RECENT IMPACTS ON THE MOON. S. D. Thompson[1], Z. R. Bowles[1], R.Z. Povilaitis[1], I. J. Daubar[2], M. S. Robinson[1]. [1]School of Earth and Space Exploration, Arizona State University, Tempe, Arizona, 85287, (sthompso@ser.asu.edu), [2]Lunar & Planetary Lab, University of Arizona, Tucson AZ, 85721.

Introduction: Recent impacts on the lunar surface are known from Earth-based observations [**1-3**] and recently by the Lunar Reconnaissance Orbiter Camera (LROC) temporal image comparisons [**4-6**]. A concerted effort is underway to search the large collection of LROC Narrow Angle Camera (NAC) repeat observations for impact craters that formed between observations. Detecting changes in the lunar surface is carried out by examining ratios of NAC images of the same terrain acquired with similar lighting conditions separated by some amount of time (>6 months). The "before-and-after" image pairs are hereafter referred to as Temporal NAC Pairs (TNP).

Search: As of 7 January 2014, 138 TNPs were searched for evidence of surface changes. Out of the near 27,000 km^2 searched, 657 features were found in 93 TNPs (67%), which are globally distributed (**Figure 1**). These numbers do not include the secondary features associated with the 17 March 2013 event [**6**], but does include the main crater of that event. Based on the relative reflectance change of the disturbed area, the crater or "splotch" (obvious disturbances in the regolith lacking a resolved crater (**Figure 2**) is classified as a low reflectance change (LRC) or a high reflectance change (HRC), where LRC is a decrease in the relative reflectance and HRC is an increase (604 LRCs and 53 HRCs have been documented with 19 (mostly HRCs) expressing an identifiable crater rim). Splotch diameters average 6.0 m (std. 7.5); resolved crater diameters average 3.9 m (std. 4.0) (**Figure 3**).

Discussion: Most of the LRCs tend to occur in multiples though not typically exhibiting the close proximity of the impact "clusters" seen on Mars [**7**] (10s – 100s m), but rather are spatially separated by 100s of meters to several kms.

Seventy splotches measured thus far have asymmetric elongate shapes, possibly indicating impact trajectory either as a primary or secondary event. In the case of a secondary event the directional indicators (linear alignments of splotches, elongate splotches) may point back to a primary crater. Such was the case for the 17 March event described in [**6**]. A key remaining question for the splotches is are they primary or secondary in nature?

Discussion: The current flux rate of NAC-detectable impact features, assuming that each feature (splotches and resolved craters) represents a unique primary event, is ~100 impacts/km^2/yr. Since we are in the early stages of this study this estimate is necessarily preliminary and likely subject to large revisions in the future. As the number of splotches and resolved impact craters discovered increases, improvements to estimates of current impacts and hazards from such will necessarily improve.

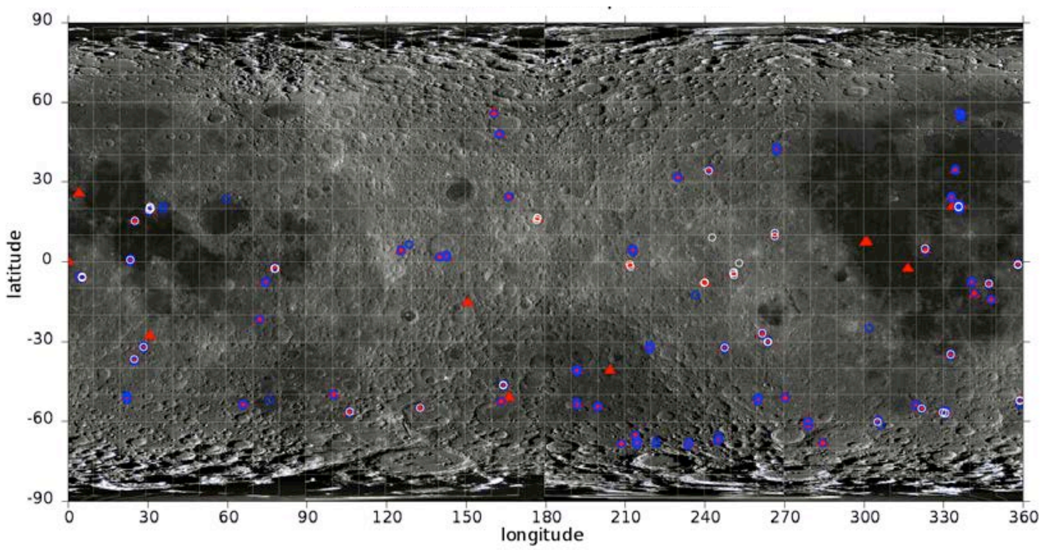

Figure 1. Locations for the changes detected. Blue rings indicate LRCs, white rings indicate HRCs, and red triangles indicate a group of impacts found in one TNP. Many of the TNPs searched record more than one type.

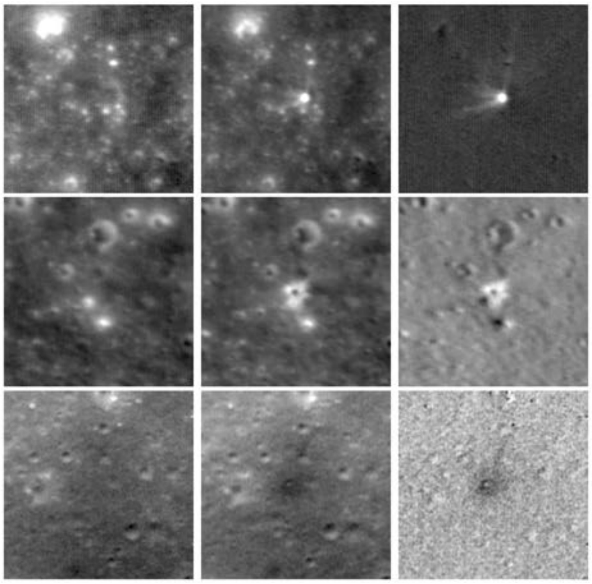

Figure 2. Before images on the left, after images in the middle. After/before ratio images on the right. Note the rays in the top and bottom row features.Top row: HRC (M186498809, 15 Mar 2012; M1117140032, 5 Mar 2013; scene width 150 m). Middle row: HRC (M106690695, 4 Sep 2009; M1101009474, 30 Aug 2012; scene width 165 m). Bottom row: LRC (M140556377, 1 Oct 2010; M1117160617, 5 Mar 2013; scene width 75 m).

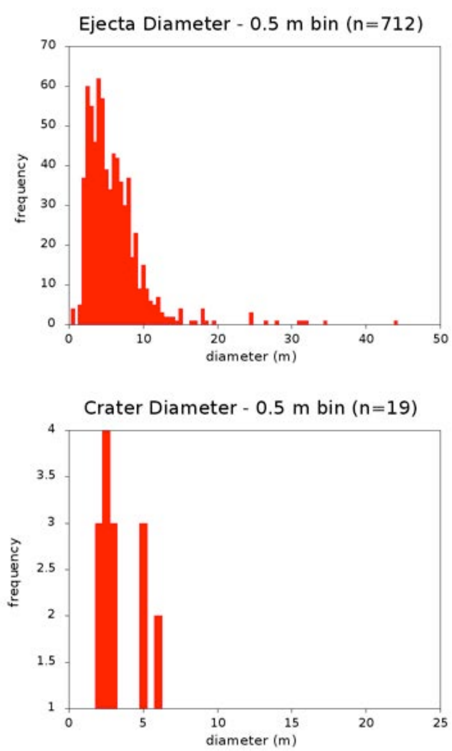

Figure 3. Frequency plots of the diameters of the measured splotches (top) and resolved craters (bottom) in 0.5 m bins.

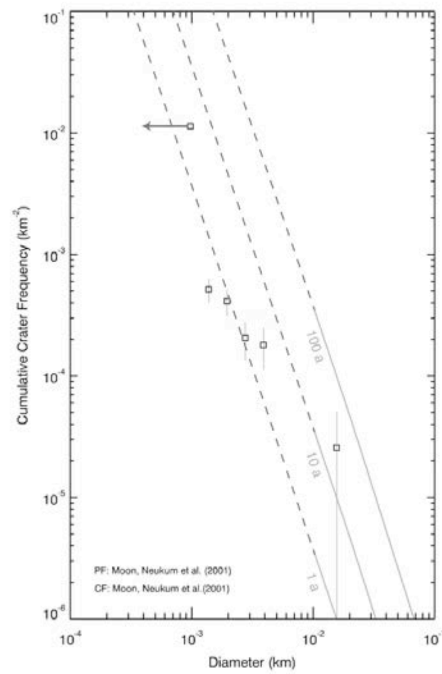

Figure 4. Cumulative crater frequency plot derived from the 19 resolved craters in root-2 diameter bins. The 17 March event [**6**] is the lower right most point. As the population of newly discovered resolved craters increased meaningful interpretations of such plots will be possible.

The current resolved 19 craters fit well the Neukum production function (NPF) [**9**]. Extrapolating the NPF [9] to smaller diameters estimates about 25 ten m diameter craters should form per year. Only one crater has been found over 10 m in diameter; the 17 March 2013 event [**6**]. However we have barely touched the full suite of LROC TNP. The potential discovery of large numbers of secondary craters from small primaries raises important scientific and engineering concerns for future lunar exploration.

References: [**1**] Rabinowitz, *et al*. (2000), *Nature* 403, 165-166. [**2**] Stuart and Binzel (2004), *Icarus*, 170, 295–311. [**3**] Nemtchinov *et al*. (1997), *Icarus*, 130, 259-274. [**4**] Thompson and Robinson, (2013) *NLSI Lunar Sci. Forum*. [**5**] Robinson *et al*. (2013), AGU Fall Meeting, P13B-1752. [**6**] Robinson *et al*. (2014) LPSC this volume [**7**] Daubar *et al*., *Icarus*, 225, 1, (2013) 506-516. [**8**] Lucey, P.G. *et al*. (2000) *JGR*, 105, 20,377-20,386. [**9**] Neukum and Ivanov, (1994), *Hazards Due to Comets and Asteroids*, U of A press, 359-416.