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 for scientific purposes and for system management – whether this is for subsurface remediation, ecosystem services optimization, or water and soil management. Current approaches to develop system understanding generally rely on 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. In addition, manual approaches are ill suited for dealing with the large volumes of heterogeneous (and often streaming) data which are increasingly available for subsurface systems.

Under a DOE SBR funded Phase II SBIR Subsurface Insights has implemented a cloud based predictive assimilation framework (PAF) which can ingest and store heterogeneous subsurface data and can visualize and process this data to provide information on the current state and evolution of the subsurface system. PAF has its roots in web based data management applications developed in support of DOE IFRC projects, but has been refactored and enhanced substantially in response to user needs in the private sector.

PAF is implemented as a modular Zend Framework 2 Web application which is organized around five integrated functions: (1) data acquisition, (2) data management, (3) data assimilation and processing, (4) visualization and result delivery and (5) orchestration. PAF is accessed using a browser, with rich client side interactive capabilities being provided through CSS/Javascript. Back end functionality is provided by python workflows.

PAF organizes its data by projects (where a project typically corresponds to a field site). All sites share the same back end database architecture, where use of the different elements of this architecture depends on the data available within a project. PAF is thus project agnostic, which allows for easy scaling and project deployment. Users can be members of different projects, and have privileges which can be assigned by a project administrator.

Responsiveness of PAF (a major concern in web applications) is achieved by implementing high level PAF capabilities as SPA (Single Page Application). This approach allows for relative simple system development and maintenance.

PAF has been developed in collaboration with LBNL SFA2 scientists and has been tested and demonstrated using hydrological, geochemical and geophysical data data from the Rifle and East River sites. PAF is seeing increasing acceptance in the private sector.