RECURSIVE TOPOGRAPHY BASED SURFACE AGE COMPUTATIONS FOR MARS: NEW INSIGHT INTO SURFICIAL PROCESSES THAT INFLUENCED CRATERS DISTRIBUTION AS A STEP TOWARD THE FORMAL PROOF OF MARTIAN OCEAN RECESSION, TIMING AND PROBABILITY.

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Introduction: This work investigates new algorithm how to measure influence on craters distribution, providing new insight into: the processes that caused this influence (probably lava flows and polar caps), the amount of resurfacing and the ocean hypothesis.

Crater Statistics: Large body of work on the impact crater statistics was already done, mostly related to so called Cratering Chronology Diagrams (CCD) shown in log/log scale, showing Cumulative Crater Frequency (N km^{-2}) as a function of Age (years) for some particular crater diameter [1]. However, as it was recently shown [2], the Mathematical Theory of Stochastic Processes (MTSP) can be applied to the Lunar and Planetary Science (LPS) and according to MTSP, this CCD is only one possible representation of bombardment of lunar/planetary surface modeled as stochastic process. The importance of other representations (SAC, SACT, SACTR, …) is that each one can provide some new information and so contribute to our knowledge about some particular lunar/planetary body.

Surface Age Computations (SAC): To use surface age as input for statistical analysis, the required input is large enough number of regions with computed surface age. However, the number of those regions is inversely proportional to their size, meaning that larger number of them results that each one is smaller and so less appropriate for CCD based computation. As a solution to this problem, SAC algorithm was proposed in [3] as follows. For any particular point a circle is defined with center in this point, large just enough to contain *m* craters. Then, in first approximation, surface age can be computed as a function of density of craters $d=m/(r^2\pi)$. In order resolution to be the same no mater how many craters there are in some data-set, *m* can additionally be defined to be proportional to the number of craters in some particular data-set, as was also proposed in [3].

Topography based SAC (SACT): The first statistical analysis that used SAC results as input is SACT algorithm as proposed in [4]. Density of craters for each point is divided with the average density of craters for point's elevation, which can easily be computed for each altitude using MOLA data. Accordingly, age is not computed as relative to the average surface age of the whole planet, like in the SAC case, but as relative to the average surface age at the corresponding altitude. The first results [4] show that the largest volcanoes, as well as the regions possibly covered by north and south polar caps, are inside the regions computed that way. This shows a possibility that influence of those surficial processes on craters statistics can be measured, indicating that using crater statistics we can reconstruct with certain probability and precision processes that have shaped the surface of the planet, including the amount of resurfacing.

Recursive SACT (SACTR): The three most important questions regarding SACT computations are: (1) how precise they are for some particular craters data set, (2) how the regions (where crater statistics is highly influenced by surficial processes) influenced the results, and (3) can we exclude this influence to obtain more precise results. As a step toward answers of those questions, the following SACTR algorithm is proposed. Once those regions influenced by surficial processes were computed using SACT algorithm we can exclude them during computation of the average surface age (that will be used in next iteration) for each altitude. Using SACTR algorithm those regions can be computed again and complete process can be repeated until difference between results (e.g. the area of excluded regions) of two consecutive iterations is smaller than some predefined threshold (e.g. 2% of the complete planet surface). Results as shown in Fig. 1-4 are very similar to one obtained using SACT algorithm. The results of two different data sets are also similar. All this strongly indicates that using SACTR we can exclude the influence of measured surficial processes on computation process itself, to measure those processes and the amount of resurfacing with wanted precision defined by threshold.

Conclusion: By measuring the influence of surficial processes on crater statistics we can measure the extent of those processes as well, what is the primary contribution of the approach. One of the interesting tasks regarding future work is investigation of the influence of each particular surficial process on crater statistics including the possible influence of the hypothetical ocean.

References: [1] Neukum G. (1988) *Workshop on Mars Sample Return Science*, 128-129. [2] Salamunićcar G. (2004) *Adv. Space Res.*, *33*, 2281-2287. [3] Salamunićcar G. (2003) *LPS XXXIV*, Abstract #1421. [4] Salamunićcar G. and Nežić Z. (2004) *LPS XXXV*, Abstract #1973.

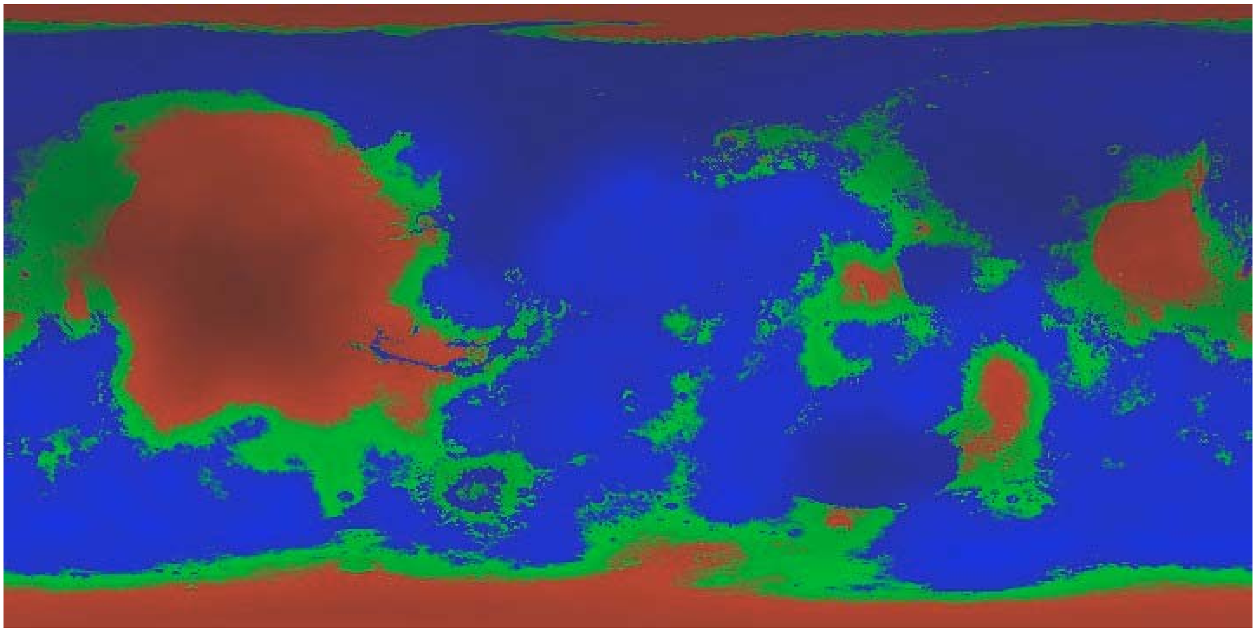

Figure 1: Recursive topography based surface age computations for 9496 craters data set and surface age as background: age < 50% (red), 50% < age < 100% (green) and age > 100% (blue), where 100% denotes the average age.

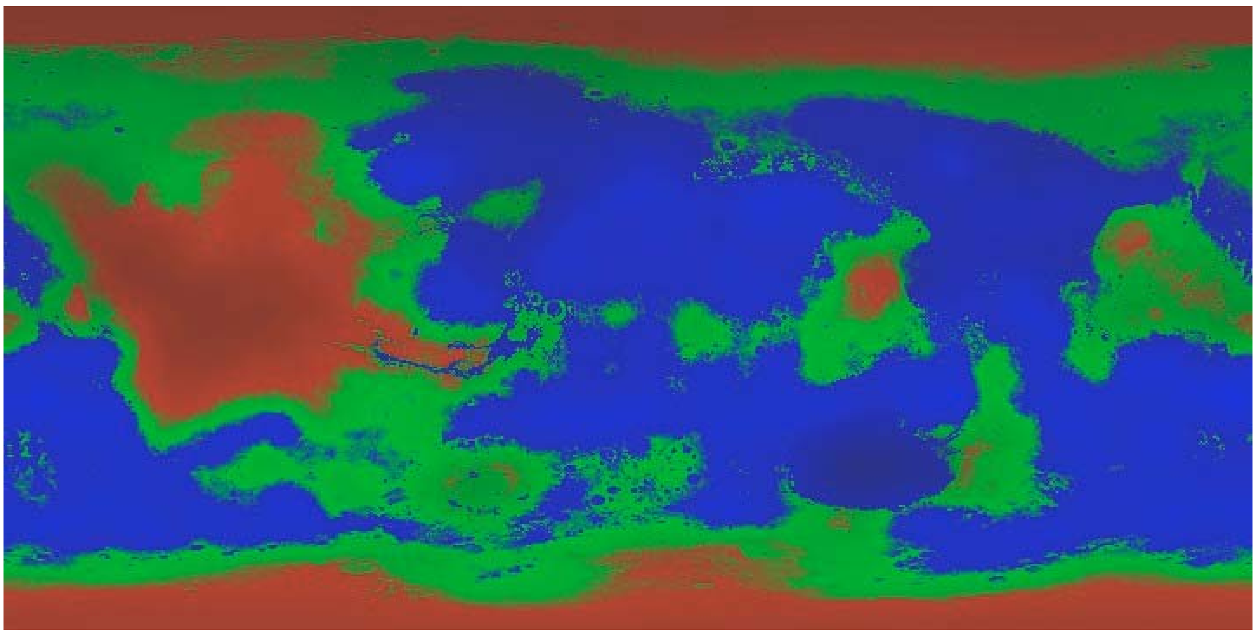

Figure 2: Recursive topography based surface age computations for 22044 craters data set and surface age as background: age < 50% (red), 50% < age < 100% (green) and age > 100% (blue), where 100% denotes the average age.

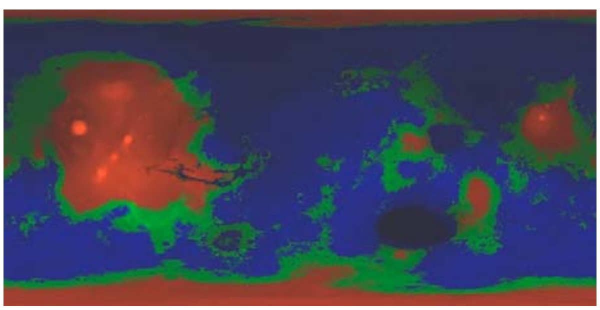

Figure 3: Topography as background for Fig. 1.

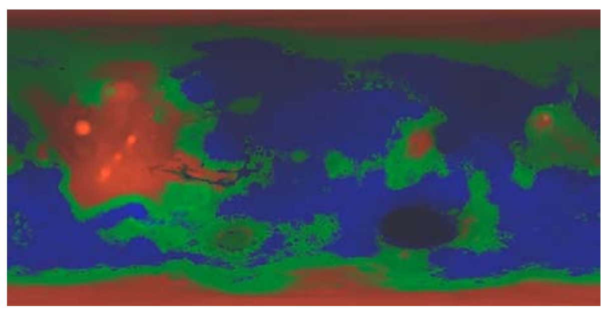

Figure 4: Topography as background for Fig. 2.