Statistics on Venus: Craters and Catastrophes(?)

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Abstract

The nature of the spatial distribution of impact craters is a key to understanding the geologic history of Venus' surface. Based solely upon impact crater centers (points) and using a variety of tests, including Mth nearest neighbor analysis, the distribution of craters cannot (with a standard level of confidence of 0.05) be distinguished from one that is completely spatially random (CSR). Within the planetary science community this has led to three interpretations: (1) the distribution of craters is random, and therefore the surface is a single age, implying a global, catastrophic resurfacing event (CRM), (2) the apparently random distribution is due to a unique competition leading to equilibrium between random crater emplacement and removal (ERM), and (3) the assumption that the distribution is indeed CSR is a non-unique interpretation, and other geologically based models may be at least as likely to be representative of the crater distribution. These interpretations and their implications will be discussed within the context of unraveling Venus' geologic evolution. The third idea will be a focus of discussion; supporting evidence includes statistically distinct crater densities for surface units defined with geologic criteria without utilizing variations in crater density. In addition, Mth nearest neighbor analysis of Monte Carlo simulations of a planet with a range of ages defined by geologic units and their respective relative crater densities indicates that the hypothesis that such models are representative of Venus cannot be rejected either. These results suggest that distributions of impact craters that are indistinguishable from random may also have a subtle structure that belies a planet's surface history. These topics are inextricably linked to the roles that statistics and randomness play in investigations of planetary evolution which will be a theme of discussion.