Crossing the Digital Divide in the hydrology domain through standard based solutions

David R. Maidment (1), Fernando Salas (1), Enrico Boldrini (2), Ben Domenico (3), and Stefano Nativi (2)

(1) University of Texas, Austin, TX, USA {maidment, salas}@mail.utexas.edu, (2) Italian National Research Council (CNR), Institute of Methodologies for Environmental Analysis (IMAA), Potenza, Italy {boldrini, nativi@imaa.cnr.it}, (3) Unidata, Boulder, CO, USA ben@unidata.ucar.edu

An important "Digital Divide" exists between the world of discrete spatial objects (e.g. GIS) and associated observations such as time series and the world of continuous space-time arrays as they are used in weather and climate science.

The Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) has developed the Hydrologic Information System (HIS), whose aim is to cross this divide in order to seamlessly handle hydrological data coming from both the worlds.

As a key ingredient toward the solution, international geospatial standards have been put as the foundations of the CUAHSI-HIS infrastructure. Several standard services and formats were identified to be used at both data and metadata levels (e.g. WFS and SOS services to publish discrete observations and features; WCS and THREDDS Data Server (TDS) for publishing the climate data, encoded with NetCDF). OGC Catalogue Service for the Web (CSW) (with its ISO Application Profile) has been identified as the catalog interface able to discover resources from both the realms.

CUAHSI Hydroserver and TDS instances were deployed all over the United States, publishing both discrete and continuous hydrology data through their WFS, WCS and TDS interfaces.

A HydroCatalog Central service was also deployed to harvest metadata records coming from the discrete spatial services and making them searchable through the published CSW interface.

GI-cat Discovery Broker was successfully tested for discovery of continuous spatial resources.
This framework federates resources published by the TDS and several other different services as well, publishing in turn the desired CSW/ISO interface.
In the current setup about 400,000 records are periodically harvested. The goal has been achieved by enhancing the GI-cat components, especially the internal database and the TDS Accessor: this component carries out the necessary mediation and adaptation between the two different data models (THREDDS and ISO-19115).
Particular emphasis has been put in addressing the user needs for the resources searching (e.g. searches "by variable names" were recently enabled, complying with a significant user scenario).
Finally, different clients have been successfully tested in order to search and access the actual data coming from both the realms, amongst them: HydroDesktop, HydroPortal, ESRI ArcGIS, the GEO/GEOSS Portal, and GI-go Geobrowser.
Interoperability with ESRI ArcGIS was achieved by creation of a custom ArcGIS profile.

The use of well-adopted standards proved to be important for interoperability development; the utilization of GIS clients (such as ArcGIS) to access continuous space-time arrays (through GI-cat/TDS) is a significant example.

Due to the present Service Oriented Architecture (SOA) shortcomings (e.g. semantics lacks and the proliferation of enterprise standard interfaces - protocols and data models) the use of flexible brokering tools is important to allow different "standard" systems interoperability.
Besides these tools are important to fine tune different implementations of the same enterprise standards.

The experimentation demonstrated that the "Digital Divide" can be addressed by adopting present Informa-

tion Technology and developing the necessary interoperability arrangements at the International level; indeed this successful case study involved CUAHSI, NetCDF/THREDDS, and GI-cat communities - which development has been funded by European Community funded projects.