Repeated vertical relative gravity measurements in a well shaft for monitoring water storage changes in the vadose zone

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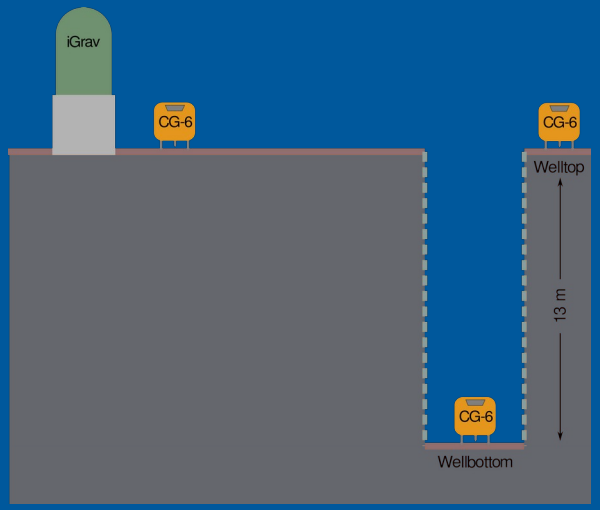
Study site

- Forest site in TERENO (North-East Germany)
- Small to zero groundwater recharge
- High interception of water by trees
- Large vadose zone (about 14 meters)
- (Peri-) Glacial deposits (terminal moraine, aeolian sand)
- Permanent sensor installations:
  - Gravity (iGrav)
  - Soil moisture
  - Groundwater
  - Meteorological parameters
  - Cosmic ray neutrons

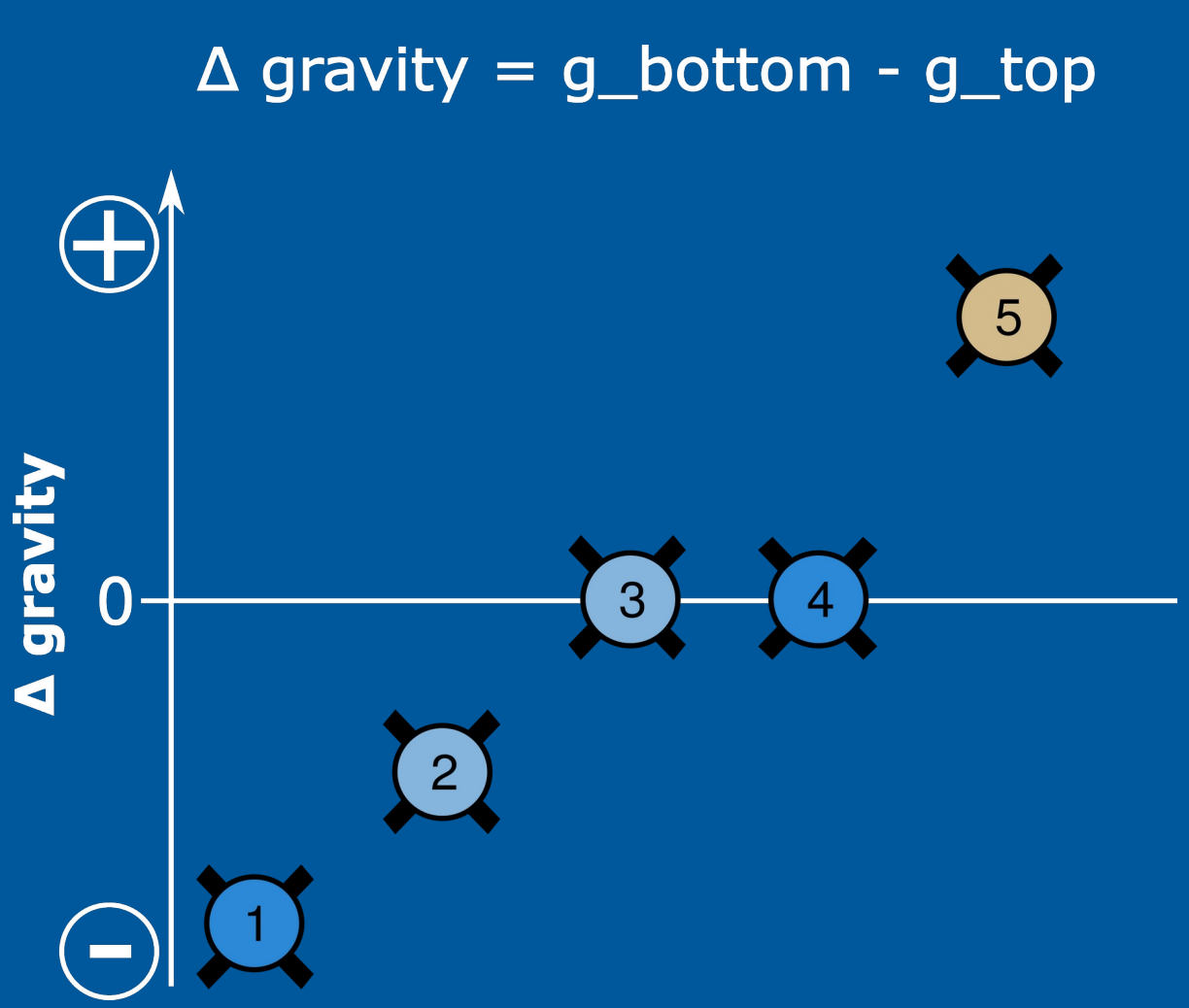
Measurement setup

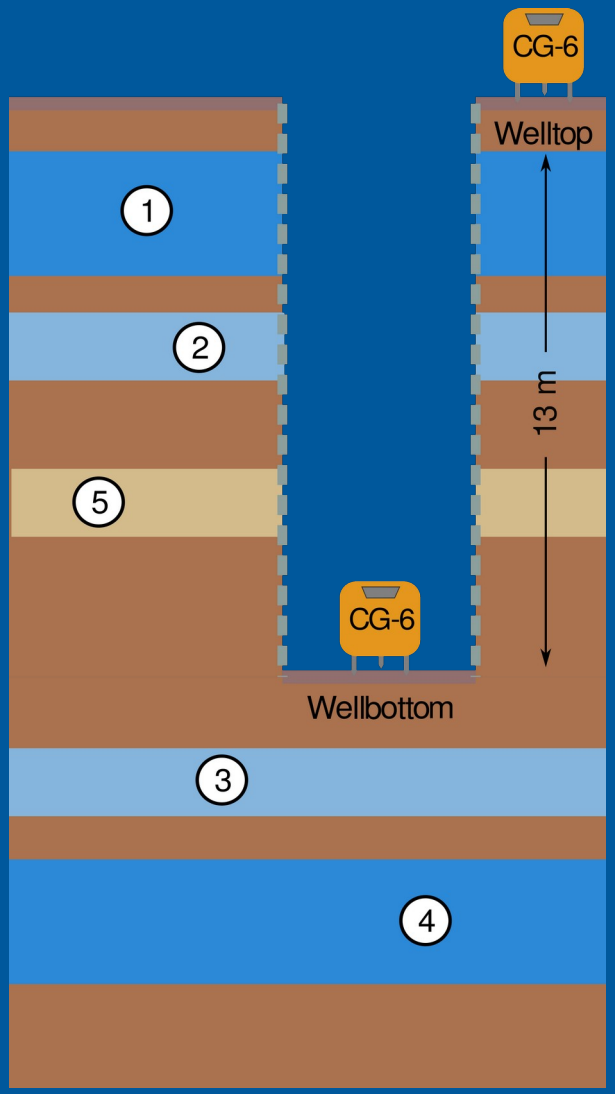
- 120 year old (dried-out) well
- Well depth: 13 m
- One pillar on top (surface), one at the bottom of the well
- Reference pillar next to iGrav
- Survey method: looping
- Monthly measurements
- Network adjustment for drift correction



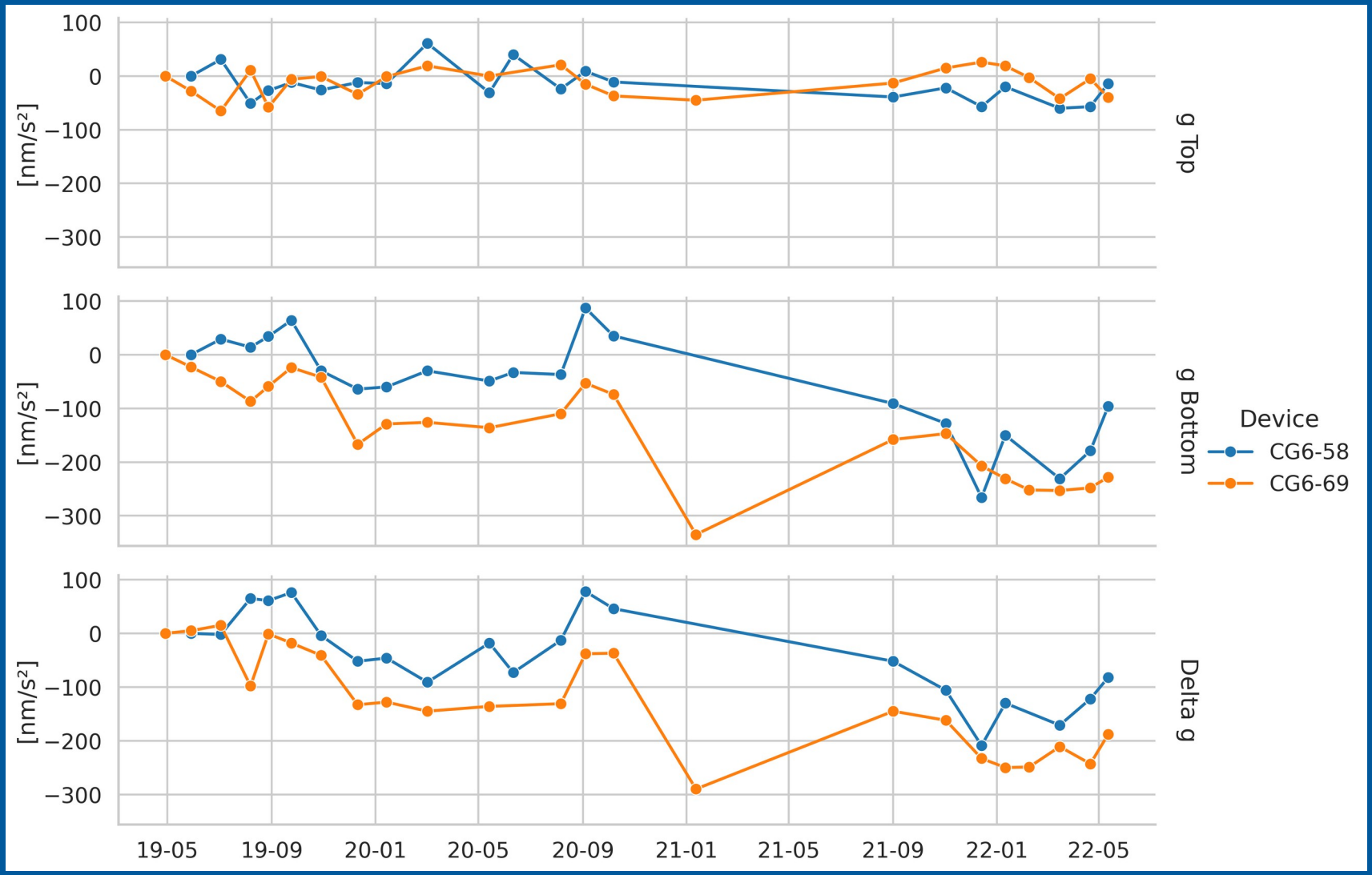
Theoretical implications

Δ gravity = g_bottom - g_top

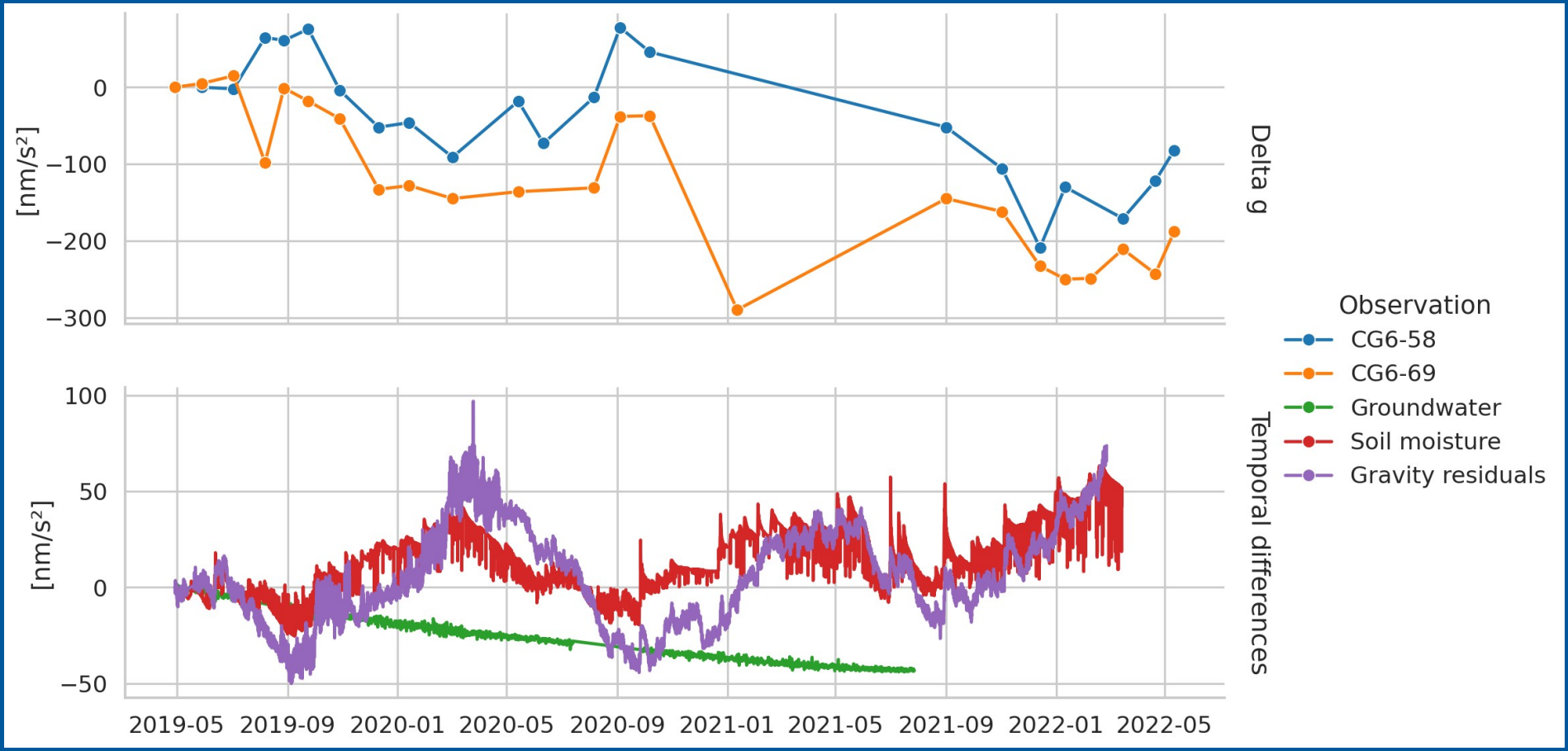




Preliminary results: delta gravity



Preliminary results: compare observed data



Take home messages

- Drift of devices a key factor for usable and reliable data
- Gravity differences between top and bottom reflect the seasonal to long-term water storage change in the vadose zone
- Effect of different support volumes seen by superficial and deep gravimeters requires further analysis
- Gradient relationships will be modeled