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Integration of Water Resource Data from Multiple Sources to Facilitate Sharing and Decision Support

WEI Wildermuth Environmental, Inc.
Eric Chiang
wchiang@weiwater.com
23692 Birtcher Dr.
Lake Forest, CA 92630

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OUTLINE

1. Problems and Our Way Out
2. HydroDaVE Database & Modules
3. Analysis Tools
4. Applications

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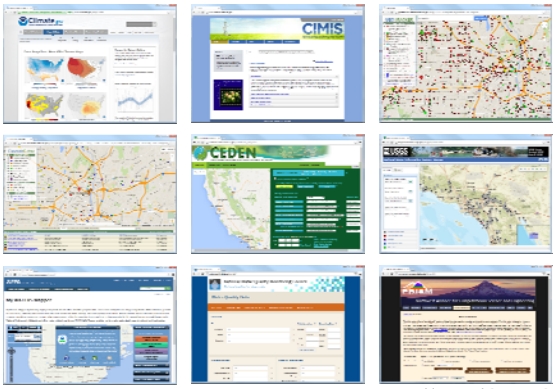
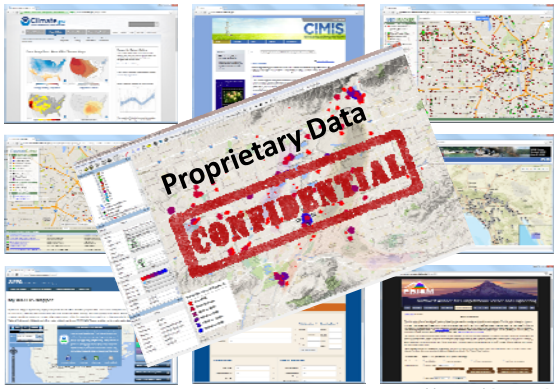
Problems: Big Challenges of Big Data



3 1. Problems and Our Way Out

Problems: Big Challenges of Big Data



4 1. Problems and Our Way Out

Our Wish and Way Out

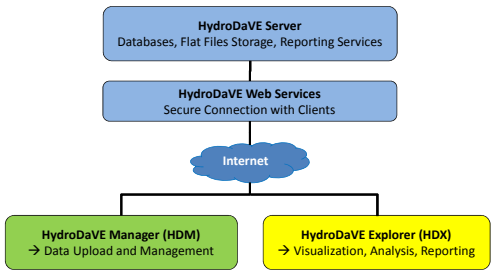
A cloud-connected platform to manage, share, visualize, and analyze proprietary and public water resources data, including

- Geospatial Information:
  - Maps.
  - Location of wells and monitoring stations.
- Temporal Information:
  - Groundwater quality, groundwater level elevation, pumping.
  - Surface water discharge and quality.
  - Climatic data – weather observations, modeled or observational raster datasets.
  - Modeling results – groundwater models, global circulation models.

5 1. Problems and Our Way Out

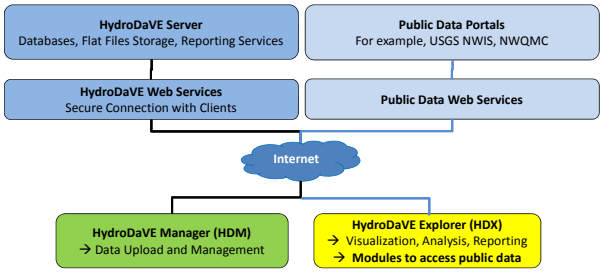
HydroDaVE Managed Service Platform

Hydrologic Database and Visual Explanations



6 1. Problems and Our Way Out

HydroDaVE Managed Service Platform & Public Data Portals

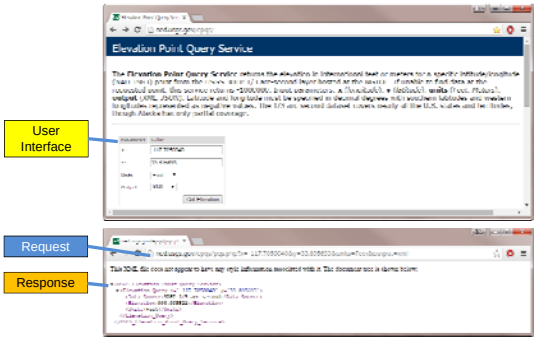


Web Services

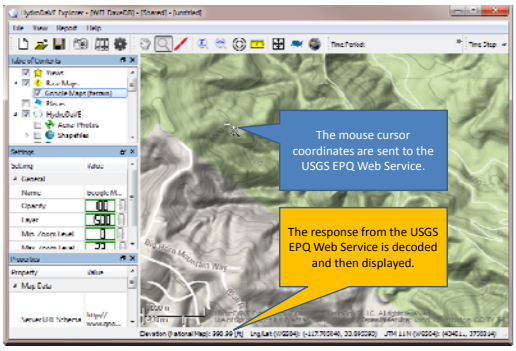
WIKIPEDIA
The Free Encyclopedia

A web service is a service offered by an electronic device to another electronic device, communicating with each other via the World Wide Web. In a web service, web technology … is utilized … for transferring machine readable file formats such as XML and JSON.

Example: USGS EPQ Web Service



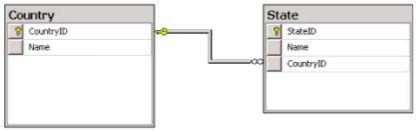
How HDX utilizes Web Services



HydroDaVE Database & Modules

- The HydroDaVE database is a relational database based on the Structured Query Language (SQL) and consists of a number of tables.
- The relationships between the tables are presented by Entity-Relationship-Diagrams (ERD).
- SQL constraints are used to ensure the integrity and reliability of the data stored in the tables. For example, the *unique* constraint prevents duplicate data.
- A number of tables and a set of HDX/HDM functionalities, that deal with a specific data type, are grouped together and referred to as a module.

A Simple ERD with Two Tables



County Table
- The *unique constraint* on Name ensures that no duplicate country name may be entered.

State Table
- The *foreign key constraint* on CountryID of the State table prevents an invalid ID being inserted, because it has to be one of the country IDs contained in the Country table.
- The *unique constraint on* the combination of CountryID and Name ensures that no duplicate State name may be defined for any given country.

HydroDaVE Modules

- Project (users, map contents, and security).
- Data Tracking (upload status, logs, and original files).
- Reference (online reference files).
- Surface Water (discharge and quality time-series).
- Climate (time-series of weather data and gridded datasets from NWS, NEXRAD, PRISM, CMIP3/5, etc.).
- Live Link to Public Data Portals (NWIS, MWQMC, etc.).
- **Groundwater**

Data Types of Groundwater Module

- **Wells**
  - Coordinates,
  - Reference elevations,
  - Well casing, lithology and geophysical logs, and
  - Attributes (such as reference files, well use, well type, owner, etc.)
- **Time-series**
  - Groundwater level elevation,
  - Groundwater quality, and
  - Production.
- **Lookup tables**
  - Water quality standards,
  - Analytes, etc.

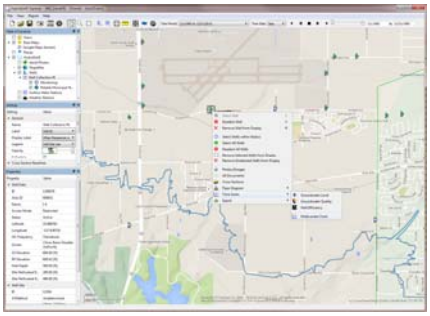
Groundwater Module ERD

Analysis Tools

1. Display of Wells
2. Multivariate Time-series Charts
3. Geological Cross-sections
4. Piper Diagram
5. Stiff Diagram
6. Scatter Map

Display of Wells

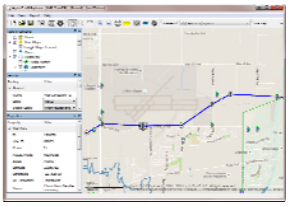
1. Displays and symbolizes wells based on various attributes.
2. Access reference files of individual wells.
3. Displays time-series charts.
4. Creates cross-sections.
5. Displays Piper and Stiff diagrams

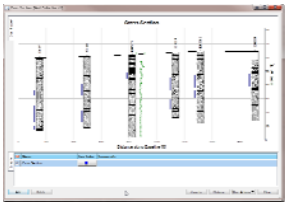


Multivariate Chart

1. Displays arbitrary combinations of groundwater level elevation, groundwater quality, and production time series charts.
2. Export time-series data.
3. Horizontal axes (time) of all charts are synced; vertical axes of individual charts can be scaled independently.

Geological Cross-sections

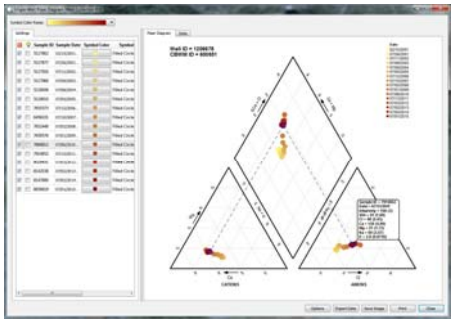




1. Prerequisites
   a. Wellsite/Borehole location and ground surface elevation
   b. Lithology logs
2. Optional Data
   a. Geophysical logs
   b. Well casing information
3. Additional Data
   a. Ground Surface Elevation from the USGS EPQ Web Service.
   b. Predefined lithology symbols
4. Output in bitmap or scalable vector graphics.

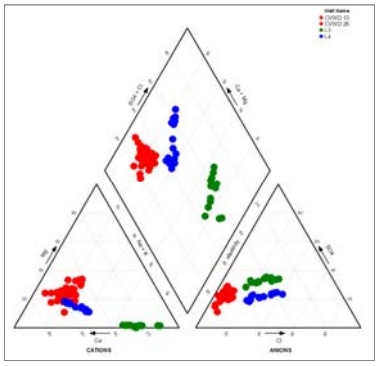
Piper Diagram at Individual Wells

1. Visually presents the cation and anion compositions of individual samples.
2. Visualize the trend of water quality over time at individual wells



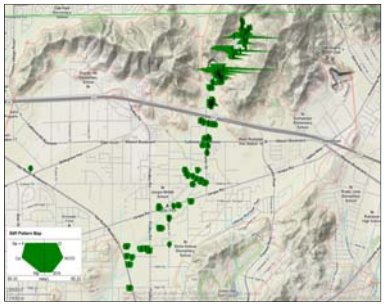
Piper Diagram of Multiple Wells

1. Visually presents the cation and anion compositions of many samples from multiple wells on a single graph.
2. Allows the major groupings or trends in the data to be discerned visually.
3. Facilitates the characterization or classification of waters. Grouping of waters on the Piper Diagram suggests a common composition and origin.
4. For details, see http://training.usgs.gov/tel/wqprinciples/lesson13-freeze.pdf



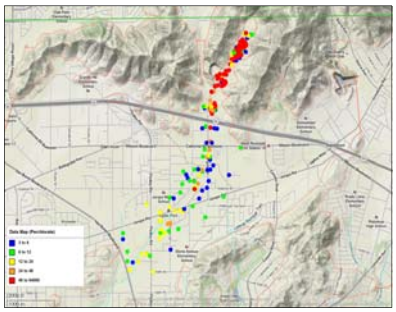
Plotting Stiff Diagrams on Map

1. Displays Stiff diagrams at well locations within a specified area based on groundwater quality measured within a given time period.
2. The shape of a Stiff diagram indicates the relative proportions of the different ions, and the size of the Stiff diagram represents the total ion concentrations.
3. Stiff Pattern maps allow similarities and differences between different waters to be seen at a glance.



Scatter Maps

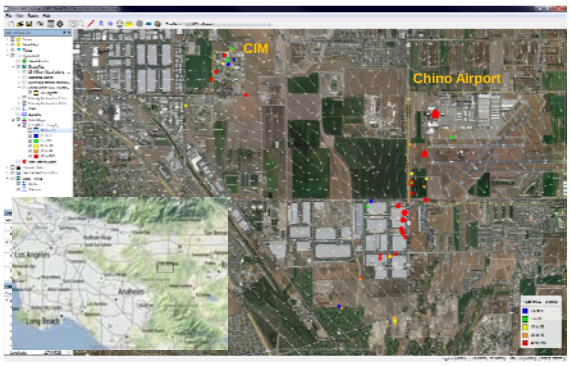
1. A Scatter Map displays the statistics of water quality or production data at the wells located within a specified area and measured within a given time frame.
2. Statistics include the minimum, maximum, and average values of the selected properties of individual wells.
3. Statistics are presented as markers on map with specified sizes and colors.



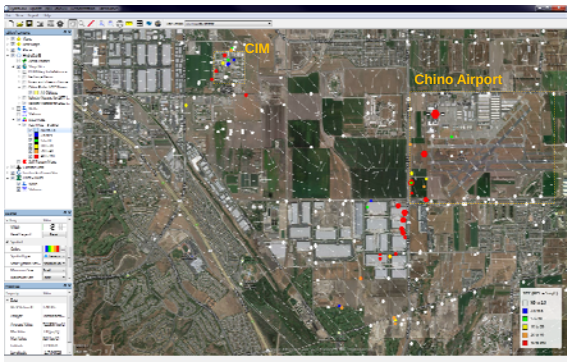
Applications

- Perform Hydrologic and Hydrogeologic Studies,
- Design Monitoring Programs,
- Develop Hydrologic Conceptual Models,
- Facilitate Development and Visualization of Models and Their Results,
- **Resolve Disputes regarding Source of Contamination (Example: Chino Airport)**.

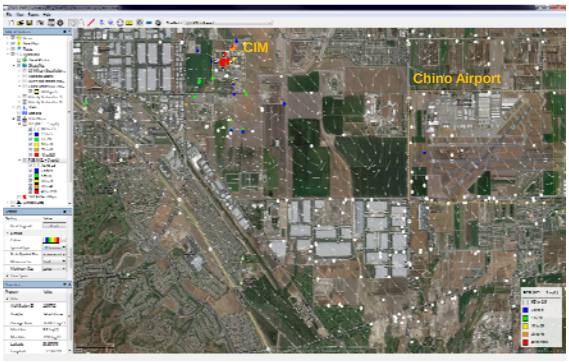
The Setting and Chino Airport Claim



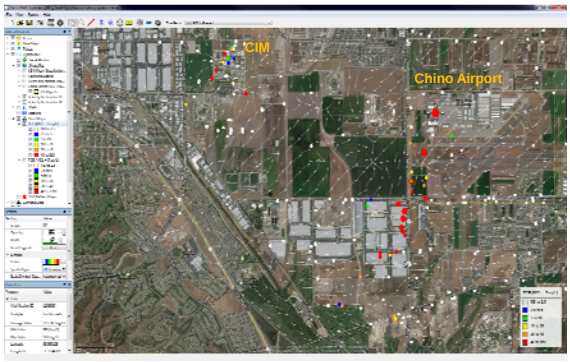
The Universe of Data for TCE



The Universe of Data for PCE



Historical Groundwater Levels and Flow Directions



Thank you!

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