THE PRODUCTION RATE OF SMALL CRATERS ON EARTH, AND THE EXPECTED CRATER POPULATION IN SOUTH AMERICA.

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Introduction: The craters preserved on the lunar mare provide a record of the rate of impacts and the impactor size distribution, over a mass range of ~10-10^{16}kg, for the 3.2-3.5Ga since the mare basalts were emplaced [1]. Constructing a similar curve for number of impacts over a given mass at the Earth's surface is complicated: the atmosphere disrupts meteoroids [2], and craters are removed by erosion and tectonism, or infilled. Since the terrestrial small crater record is incomplete, we chose to scale the known impact rate at the upper atmosphere to a flux at the surface by modelling how a given bolide behaves in the atmosphere.

Methodology: Most semianalytical approaches have considered impactors as strengthless liquid-like objects: so-called 'pancake' models, in which clouds of fragments are modelled as a continuous, lower-density, deformed impactor [2-4]. Unfortunately, these models are not capable of reproducing the cratering behaviour of fragmented asteroids. In contrast, Artemieva and co-workers [6-8] have developed a model that calculates motion, aerodynamic loading, and ablation, for each individual particle or fragment in a disrupted impactor. This approach allows us to predict a mass- velocity-distribution at the Earth's surface for a given impactor at the top of the atmosphere. The flux at the upper atmosphere has recently been constrained over a large portion of the mass range [9-16]. Our modelling data allows the flux curve for the upper atmosphere to be scaled to an impact rate at the Earth's surface, for objects from meteorites to 1km asteroids [17].

Discussion: Based on our calculated surface flux curve, we estimate that over the last 100Ma the continent of South America has experienced impacts producing ~18 craters >10km, of which 12 would be >20km, and 1 ~75km. Over a 1Ma period we would expect a single 1km crater, and ~200 Campo del Cielo events.

The number of confirmed craters in Brazil (Araguainha, Serra da Cangalha, Riachão, Vargeão) is much lower than we would expect given the large area of the country, and the area and age of geologically stable target. It is interesting that the size-frequency distribution of possible craters derived from recent remote sensing data is a very close match to the expected population, given estimated impact rate, and the area and age of Brazilian basins.

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