data.gov
 - Comprehensive meteorite landing data set from The Meteoritical Society
 - Consists of data of 34,513 meteorites, including year, location, mass, and meteorite type and classification
- Data Carpentry was my first priority.
 - Discovered several “meteorongs” including misidentified meteorites, over 6,000 without a geolocation, and almost 5,000 in the same location in Antarctica (at a site Google Maps marked with a photo of a stack of pancakes).
 - After completion, left with 9,781 valid meteorite impacts.



Data Suitability and Preparation



Two graphs to demonstrate the distribution of meteorites in the dataset.

Data Suitability and Preparation

- Additional datasets were needed:

- Meteorite Classification System

- I created a CSV from a “traditional clas

- Historical Land Cover

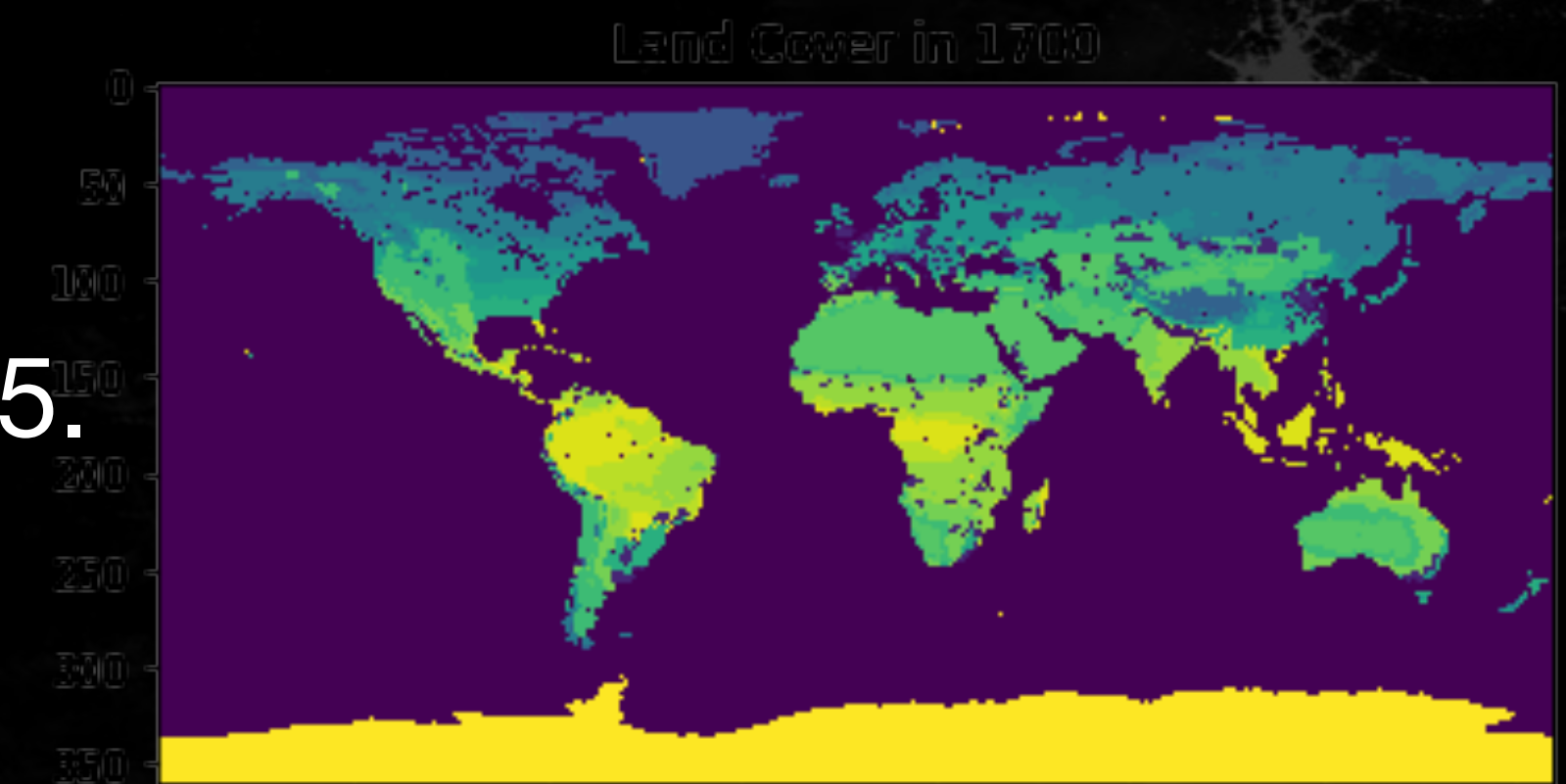
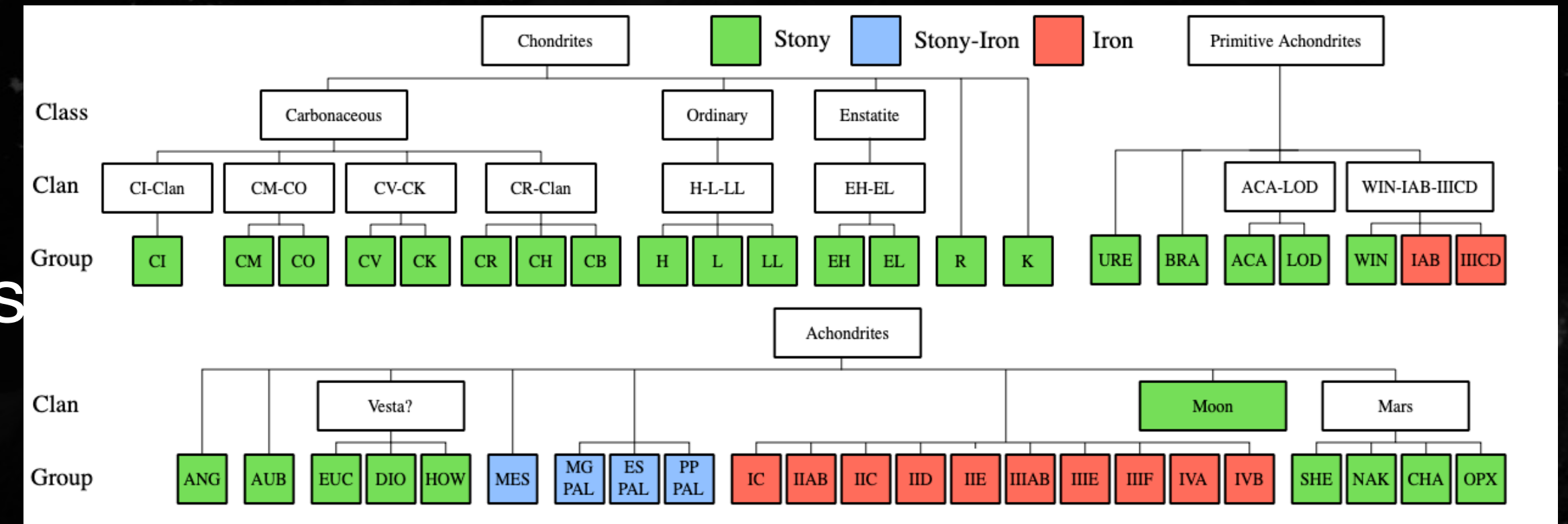
- A raster dataset showing the changes in landcover from the preindustrial age (1700), followed by 50 year increments to 1950, then 1970 and 1990.

- Historical Urban Population

- Population of cities and urban areas between 3700 BC and AD 2000.

- Historical Global Population Density

- Rasters of global population density for 1990 and 1995.

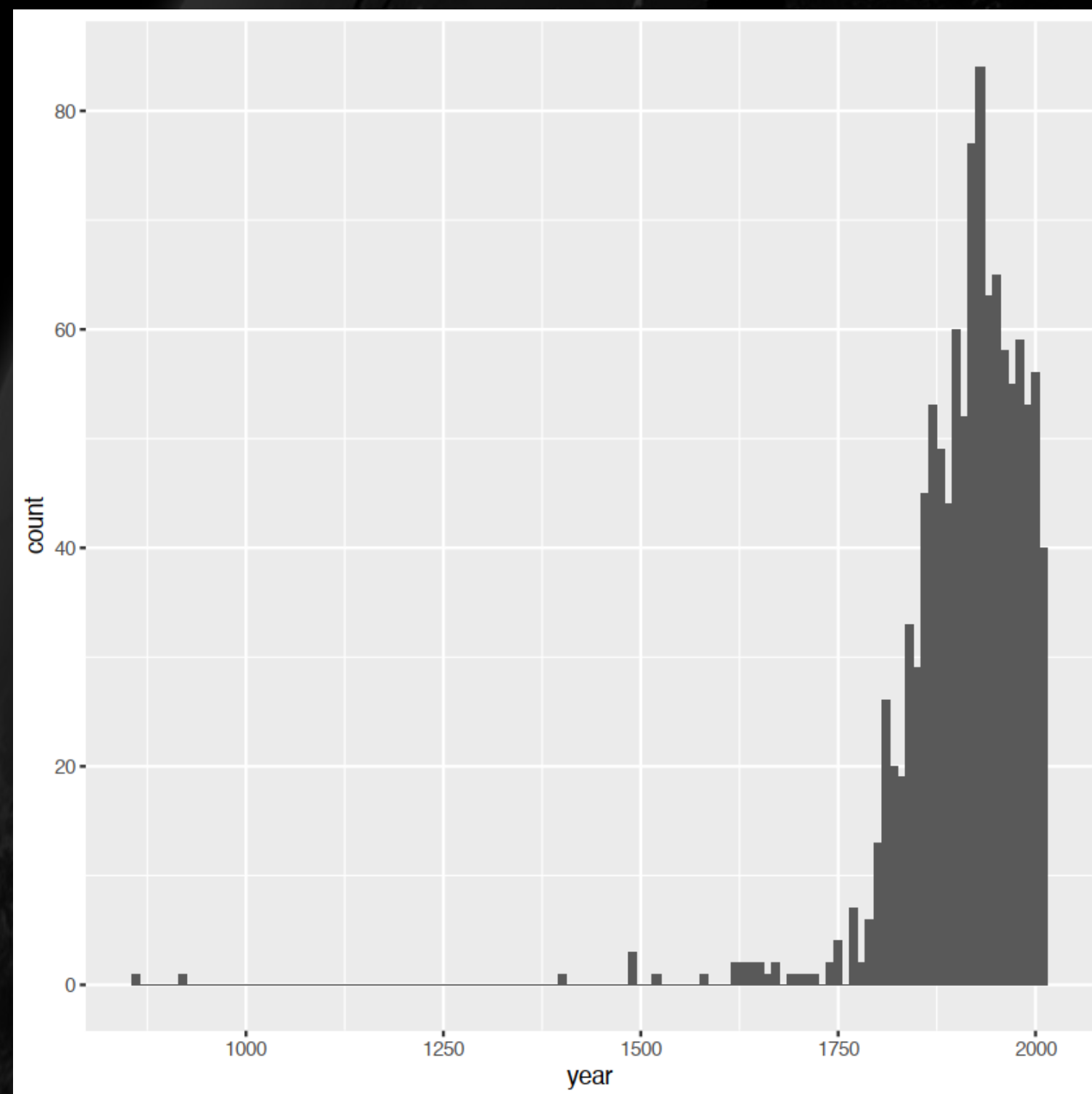


Data Suitability and Preparation

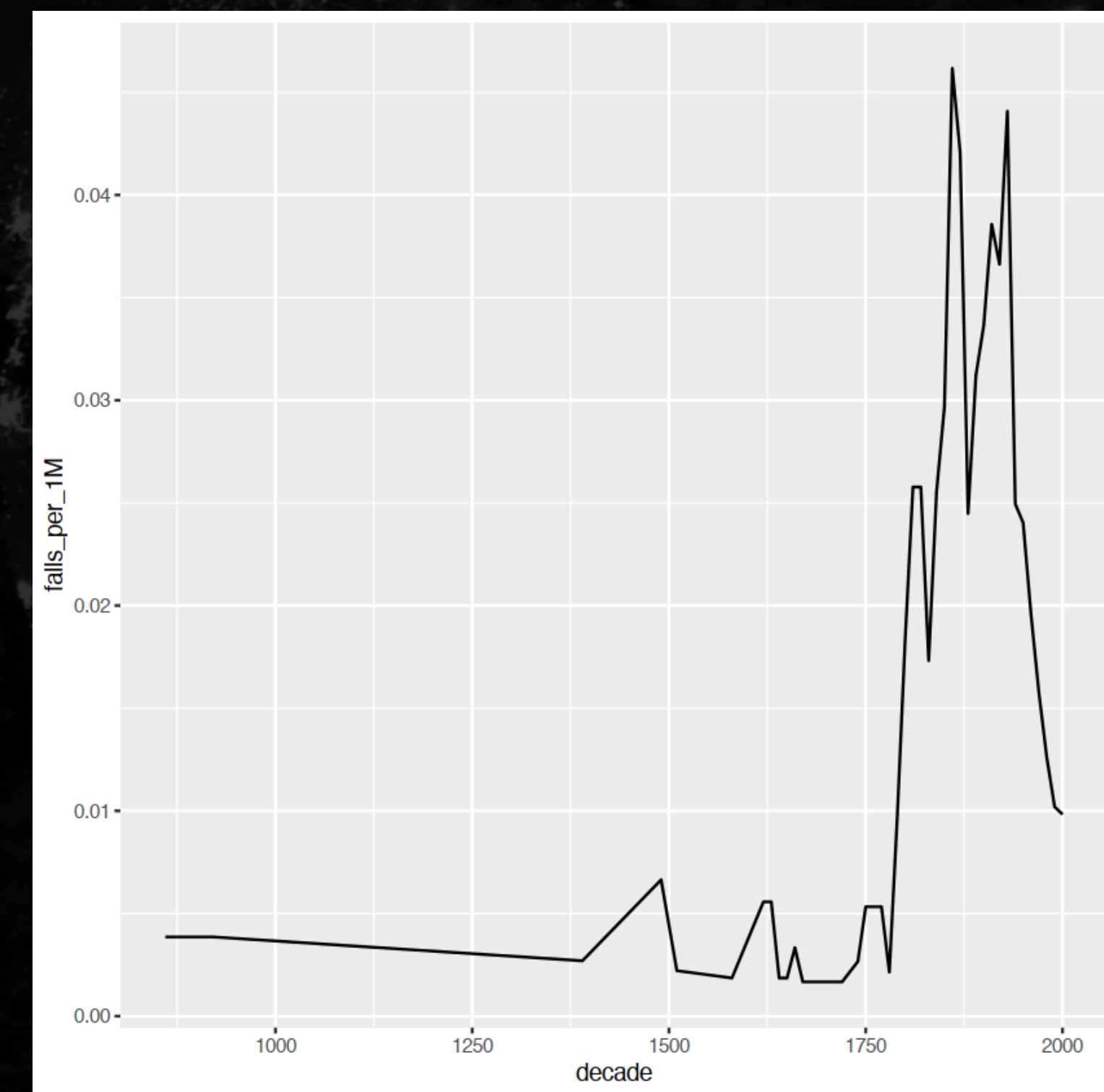
- Meteorite Classification System
 - I joined a table to the meteorite data to give more information on the type of meteorite at that location.
- Historical Land Cover
 - I used this data to determine the land type at every impact site.
- Historical Urban Population
 - This allowed me to find urban areas near impacts, as the number of people increases, so too is the likelihood of someone seeing a meteorite impact or finding one on the ground.
- Historical Global Population Density
 - This dataset was found not to be useful.

Analysis and Results

- Are the numbers of meteorite falls consistent over history or are they changing?
- The number of meteorites observed falling has dramatically risen, even when population growth is taken into consideration.



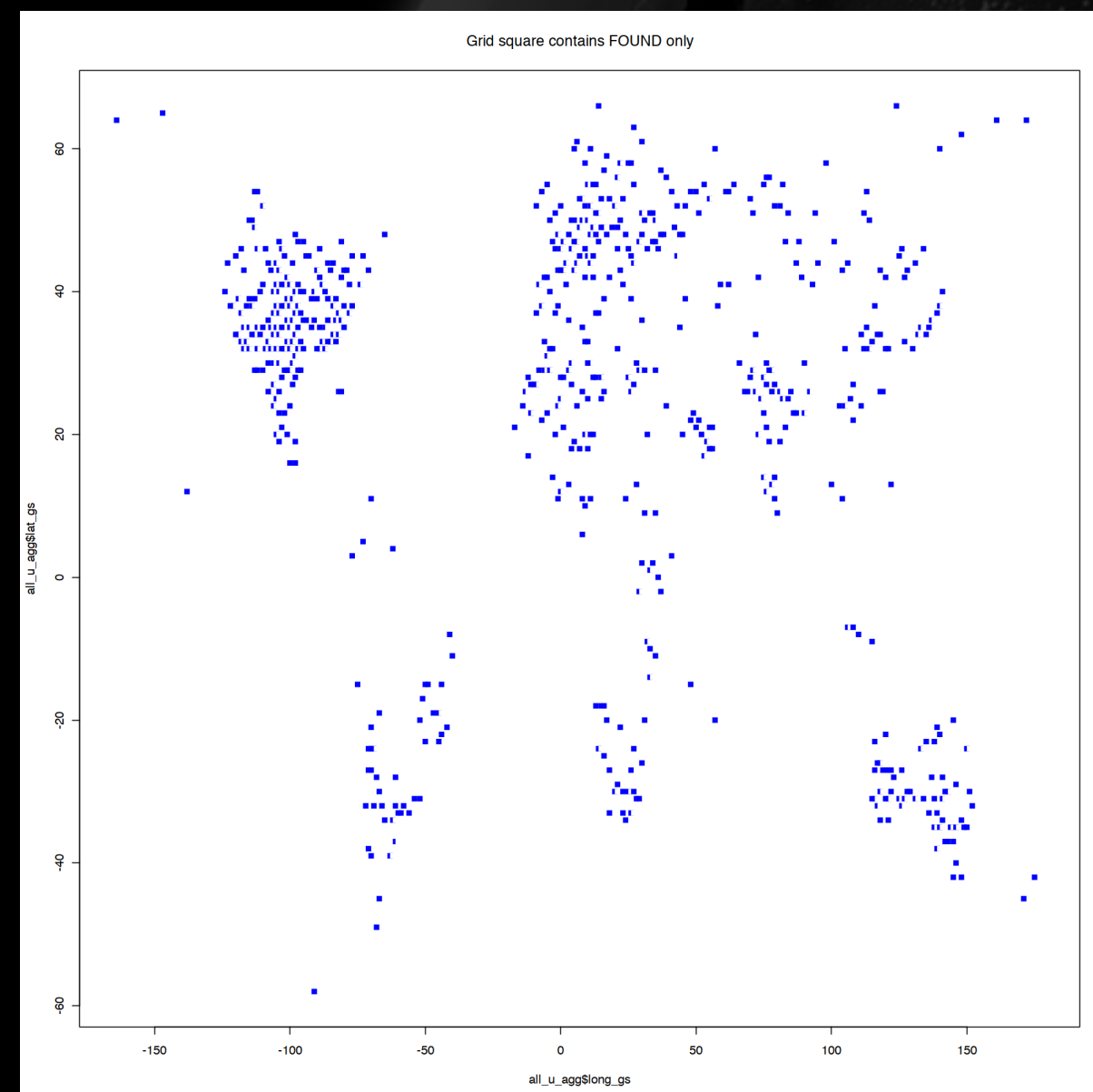
Histogram of meteorites observed falling by year



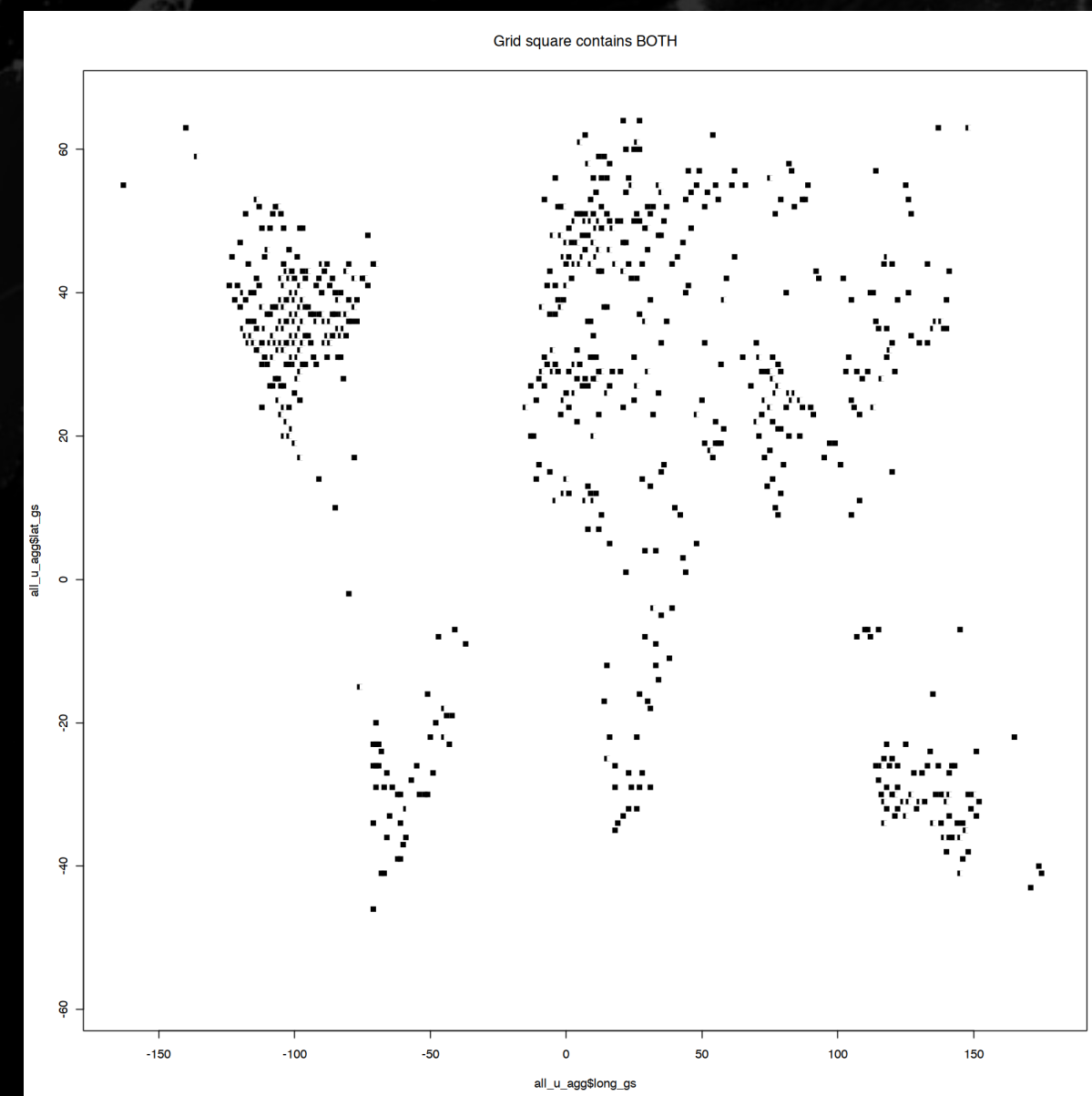
Line graph of meteorites observed falling per 1 million people on Earth.

Analysis and Results

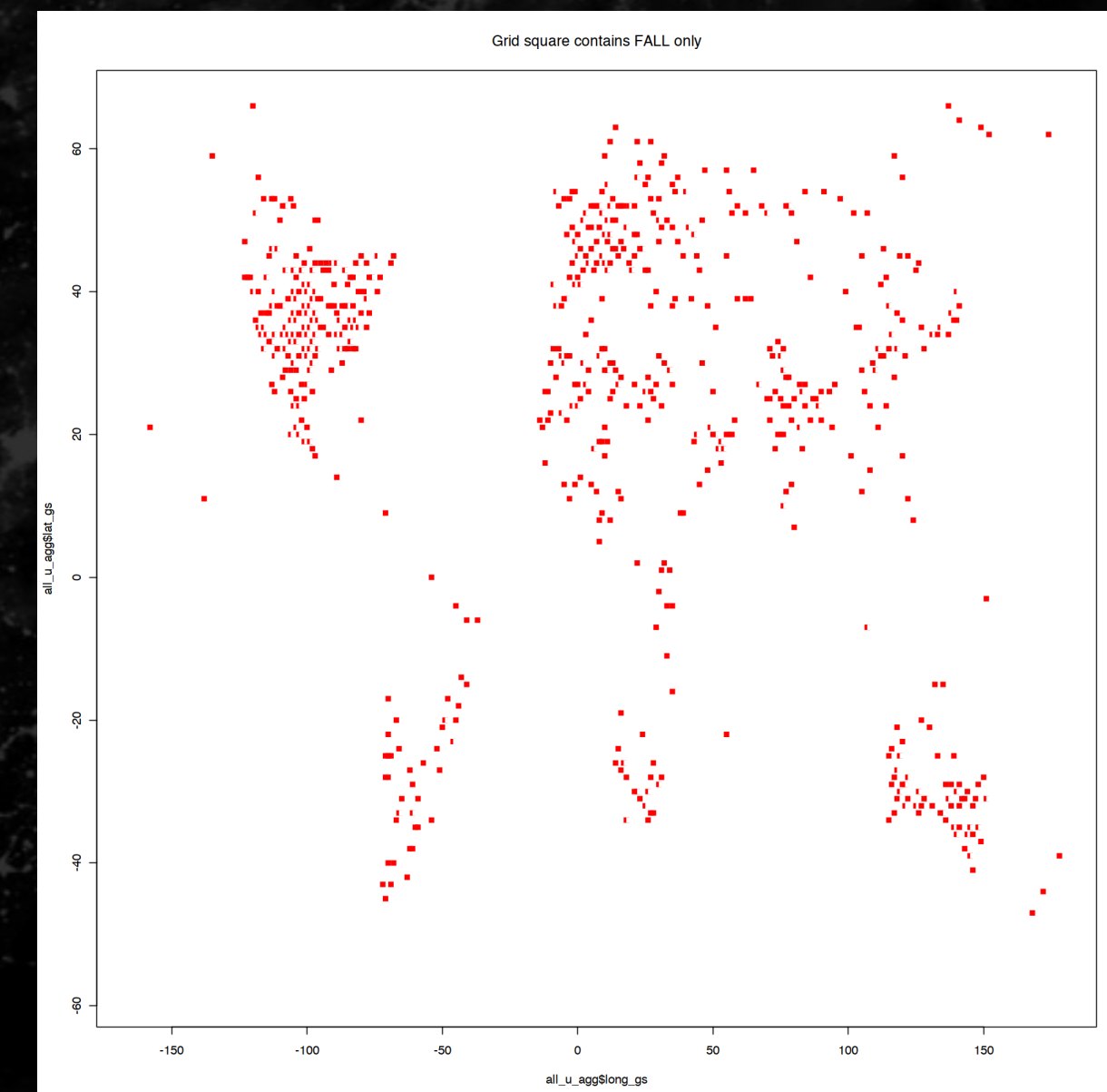
- Are there trends between meteorites that have been observed falling to the ground and meteorites that are found *in situ*?
- This analysis was accomplished by creating a $1^\circ \times 1^\circ$ grid and counting whether meteorites had fallen and/or had been found. Only 181 grid squares had both, while 712 only had falls, and 1063 only had finds.



Grid squares with found only



Grid squares with both



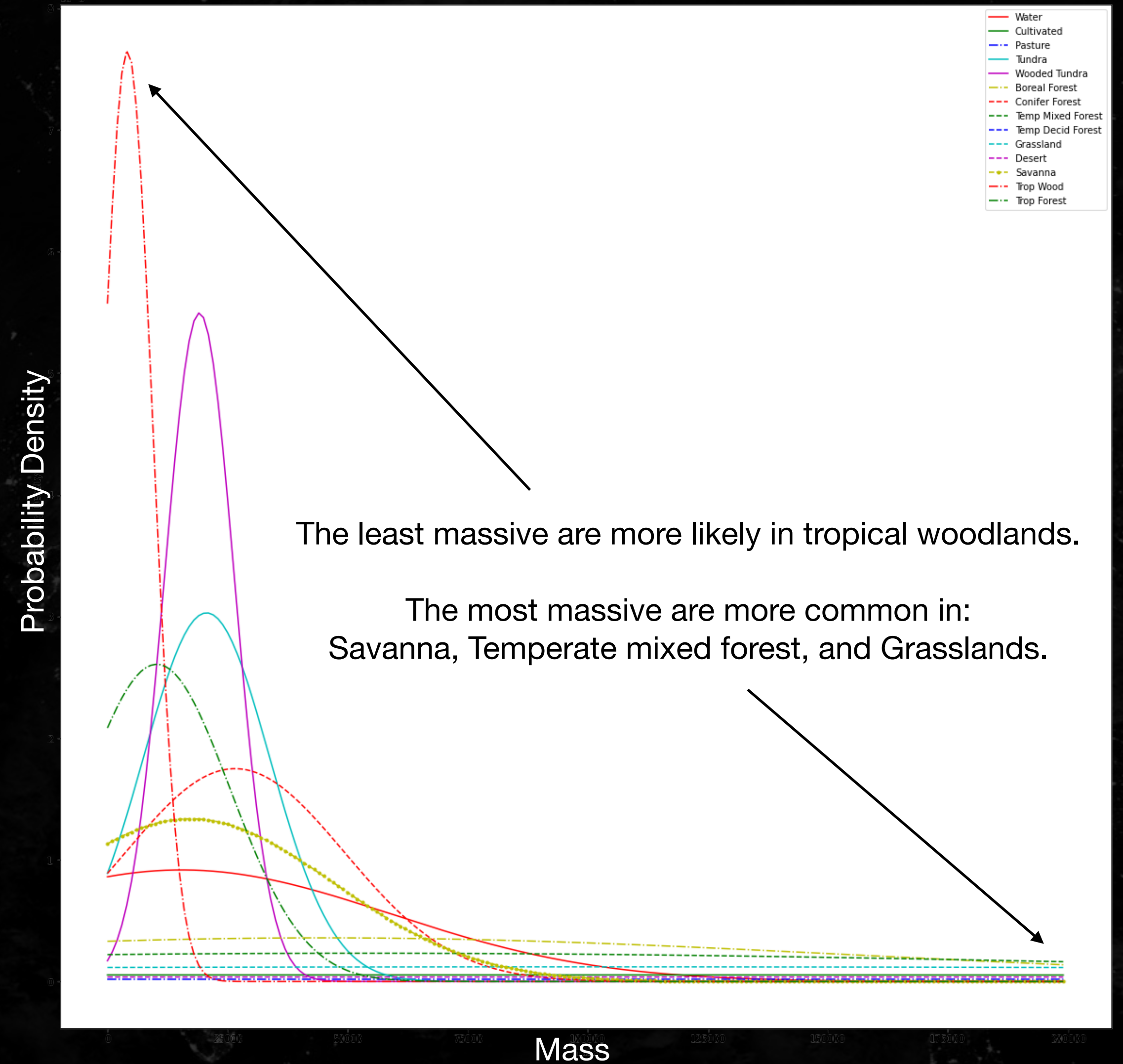
Grid squares with falls only

Analysis and Results

- Is there any correlation between impacts and human population?
 - “If a meteorite falls in the forest, and there’s no one there to see it, does it get recorded in the dataset?”
 - Large unpopulated areas of Earth, such as the Amazon rain forest, have no reported impacts.
- However, only 239 of the impacts were within 0.25 degrees (~ 20 miles) of an urban area

Analysis and Results

- Do meteorites fall at random, or are there patterns to their impact locations?
- There were some correlations found:
 - Latitude + longitude ~ Found or Fall
 - mass ~ land covers 0 (water bodies) and 2 (pasture land)
- Land cover PDF analysis: Different masses are more common with different land covers.



Analysis and Results

- Can predictions be made about future meteorite impacts by studying past impact events?
 - Ultimately, I was unable to find a correlation or method to allow me to predict future meteorite impact locations from past locations.
 - However, the other trends discussed in this report should theoretically continue for the foreseeable future.

Conclusions

- This was a very interesting project to work on and discover how to use Data Science techniques in a “real life” problem set, rather than manufactured problems for Data Science classes
- It was hoped that this study could lead to application in the classified environment. While the material itself did not lead to any definitive conclusions or predictions, the techniques and skills I learned will be useful as I apply them to my account.
- All data and jupyter notebooks, containing my Python and R coding, are available at : <https://www.github.com/mwy912/capstone>