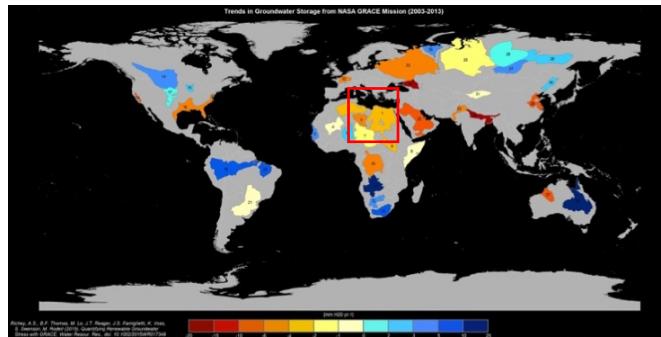


## Artificial Intelligence for Water Exploration

Limited surface water supplies with various competing demands, such as increased agricultural production or domestic drinking water resources are forcing the re-evaluation of the availability and abundance of fresh-water resources. Whether on a global, national, or local scale, the discovery and management of accessible water resources is rapidly becoming a relevant concern with significant implications world-wide.

The discovery of a sizeable water resource can have dramatic ramifications for the economic, geopolitical, and sustainable viability of a region or project. For example, the discovery of the Nubian Sandstone Aquifer System (NSAS), located in the eastern end of the Sahara Desert, highlights the impact a large aquifer can have on a global scale. Containing approximately 150,000 km<sup>3</sup> of groundwater, the significance of the NSAS as a potential water source for local arid countries is extraordinary.

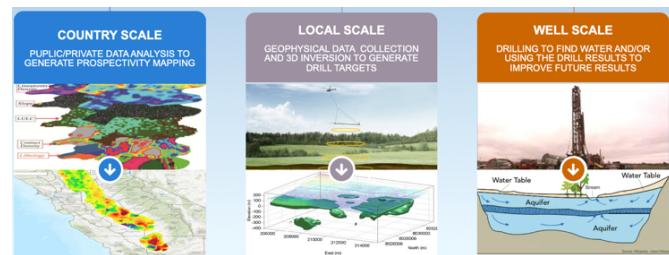
Although there has been significant large-scale structural mapping of aquifers globally, pictured below in the image from NASA GRACE satellite, much remains to be explored.



Exploration for such aquifers has traditionally been conducted by hydrogeologists and hydro-geophysicists via visual interpretation of available geology, topography, and surface water flow maps using expert intuition to infer prospective targets. However, this process may miss subtle relationships in the large datasets. With the abundant availability of remote sensing data, including geophysical surveying and satellite imagery, the opportunity for the development of powerful new AI-driven techniques to augment traditional aquifer identification presents itself with new challenges in processing, integrating, and interpreting these datasets.

Computational Geosciences, Inc. (CGI) is ideally positioned to tackle these challenges, having decades of experience in

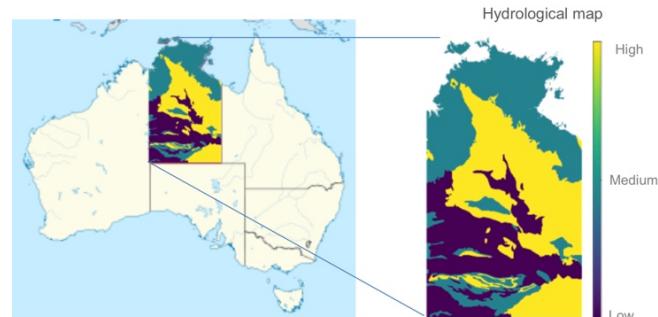
natural resource exploration and an expert multidisciplinary team of geophysicists & data scientists, who have developed cutting-edge exploration data processing, inversion, and management tools for country-scale, local-scale, and well-scale projects. CGI is developing new AI algorithms for a broad suite of geoscience problems, including exploration for groundwater resources.



Given a set of example targets, CGI's AI algorithms can be trained to identify similar patterns in a multidisciplinary dataset in order to discover new country-scale prospective areas. CGI has applied this methodology, termed *prospectivity mapping*, to two regions, Australia, and California, to demonstrate the potential of the method as a valuable component of a water exploration program.

### Water exploration: Australia

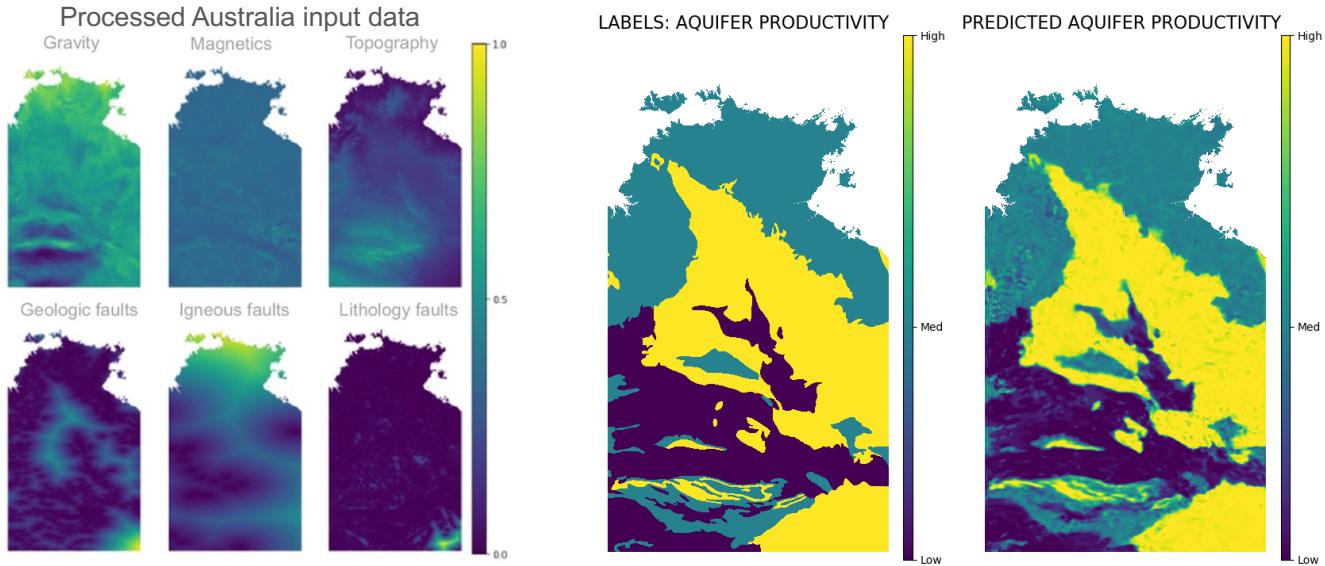
CIG's AI team has acquired gravity, magnetic, topographic, and geologic datasets covering Australia's Northern Territory through geoscience Australia's extensive public database.



The data-sets were pre-processed by our AI team and subsequently our V-Net, a type of convolutional neural net (CNN) developed in-house, was trained to predict a hydrologic map of aquifer productivity.



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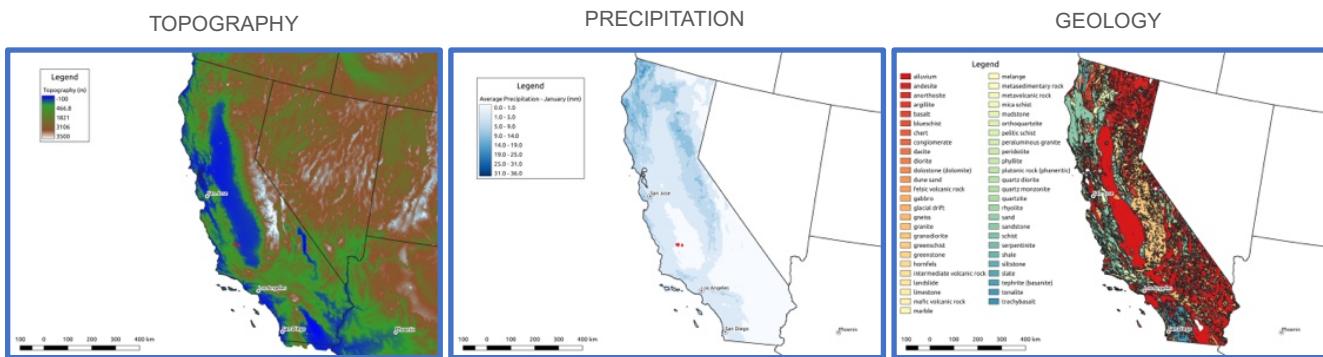


CGI's AI algorithm was able to integrate the information from six different map data sets, to predict the hydrologic map productivities with promising success. In particular, the structure of the known productive aquifers is well delineated in the predictions.

## Water Exploration: California

In the case where a detailed map of aquifer productivity is not available, locations of water wells can be used as training labels, with probabilities assigned to their locations. Groundwater probability at well locations was estimated by assigning probabilities based on average water level measurements at each well.

CGI's AI team trained our V-Net using topographic, surface geologic, and average precipitation data to predict the probability of groundwater over the entire state of California, with results that corroborate with the known California water basin map.



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98.97

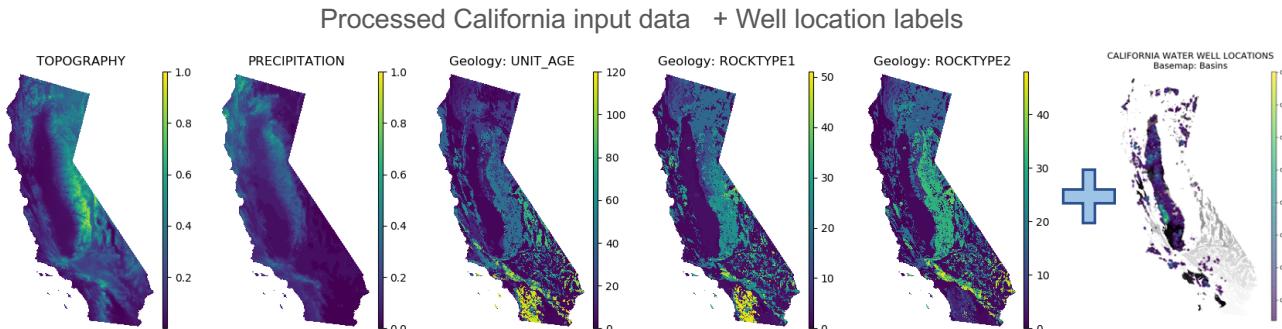
99.22  
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56.31

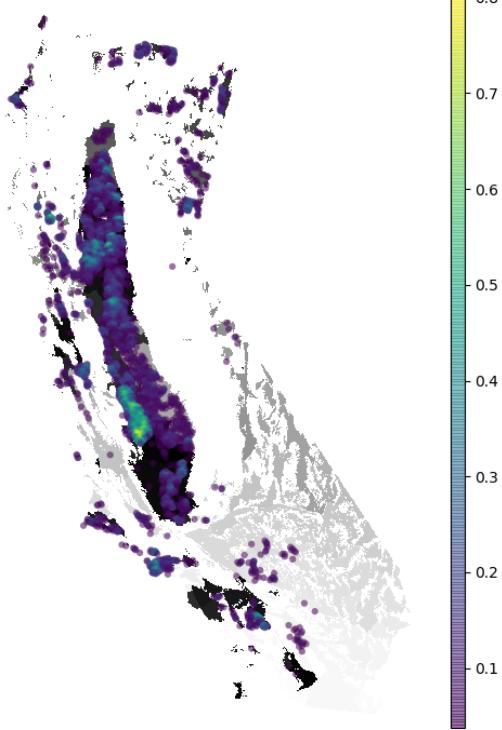
86.04

37.50

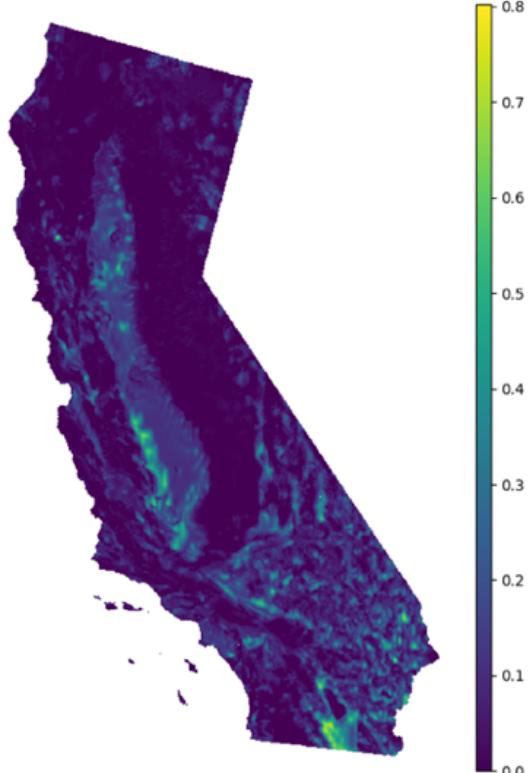
33.39



CALIFORNIA WATER WELL LOCATIONS  
Basemap: Basins



PREDICTED PROBABILITY of WATER



CGI's algorithm is able to predict prospective groundwater regions for the entire state of California which correspond to the known aquifer basins as well as regions of new interest with information at only 4951 water well locations. This prospectivity map can potentially be used to identify local scale regions which warrant further exploration.

With these examples, CGI has illustrated the potential for water prospectivity mapping to integrate multidisciplinary datasets to identify new exploration targets or better delineate known groundwater regions for hydrologists or hydrogeophysicists as part of a water exploration program.

