Evaluating aquifer flow conditions using heat as an in-well tracer

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What can borehole flow tell us?
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- Identify permeable features
- Identify aquitards
- Determine flow direction (up or down)
- Understand implications for contaminant transport
Research goals:

• Use heat as an in-well tracer to measure borehole flow

• Use borehole flow data to characterize aquifer flow conditions
In-well heat tracer tests:

- Induce heat pulses at discrete depths using downhole heater
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• Monitor temperatures in the well with fiber optic Distributed Temperature Sensing system (DTS)
In-well heat tracer tests:

- Induce heat pulses at discrete depths using downhole heater
- Monitor temperatures in the well with fiber optic Distributed Temperature Sensing system (DTS)
- Use heat movement to determine flow direction, calculate flow velocities
Optical Borehole Images of the Pheasant Branch borehole

- Depth (m)
- Mt. Simon sandstone
- Eau Claire shale
- Mt. Simon sandstone
- Wonewoc sandstone
Plot of temperature versus time at depth of 99 m
Summary and Conclusions
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- Heat tracers are an effective tool for borehole flow characterization
**Experiment Design**

- A temperature is recorded for every meter of cable
- Temperatures are re-measured every 40 seconds