# Managing Monitoring Equipment: A Sensor Extension for the Observations Data Model

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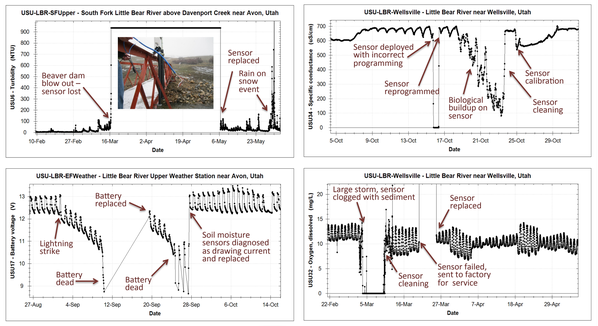
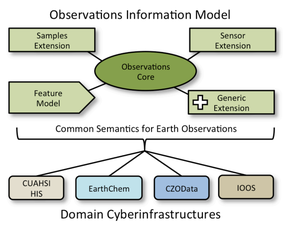
**Background:** The Observations Data Model (ODM) was designed to capture consistent descriptions of environmental observations and is implemented in a relational data model for storage and management. ODM 1.1 was intended for publication of point-based hydrologic observations using the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) Hydrologic Information System (HIS). Because of its focus on data publication, ODM 1.1 does not provide all of the functionality needed to fully describe the data collection and management process for sensor and sample-based observations. A new version of ODM (ODM2) that better supports both management and publication of sensor and sample-based observations is under development.

**Motivation:** Research sites conducting long term monitoring using *in situ* sensors need the functionality to track equipment, deployments, calibrations, and other events related to site maintenance and to link this information to observational data. This information is typically recorded in field notes or files, but is rarely organized with data. Yet, performing quality control and eventual interpretation and analysis of the data often require consulting the record of field activities.



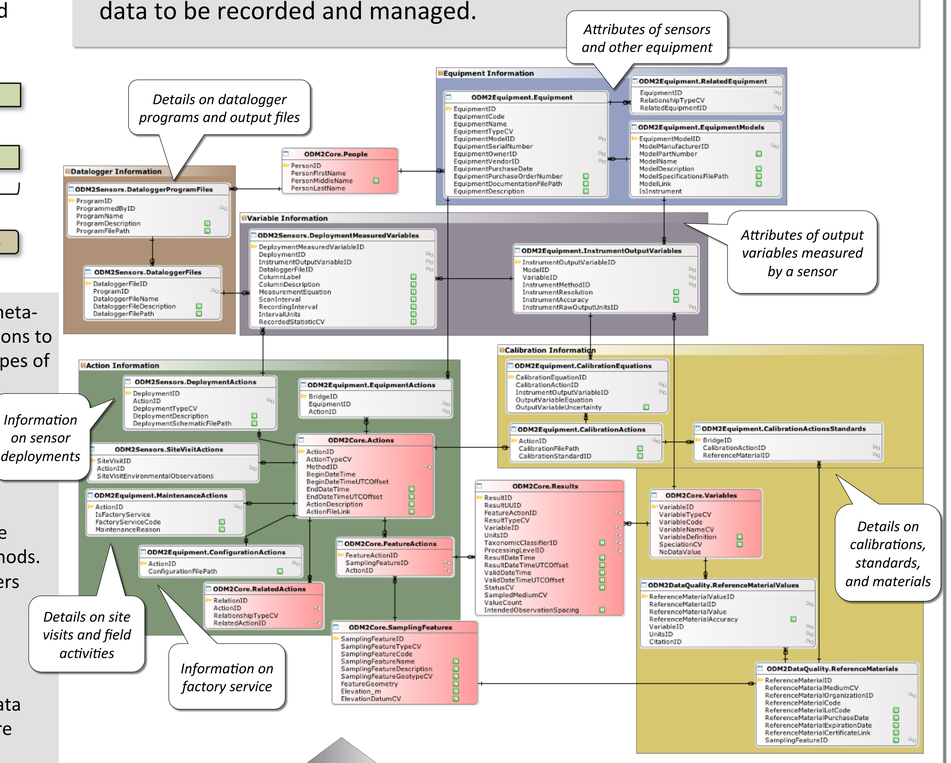
**ODM2 Core:** A core set of entities common to most types of observational data to describe location, observed variable, and time.



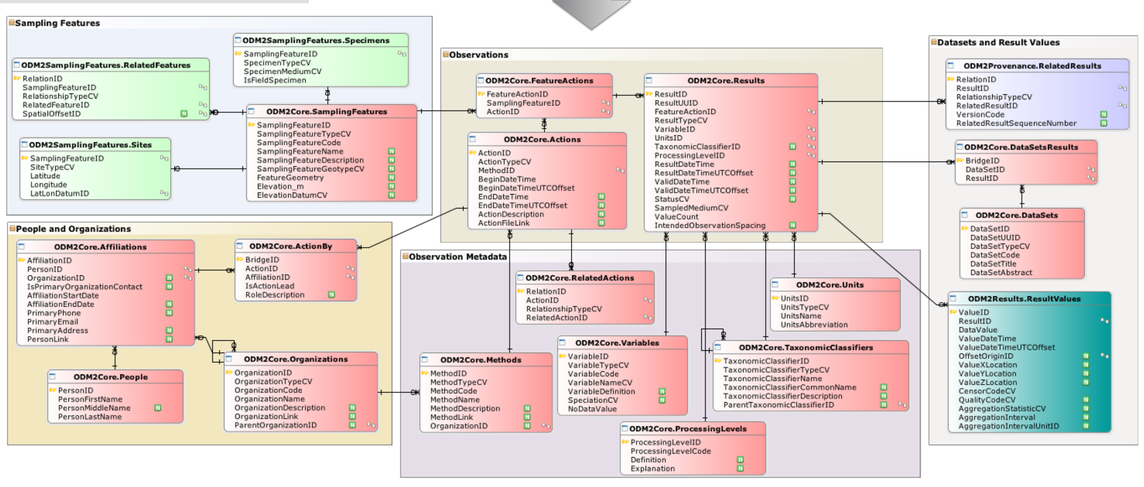

**ODM2 Extensions:** Additional meta-data can be provided via extensions to the core to support particular types of observations.

- **Sensors and Equipment:** describe monitoring equipment, deployments, calibrations, and *in situ* time series.
- **Lab Analyses**: capture sample hierarchy and analytical methods.
- **Annotations:** provide qualifiers or comments to variables or observations.
- **Provenance**: describe data versioning and processing.
- **Data Quality:** describe the data quality of results and compare to reference materials.
- **Results**: capture information specific to different result types and dimensions.
- **General Extensibility:** extend any of the core entities.

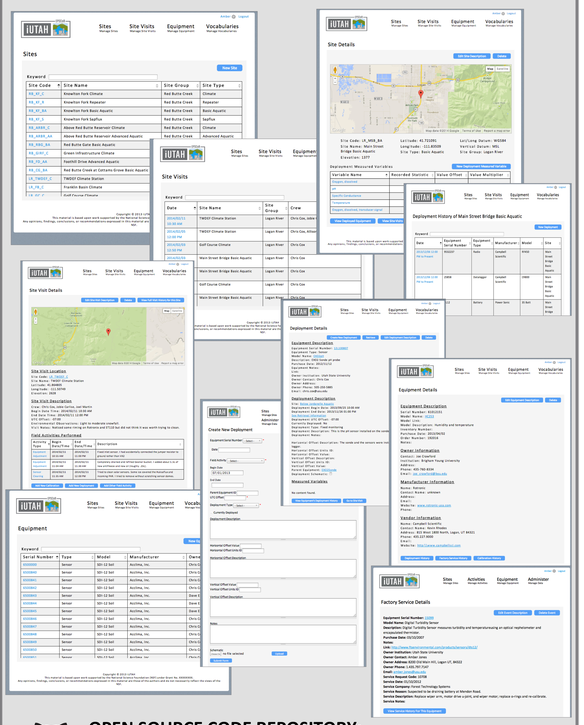
**Sensors and Equipment Extension**. These extensions permit information about individual sensors, deployments, and the associated observations data to be recorded and managed.




**Linkage to ODM2 Core:** The connection between the Sensors and Equipment Extensions and the ODM2 Core provides linkages between observations and associated equipment and events. Linkages are made with Variables, Actions and Methods, Sampling Features and Sites, Organizations and People.

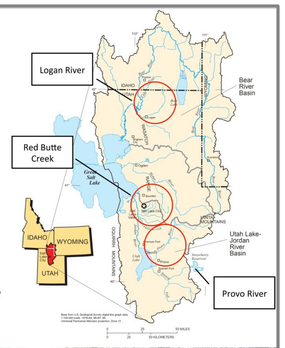



**Web Interface:** Field technicians and other researchers can use the web interface for the Sensors Extension to add and edit sensors, sites, and field activities such as calibrations and deployments. The interface can be used to address questions such as what sensors are deployed at a site, the deployment history or factory service history of a sensor, and the history of field activities performed at a site.



**OPEN SOURCE CODE REPOSITORY:** The web application for the Sensors Extension is available on GitHUB https://github.com/UCHIC/ODM2Sensor

**Implementation:** The iUTAH (innovative Urban Transitions and Aridregion Hydro-sustainability) network of aquatic and terrestrial sensors is being used as a test case for the Sensors Extension. The ODM2 Sensors Extension and associated tools will be useful for similar large scale and long term monitoring networks. See http://data.iutahepscor.org.



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