Using remote sensing to estimate groundwater-surface water interaction

Barney Austin[1], Peter Zamora[1], Mike Vielleux[1], Chad McKenna[2], and Mike Milczarek[2]

[1]***Aqua Strategies Inc.***, *13341 Hwy 290, Bldg. 2, Austin TX 78737*

[2]***GeoSystems Analysis***, *8601 Paseo Alameda NE, Suite B Albuquerque, NM 87113*

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

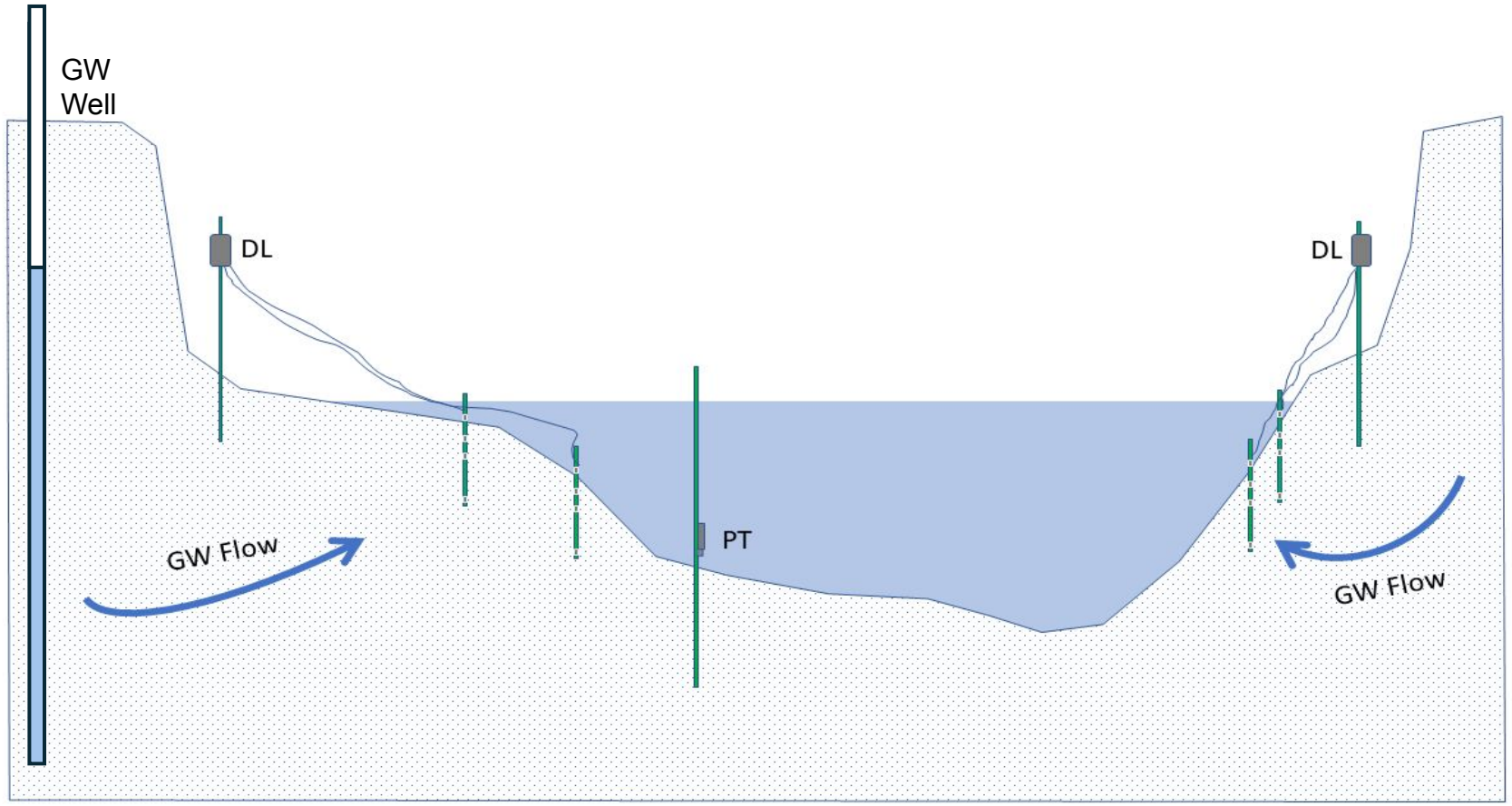
- Downscale Dynamic Surface Water Extent (increase spatial and temporal resolution
- Predict WSE and discharge by comparing satellite, drone imagery, photogrammetry and LiDAR derived terrain models
- Compare outputs with SWOT predictions
- Integrate SWOT predictions with other platforms
- Quantify GW-SW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

Field Data Collection

Stream gaging and water level monitoring to develop stream rating curve

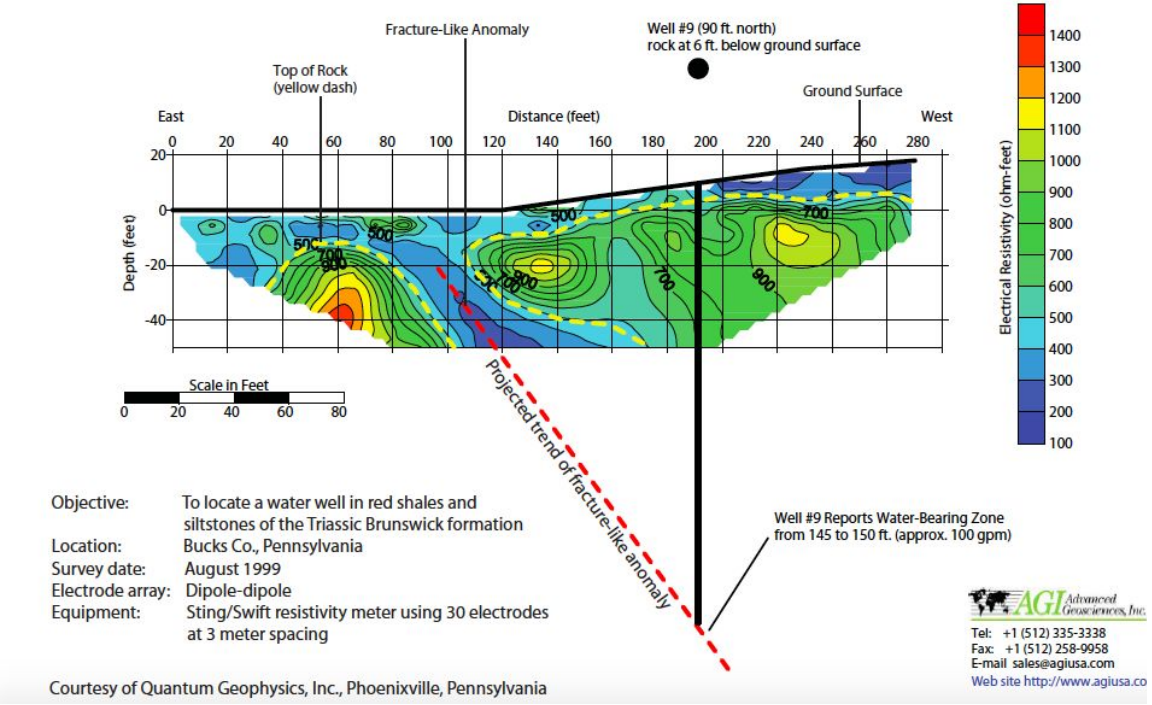
Hatch, New Mexico

Field Data Collection



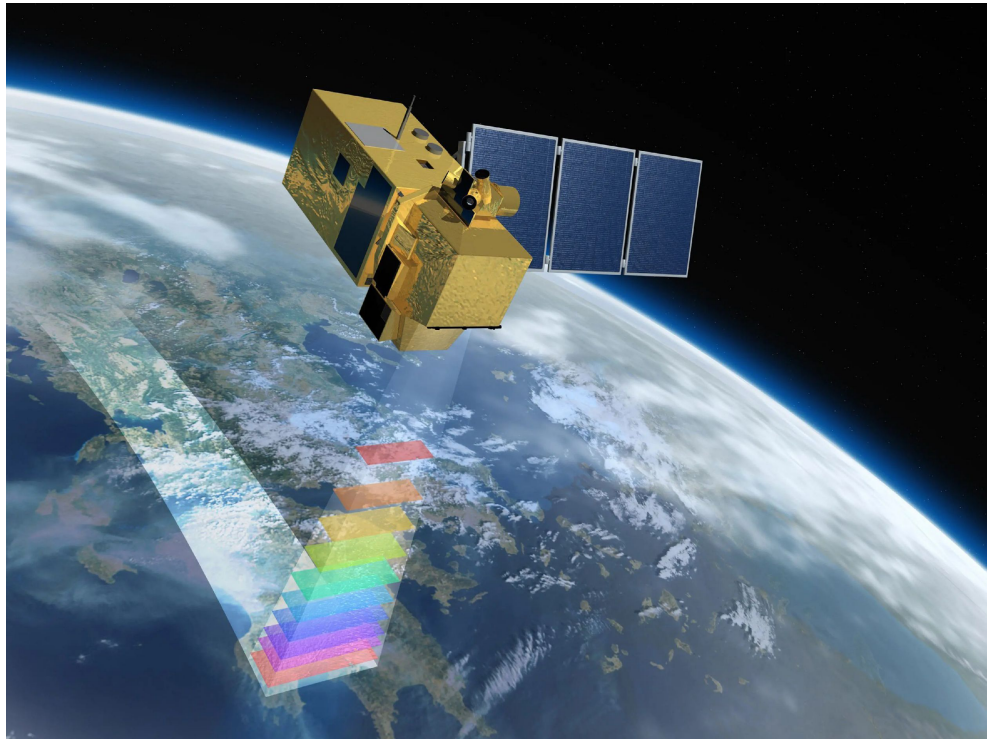
Thermal profiling and surface and groundwater (GW) level monitoring to quantify flow and groundwater discharge/recharge

Field Data Collection



Electrical resistivity imaging to evaluate the hydrogeologic framework

Remote Sensing Analysis



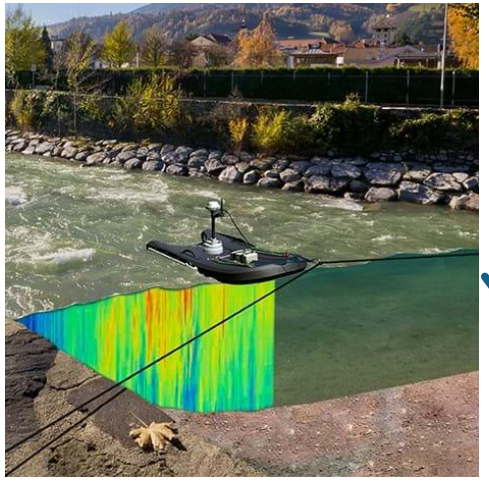
Drone and satellite-based imagery

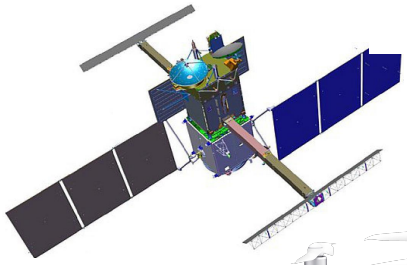
Drone Data Collection

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

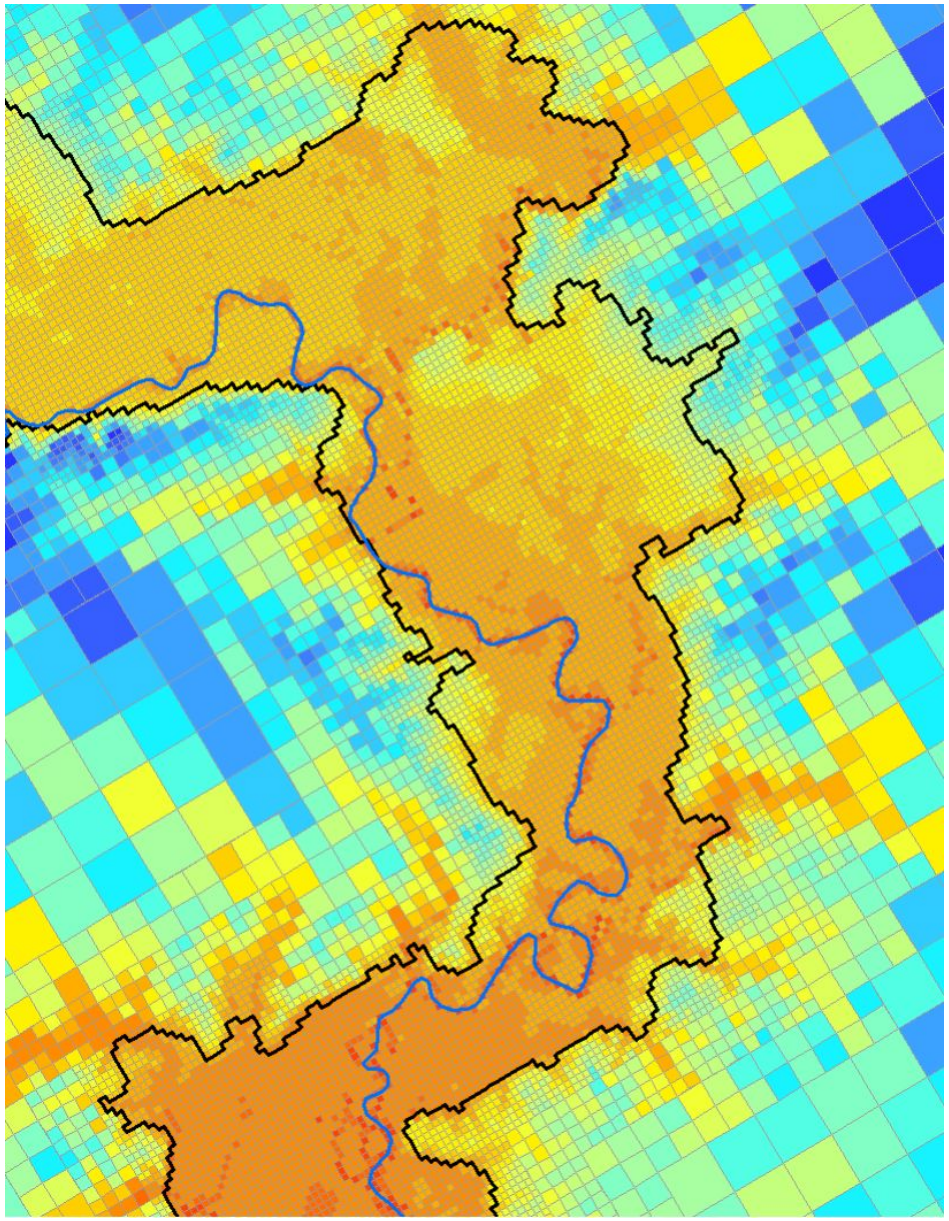




Photogrammetry and Imagery analysis

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