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A Cyber-Infrastructure for a Virtual Observatory and Ecological Informatics System – VOEIS

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CUAHSI's Hydrological Information System (HIS) is an internet-based system that supports the distribution of hydrologic data. It is comprised of hydrologic databases and servers connected through web services as well as software for data publication, discovery and access. Though HIS provides exceptional server side support, data entry and quality control client tools, HIS presumes that individual research labs posses sound internal data management practices, doesn't provide tools for managing metadata about field and analytical lab actions, and has a limited data model for geospatial reference. CUAHSI's Observations Data Model (ODM) is founded upon an information model for observations at stationary points. This model is insufficient to characterize complex spatio-temporal relationships that arise under circumstances where hierarchical and dynamic sampling locations occur.
VOEIS is an integrated sensor and ecological informatics system that complements CUAHSI's HIS capabilities by supporting all-encompassing workflows; from the collection of streaming senor data to the application of those data in simulation models and visualizations. VOEIS facilitates the management of data and metadata within individual research labs, solves the problem of the static geospatial data model, and interfaces with HIS to allow labs to share some or all data via the HIS protocols.
The VOEIS infrastructure is designed to extend the functionality and knowledge representation capabilities of CUAHSI HIS by providing necessary interfaces, software components, and a complementary Field Data Model (FDM) schema that captures data processed in the lab or collected by scientists in the field. The modular design of VOEIS is intended to allow integration of other components and data types that originate as a function of field work, but require different data management pathways. To illustrate why an FDM is necessary, consider that observations are made, samples are taken, and sensors are deployed at specific points in three dimensional space. In order to catalog and track the location of field "actions" (e.g., observations, samples, or deployments) in a database, the action must occur at some known spatial reference. For instance, when we monitor the elevation of the water table, we typically survey the top of a well to determine a spatial reference, and then measure the distance from the top of the well to the water table repeatedly, over time. However, well casings are occasionally broken off (especially PVC casings), which changes the elevation of the top of the well. Thus, our database of "depth to the water table" becomes useless if we don't track how the elevation of the top of the well casing changes over time.

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