

A satellite image of a desert landscape, likely in the southwestern United States. The terrain is arid and brownish, with a prominent river valley running through the center. The river is dark and winding. There are several green rectangular patches scattered throughout the landscape, which appear to be agricultural fields or irrigated areas. The overall scene is a mix of natural desert features and human-made agricultural infrastructure.

Using remote sensing to estimate groundwater-surface water interaction

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Study Questions

- What field data are needed to improve remotely-sensed estimates of flow in streams and rivers?
- Can remote sensing tools be used to estimate flows up to a level of accuracy where stream losses and gains along reaches can be quantified, and with what level of certainty?
- Can remote sensing data be downscaled and improved using high resolution data such as field flow observations, higher resolution satellites, and drone photogrammetry?
- Can integration with other remote sensing data and tools, such as InSAR, be used to improve SWOT altimetry estimates?

Key Steps

Field Data Collection

- Temporary Stream Gauges and flow measurements
- Groundwater Monitoring
- Multispectral Drone

Remote Sensing Analysis

- Downscale Dynamic Surface Water Extent (increase spatial and temporal resolution)
- Predict WSE and discharge by comparing satellite, drone imagery, photogrammetry and LiDAR derived terrain models
- Compare outputs with SWOT predictions
- Integrate SWOT predictions with other platforms
- Quantify GW-SW predictions, predict flux

Field Data Collection

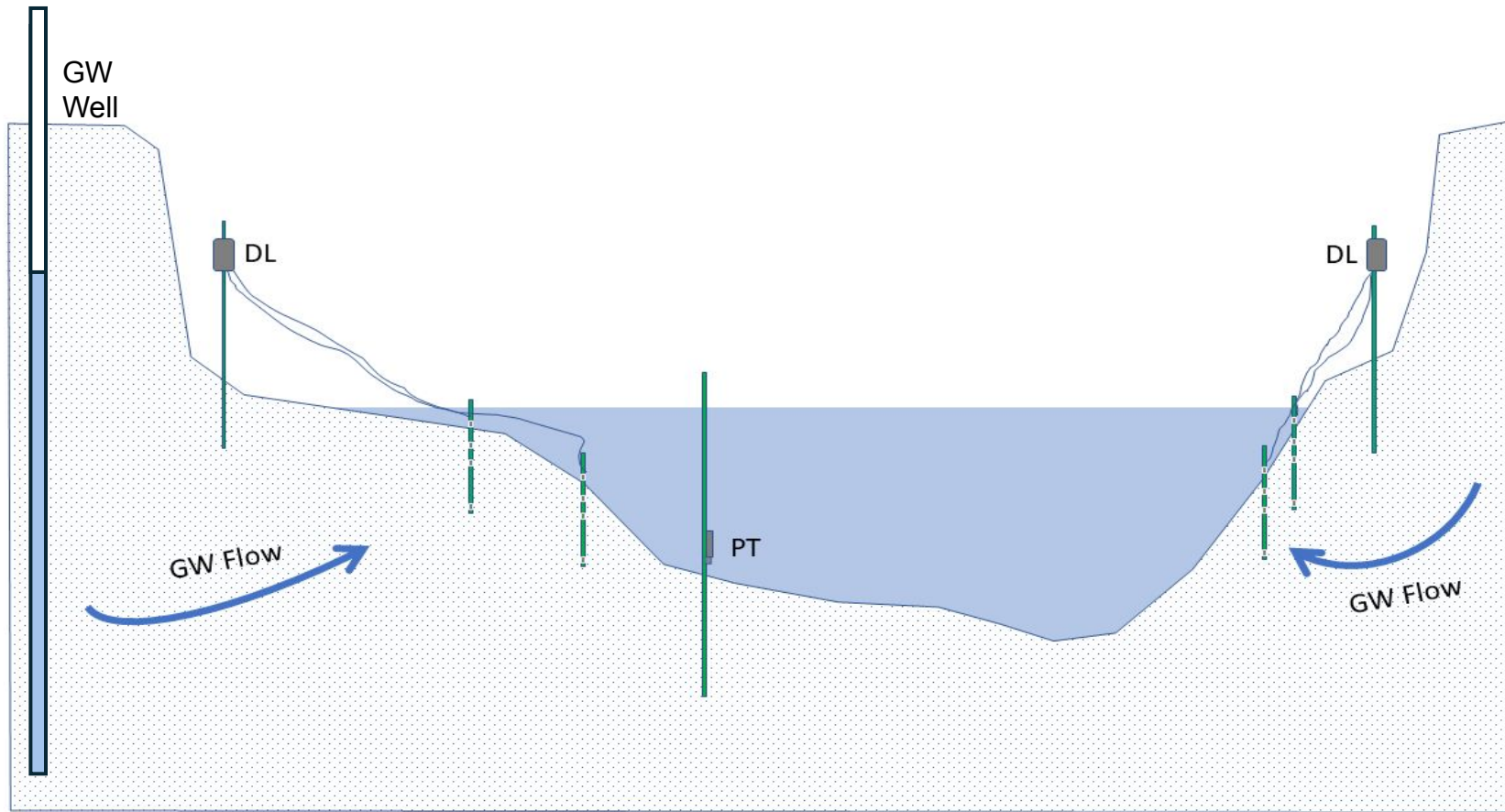


Stream gaging and water level monitoring to develop stream rating curve

Hatch, New Mexico

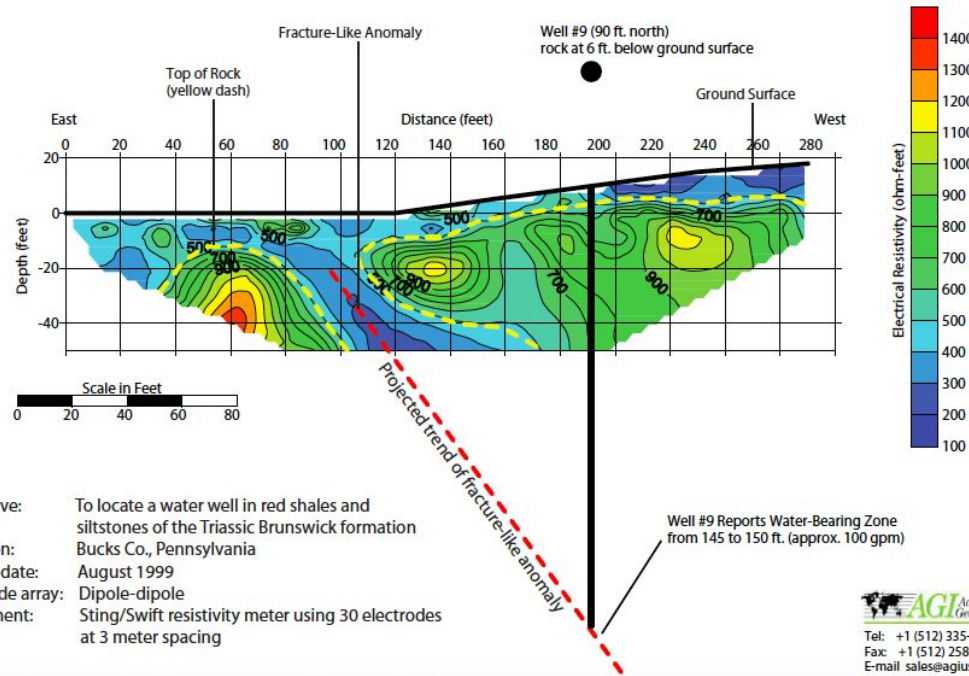


Field Data Collection



Thermal profiling and surface and groundwater (GW) level monitoring to quantify flow and groundwater discharge/recharge

Field Data Collection



Objective: To locate a water well in red shales and siltstones of the Triassic Brunswick formation
Location: Bucks Co., Pennsylvania
Survey date: August 1999
Electrode array: Dipole-dipole
Equipment: Sting/Swift resistivity meter using 30 electrodes at 3 meter spacing

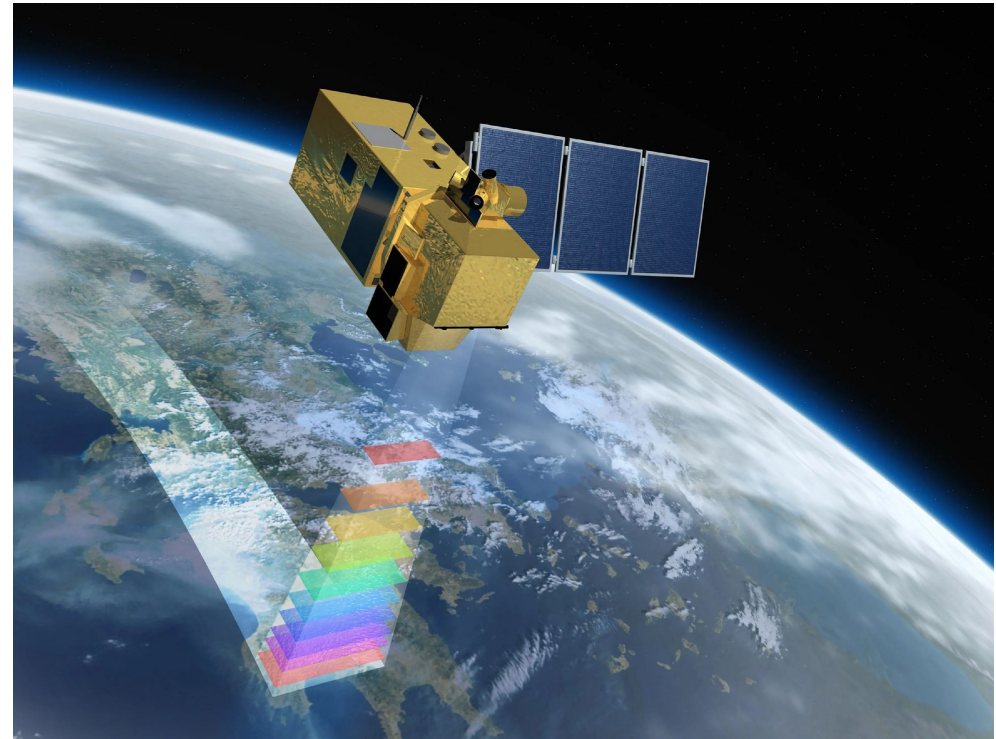
Courtesy of Quantum Geophysics, Inc., Phoenixville, Pennsylvania

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Electrical resistivity imaging to evaluate the hydrogeologic framework

Remote Sensing Analysis



Drone and satellite-based imagery

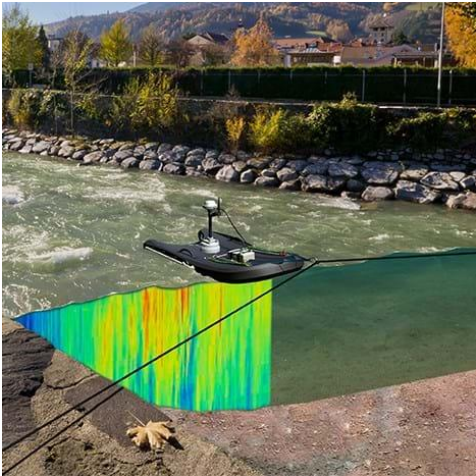


Drone Data Collection

Products:

- RTK/PPK corrected Ground Control Points
- Multi-spectral data acquisition
 - Very high resolution (1-to-3-inch pixel size)
- Photogrammetry derived point clouds and three-dimensional mesh
- Thermal acquisition

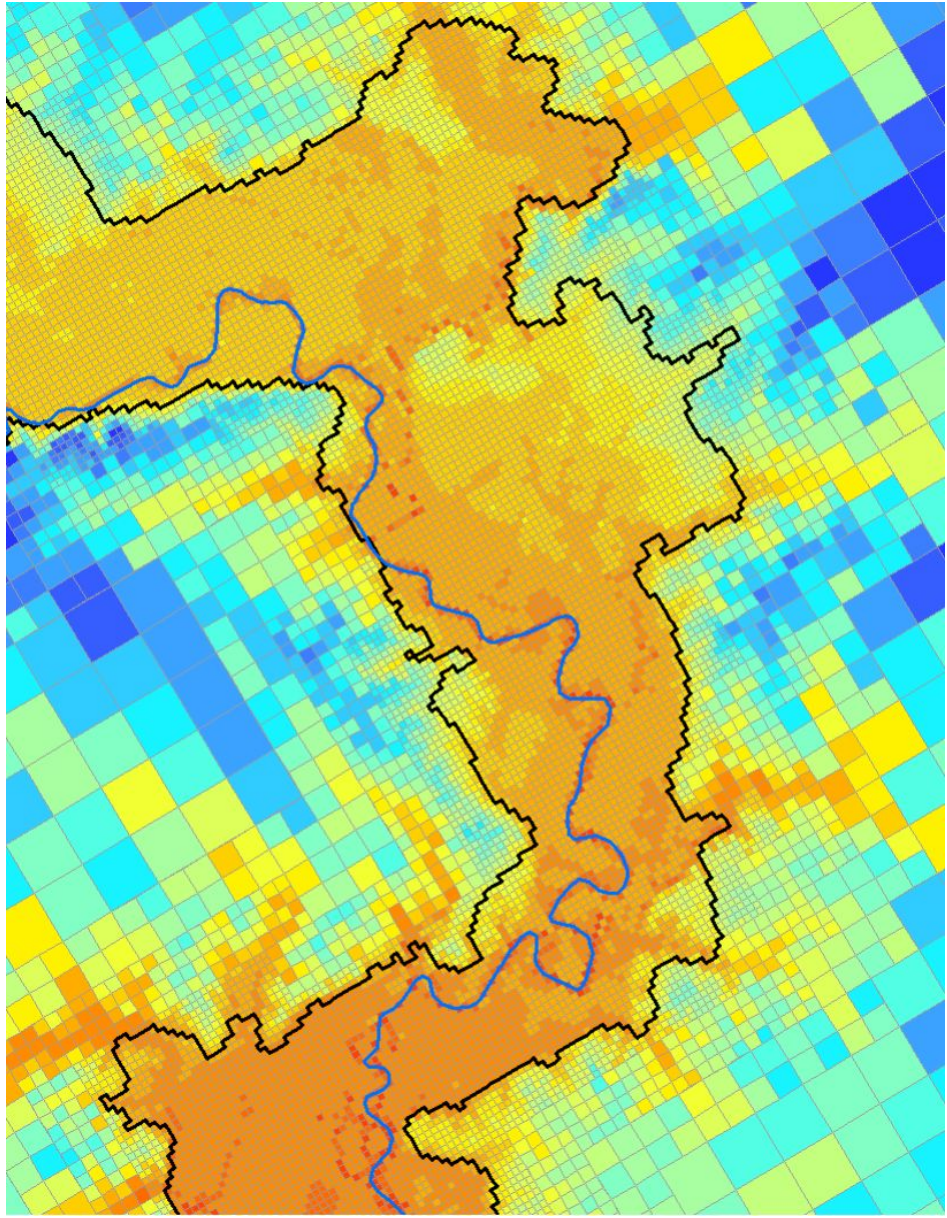
Field and RS data integration



Photogrammetry
and Imagery
analysis

Δ Discharge

Groundwater Availability Model



Brazos River Alluvium

Predicted Outcomes

- a) A statement on whether the use of NASA remote sensing tools, including SWOT, can **improve estimates of flow in ungauged river reaches**, including any ground-truthing needed.
- b) An assessment of the **accuracy and reliability of SWOT** for estimating gains and losses in rivers.
- c) A better understanding of the **resolution and frequency of ground-truthing data needed** to verify SWOT and other NASA data.
- d) An assessment of whether **downscaling can improve the utility of coarser resolution sensors** for the purpose of predicting streamflow, water surface elevation, water extent, and hydraulic model integration.
- e) A full set of **water monitoring and modeling data** that can be used for other studies beyond the current report.
- f) A better understanding of **GW-SW interaction** in an important region of the Rio Grande river.
- g) A proposed set of **next steps** to further improve estimates of flow and groundwater-surface water interaction using remote sensing techniques.

Project Partners

NASA Advisory Committee

Jet Propulsion Laboratory

Texas Water Development Board

United States International Boundary and Water Commission

World Wildlife Fund

NADBank