Abstract Title

Exploring the Arctic: Integrating Earth Observations on the WorldView Discrete Global Grid System

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Abstract Text

Humanity's ability to measure, monitor, and communicate over the vastness of the entire Earth is unprecedented. Trends point to ever growing volumes of rich data describing the planet. People, from scientist to citizens, expect this information in a form that can answer their pressing questions…instantly. At the same time, we are experiencing the rapid unprecedented consequences of environmental changes. It is hoped that the data and information describing these changes can be transformed into the knowledge and decisions that will mitigate the cost.

Nowhere are these changes more evident than in the Arctic. The singularity of a pole in a region of vying national interests, climate change, resource extraction, emerging shipping routes, and a suffering ecosystem have given the Arctic new attention. However, access to Arctic geospatial data has long been a challenge. Remoteness and equatorial fixated map projections have made it difficult to include polar data in the normal offerings of scientific and consumer mapping products. Timely decisions are further hampered by the conventional GIS approach where data must be pre-integrated by expert analysts before it can produce answers and insight to pressing geospatial questions. Arctic projected webmaps provide anticipated stop gap but fail to produce the robustness of a system that can answer unanticipated questions.

The Open Geospatial Consortium (OGC) has recently introduced a new Earth reference standard that promises to solve these challenges. It is formally called a Discrete Global Grid System (DGGS) and is analogous to any discrete "Digital" data structure - as opposed to the continuous "Analog" model of the Earth represented by geographic coordinates. OGC defines a DGGS as: *"a spatial reference system that uses a hierarchical tessellation of cells to partition and address the globe. DGGS are characterized by the properties of their cell structure, geo-encoding, quantization strategy and associated mathematical functions."*

Essentially, a DGGS is a spatial reference that uses equal area cells to partition and address the entire globe. Each tiny cell – they can be infinitesimally small - has a unique address similar to the cells of a spreadsheet. The hierarchy of cells provide rapid aggregation and decomposition of data necessary for online access and transmission speeds. As a global spatial reference system, Polar data in a DGGS is accurately portrayed and equally integrated with any map information of the world. Geospatial data values from any source, type, format, spatial reference, spatial scale, or frequency can be held in a DGGS. With the trend to more open on-demand systems, DGGS provide a user centric approach where end-users can search and explore for interesting data from multiple content providers simultaneously. Answering complex geospatial questions in the form

of “Where is it?” and “What is here?” are simple set theory operations. Big Earth Data that is aligned to a DGGS is easy to access, store, sort, process, transmit, integrate, visualize, analyse and model.

PYXIS WorldView DGGS has been shown to fulfill a vision for a web enabled Digital Earth that is so simple to use that children can effectively understand facts and events that define the condition and history of our planet. WorldView allows multiple data sources to be integrated and analyzed in one workflow without the need to convert or change spatial reference systems. WorldView DGGS permits easy repeatable manipulation, visualization and analysis of measurements from any location at any scale. The rapid search, discovery, and combing of geospatial content across multiple data jurisdictions has been successfully demonstrated using the WorldView DGGS in many OGC testbeds and Global Earth Observation System of Systems (GEOSS) pilot projects.

Visualization of complex analysis can be an effective method of influencing a multitude of policy and decision making processes which impact Arctic issues. A DGGS can be a major advancement in the understanding of the Arctic environment where data can be accurately represented with minimal distortion. Users can easily access and combine data to problem solve and make decisions concerning issues in the Arctic in a timely manner. Access to large scale Arctic data sources that can be viewed geospatially is a common process shared between scientists, engineers, teachers, and citizens.

The new OGC DGGS standard provides the basis for adopting this new digital Earth approach to geospatial decision-making. WorldView demonstrates that a DGGS is a simple solution for data integration, visualization and analysis. The authors will present use cases that exemplify how WorldView DGGS supports easy access to large and complex Arctic geospatial datasets to perform analysis, on one platform, in one workflow.

Keywords

Digital Earth Reference Model, Discrete Global Grid System, OGC, Arctic, Geographic Information Systems (GIS), Spatial Analysis, Earth Observations, Polar Projections