COMBINING SATURNIAN CRATERS AND KUIPER BELT OBSERVATIONS TO BUILD AN OUTER SOLAR SYSTEM IMPACTOR SIZE-FREQUENCY DISTRIBUTION. D. A. Minton[1], J. E. Richardson[1], P. Thomas[2], M. Kirchoff[3,4], and M. E. Schwamb[5,6], [1]Purdue University Department of Earth & Atmospheric Sciences, 550 Stadium Mall Drive, West Lafayette, IN 47907 (daminton@purdue.edu),[2]Center for Radiophysics and Space Research, Cornell University, Ithaca, NY [3]Southwest Research Institute, 1050 Walnut St., Suite 300, Boulder, CO 80301, [4]NASA Lunar Science Institute, [5]Yale Center for Astronomy and Astrophysics, Yale University,P.O. Box 208121, New Haven, CT 06520 and [6]Department of Physics, Yale University, New Haven, CT 06511

Introduction. Here we use results of a powerful new tool, the Cratered Terrain Evolution Model (CTEM) [2], to illuminate the outer solar system impactor population. Using *Cassini* mission imagery of the icy satellites of Saturn (see Richardson et al., this meeting), we show that both ancient and young terrains on these icy satellites were bombarded by a common, heliocentric impactor population. Assuming that the common population originates in the scattered disk of the Kuiper belt, we use observations of the Kuiper belt luminosity function in combination with our derived size-frequency distribution of icy satellite impactors to produce a model Kuiper belt SFD that spans from tens of meter-sized comets up to thousand kilometer-sized Dwarf Planets such as Pluto and Eris.

The scaled impactor size distribution from craters on icy satellites of Saturn. Using CTEM and crater counts based on imagery data from the *Cassini* mission, we are able to derive a common size frequency distribution for heliocentric impactors onto icy satellites of Saturn (Fig. 1). We used crater counts of seven saturnian satellites (Phoebe, Hyperion, Mimas, Tethys, Dione, Rhea, & Iapatus), all of which have been imaged at high-resolution by the Cassini ISS. The three small satellies (Phoebe, Hyperion, & Mimas), crater-counted by P. Thomas, are small enough such that endogenic processes are negligible, and have very low escape velocities (¡ 170 m s^1), such that secondary cratering is negligible. The four larger satellites (Tethys, Dione, Rhea, & Iapatus), crater-counted by M. Kirchoff, use selected regions (for small crater counts) were chosen wherein the effects of endogenic processes are minimal. Comparison of the four larger satellite cratering records to those of the three smaller satellites indicate very little contamination from either secondary or sesquinary (planetocentric) impactors, except perhaps on the small- est scales ($<\sim$1 km crater diameter).

The size distribution of Kuiper belt objects from observations. Numerous telescopic surveys of Kuiper belt objects have uncovered some basic characteristics of the Kuiper belt luminosity function.a Converting a luminosity function to a size-frequency distribution is a task that requires many assumptions, including the mean distance of the surveyed objects and their albedos.

Implications. By combining size distributions derived for saturnian system impactors with those of Kuiper belt observations, we can put better constraints on the absolute number of small comets. This will have implications for models of the cometary contribution during the Late Heavy Bombardment [3]. Using flux estimates of comets, we can also use our derived impactor size-frequency distribution toward a crater count chronological system for the outer solar system. We compare results from our system with those of Zahnle et al. (2003) [4] and those based on asteroid impacts onto bodies in the inner solar system, such as Ivanov et al. (2002) [5].

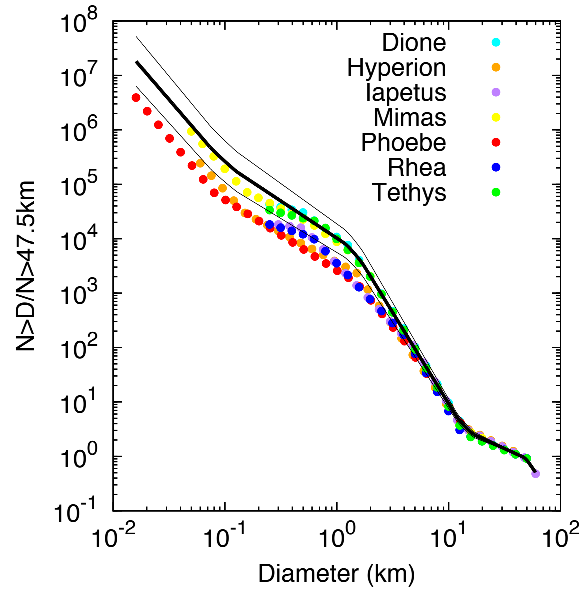

Figure 1: Comparison between the model size frequency distribution the derived impactor populations for each of the saturnian satellites. Colored lines are the derived impactor population for the satellites. The thick black line is the best fit, weighted by the number of craters counted over a common-slope segment. The thin black lines reflect the uncertainties in the slope estimates. All size distributions have been normalized to N>47.5 km=1.

References

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