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Harmonization - Towards A Standardized River Geometry Format

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A CONCEPTUAL OUTLINE FOR AN INFORMATION MODEL OF RIVER GEOMETRY, STREAMBED CHARACTERISTICS, AND FLOW

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RiverML is a proposed language for conveying a description of river channel and floodplain geometry and flow characteristics through the Internet in a standardized way, which is currently in the early stages of development. A conceptual outline of the information model is presented, and the direction of future improvements is identified. RiverML is a joint effort between the CUAHSI HydroShare development team, the World Meteorological Organization (WMO) / Open Geospatial Consortium (OGC) Hydrology Domain Working Group, and an international community of data providers, data users, and software developers.

INTRODUCTION

RiverML is a proposed standard information model for the representation of river surface and water observations data, with the intent of allowing the exchange of such data sets between information systems. In this context, the term river surface is interpreted broadly to include data commonly required for hydraulic modelling such as coordinate geometry, network connectivity, and roughness values. RiverML builds on WaterML 2.0, the existing OGC standard for water-related time series observations, and is intended for eventual adoption as a standard extension of WaterML 2.0 by the OGC.

RiverML is designed as an extensible schema to allow encoding of data to be used in a variety of exchange scenarios. Example areas of usage are: exchange of data for operational flood modelling programs; dissemination of national river morphology data; cross-border exchange of observational data; supporting operation of infrastructure (e.g. dams, supply systems); enhancing disaster management through data exchange; facilitating the protection of aquatic ecology; and exchange in support of national reporting.

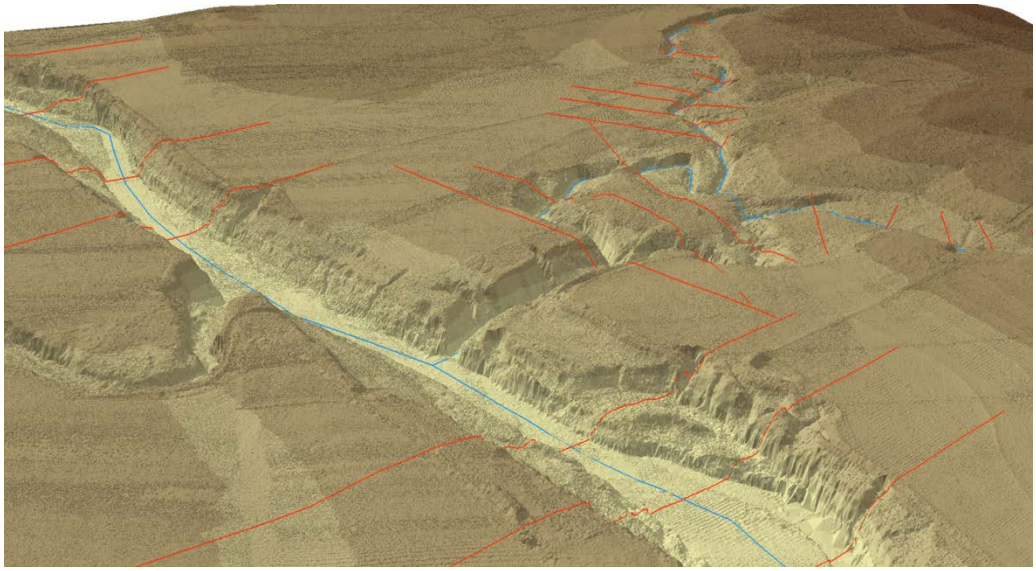

Figure 1. Example cross section and flowline geometry extracted from LiDAR terrain

RiverML 0.1

A proof of concept version, RiverML 0.1, has been developed and will serve as the starting point for future investigations and experiments. The XML Schema for RiverML 0.1, as well as a sample project, can be found at http://tools.crwr.utexas.edu/riverml/.

The general characteristics of RiverML 0.1:

1. Communicates the semantics of hydraulic data used in 1-dimensional flow models;
2. Allows data regarding network connectivity, geometry, and time series to be unambiguously related via association to stable points of reference.
3. Allows changes in river geometry as a function of time or survey techniques to be expressed.
4. Enables the distinction between actual and hypothetical surface data, such as the existing conditions and those proposed by a flood management project.
5. Allows definition of scenarios which specify a subset of surface and water observations which represent a coherent unit, such as the inputs and outputs for a specific hydraulic model.
6. Provides a flexible exchange schema which can be re-used to meet a number of exchange objectives;
7. Enables the encoding of information relating to the provenance of surface data (i.e. how the geometry was created).

The core aspect of the model is a consistent framework for relating observational data (e.g. cross section geometry, water surface elevation, network connectivity) to stable points of reference. These common Reference Points then allow observations to be related to each other. The framework is designed such that the description of surface geometries which change over time, as well as the description of hypothetical surfaces, are explicitly supported.

RiverML consists of two parts: A conceptual information model (UML) for observational data, and an implementation of the model in XML Schema (specifically an OGC GML 3.2 conformant XML schema). This separation allows capturing the information model in an implementation-agnostic fashion to allow multiple implementations to occur. In addition to GML, other implementations in future work may include JSON, NetCDF, non-GML conformant XML, etc.

FUTURE WORK

RiverML 0.1 serves as a conceptual starting point to focus future efforts. A Harmonization Paper will be prepared which will compare existing standards from key agencies in various countries as well as the data requirements of existing modelling software. Through this investigation, RiverML will be revised and expanded until a version is produced which is suitable for an OGC Interoperability Experiment.

While RiverML 0.1 is based on data required for 1-dimensional hydraulic models, RiverML is intended to be extensible to related domains such as 2-dimensional and 3-dimensional models, catchment hydrology, and interactions between surface and subsurface water.

There are many outstanding questions and additional metadata which need to be resolved before RiverML is a viable standard. A few of the key improvements needed are listed here:

1. Develop information model for describing structures such as roadways, culverts, dams, and levees.
2. Develop information model for describing properties which vary along geometry lines, such as roughness coefficients.
3. Develop information model for representing lakes or reservoirs as either geometry and network features.
4. Enhance the Terrain feature class to allow entire TIN or raster surfaces to be included, either directly or by reference.
5. Expand the information model to support advanced observation techniques such as Acoustic Doppler Current Profilers (ADCP).

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