Regional-Scale Weather Highlights from the MAVEN/IUVS Instrument. K. Connour[1], N. M. Schneider[1], J. Deighan[1], [1]Laboratory for Atmospheric and Space Physics (kyle.connour@colorado.edu)

Introduction: The Imaging Ultraviolet Spectrograph (IUVS) instrument on the Mars Atmosphere and Volatile EvolutioN (MAVEN) spacecraft takes mid-ultraviolet (MUV) spectral images of the Martian surface and atmosphere. Due to MAVEN's short-period, elliptical orbit, IUVS has the ability to measure local time variability of an assortment of atmospheric features including: topographic clouds, polar hoods, and regional dust storms. This puts our instrument in a unique position to determine how these features evolve over the course of a day and, when taken as a whole, determine their seasonal evolution [1, 2].

We present IUVS apoapse observations of the aforementioned phenomena, along with evolution of the polar caps, to the broader Mars science community. These observations may prove beneficial for contextualizing local atmospheric conditions, or expand other datasets if we made concurrent measurements.

Observations: All observations were taken with MUV data spanning 200—300 nm. Images created with the data are taken in native swath format---what the instrument sees as it scans across the planet. To create these images, the spectral bins at 200, 255, and 300 nm are used to create the separate RGB color channels. Each color channel was independently optimized to create maximum contrast across the entire image.

Topographic clouds: Topographic clouds are a subset of aphelion cloud belt (ACB) clouds and are indicative of local temperature structures. The ACB forms around aphelion (L_s = 71˚) and remains longitudinally continuous until around L_s = 140˚, when these clouds start to thin. After this time, only topographic clouds remain and persist throughout the year. These clouds are only able to form as winds increase the density of water around the volcanoes and cause temperature perturbations large enough for these clouds to form [3].

IUVS observed a plethora of topographic clouds and watched their seasonal evolution. Most of our observations show discrete structures around the Tharsis volcanoes, with trailing streaks and aster patterns (see Fig. 1). Air parcels cool as the cross the evening terminator, resulting in more spatially extended clouds. Approximately every eleven orbits IUVS returns to the same location and is thus able to watch seasonal changes in these features.

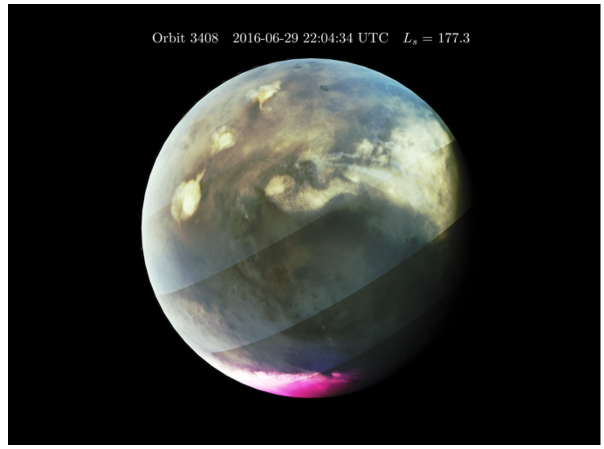


Fig. 1: An example of an IUVS observation of topographic clouds, taken around L_s = 180˚.

Polar hoods: Polar hoods are a thick conglomeration of clouds centered on the poles which form during fall-winter-spring. These clouds often form amorphous structures, but they do sometimes exhibit streaks and gravity waves along their boundary. These clouds are associated with extremely cold temperatures over the pole and presumably influence the amount of water ice exchanged between the clouds and polar cap. Ozone (which appears magenta in our images) is also associated with polar hoods, playing a significant role in regional photochemistry [3].

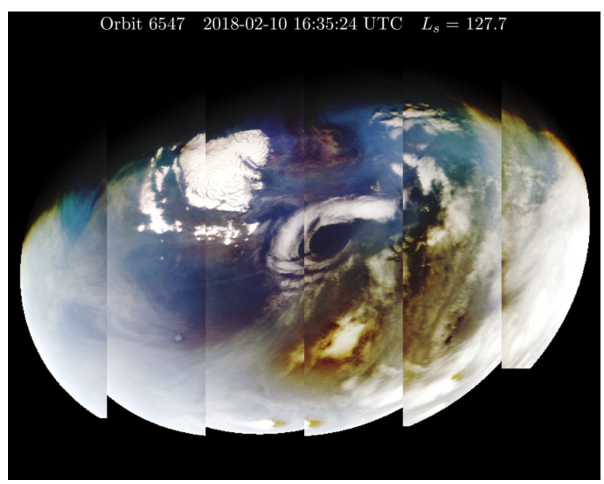


Fig. 2: Examples of cyclonic features, contrails, and general clouds observed over the north pole.

IUVS observed polar hoods over several seasons. During northern fall, our dataset shows examples of cyclonic features, vorticies, and contrails (see Fig. 2).

During southern winter, we see generally-amorphous clouds around the pole and an abundance of ozone.

Dust storms: Dust storms regularly occur on Mars and may play a significant role in controlling water escape from the planet. They are most likely to occur during the perihelion season and range from local to global scales. During the largest of these storms, the increased abundance of dust in the atmosphere leads to increased heating rates. Previous work has correlated the presence of global dust storms with increased H escape measurements, suggesting that dust storms may cause enough heating to allow water to reach the high altitudes needed for escape [4]. See Fig. 3 for an example image.

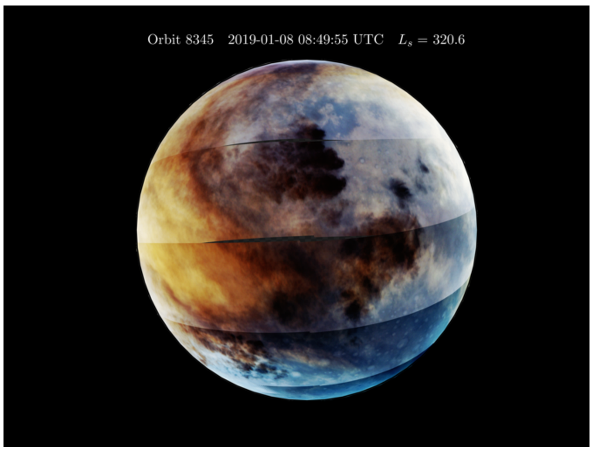


Fig. 3: A regional dust storm in our dataset. The black patches are dust, while the red-orange-yellow is brightened dust. This brightening is normal for observations near the limb.

IUVS already observed evidence of enhanced water escape rates. During the early 2019 regional dust storms, we observed clouds disappear during the dust storm and reappear after the storm (see Fig. 4). During this time, IUVS also observed an enhancement in H escape rates. This may tie together the story of dust-drive H escape and shed light on how water is lost from the planet.

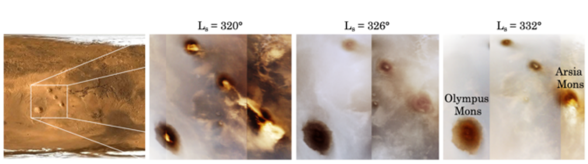
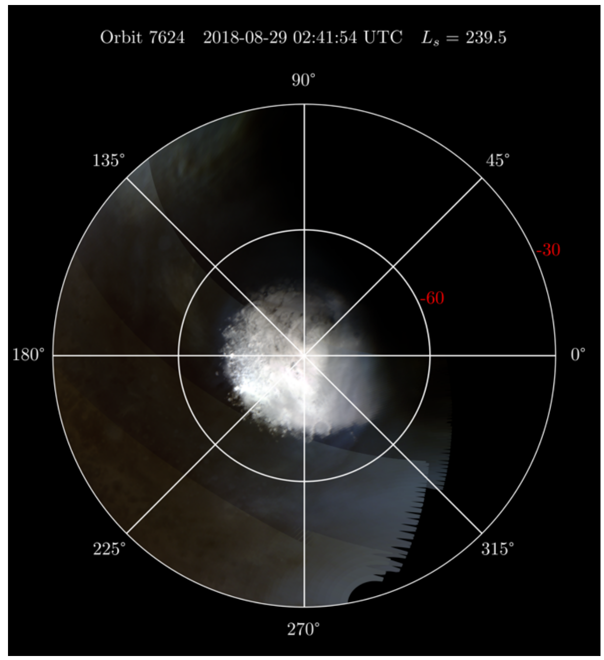


Fig. 4: IUVS observed clouds before the storm, an abatement of these clouds during dust loading conditions, and clouds returning upon cessation of dust activity. This provides observational evidence dust storms break the cold trap, allowing water to reach higher altitudes where it may escape.

Polar caps: IUVS also imaged the polar caps. From this dataset we have been able to observe polar retreat (see Fig. 5), and future data will allow us to watch polar growth. In particular, we are hopeful that our far ultraviolet channel may be able to distinguish spectroscopic differences between water ice and CO_2 ice, allowing us to independently observe their changes. If combined with other datasets, we hope these observations may be useful for determining how water is transported from the poles and circulated throughout the atmosphere.



References: [1] Jakosky, B.M. et al. (2015) *Space Science Reviews, 195,* 3-48. [2] McClintock, W.E. (2015) *Space Science Reviews, 195,* 75-124. [3] Clancy, R.T. et al. *The Atmosphere and Climate of Mars, Chapter 5,* Cambridge Univeristy Press. [4] Chaffin. M.S. et al. (2013) *GRL, 41,* 314-320. [5] Madeleine, J.-B. et al. (2012) *GRL Planets, 39, doi:* 10.1029/2012GL053564.