Time-varying spatial data integration and visualization: 4 Dimensions Environmental Observations Platform (4-DEOS)

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In environmental studies the integration of heterogeneous and time-varying data, is a very common requirement for investigating and possibly visualize correlations among physical parameters underlying the dynamics of complex phenomena. Datasets used in such kind of applications has often different spatial and temporal resolutions. In some case superimposition of asynchronous layers is required. Traditionally the platforms used to perform spatio-temporal visual data analyses allow to overlay spatial data, managing the time using 'snapshot' data model, each stack of layers being labeled with different time. But this kind of architecture does not incorporate the temporal indexing neither the third spatial dimension which is usually given as an independent additional layer. Conversely, the full representation of a generic environmental parameter $P(x,y,z,t)$ in the 4D space-time domain could allow to handle asynchronous datasets as well as less traditional data-products (e.g. vertical sections, punctual time-series, etc.) .

In this paper we present the 4 Dimensions Environmental Observation Platform (4-DEOS), a system based on a web services architecture Client-Broker-Server. This platform is a new open source solution for both a timely access and an easy integration and visualization of heterogeneous (maps, vertical profiles or sections, punctual time series, etc.) asynchronous, geospatial products. The innovative aspect of the 4-DEOS system is that users can analyze data/products individually moving through time, having also the possibility to stop the display of some data/products and focus on other parameters for better studying their temporal evolution. This platform gives the opportunity to choose between two distinct display modes for time interval or for single instant. Users can choose to visualize data/products in two ways: i) showing each parameter in a dedicated window or ii) visualize all parameters overlapped in a single window. A sliding time bar, allows to follow the temporal evolution of the selected data/product. With this software, users have the possibility to identify events partially correlated each other not only in the spatial dimension but also in the time domain even at different time lags.