Mars' Atmospheric Escape: Variability in the Upper Atmosphere

Noora Alsaeed
American University of Sharjah, Sharjah, U.A.E.
LASP, Boulder, CO
Mentors: Bruce Jakosky, Marek Slipski

Whether it is to shed light on the evolution of planetary atmospheres or to tackle the possibility of life having existed on the red planet, Mars' atmosphere has been a subject of extensive research for the past several decades. Evidence of past liquid water suggests that Mars' atmosphere must have been thicker. The thin atmosphere we see today is thus thought to be a result of atmospheric escape to space, which the Mars Atmosphere and Volatile Evolution (MAVEN) mission is investigating. Our research is focusing on understanding the variability in the upper layers of the current Martian atmosphere, as it is central to the MAVEN analysis that points toward significant loss of atmosphere to space. Specifically, we are looking at variations in altitudes that we've derived for the exobase, the boundary above which molecules can escape to space, and the homopause, the boundary below which the atmosphere is well mixed. Using the values of these altitudes for each orbit, as well as the corresponding spacecraft location parameters such as latitude, longitude, local solar time and solar zenith angle, we investigate short term and long term variability. For the short term variability, we looked at each orbit's density profiles to determine if factors such as wave structures had a role in the variability. Furthermore, since some ranges of orbits seem to have more variability than others, we've grouped the data accordingly and performed statistical analysis to determine possible causes for these variations. The short scale variability may also be attributed to the nature of the method used in deriving the values for the exobase and homopause. As for the long term variability, we can see obvious trends with time that are convolved with changes in the spacecraft location parameters. We find that there is noticeably higher variability in the night time measurements compared to day time measurement, and more variability in measurements closer to the poles. Furthermore, we notice a trend in homopause altitudes versus latitude that is similar to a trend observed here on Earth in the literature, but have yet to study the underlying mechanism. Further work on this research is needed to pin down the causes behind the variations we observe.