SOCRATES
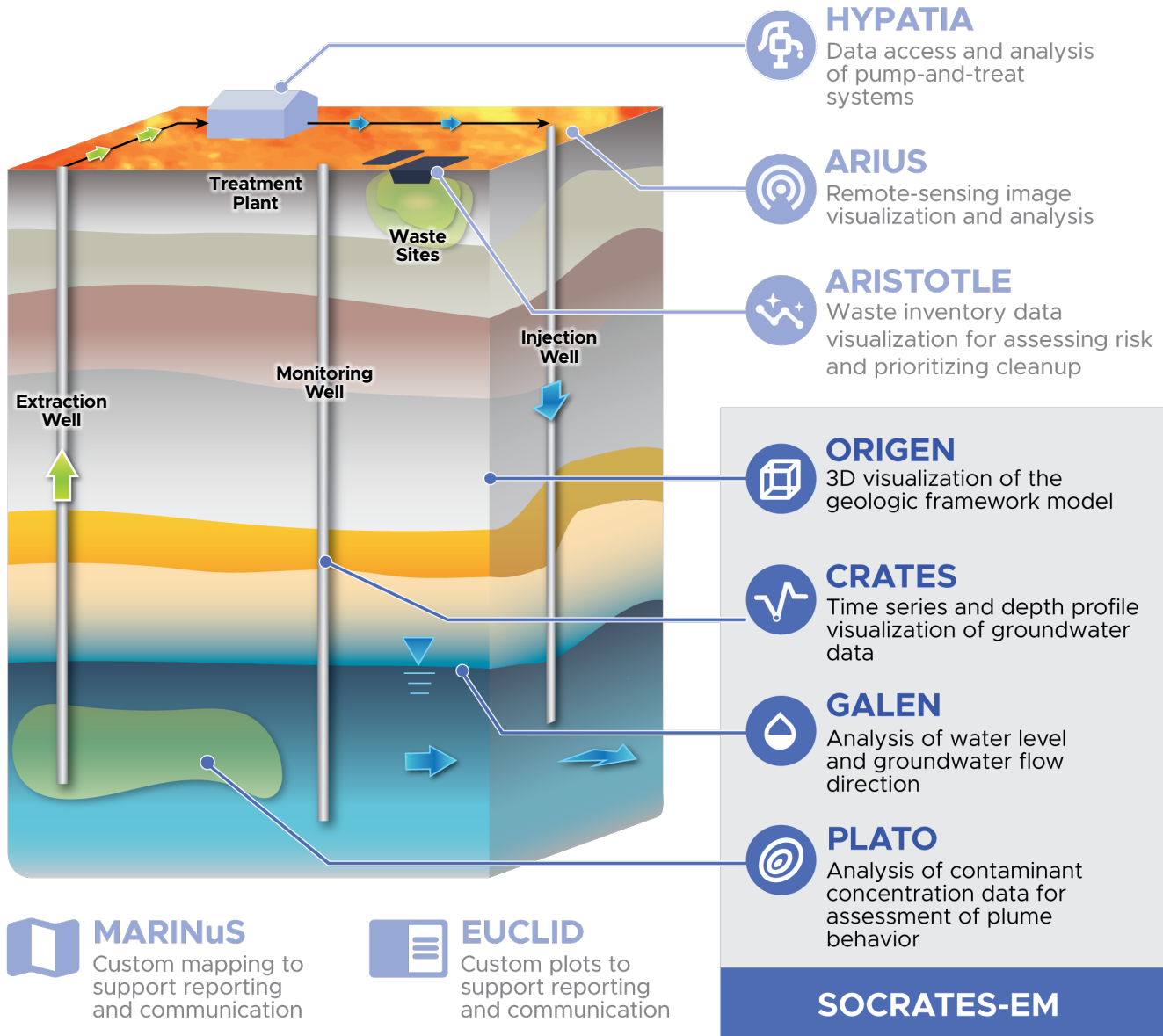## Suite of Comprehensive Rapid Analysis Tools for Environmental Sites

Web-based Tools to Support Remedy Decisions

SOCRATES is a suite of online tools that can be customized to provide rapid data analytics and visualization of environmental data. The tools support environmental management decisions associated with remedy selection, optimization, and exit strategies.

Treatment Plant

Waste Sites

Injection Well

Monitoring Well

Extraction Well

HYPATIA
Data access and analysis of pump-and-treat systems

ARIUS
Remote-sensing image visualization and analysis

ARISTOTLE
Waste inventory data visualization for assessing risk and prioritizing cleanup

ORIGEN
3D visualization of the geologic framework model

CRATES
Time series and depth profile visualization of groundwater data

GALEN
Analysis of water level and groundwater flow direction

PLATO
Analysis of contaminant concentration data for assessment of plume behavior

SOCRATES-EM

MARINuS
Custom mapping to support reporting and communication

EUCLID
Custom plots to support reporting and communication
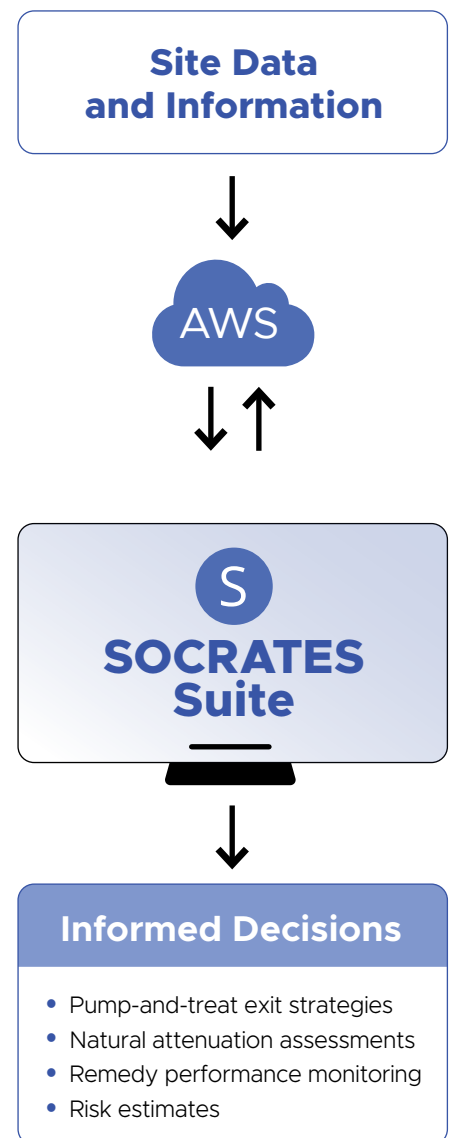
Capabilities

About SOCRATES

SOCRATES tools allow users to perform rapid visualization of data and data analytics that support environmental decisions. These tools bring together data from disparate databases to provide information at multiple levels of detail. They can be used to assess remedy performance, optimization, and endpoints, as well as support short- and long-term site management and monitoring decisions. Using the power of cloud-based computing, complex analyses involving calculations and graphics generation are completed in seconds, making traditional rote, time-consuming spreadsheet calculations obsolete.

Who can use SOCRATES?

Access to SOCRATES is determined by the site using the software. Permissions are granted through a role-based access and profile management system. Portions of SOCRATES may be made publicly available, while other portions are only available to authorized users. The SOCRATES-EM software was developed for U.S. Department of Energy (DOE) Office of Environmental Management (EM) sites; multiple sites are in the process of adopting the software and adding their data for visualization and analysis. SOCRATES-EM is available for licensing for entities beyond DOE.

What data are required for SOCRATES?

SOCRATES-EM works with multiple types of data. Key data include well information (locations, screen elevations, construction information, etc.), groundwater chemistry analytical results, water levels, and geologic model layer information. Specifics about the type of data and data fields that are required for SOCRATES-EM are identified in the associated documentation (PNNL-35029). Data can be ingested via comma-separated value (CSV) data files or by connection with a data service that provides the required information. Hanford-specific modules in SOCRATES bring in additional types of data, including SCADA sensor data for pump-and-treat remediation systems, satellite/remote sensing data, and waste site inventory/descriptions.

Site Data and Information

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AWS

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SOCRATES Suite

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Informed Decisions

- Pump-and-treat exit strategies
- Natural attenuation assessments
- Remedy performance monitoring
- Risk estimates

Highlights

- Convenient access to environmental data and consistent, reproducible, and rapid analytics to support environmental decision-making

- Cloud computing for performing computationally intensive near-real-time analytics for big data (e.g., satellite and remotely sensed data)

- Implementation on Amazon Web Services for robust and reliable performance

- Integrated profile management system that supports workspace customization and streamlined web-based reporting and analysis

- Analytics to support remedy exit strategies, remedy optimization, and adaptive site management that are based on standard statistical methods and U.S. Environmental Protection Agency and U.S. Geological Survey guidance

- User dashboard that saves analyses and graphics and allows for sharing of active working sessions

- Developed under a program that is compliant with the American Society of Mechanical Engineers Nuclear Quality Assurance (NQA-1) standard

These SOCRATES modules are data-source agnostic and are available for licensing to support remediation at complex sites worldwide:

ORIGEN

The ORIGEN (**O**nline **R**etrieval **I**nterface for **GE**ologic **IN**formation) module is a viewer that provides access to site geology, with features to create cross sections and access information on stratigraphic thicknesses, water table elevation, and well construction information.
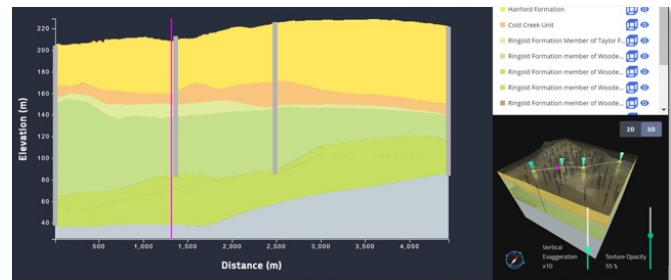
PLATO

PLATO (**PL**ume **A**nalysis **TO**ol) analyzes groundwater data to assess contaminant plume behavior, providing a consistent framework to quantify groundwater contaminant plume dynamics that support remedial decisions. PLATO implements data-driven, quantitative analyses based on standard statistical methods and published guidance from the U.S. Environmental Protection Agency and U.S. Geological Survey.
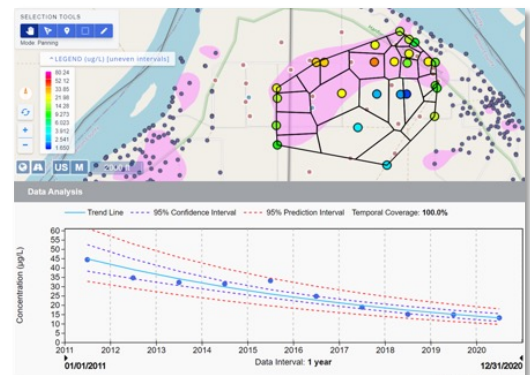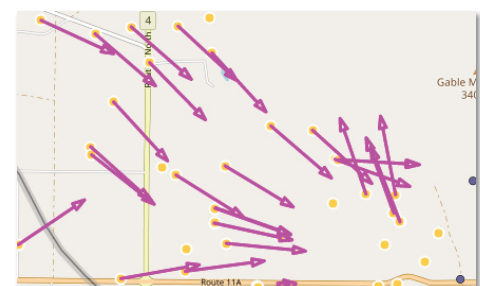

CRATES

CRATES (**C**harting, **R**eporting **A**nd **TE**mporal visualization**S**) is a plotting tool primarily used for visualizing groundwater concentration data. CRATES provides streamlined, quality-assured data visualization, enabling the user to easily identify well locations for plotting user-specified contaminants of concern, with export features for graphics and tabulated data.

GALEN

GALEN (**G**roundwater **A**na**L**ytics for the **EN**vironment) can provide access to multiple sources of water level data through a single access portal. It includes tools for visualization and analysis of groundwater level and flow direction over time, key elements in supporting site characterization and enhancing remediation system design and performance monitoring.

These additional SOCRATES modules were developed specifically for the Department of Energy's Hanford Site:

HYPATIA

HYPATIA (**HY**draulic **P**ump-**A**nd-**T**reat **I**nformation **A**nalytics) supports a data-driven management approach by providing data access and tools for analyzing pump-and-treat data, including extraction well and treatment plant chemistry and control system sensors that are often stored in separate databases. HYPATIA also provides methods for statistical analysis of time series data and includes calculated metrics, such as mass flow rate and injectivity for assessing P&T system performance.
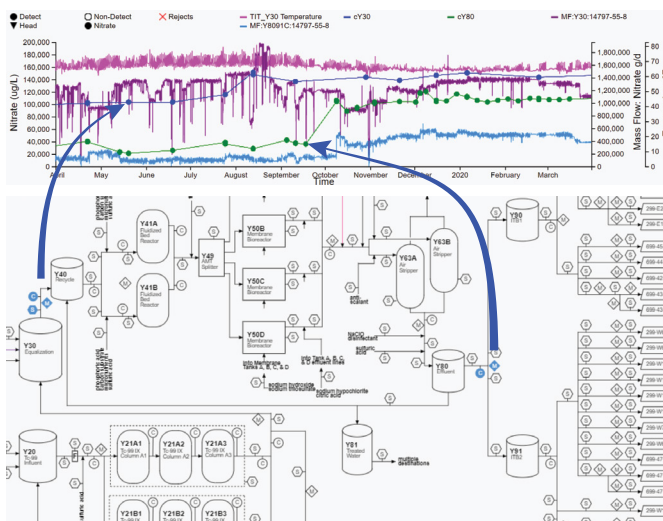
ARIUS   `Beta`

The ARIUS (**A**dvanced **R**emote-sensing **I**mage **US**er interface) web-based application performs full end-to-end automated acquisition of remote-sensing datasets using a matrix of cloud-based technologies. The tool streamlines complex workflows and processes satellite data pertaining to variation in both ground surface elevation and ground surface temperatures. Both LiDAR (light detection and ranging) and SENTINEL-1 data are used to monitor surface displacement, whereas the Landsat 8 and 9 satellites are used to monitor surface temperatures as an indirect measure of groundwater and surface water interactions.
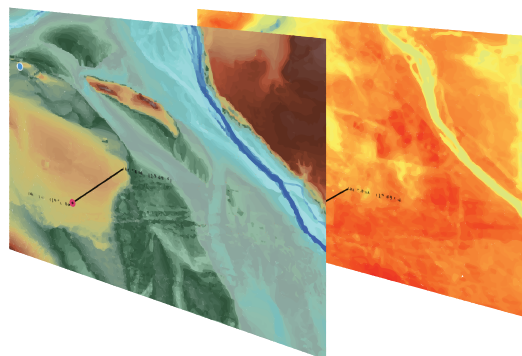
ARISTOTLE

ARISTOTLE (**A**daptive **R**isk **I**nformed **S**ystem **T**o **O**btain **T**he **L**ikely **E**ndstate) provides geospatial visualization of waste site inventory data from multiple data sources to help assess risk and prioritize remedy actions across spatial scales. Estimates of both chemical and radiological inventories from historical discharges are important for identifying risks of residual inventories of contaminants still present in the subsurface, and to qualitatively and quantitatively assess site cleanup priorities.

MARINuS & EUCLID

MARINuS (**M**apping **A**nd **R**eporting **IN S**OCRATES) and EUCLID (**E**ditable c**U**stom **C**hart facil**LI**tating **D**ocumentation) provide custom mapping and plots to support reporting and communication.