Geophysical Research Abstracts
Vol. 16, EGU2014-7670-1, 2014
EGU General Assembly 2014

Modeling change from large-scale high-dimensional spatio-temporal array data

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The massive data that come from Earth observation satellite and other sensors provide significant information for modeling global change. At the same time, the high dimensionality of the data has brought challenges in data acquisition, management, effective querying and processing. In addition, the output of earth system modeling tends to be data intensive and needs methodologies for storing, validation, analyzing and visualization, e.g. as maps. An important proportion of earth system observations and simulated data can be represented as multi-dimensional array data, which has received increasingly attention in big data management and spatial-temporal analysis.
Study cases will be developed in natural science such as climate change, hydrological modeling, sediment dynamics, from which the addressing of big data problems is necessary. Multi-dimensional array-based database management and analytics system such as Rasdaman, SciDB, and R will be applied to these cases. From these studies will hope to learn the strengths and weaknesses of these systems, how they might work together or how semantics of array operations differ, through addressing the problems associated with big data.

Research questions include:
• How can we reduce dimensions spatially and temporally, or thematically?
• How can we extend existing GIS functions to work on multidimensional arrays?
• How can we combine data sets of different dimensionality or different resolutions?
• Can map algebra be extended to an intelligible array algebra?
• What are effective semantics for array programming of dynamic data driven applications?
• In which sense are space and time special, as dimensions, compared to other properties?
• How can we make the analysis of multi-spectral, multi-temporal and multi-sensor earth observation data easy?