3D VISUALIZATION FOR PLANETARY MISSIONS. A. W. DeWolfe,[1] K. Larsen,[1] D. Brain[1], [1]Laboratory for Atmospheric and Space Physics (LASP), University of Colorado, Boulder, CO, alex.dewolfe@lasp.colorado.edu, kristopher.larsen@lasp.colorado.edu, david.brain@lasp.colorado.edu.

We have developed visualization tools for viewing planetary orbiters and science data in 3D for both Earth and Mars, using the Cesium open-source Javascript library. Our tools allow viewers to visualize the position and orientation of one or more spacecraft, as well as science data and atmospheric models. Other 3D viewers exist but are expensive to develop and maintain, and often require the user to download and install standalone software. Cesium and LaTiS are both free and open-source, and allow the user to interact with the 3D visualization and preview science data on the mission's website.

We initially developed this tool as a 3D Mars viewer for NASA's Mars Atmosphere and Volatile EvolutioN (MAVEN)[1] mission. MAVEN has been collecting data at Mars since September 2014, exploring the planet's upper atmosphere, ionosphere, and interactions with the Sun and solar wind. We used Cesium to display MAVEN's orbit around Mars, its orientation as it points in different directions during its orbit, and the science data it collects from the Martian atmosphere and the solar wind. Some of the instruments collect data along the path of the spacecraft ("in situ" measurements), and some measure magnetic fields or particle velocities that need to be displayed as 3D vectors branching out from the orbital path. Viewers can choose to display the spacecraft in the planet's reference frame so that Mars remains stationary, or an inertial reference frame to watch the planet rotate. We have also added the capability to display the M-GITM atmospheric models overlaid on the surface of Mars.

In order to stream the data from a set of ASCII files stored on our server, we use LaTiS[2], a free, open-source unified data access service developed here at LASP to stream time-series data and convert between formats. This allows us to stream the science data into a JSON object that can be easily displayed by the Cesium code. In addition, LaTiS can use NASA's SPICE libraries to compute ephemeris information and provide it as JSON, so that the ephemeris and pointing information for any spacecraft can be displayed in Cesium.

After adapting Cesium and LaTiS to display MAVEN at Mars, we began modifying it to display NASA's Magnetospheric MultiScale (MMS)[3] mission, a four-spacecraft constellation currently orbiting the Earth to measure Earth's magnetic field and its interaction with the solar wind. MMS's orbit and constellation configuration are challenging to visualize, making an interactive 3D viewer highly useful for the science team as well as a useful educational tool.

References:

[1] http://lasp.colorado.edu/home/maven/
[2] https://github.com/latis-data/latis
[3] https://mms.gsfc.nasa.gov/