Meteoritics and Planetary Science

Supporting Information for

Can Spatial Statistics Help Decipher Impact Crater Saturation?

Michelle R. Kirchoff

Southwest Research Institute, Boulder, CO, USA

Contents of this file

Figures S1 to S17

Introduction

Figures S1 and S2 provide visual comparisons of crater spatial density and spatial statistic results from other crater simulations to back up descriptions given in the main text. Figures S3-S17 provide additional details for the crater measurements used in computing the observed crater spatial densities and spatial statistics given in the main text. The location of the region of interest for each world is shown and the area of the region is given in the captions. Also shown is the cumulative size-frequency distribution with the fit for the given cumulative slope for each region of interest and the number of craters used for the analyses are given in the captions. Raw crater measurements as csv files for each region is provided online at http://data.boulder.swri.edu/~kirchoff/saturation.



Figure S1. Comparison of simulation results from Squyres et al. (1997) (left column) to simulation results from this work (right column). Simulation parameter values for this work are used as in Squyres et al. (1997): b = -2.73, effective crater radius is 1.3xR (for top four panels) or 1.5xR (for bottom two panels), R_{stat} is $3x R_{min}$, and rim percentage needed to recognize crater is 50%. Plots from Squyres et al. (1997) are modified from their Figs. 8, A2.



Figure S2. Spatial density and statistical analysis of results from the CTEM 3-D simulations (provided by David Minton; see Richardson et al. [2009] and Minton et al. [2015] for details of CTEM). Top row show results for b = -1 and bottom row is for b = -2 (other parameters used in 2-D simulation are not required in the 3-D simulation). Values and figure notations are as described to Figs. 4-7 in the main text.



Figure S3. Study region for Mimas. (a) Region in global context. (b) Close up of region. Note that craters are slightly offset due to change in coordinate system since craters were measured. (c) Cumulative crater SFD and best fit slope. Diameters range from 4-45 km. Area within the red outline is 43233 km². There are 298 craters within the red outline and 559 craters total.



Figure S4. Study region for Tethys. (a) Region in global context. (b) Close up of region. Note that craters are slightly offset due to change in coordinate system since craters were measured. (c) Cumulative crater SFD and best fit slope. Diameters range from 4-40 km. Area within the red outline is 38327 km². There are 296 craters within the red outline and 435 craters total.



Figure S5. Study regions for Dione. (a) Regions in global context. Close up of (b) DDCP, (c) DICP, and (d) DEE. Note that craters are slightly offset due to change in coordinate system since craters were measured. Cumulative crater SFD and best fit slope for (e) DDCP, (f) DICP, and (f) DEE. Diameters range from (e) 4-60 km, (f) 4-43 km, and (g) 4-27 km. Area within the red outline for DDCP is 38712 km², DICP is 53552 km², and DEE is 102449 km². There are 265 craters within the red outline and 386 craters total for DDCP, 299 and 432 for DICP, and 65 and 145 for DEE.



Figure S6. Study regions for Iapetus. (a) Regions in global context. Close up of (b) IDCP (small craters), (c) IBCP, and (d) IDCP (large craters). Note that craters are slightly offset due to change in coordinate system since craters were measured. Cumulative crater SFD and best fit slope for (e) IDCP (small), (f) IBCP, and (f) IDCP (large). Diameters range from (e) 2-48 km, (f) 10-95 km, and (g) 10-430 km. Area within the red outline for IDCP (small) is 32384 km², IBCP is 48701 km², and IDCP (large) is 289988 km². There are 441 craters within the red outline and 691 craters total for IDCP (small), 23 and 66 for IBCP, and 101 and 186 for IDCP (large).



Figure S7. Study region for Enceladus. (a) Region in global context. (b) Close up of region. Note that craters are slightly offset due to change in coordinate system since craters were measured. (c) Cumulative crater SFD and best fit slope. Diameters range from 1-22 km. Area within the red outline is 4643 km². There are 259 craters within the red outline and 539 craters total.



Figure S8. Study regions for Earth's Moon. (a) Regions in global context. Close up of (b) MnH, (c) MnSPA, and (d) MnM. For each region the red outline and blue circles indicate area and measurements for the bigger craters ($D \ge 25$ km), while the white outline and purple circles indicate area and measurements for the smaller craters ($D \ge 6$ km). Cumulative crater SFD and best fit slope for (e) MnH, (f) MnSPA, and (f) MnM and the big and small craters as indicated. Diameters range from (e) 10-161 km (big), 3-45 km (small), (f) 10-110 km (big), 3-105 km (small), and (g) 10-94 km (big), 3-39 km (small). Area for MnH within the red outline is 79058 km² and white outline is 13488 km². Area for MnSPA is 71477 km² (red) and is 21510 km² (white). Area for MnM is 841025 km² (red) and is 284298 km² (white). Number of MnH big craters: 92 within outline and 145 total. Of MnH small craters: 91 within outline and 148 total. Of MnSPA big craters: 48 within outline and 82 total. Of MnSPA small craters: 93 within outline and 147 total. Of MnM big craters: 25 within outline and 45 total. Of MnM small craters: 59 within outline and 103 total.



Figure S9. Study regions for Mercury. (a) Regions in global context. Close up of (b) McCP, (c) McIP, and (d) McSP. For each region the red outline and blue circles indicate area and measurements for the bigger craters ($D \ge 10$ km), while the white outline and purple circles indicate area and measurements for the smaller craters ($D \ge 2$ km). Note smaller craters were not measured for the McCP because of the high density of secondaries. Cumulative crater SFD and best fit slope for (e) McCP, (f) McIP, and (g) McSP for the big and small craters as indicated. Diameters range from (e) 10-161 km (big), (f) 10-214 km (big), 2-10 km (small), and (g) 10-104 km (big), 2-10 km (small). Area for McCP within the red outline is 567347 km². Area for McIP is 779962 km² (red) and is 3427 km² (white). Area for McSP is 2138118 km² (red) and is 10934 km² (white). Number of McCP big craters: 100 within outline and 179 total. Of McIP big craters: 111 within outline and 192 total. Of McIP small craters: 84 within outline and 123 total. Of McSP big craters: 164 within outline and 284 total. For McSP small craters: 43 within outline and 72 total.



Figure S10. Study regions for Miranda. (a) Regions in global context. Close up of (b) MrCP and (c) MrTP. Because of the proximity of the regions crater measurements are represented by blue circles for MrCP and purple circles for MrTP. Cumulative crater SFD and best fit slope for (d) MrCP and (e) MrTP. Diameters range from (d) 1.5-23 km and (e) 1.5-13 km. Area within the red outline for MrCP is 15903 km² and MrTP is 13757 km². There are 144 craters within the red outline and 231 craters total for MrCP and 29 and 50 for MrTP.



Figure S11. Study region for Callisto. (a) Region in global context. (b) Close up of region. Note that craters are slightly offset due to change in coordinate system since craters were measured. (c) Cumulative crater SFD and best fit slope. Diameters range from 1.5-30 km. Area within the red outline is 13809 km². There are 200 craters within the red outline and 315 craters total.



Figure S12. Study regions for Ariel. (a) Regions in global context. Close up of (b) ACP and (c) ATP. Because of the proximity of the regions crater measurements are represented by blue circles for ACP and purple circles for ATP. Cumulative crater SFD and best fit slope for (d) ACP and (e) ATP. Diameters range from (d) 6-39 km and (e) 6-84 km. Area within the red outline for ACP is 16641 km² and ATP is 67466 km². There are 17 craters within the red outline and 38 craters total for ACP and 13 and 38 for ATP.



Figure S13. Study regions for Ganymede. (a) Regions in global context. Close up of (b) GCP, (c) GBP (big craters), and (d) GBP (small craters). Cumulative crater SFD and best fit slope for (e) GCP, (f) GBP (big), and (f) GBP (small). Diameters range from (e) 10-235 km, (f) 12-110 km, and (g) 1-15 km. Area within the red outline for BCP is 605430 km², GBP (large) is 1868153 km², and GBP (small) is 15310 km². There are 122 craters within the red outline and 297 craters total for GCP, 127 and 209 for GBP (big), and 70 and 112 for GBP (small).



Figure S14. Study region for Oberon. (a) Region in global context. (b) Close up of region. (c) Cumulative crater SFD and best fit slope. Diameters range from 22-225 km. Area within the red outline is 318197 km². There are 89 craters within the red outline and 192 craters total.



Figure S15. Study region for Umbriel. (a) Region in global context. (b) Close up of region. (c) Cumulative crater SFD and best fit slope. Diameters range from 20-272 km. Area within the red outline is 382234 km². There are 162 craters within the red outline and 230 craters total.



Figure S16. Study region for Rhea. (a) Region in global context. (b) Close up of region. Note that craters are slightly offset due to change in coordinate system since craters were measured. (c) Cumulative crater SFD and best fit slope. Diameters range from 10-357 km. Area within the red outline is 235816 km². There are 147 craters within the red outline and 313 craters total.



Figure S17. Study region for Titania. (a) Region in global context. (b) Close up of region. (c) Cumulative crater SFD and best fit slope. Diameters range from 13-338 km. Area within the red outline is 242638 km². There are 85 craters within the red outline and 158 craters total.