

DOE SBIR/STTR SUCCESS

Single frame of time lapse geophysics map showing the subsurface resistivity change following controlled liquid injection. The blue end of the spectrum shows the largest changes.

SUBSURFACE INSIGHTS

Time lapse geophysical techniques can provide real time insights in subsurface processes such as enhanced bioremediation. As an expert in time lapse geophysics, and a scientist working at Idaho National Laboratory, Dr. Roelof Versteeg was determined to improve the understanding of time lapse geophysical data through the use of geochemical, hydrological and remote sensed data.

This work motivated Dr. Versteeg to found Subsurface Insights in 2012 to address a need which exists across water resources, site remediation and agriculture: how to effectively and automatically collect, manage and analyze geoscience data sets to generate actionable information on subsurface processes.

FACTS

PHASE III SUCCESS

After two DOE SBIR/STTR Phase II awards Subsurface Insights is generating growing sales of its products.

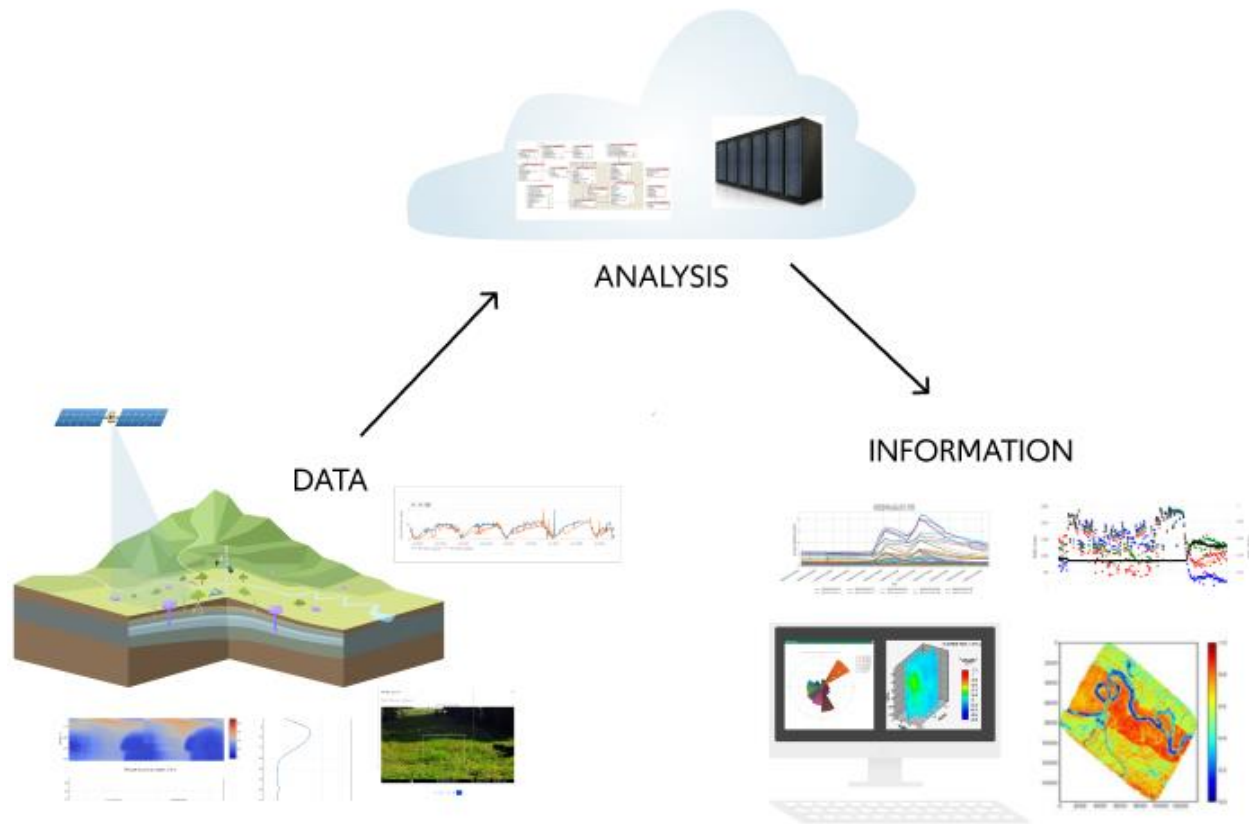
IMPACT

Integrating multiple data sets and high-end software, Subsurface Insights developed an autonomous platform capable of monitoring, delivering information and controlling subsurface processes.

DOE PROGRAM

Biological and Environmental Research (BER)

WWW.SUBSURFACEINSIGHTS.COM



Addressing this challenge required the development from the ground up of an integrated cloud based cyberinfrastructure. This cyberinfrastructure is designed to provide modular and extendable capabilities for data acquisition and ingestion, data analysis and information delivery. Some of this data is obtained from public data sources (through data.gov), some from commercial providers, some from project specific commercial sensors and some from Subsurface Insights developed sensors.

The design and development of this cyberinfrastructure (Predictive Assimilation Framework) was made possible by a Phase II SBIR award from the DOE's Biological and Environmental Research (BER) program and through close collaboration with multiple DOE National Laboratories. Currently, with a SBIR Phase II award funded by the Advanced Scientific Computing Research (ASCR) program, Dr. Versteeg is enhancing this cyberinfrastructure by integrating the massively parallel reactive transport PFLOTRAN modeling code developed by DOE scientists. This powerful code will be available through a user-friendly web interface which will allow a broad audience to easily generate valuable insights that would normally require major analytical and computational skills.

Now that the core system which can collect, ingest and analyze data is operational Subsurface Insights is working on addressing two new challenges. The first is the integration of microbiological data and processes in the infrastructure by developing an integration with the DOE developed KBASE platform. The second is the development of a broadly applicable model driven control capability which should allow for manipulation and control of subsurface processes.

This capability is increasingly being required by Subsurface Insights' customers, for instance for Aquifer Thermal Energy Storage (ATES) – a heat pump technology in which the subsurface is used as a heat storage medium. In ATES data and models are needed to optimize overall system performance, and Subsurface Insights is developing this in collaboration with end users. Similar control challenges exist in other domains such as enhanced bio remediation (one of the original areas motivating Subsurface Insights' activities), agriculture and water resources.

In all of these applications the tools that Subsurface Insights is developing can be used to determine control parameters in near real time. These parameters are then provided to external supervisory control systems. For example, in ATES, Subsurface Insights' control capability will allow users to visualize heat flow and to know exactly when to turn controls on and off depending on how the system responds to multiple internal and external variables in real time, making it possible to minimize electricity consumption. While there are still numerous challenges to be solved in this area, Subsurface Insights feels that it is on the right path to provide this capability in the near future.

Subsurface Insights is providing its cyberinfrastructure under a Software as a Service (SAAS) model, either standalone or integrated with its in house developed autonomous hardware. Subsurface Insights has so far generated a revenue of about \$300,000, and expects this number to grow in 2019 and beyond. By using a business to business to business (B2B2B) approach Subsurface Insights can leverage existing sales channels in different application domains to reach an existing customer base at low customer acquisition costs, something which allows Subsurface Insights to offer its software and hardware at affordable price points.

Subsurface Insights extensively uses open data and open source software components developed by university and federal government scientists in its cyberinfrastructure. Subsurface Insights also actively contributes to the enhancement of several of these components.

Dr. Versteeg sees this approach as a positive one for both societal and business reasons. Sustainable and optimal use of subsurface resources, which is needed in light of expected population growth and stresses on existing soil and water resources, requires an actionable, affordable and near real time understanding of subsurface processes. Developing this understanding requires ubiquitous measurements of physical, chemical and microbiological properties and the effective analysis and use of this data (the "instrumented earth"). The challenge associated with developing this understanding is so great that no single entity can address it on its own.

By using open source software, technical and scientific advances can proceed much quicker than if different groups were working in isolation. Moreover, the open source approach provides tools for modeling and approach validation that are not available in proprietary models. This approach also allows Subsurface Insights to work synergistically with DOE National Laboratories and universities, all of which are currently required by their funding agencies to develop software as open source.

While some companies may see the use of open source software as a negative aspect, Subsurface Insights embraces it. Dr. Versteeg explains "Most people are interested in information, not the data or tools that are used to extract the needed information. Many people will gladly pay for the convenience

of someone else generating this information for them as long as they have confidence in the analytical process. An open source approach can provide this confidence”.

In the end, Subsurface Insights value proposition consists of delivering actionable information to a broad array of users in a transparent and auditable manner at an affordable price point without the need for these users to have a PhD in geosciences. Developing this capability was made possible by the SBIR program.

Claudia Cantoni, Commercialization Program Manager, DOE SBIR/STTR, April 2019.