Mapping Planet Earth in ESSG: CTA Model and Global Spatial Data Visualization

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The planet Earth is a complex dynamic geo-system comprised of several structured spheres, such as mantel, lithosphere, coversphere, atmosphere and ionosphere. To organize GEOSS datasets and to map the planet Earth in spheroid manifold space but not Euclidean space is a back to nature and an advance to future. Referring to planet Earth's characteristics in multi-sphere structured and autorotation, a universal earth system spatial grid (ESSG)[1] which is a new member of global discrete grid (GDG)[2-5], is developed from spheroid degenerated octree grid (SDOG)[6,7]. The SDOG-based ESSG has features in sphere-shelled data structure, seamless global coverage, hierarchical grid subdivision, homogeneous grid granularity, and unique spatial code. These features make the SDOG-based ESSG be able to act as new universal spatial framework.

Different from traditional spatial data model and data structure, the massive global data/information can be organized with a CTA model, in which ***C*** is the unique geocode of a grid in ESSG by octal system, the ***T*** is the time stamp of attribute data, and ***A*** is the data value of any attributes. In view of data base, a triple CTA leading by a unique ***C*** acts as an open 2D table, which has limitless length in time row and any length in attribute column. As in Figure 1, any grid in ESSG is not only a geometric representation of the tessellated manifold space, but also a container of historical and dynamic attribute data related to the grid space. Any observation data can be "put into" a grid as the attributes of the grid at any time, and then it can be spatially and statistically computed, after decoding and rendering, at a visualization mode as you like.

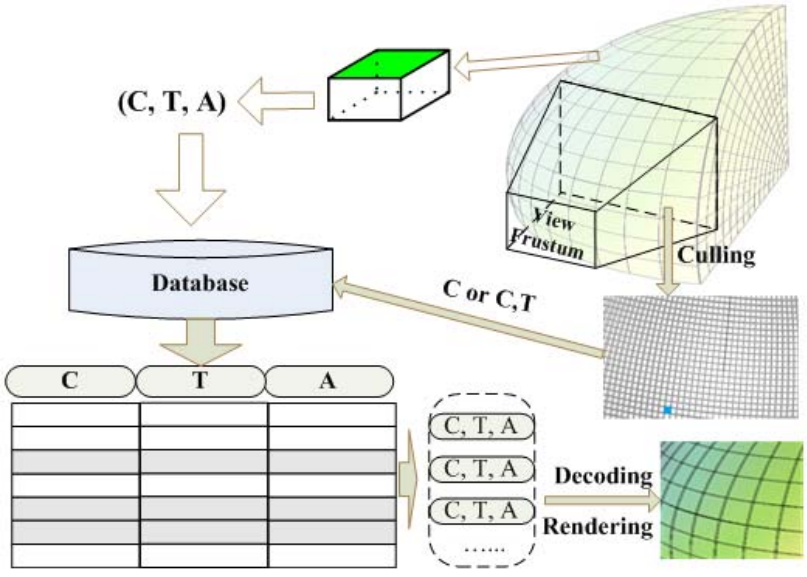

Fig.1 ESSG-based global spatial data/information management with a CTA model

For example, with ESSG of particular/corresponding spatial resolution, the seismic velocity, the rock type and crust temperature of lithosphere can be “put into” the underground grids[8]; the atmosphere temperature, moisture and aerosol density can be “put into” the overground grid; and the elevation, coverage, and image of Earth surface can be “put into” the surface grid All data in-putted to ESSG can be easily indexed and freely accessed with the unique ***C*** no matter the data is locally stored or cloud stored.

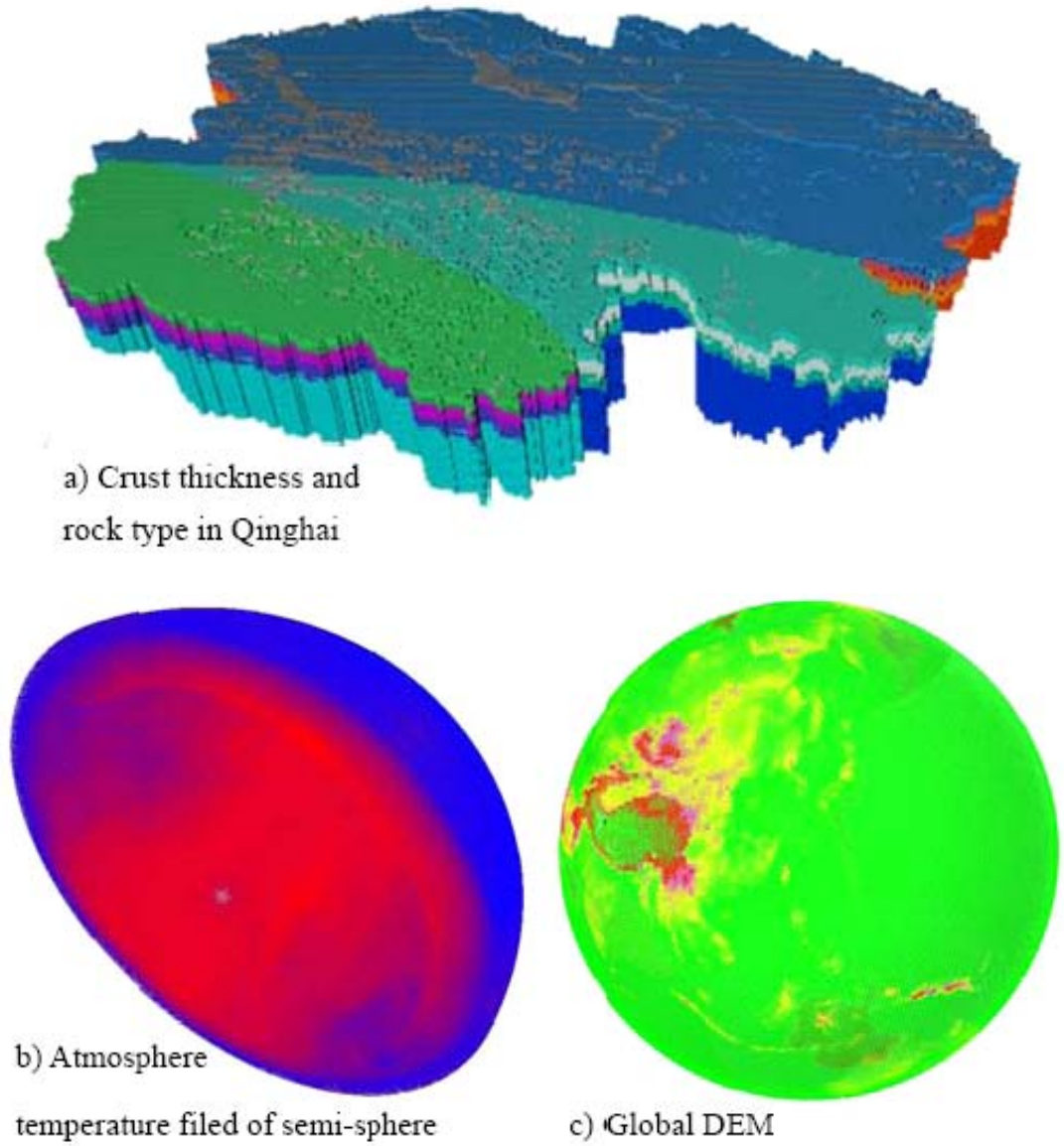

Figure 2 Global mapping and geo-computation visualization in ESSG

Support with SDOG-based ESSG, the visualization on global data and on planet Earth can be improved, and the geocomputation can be performed in a transparent 3D space with tessellated manifold grids. As in Figure 2, a crust plate can be represented and visualized as a group of crust grids with face-, edge- and node-adjacency, and the atmosphere temperature field can be visualized at any mode by the atmosphere grids rendered with different temperature values. In-putting datasets from USGS, NOAA and WDC to the SDOG-based ESSG, this paper demonstrate the organization of global data with CTA model, and the 3D mapping and data visualization on global DEM, lithosphere, and atmosphere.

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