# A look inside the Panola trenched hillslope

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# A tracer test at the well-known Panola trenched hillslope

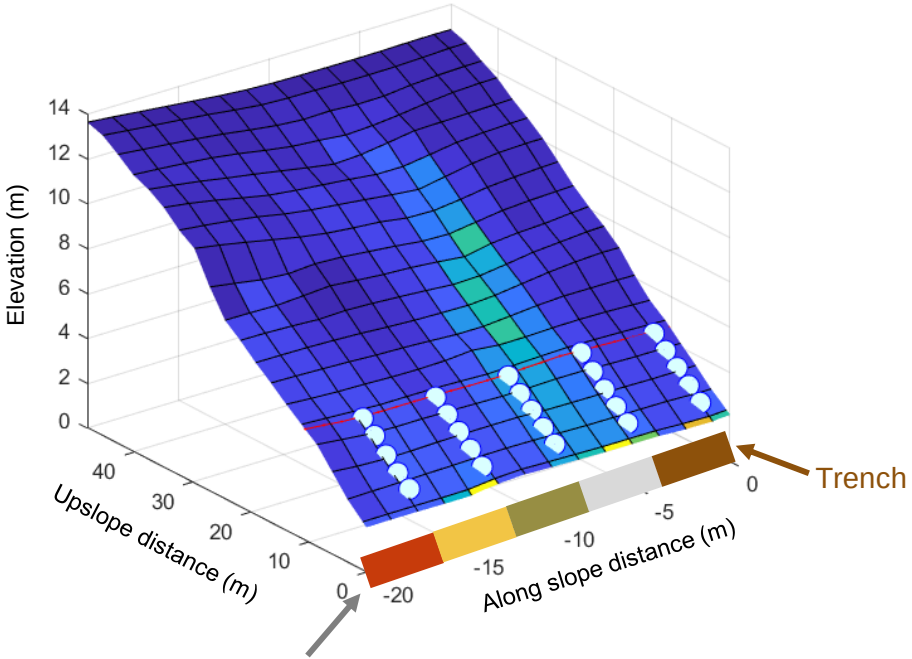
# Methods

- Bromide line application
  - 10 m upslope from the trench
  - 5 cm below the soil surface
  - 512 g Br
- Chloride area application
  - Sprayed on top of soil surface
  - Lower 10 m of the hillslope
  - 3.1 kg Cl
- Sampling
  - At 49 suction lysimeters
    - Shallow: ~ 17 cm
    - Deep: ~ 60 cm
    - 1055 samples
  - At 2 m wide trench sections during events
    - 1286 samples

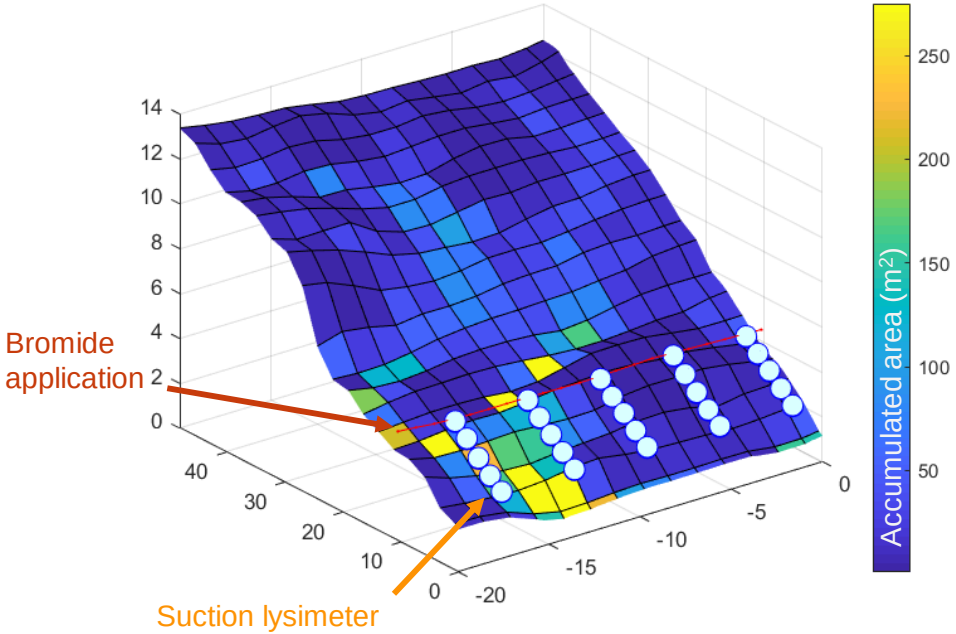
# Sampling sites and surface and bedrock topography

Note the large vertical exaggeration

- Surface topography



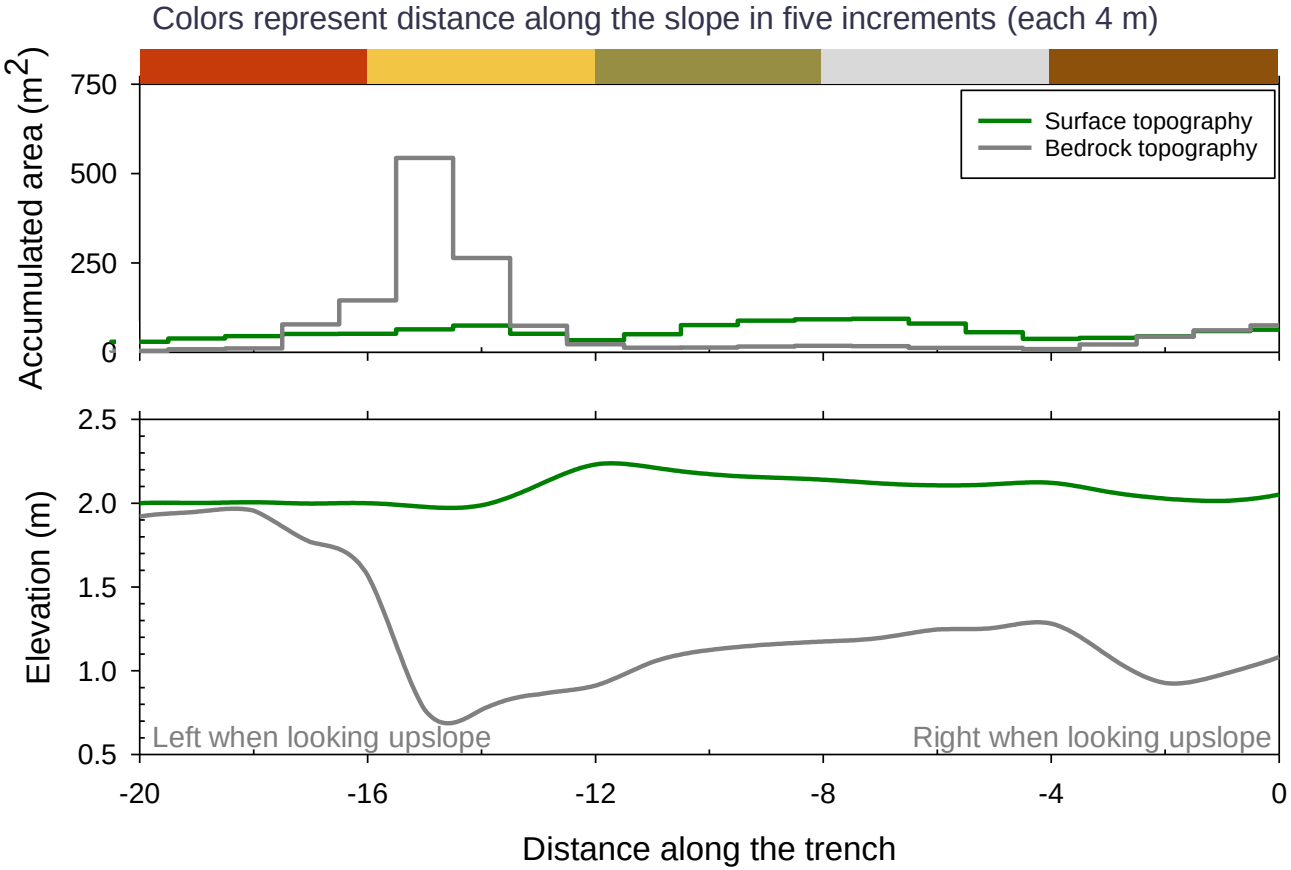

- Bedrock topography




The colors at the lower end of the hillslope represent the distance along the slope in five increments (each 4 m) and will be used throughout this presentation

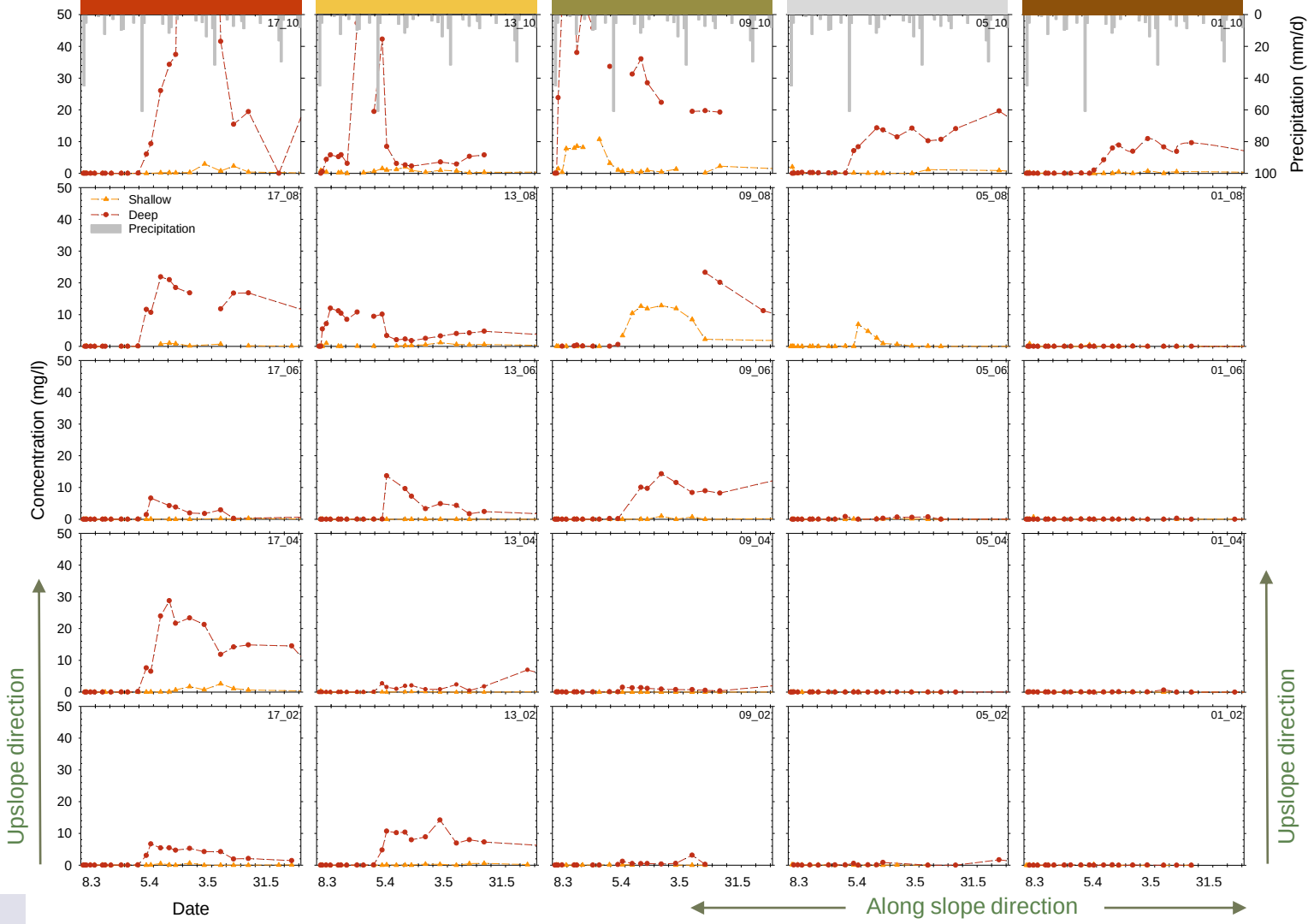
# 20 m trench

- Well known difference between surface and bedrock topography leads to large spatial variation in subsurface flow volume



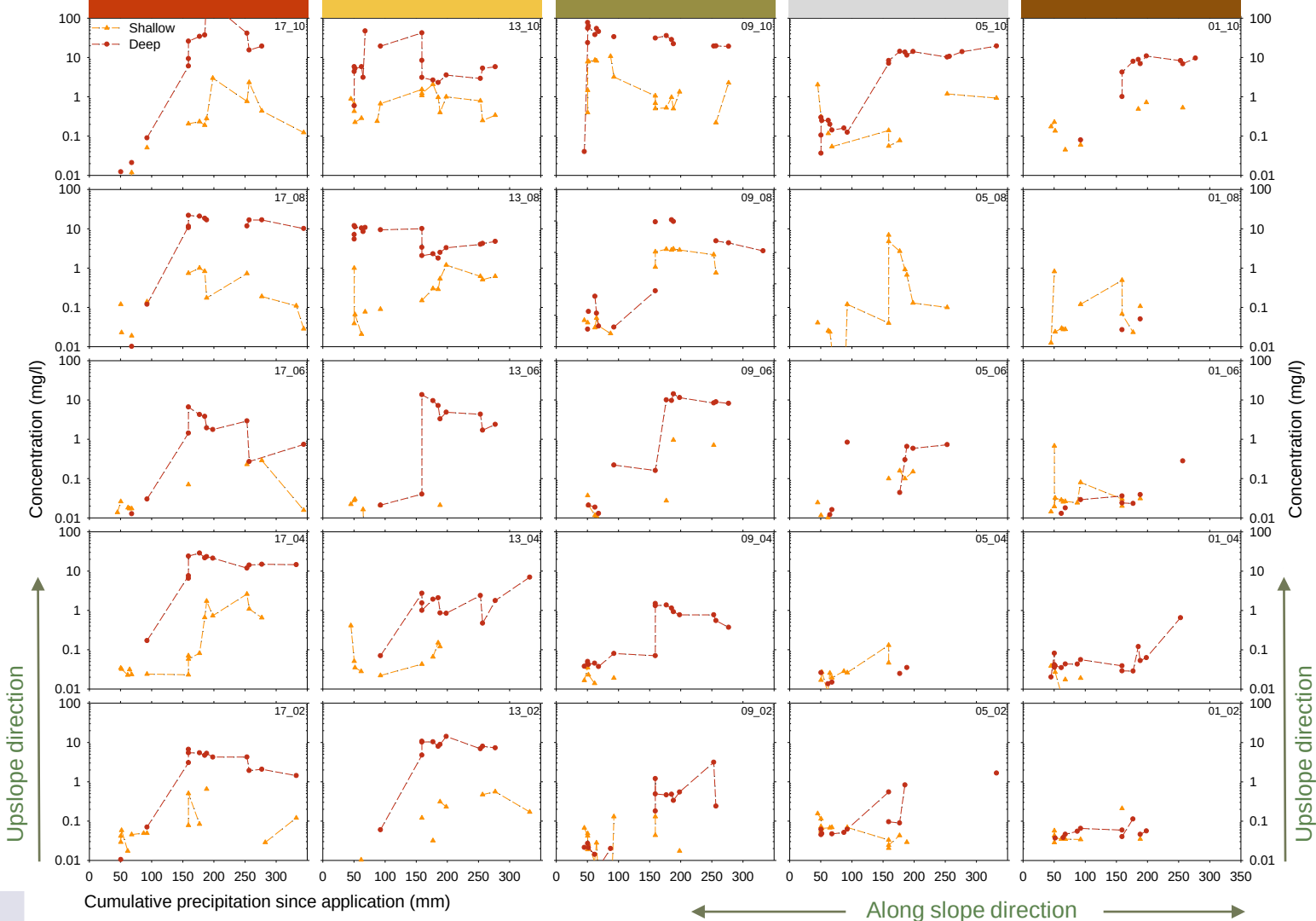
# Suction lysimeter data: Bromide

Each subplot shows the time series of the bromide concentrations for one location on the hillslope
**Orange**: shallow
**Red**: deep



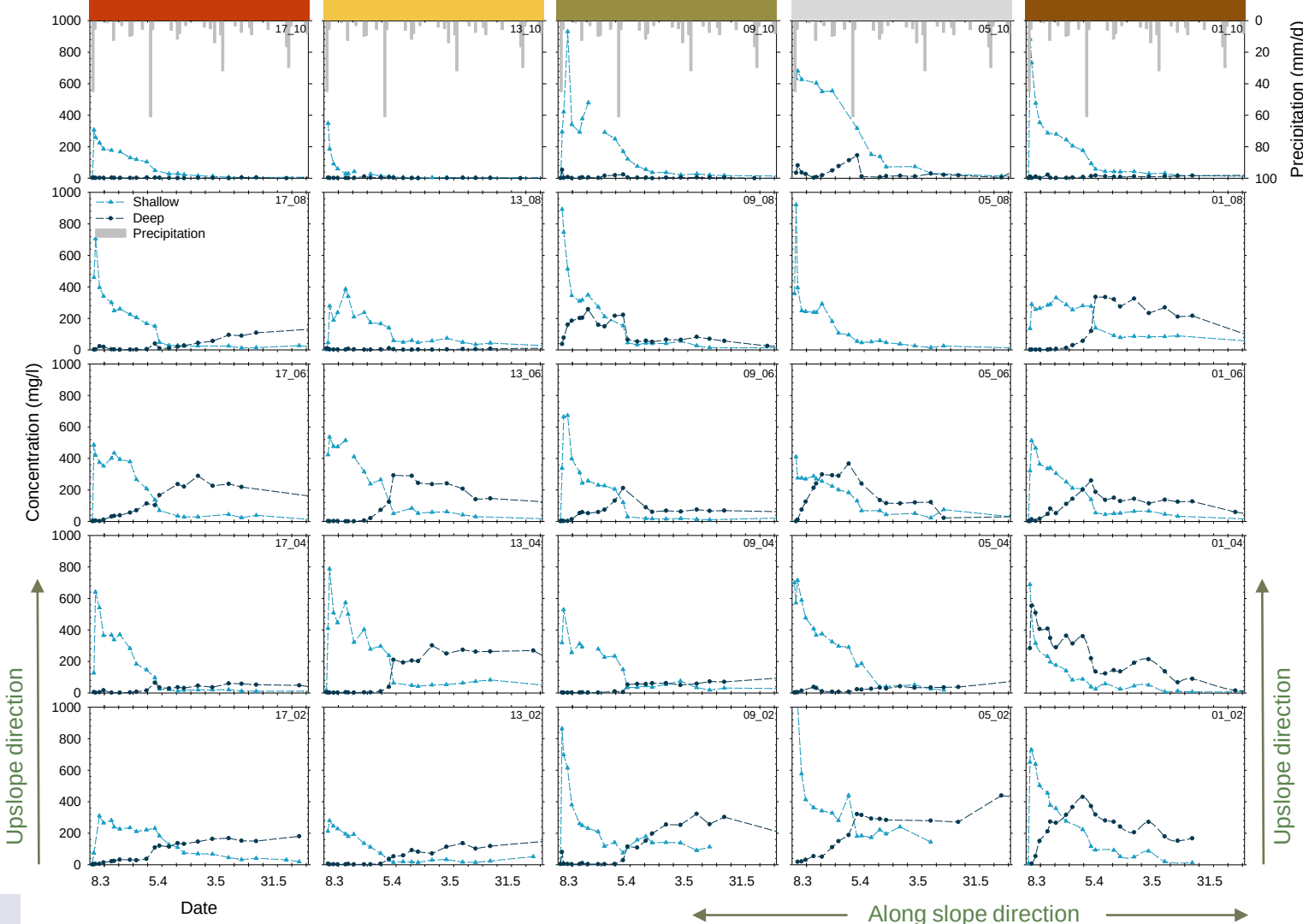
# Suction lysimeter data: Bromide

Each subplot shows the bromide concentrations as a function of **cumulative precipitation** for one location on the hillslope
**Orange**: shallow
**Red**: deep



# Suction lysimeter data: Chloride

Each subplot shows the time series of the chloride concentrations for one location on the hillslope
**Light blue**: shallow
**Dark blue**: deep



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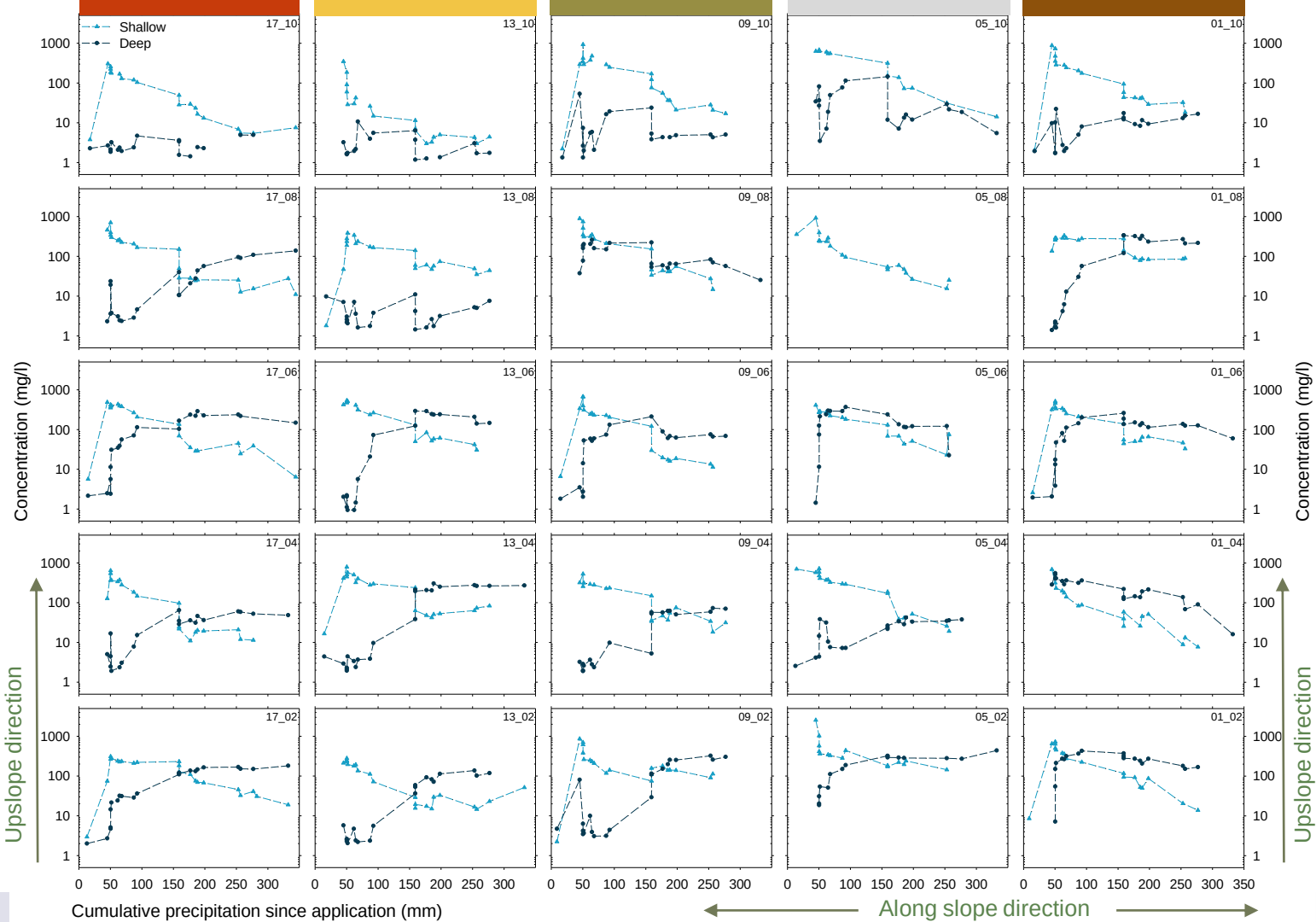

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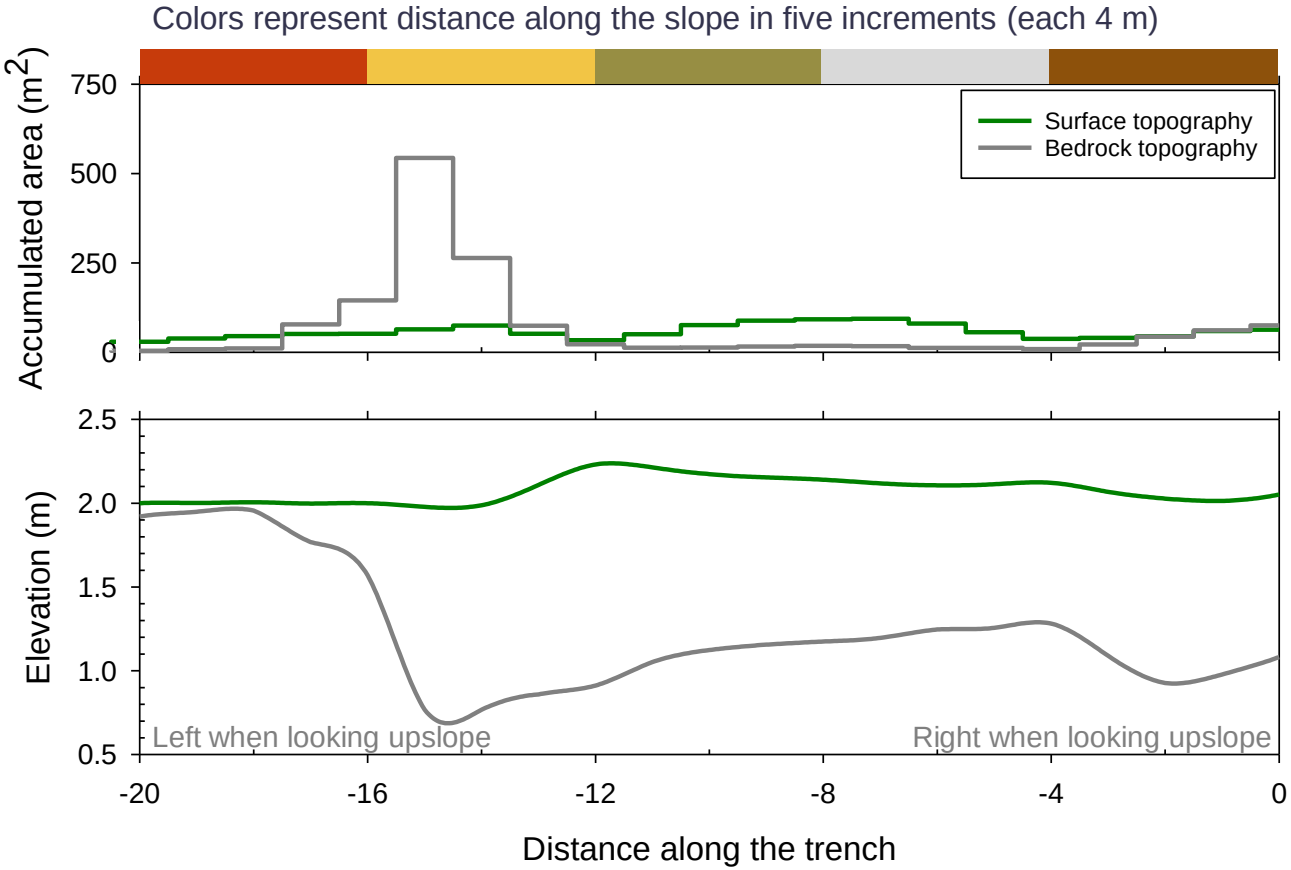
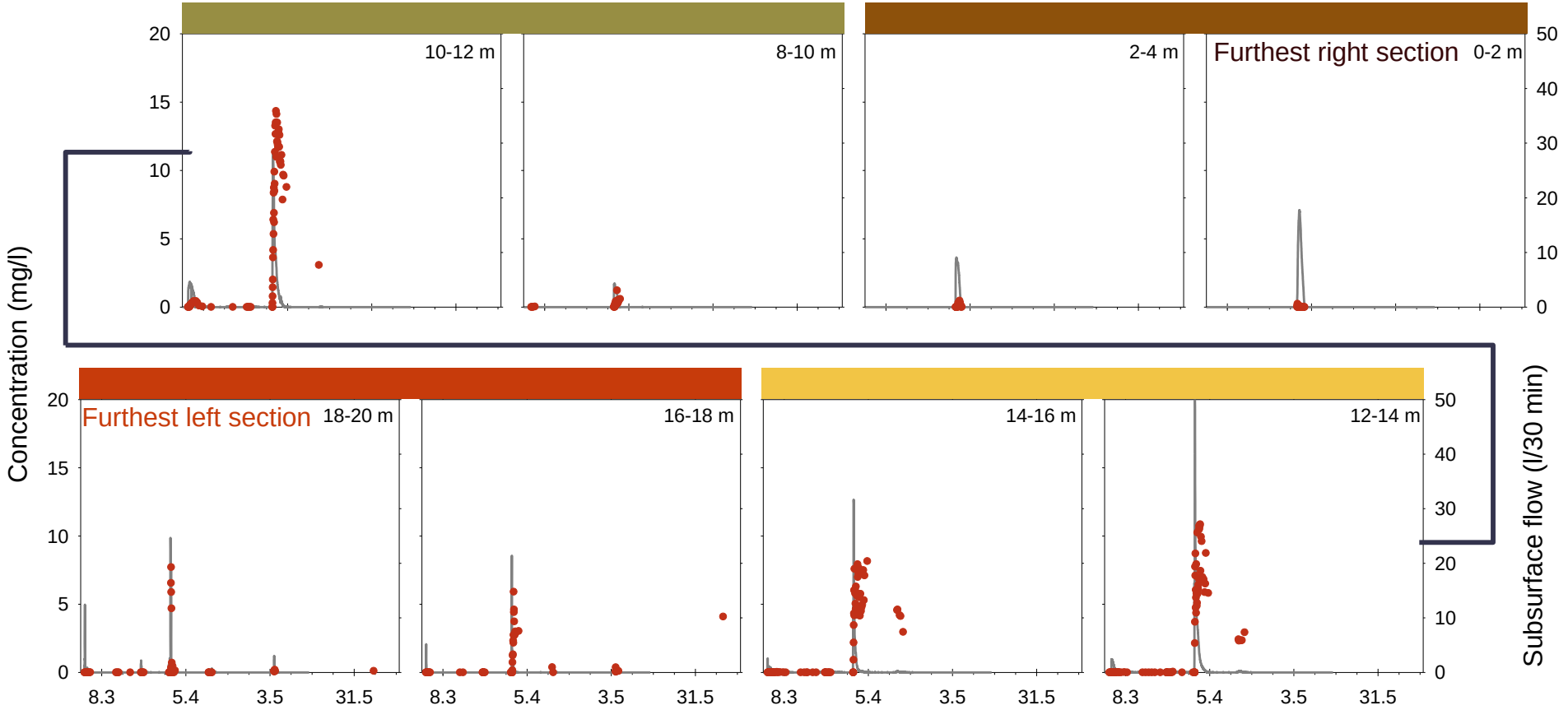
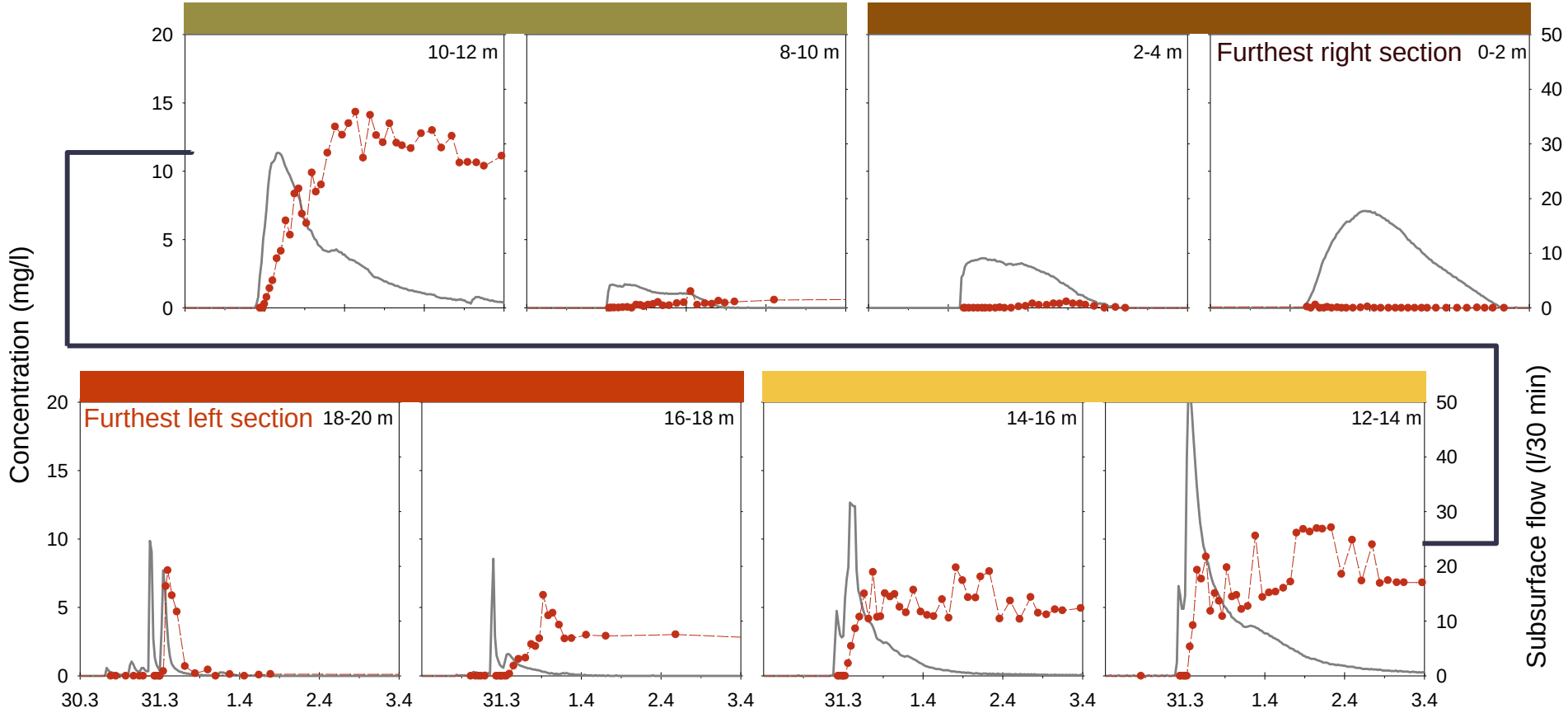


# Trenchflow data: Bromide



# Trenchflow data: Bromide - event



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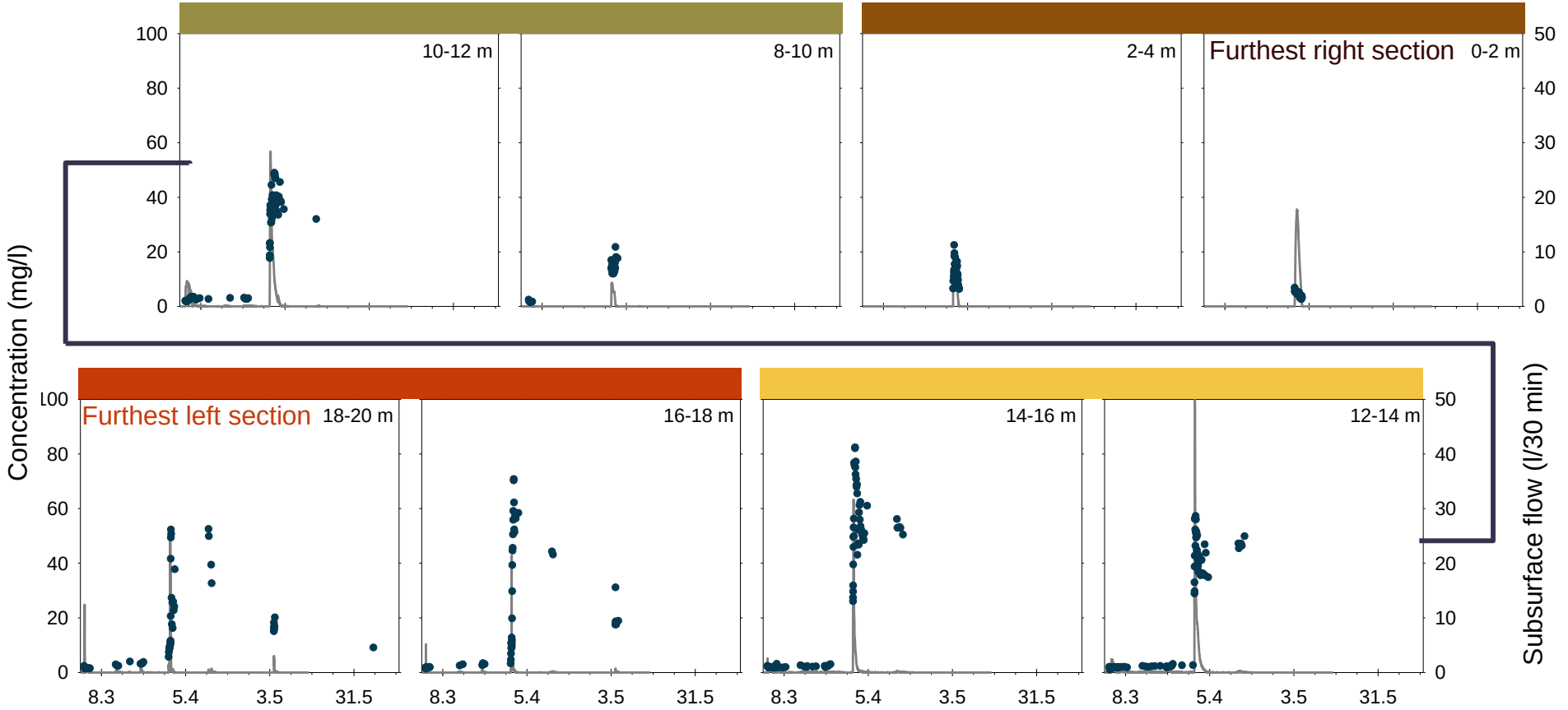

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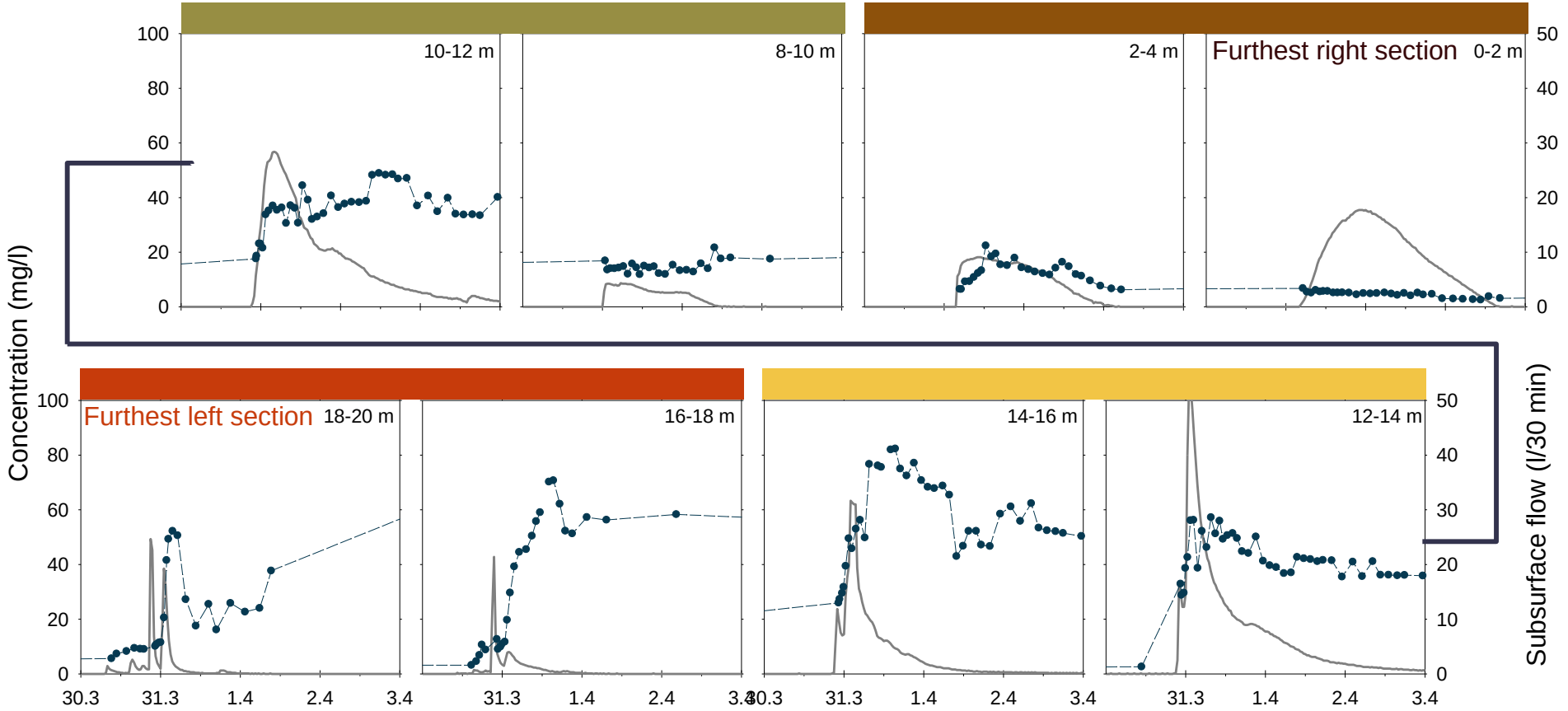

# Take home messages and next steps

- Take home messages:
  - Rapid transport during large events
  - Highly variable tracer breakthrough related to main flow pathways and spatial variability in saturated flow occurrence
- Data analysis has just started.
- Next steps:
  - Compare data from wells to data from suction lysimeters
  - Determine velocities and celerities
  - Analyse data during rainfall simulation on part of the hillslope

For questions and suggestions, email me:
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# References for the Panola hillslope

- Hydrometric data:
  - Tromp-van Meerveld, H.J., A.L. James, J.J. McDonnell, and N.E. Peters (2008), A reference data set of hillslope rainfall - runoff response, Panola Mountain Research Watershed, United States, *Water Resources Research*, *44*(6), W06502.

- Papers:
  - McDonnell, J.J., J. Freer, R. Hooper, C. Kendall, D. Burns, K. Beven, and J. Peters (1996), New method developed for studying flow on hillslopes, *Eos, Transactions American Geophysical Union*, *77*(47), 465-472.
  - Freer, J., J. McDonnell, K.J. Beven, D. Brammer, D. Burns, R.P. Hooper and C. Kendal (1997), Topographic controls on subsurface storm flow at the hillslope scale for two hydrologically distinct small catchments, *Hydrological Processes.*, *11*, 1347-1352.
  - Freer, J., J. McDonnell, K.J. Beven, N.E. Peters, D.A. Burns, R.P. Hooper, B. Aulenbach, and C. Kendal (2002), The role of bedrock topography on subsurface storm flow, *Water Resources Research*, *38*(12), 1269.
  - Tromp-van Meerveld, H.J., and J.J. McDonnell (2006), Threshold relations in subsurface stormflow: 1. A 147-storm analysis of the Panola hillslope, *Water Resources Research*, *42*(2)
  - Tromp-van Meerveld, H.J., and J.J. McDonnell (2006), Threshold relations in subsurface stormflow: 2. The fill and spill hypothesis, *Water Resources Research*, *42*(2), W02411.
  - Tromp-van Meerveld, H.J., and J.J. McDonnell (2006), On the interrelations between topography, soil depth, soil moisture, transpiration rates and species distribution at the hillslope scale, *Advances in Water Resources*, *29*(2), 293-310.
  - Tromp-van Meerveld, H.J., N.E. Peters, and J.J. McDonnell (2007), Effect of bedrock permeability on subsurface stormflow and the water balance of a trenched hillslope at the Panola Mountain Research Watershed, Georgia, USA, *Hydrological Processes*, *21*(6), 750-769.
  - Tromp-van Meerveld, I., and M. Weiler (2008), Hillslope dynamics modeled with increasing complexity, *Journal of Hydrology*, *361*(1-2), 24-40.