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3d morphometric analysis of lunar impact craters: a tool for degradation estimates and interpretation of maria stratigraphy

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In this study we have applied 3D morphometric analysis of impact craters on the Moon by means of high resolution DTMs derived from LROC (Lunar Reconnaissance Orbiter Camera) NAC (Narrow Angle Camera) (0.5 to 1.5 m/pixel). The objective is twofold: i) evaluating crater degradation and ii) exploring the potential of this approach for Maria stratigraphic interpretation.
In relation to the first objective we have considered several craters with different diameters representative of the four classes of degradation being C1 the freshest and C4 the most degraded ones (Arthur et al., 1963; Wilhelms, 1987). DTMs of these craters were elaborated according to a multiscalar approach (Wood, 1996) by testing different ranges of kernel sizes (e.g. 15-35-50-75-100), in order to retrieve morphometric variables such as slope, curvatures and openness. In particular, curvatures were calculated along different planes (e.g. profile curvature and plan curvature) and used to characterize the different sectors of a crater (rim crest, floor, internal slope and related boundaries) enabling us to evaluate its degradation. The gradient of the internal slope of different craters representative of the four classes shows a decrease of the slope mean value from C1 to C4 in relation to crater age and diameter. Indeed degradation is influenced by gravitational processes (landslides, dry flows), as well as space weathering that induces both smoothing effects on the morphologies and infilling processes within the crater, with the main results of lowering and enlarging the rim crest, and shallowing the crater depth.
As far as the stratigraphic application is concerned, morphometric analysis was applied to recognize morphologic features within some simple craters, in order to understand the stratigraphic relationships among different lava layers within Mare Serenitatis. A clear-cut rheological boundary at a depth of 200 m within the small fresh Linnè crater (diameter: 2.22 km), firstly hypothesized through numerical investigation (Martellato et al.), has been well identified as a bland morphological step on the inner crater scarp by using slope and curvature maps derived from a NAC DTM. In addition to this main morphological feature, other minor layers have been detected allowing to consider impact crater as stratigraphic logs to perform an interpretative subsurface map of a selected sector of Mare Serenitatis.

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