



Determination of impact crater size-frequency distributions in GIS environments

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Analysis of crater size-frequency distributions (CSFD) of impact craters on planetary surfaces is a well-established method to derive absolute ages on the basis of remotely sensed image data. Although modelling approaches and the derivation of absolute ages from a given CSFD have been described in considerable depth since the late 1960s, there is no standardized methodology and guideline for measuring impact-crater diameters and area sizes that are both needed in order to determine absolute ages in a correct way. Distortions of distances (i.e., diameters) and areas within different map projections are considerable error sources within this measurement phase. In order to address that problem and to minimize such errors, a software extension for ESRI's ArcMap (ArcGIS) has been developed where CSFDs on planetary surfaces can be measured independently of image and data frame map projections and which can be theoretically transferred to every GI system capable of working with different map projections. Using this new approach each digitized impact crater is internally projected to a stereographic map projection with the crater's central-point set as the projection center. In this projection the circle is defined without any distortion of its shape (i.e., conformality). Using a sinusoidal map projection with a center longitude set to the crater's central point, the diameter of the impact crater is measured along this central meridian which is true-scale and does not show any distortion. The crater is re-projected to the map projection of the current data frame and stored as vector geometry with attributes (shapefile). Output of this workflow comprises correct impact-crater diameters and area sizes in sinusoidal map projections and can be used for further processing, e.g., absolute age determinations. For GIS-based measurements we strongly recommend our procedure to be the standardised methodology to determine CSFD on planetary surfaces in order to minimize map distortion effects for further analysis. The ESRI ArcMap toolbar developed in this context significantly helps to improve and simplify the crater size-frequency measurement process.