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Definition of a map grid system for minimum distortion representation of the topography of the planet Mars

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The future and even the present progress of the Martian geosciences (areosciences) raises a demand of one or more unified map grid system(s) for large scale representation of the digital data of the surface of the planet. The release of the Mars Orbiter Laser Altimeter (MOLA) elevation dataset made this demand more urging. For large scale satellite image mapping and geoscientific analyses of superficial features, the defined map grid system should provide minimum distortion. A projection system, very similar to the terrestrial UTM (Universal Transverse Mercator) grid is appropriate for most analyses and applications, at least at the present resolution of the MOLA dataset. To make complex and unified interpretation of remotely sensed images and elevation models, this grid system should be applicable in GIS packages.

To define such a grid in a GIS, we need appropriate choices for:

- An ellipsoid convenient for Martian mapping, having substantially different semi-major axis and flattening from the Earth's ellipsoid.

- A 'geodetic' datum. As the MOLA database contains elevation data above or below the areoid (the Martian geoid), the ellipsoid center should be set to the mass center similarly to its terrestrial counterpart of the WGS84. (For later studies and applications, however, there may be a need to define a datum with the center set to the center of figure, which is out of the scope of this study.)

- A system of map grids, based on a projection providing low distortion in a certain area, interpreted on the pre-defined datum.

In the present work we define a UTM-like grid system, the Transverse Martian System

(TMS) with 60 zones based on elliptical cylindric projection. However, the flattening of the Mars is considerably larger, than that of the Earth, the use of elliptic cylinders makes distortion acceptable for topographic mapping. As a consequence of the projection choice, the TMS, like the UTM, is not suitable for the polar regions, e.g., the area of the ice caps.

A representative example of usage is to analyse the ‘geomorphology’ and the surface process modelling of the Mars. Owing to the new results of the recent Martian remote sensing, the question whether water runoff played any role in the surface formation of the Mars can be positively answered. Consequently, some of the methods of the geomorphology can be applied on the elevation data, and - though at the present level of knowledge only with limited validity - the surface can be analysed with these methods.

In the fluvial surface formation the discharge and the slope angle play the primary role. So far there is no applicable estimation on the discharge of the Martian catchments, but the slope distribution can be analysed roughly based on the MOLA data. This analysis, however, needs undistorted slope values. The latitude/longitude representation of the MOLA data set is not suitable for this purpose. Our TMS grid provides an appropriate, low-distortion mapping system, which is suitable for GIS integration, too.