OBSERVATIONS OF SOLAR SYSTEM OBJECTS WITH K2. J. L. Dotson[1], C. Hedges[2], and G. Barentsen[2], [1]NASA Ames Research Center (jessie.dotson@nasa.gov), [2]NASA Ames Research Center & Bay Area Environmental Research Institute.

Introduction: The K2 mission [1] utilizes the Kepler space telescope to perform high-precision, uninterrupted photometry of different fields along the ecliptic plane. Each ~ 100 square degree field is observed for ~ 80 days at a time. Data has been obtained for over 300 solar system objects over 17 pointings of the spacecraft. We will review the solar-system sources observed, the properties of the data, results to date and discuss an ongoing effort to develop improved data formats and tools for analysis.

K2 Observations: Only a small fraction of the Kepler photometer's pixels are stored and downlinked due to the limited size of the on-board solid state recorder and the data downlink rate. For stationary targets like stars and galaxies, a small postage stamp of pixels centered around the object of interest are stored and downlinked. For moving objects (e.g. solar system objects), a track of pixels is stored and downlinked. This track covers a portion of the object's path during the campaign, usually centered around the stationary point. For large fields such as the microlensing campaign, clusters or planets 'superstamps' are used, composed of 100's of pixels. There are two possible data cadences – 1 minute and 30 minutes. The vast majority of observations are executed utilizing the 30 minute cadence.

Observed Solar System Sources: A range of solar system objects have been observed – including planets, moons and various small bodies. Uranus and Neptune have been observed, as well as several of their moons. Observations were also performed of Titan and Enceladus. Data has been obtained for over 200 asteroids, more than 60 TNOs and 19 comets.

Numerous solar system objects have been observed by K2 serendipitously as the objects move through pixels stored in order to observe other objects. In particular, large 'superstamps' designed to observe clusters and planets have provided observations of high numbers of solar-system bodies. The investigation of fortuitously observed solar system objects has barely begun. Molnar [2] has examined the region of the focal plane stored to observe Uranus during Campaign 8. Photometry was obtained for over 600 main belt asteroids which crossed this portion of the Kepler focal plane and rotation rates were estimated for 90 asteroids. Other superstamps have not been examined for serendipitous observations.

Data Formats & Tools: In order to efficiently use the limited resources on the spacecraft, the tracks which trace out the path of moving objects are stored a series of tiles. Pixel level data for each of these tiles is currently available at the Mikulski Archive for Space Telescopes [3]. We will describe an ongoing effort to develop python use tools as part of the PyKE [4] package to facilitate access to moving object data as well as perform photometry on these moving objects.

Example Results: All targeted observations made by K2 are through the peer reviewed Guest Observer program; as a result a variety of science use cases have been identified and implemented utilizing K2 solar system observations. To highlight a few recent results, Pal [5] combined rotation rates determined from K2 with Herschel observations to determine that 2007 OR10 was significantly larger and redder than previously thought. Ryan [6] determined the rotation rates of over 50 Trojan asteroids. The long-timeline, uninterrupted K2 photometry allowed [6] to determine that 10% of their sample had rotation periods longer than 100 hours. Gaulme [7] used Neptune as a mirror to observe solar oscillations, providing a glimpse of the measurements K2 would return when observing a star like the sun. Rowe [8] also searched the K2 observations of Neptune to place limits on intrinsic global oscillations of the planet.

While these results represent the variety of science investigations enabled by K2 observations of solar system objects, the vast majority of K2 data on solar system objects remains unexamined. All K2 data is publicly available at [3].

References:

[1] Howell, S. B. et al (2014) *PASP, 126,* 398. [2] Molnar et al. (2017) 2017arXiv170606056M. [3] archive.stsci.edu/k2/ [4] pyke.keplerscience.org/ [5] Pal A. et al (2016) *AJ, 151*, 117. [6] Ryan E. L., Sharkey, B. N. L., and Woodward, C. E. (2017) *AJ, 153,* 116. [7] Gaulme, P et al (2016) *ApJ, 833,* 13. [8] Rowe, J. F. et al (2017) *AJ, 153,* 149.