Cloud based predictive assimilation framework for subsurface site management

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Subsurface system behavior is driven and controlled by the interplay of physical, chemical, and biological processes which occur at multiple temporal and spatial scales. Timely predictive understanding of this behavior is needed both for scientific purposes and for effective system management – whether this is for subsurface remediation, ecosystem services optimization, or water and soil management. Current approaches to develop system understanding typically use desktop based manual approaches for data reduction, numerical modeling and data visualization. Such approaches have fundamental limitations in how timely, effectively and reproducibly they can provide the required understanding.

Under a DOE SBR funded SBIR Subsurface Insights is implementing a cloud based predictive assimilation framework (PAF) which automatically ingests, quality controls and stores heterogeneous subsurface data and processes these data using different inversion and modeling codes to provide information on the current state and evolution of the subsurface system. PAF is implemented as a cloud based software application which has five components: (1) data acquisition, (2) data management, (3) data assimilation and processing, (4) visualization and result deliver and (5) orchestration. Data is associated with discrete projects. Users are associated with one or more projects and different project specific access levels. Users interact with PAF through a standard browser. Modularity of the system is achieved by implementing each core capability of PAF (such as data visualization, user configuration and control, electrical geophysical monitoring and email/SMS alerts on datastreams) as a SPA (Single Page Application). This approach allows for relative simple system development and maintenance. PAF is implemented server side as a modular Zend Framework 2 Web application, supported by different components such as Doctrine (a PHP library for automated object mapping), automated parsers, public data harvesters (e.g. waterlevel and weather data), data standards and python workflows. The client side of PAF is mainly Javascript, which provides for responsive capabilities. Data in PAF is exposed through webservices which allows for easy integration of PAF components in 3rd party applications as well as in planned mobile applications. Data assimilation capabilities for PAF are being developed in collaboration with scientists from the LBNL SFA2. PAF is being validated and tested using hydrological, geochemical and geophysical data from the Rifle field site.