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COMPARATIVE STUDY OF IMPACT CRATERS ON EARTH AND TITAN USING RADAR

Abstract

Titan, the largest moon of Saturn, is a prime candidate for future space exploration. It is the only planetary body in our solar system, besides Earth, that has liquid (methane) on its surface and a thick, nitrogen-rich atmosphere. The RADAR instrument on NASA's Cassini spacecraft mapped the surface of Titan and detected an unusually low number of impact craters compared to nearby Saturnian satellites [1]. The low crater count is likely a result of atmospheric shielding (reduces craters with D $<$ 20km), and erosion and burial of craters (affects craters or all sizes). This is similar to the reduced number of craters seen on Earth, as a result of weathering and erosion, compared to the heavily cratered lunar surface. Earth and Titan are comparable because erosion and burial are dominant processes responsible for crater degradation on both surfaces, making Earth a strong analogue for studying Titan's craters. There are 188 confirmed craters on Earth which have been identified by a combination of field and laboratory studies. Of these craters, 60 are buried and therefore unobservable from orbit. In addition, craters formed in marine environments (also present on Titan) lack significant surface topography that may prevent them from being recognized from orbital satellites [2]. This study proposes to determine the percentage of exposed terrestrial craters that can be recognized with synthetic aperture radar (SAR) data, as an analogue for Titan. Data from ESA's Sentinel-1 satellites (C-band) and Japan's Advanced Land Observation Satellite (L-band) will be used, allowing for the investigation of the roughness of craters at centimeter to decimeter scales. Preliminary results show that of the 20 mapped craters, approximately 45% are distinctly visible. A complete study of terrestrial craters will help us to infer the number of unobservable impact craters on Titan. An accurate crater population for Titan will help us to determine constraints on the age of its surface, a value which is critical for models of the formation and evolution of Titan. All of these factors will help us to determine a comprehensive history and understanding of Titan, one of the most astrobiologically significant planetary bodies in our solar system.

References: [1] Lorenz, et al. (2007). Titan's young surface: Initial impact crater survey by Cassini RADAR and model comparison. Geophysical Research Letters, 34(7). doi:10.1029/2006gl028971. [2] Collins, G. S.,& Wünnemann, K. (2005). How big was the Chesapeake Bay impact? Insight from numerical modeling. Geology, 33(12), 925. doi:10.1130/g21854.1