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An international standard for observation data

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A generic information model for observations and related features supports data exchange both within and between different scientific and technical communities. Observations and Measurements (O&M) formalizes a neutral terminology for observation data and metadata. It was based on a model developed for medical observations, and draws on experience from geology and mineral exploration, in-situ monitoring, remote sensing, intelligence, biodiversity studies, ocean observations and climate simulations. Hundreds of current deployments of Sensor Observation Services (SOS), covering multiple disciplines, provide validation of the O&M model. A W3C Incubator group on 'Semantic Sensor Networks' is now using O&M as one of the bases for development of a formal ontology for sensor networks.

O&M defines the information describing observation acts and their results, including the following key terms: observation, result, observed-property, feature-of-interest, procedure, phenomenon-time, and result-time. The model separates of the (meta-)data associated with the observation procedure, the observed feature, and the observation event itself. Observation results may take various forms, including scalar quantities, categories, vectors, grids, or any data structure required to represent the value of some property of some observed feature. O&M follows the ISO/TC 211 General Feature Model so non-geometric properties must be associated with typed feature instances. This requires formalization of information that may be trivial when working within some earth-science sub-disciplines (e.g. temperature, pressure etc. are associated with the atmosphere or ocean, and not just a location) but is critical to cross-disciplinary applications. It also allows the same structure and terminology to be used for in-situ, ex-situ and remote sensing observations, as well as for simulations. For example: a stream level observation is an in-situ monitoring application where the feature-of-interest is a reach, the observed property is water-level, and the result is a time-series of heights; stream quality is usually determined by ex-situ observation where the feature-of-interest is a specimen that is recovered from the stream, the observed property is water-quality, and the result is a set of measures of various parameters, or an assessment derived from these; on the other hand, distribution of surface temperature of a water body is typically determined through remote-sensing, where at observation time the procedure is located distant from the feature-of-interest, and the result is an image or grid.

Observations usually involve sampling of an ultimate feature-of-interest. In the environmental sciences common sampling strategies are used. Spatial sampling is classified primarily by topological dimension (point, curve, surface, volume) and is supported by standard processing and visualisation tools. Specimens are used for ex-situ processing in most disciplines. Sampling features are often part of complexes (e.g. specimens are sub-divided; specimens are retrieved from points along a transect; sections are taken across tracts), so relationships between instances must be recorded. And observational campaigns involve collections of sampling features. The sampling feature model is a core part of O&M, and application experience has shown that describing the relationships between sampling features and observations is generally critical to successful use of the model.

O&M was developed through Open Geospatial Consortium (OGC) as part of the Sensor Web Enablement (SWE) initiative. Other SWE standards include SensorML, SOS, Sensor Planning Service (SPS). The OGC O&M standard (Version 1) had two parts: part 1 describes observation events, and part 2 provides a schema sampling features. A revised version of O&M (Version 2) is to be published in a single document as ISO 19156.

O&M Version 1 included an XML encoding for data exchange, which is used as the payload for SOS responses. The new version will provide a UML model only. Since an XML encoding may be generated following a rule, such as that presented in ISO 19136 (GML 3.2), it is not included in the standard directly. O&M Version 2 thus supports multiple physical implementations and versions.