

WATER MANAGEMENT INFORMATION SYSTEM IN MEXICO- UNITED STATES OF AMERICA BORDER REGION

Symposium topic: Sharing Data and Information

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Summary

Assessing water scarcity requires modeling both water availability and water use. Determination of natural water availability on a large spatial scale is an essential prerequisite to understand and to mitigate economic and social impacts of droughts of regional and state-wide extent. The main coupling aspect of water availability and water use/management is achieved by balancing the water resources available for water use. Different types of natural water resources and different sectors of water use have to be distinguished. This is important in the case where water demand exceeds available water resources and water management/use affects downstream water availability. The use of GIS and remote sensing to facilitate the estimation of hydrologic parameters for watersheds has gained increasing attention in recent years. This is mainly due to the fact that hydrologic models include both spatial and geomorphic variations. GIS technology provides suitable alternatives for efficient management of large and complex databases.

In previous research, the Center for Research in Water Resources (CRWR) of The University of Texas at Austin, and the National Water Commission (CONAGUA) of Mexico cooperated to develop the Rio Grande/Bravo Water Management Information System in which most of the water quantity and quality data for the binational Rio Grande/Bravo basin are included in a geographically referenced relational database (i.e., a geodatabase). This geodatabase consists of a Geographic Information System (GIS) containing water quality, hydrologic, hydraulic and related data for the basin. ArcHydro was used as the basis of the geodatabase since it allows the river basin to be represented in a realistic network of upstream to downstream connections. The ArcHydro data model defines attributes, relationships, and connectivity between hydrologic features in a GIS database. The Rio Grande/Bravo water quantity and quality geodatabases represent the first major attempt to establish a more complete understanding of the basin as a whole, using both Mexican and the United States of America data.

In this research, CRWR, CONAGUA and the Mexican Institute of Water Technology (IMTA) are cooperating to build on the results of the previous project to accomplish three tasks: develop the geodatabase for basins to the west of the Rio Bravo basin along the Mexico-USA border including both water quantity and quality data; using data from the geodatabase, create water quality models for selected basins of critical interest along the Mexico-USA border; and create a geodatabase of groundwater information for aquifers along the Mexico-USA border.

This project will assist Mexico to develop advanced capability to manage critical water resources in the border region shared with the USA and in developing bi-national cooperation between Mexico and the United States, providing accurate and reliable data necessary for analysis and resolution of water resources issues.

Problem statement

Integrated river basin management requires the development of data sources and models which are used for many purposes, e.g. to assess risks and possible mitigation strategies for droughts and floods, fulfillment of water rights, management of water quality, and simply to understand basin hydrology. For transboundary basins, various international water law documents, e.g., the Helsinki Rules (ILA, 1966), the Helsinki Convention (UNECE, 1995), and The 1997 United Nations Convention on the Law of the Non-navigational Uses of International Watercourses establish the idea that countries sharing a basin should exchange data and information on the condition of the transboundary basin, especially data of a hydrological, meteorological, hydro-geological and ecological nature and data related to the water quality as well as related forecasts. Based on this idea, in transboundary river basins, the

development of shared, multinational databases that can access, process, and display the various data needed to describe the systems is fundamental.

The border of Mexico and the USA, the fastest growing region in North America and one of the regions of highest economic development and growth in Mexico, has several critical, shared river basins and aquifers. These transboundary water sources shared by the United States and Mexico are the lifeblood for much economic activity on both sides of the border. Recently, the several highly developed water resources and decade-long drought conditions have created tensions over water sharing in the region. Areas of conflict and several possible negotiated remedies are being identified, but access to reliable data for analysis of alternative solutions to these problems is lacking. Although many separate research efforts have been carried out in the United States and Mexico, an integral database that includes information from both sides of the Rio Grande/Bravo basin has not been developed previously. As in many watersheds, knowledge and information available about the basin is fragmented, disjointed, incomplete, and sometimes inaccurate. This project will help to solve the fundamental problem of making accurate data available for decision makers in the basin. These data are being provided in the industry-standard ArcHydro geographic information system (GIS) which provides ready access to data for hydrologic and policy analysis using a wide variety of hydrologic, water quality, economic, and environmental models. ArcHydro makes it possible to store information about a river basin in a way that resembles the physical geography of the real basin, so that you can analyze effects from upstream or on downstream in a connected manner.

In addition, recent studies have shown that there is a lack of access to data regarding water quality along the border between the two countries. This has prevented progress in analyzing the effects of investments in water quality improvement infrastructure along the border. There is a critical need to have water flow and quality data available in a form that support the development of water quality models for this region. As the border region develops, there is increasing pressure to develop further the groundwater resources of the region. At the present time, there is little data on the extent and availability of groundwater along the border. In this research, information about these critical resources will be compiled into a geodatabase for use in water availability studies.

Methodology & Results

Now that the Rio Grande/Bravo water quantity geodatabase has been created and the water quality geodatabase are being updating, they will be available for use in various water management agencies within the USA (Environmental Protection Agency, EPA; Texas Commission on Environmental Quality, TCEQ; International Boundary & Water Commission, IBWC) and Mexico (CONAGUA, IMTA, Secretary of Environmental and Natural Resources, SEMARNAT; National Institute of Statistics, Geography and Information, INEGI; and Mexican International Boundary & Water Commission, CILA), and these agencies have shown great interest in their use. The study proposed here is building on the results of the previous projects to accomplish three main tasks:

Task 1 - Develop the geodatabase for basins to the west of the Rio Bravo basin along the Mexico-USA border including both water quantity and quality data

The case study area considered for this research includes binational basins along the whole border between Mexico and the USA, covering part of six states on the USA and seven Mexican states (figure 1). Relational databases including water quantity and quality information are being created for basins to the west of the binational rio Bravo/Grande basin, following next steps:

- (1) **Obtain the geo-spatial data from original sources and document the data.** Hydrological and water quality information were obtained from Mexican and USA agencies in order to have binational information for the whole basins.
- (2) **Project the geo-spatial data from its original projection into the project projection.** The Albers equal area projection was proposed for the project projection in order to preserve the areas, as well as a more recent Datum so the data conforms to most international datasets.
- (3) **Clip or merge the geo-spatial data sets depending on their original extent.** Data distributed on a national or state level, had to be clipped; while data distributed at a county or Hydrologic Cataloging Unit level, had to be merged into a single and larger data set.
- (4) **Import the data sets and time series into a feature dataset of a geodatabase.** This step includes the processing of available information into the ArcHydro geodatabase. Several feature datasets were created that included the feature classes related to each type of information. The whole border was divided into several hydrological sub-regions in order to apply the ArcHydro tools sub-region by sub-region. The ArcGIS format was applied to all temporal data in order to include and relate the time series to the monitoring and control points in the geodatabase.

Task 2 - Using data from the geodatabase, create water quality models for selected basins of critical interest along the Mexico-US border

Additional data regarding the water quality model not included in the geodatabases, e.g., re-aeration coefficients, decay rates, etc., are being gathered from both nations. Using the Water Evaluation and Planning System (WEAP) platform, a water quality model for the Rio Bravo basin is being created at this moment. This model will consider conservative constituents (e.g., salinity) and non-conservative constituents (e.g., DO, BOD, etc.). The WEAP model is being built on the results of the previous Physical Assessment Project directed by CRWR. While WEAP is not as comprehensive water quality software as USEPA Qual2e, it will be easier to implement.

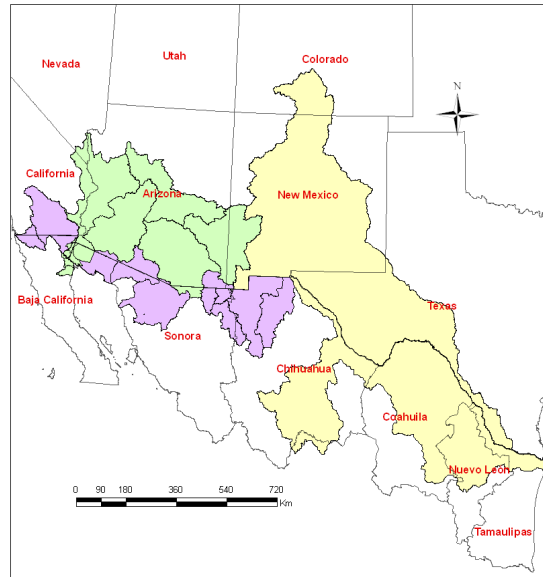


Figure 1 Case study area: Binational basins along the Mexico – USA border

Task 3- Create a geodatabase of groundwater information for aquifers along the Mexico-USA border

Geo-spatial data related with groundwater information are being gathered from Mexican and USA agencies in this step of the project. Once all information have been collected, it would be re-projected using the Albers equal area projection as well as a more recent Datum so the data conform to most international dataset. After this step, geo-spatial information will have to be clipped or merged, depending on their original extent. Data distributed on a national or state level, will need to be clipped. A similar ArcHydro framework will be applied to the original information in order to have a standard structure for the water quantity, water quality and groundwater information along the whole border between Mexico and the United States of America.

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