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Editorial

Special Issue "Global Grid Systems"

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This Special Issue is dedicated to research papers on topics related to global grid systems, from their geometric foundations to their cutting-edge applications.

In the era of big Earth data, novel and disruptive methods for constructing sophisticated geographic information system (GIS) and globe-based Digital Earth systems are needed [1]. An emerging approach to developing such systems discretizes a curved model of the Earth into hierarchical sets of highly regular cells, each of which represents a distinct region of the Earth. Due to its discrete and regular nature, this approach is also known as the (discrete) global grid system (DGGS). Each cell in a DGGS is assigned a unique index which is used to reference geospatial information related to that cell. In order to support multiple spatial resolutions, cells are hierarchically subdivided using simple refinements [2,3]. Some of the important advantages of this multiresolution approach have been reported in [1–4] and the Open Geospatial Consortium (OGC) has recently approved an abstract standard for DGGS [5].

In this Special Issue, eight research articles are presented that contribute to both the breadth and depth of DGGS literature on multiple fronts including foundational theory [6–9], applications [10–12] and extensions [13].

Foundational papers include Hall et al.'s novel DGGS based on using a disdyakis triacontahedron (DT) as the initial DGGS polyhedron, moving away from the commonly used Platonic solids while reducing the projection's angular distortion [6]. They modify and extend all components of DGGS in order to efficiently work with this new initial polyhedron. Wang et al. [7] explore a new indexing scheme that can be used when mixing two specific types of refinement, allowing for a wider range of grid resolutions. To improve the performance of indexing in hexagonal DGGSs (a popular choice for DGGSs), J. Zhou et al. employ a hexagonal lattice quad-tree structure (HLQT) encoding [8] and validate the efficiency of the proposed HLQT-based indexing via comparison with conventional indexing methods. Finally, L. Zhou et al. attempt to address the issue of topological change that can emerge when vector data are converted into a DGGS's discrete representation [9]. They take advantage of the hierarchical structure of a DGSS to fix three different types of topological distortion.

On the subject of applications, Zhai et al. [10] address collision detection for unmanned aerial vehicles (UAV). In this article, the authors motivate the use of a 3D grid system to improve the computational cost of traditional non-grid based methods (achieving an approximately 50%–80% improvement under different scenarios). For air traffic planning, Miao et al. [11] explore the use of a multi-grid space subdivision method in order to reduce the computational time for flight conflict detection. Lastly, Bowater and Wachowicz [12] present a case study related to the Internet of Things (IoT), in which they demonstrate an offsetting model's use (within the framework of a DGGS) in determining nearby regions for static and mobile IoT devices.

In the final paper of this Special Issue, dealing with extending existing DGGSs, Ulmer et al. [13] propose a general method to generalize 2D global grid systems (i.e., embedded in the surface of the Earth) to 3D (i.e., volumetric) Earth-centric DGGSs. In addition to the novel construction of the grid, they propose encoding, decoding, and indexing operations in a way that supports interoperability between the 2D and 3D versions of a DGGS.

As two of these articles have been produced by our research team, they have been handled by another anonymized editor of the ISPRS International Journal of Geo-Information.

We hope that this issue and the novel methods it offers enrich and contribute to the development of DGGS as the next generation of GIS and to pushing the boundaries of science in the geo-information community.

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