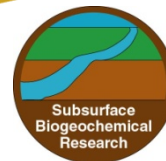


Observed and Simulated Results for the November 2008 Tracer Test at the Hanford 300 Area IFRC Site

Mark Rockhold

Hanford 300A IFRC Project Meeting
January 19-20, 2011, Richland, Washington



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Outline

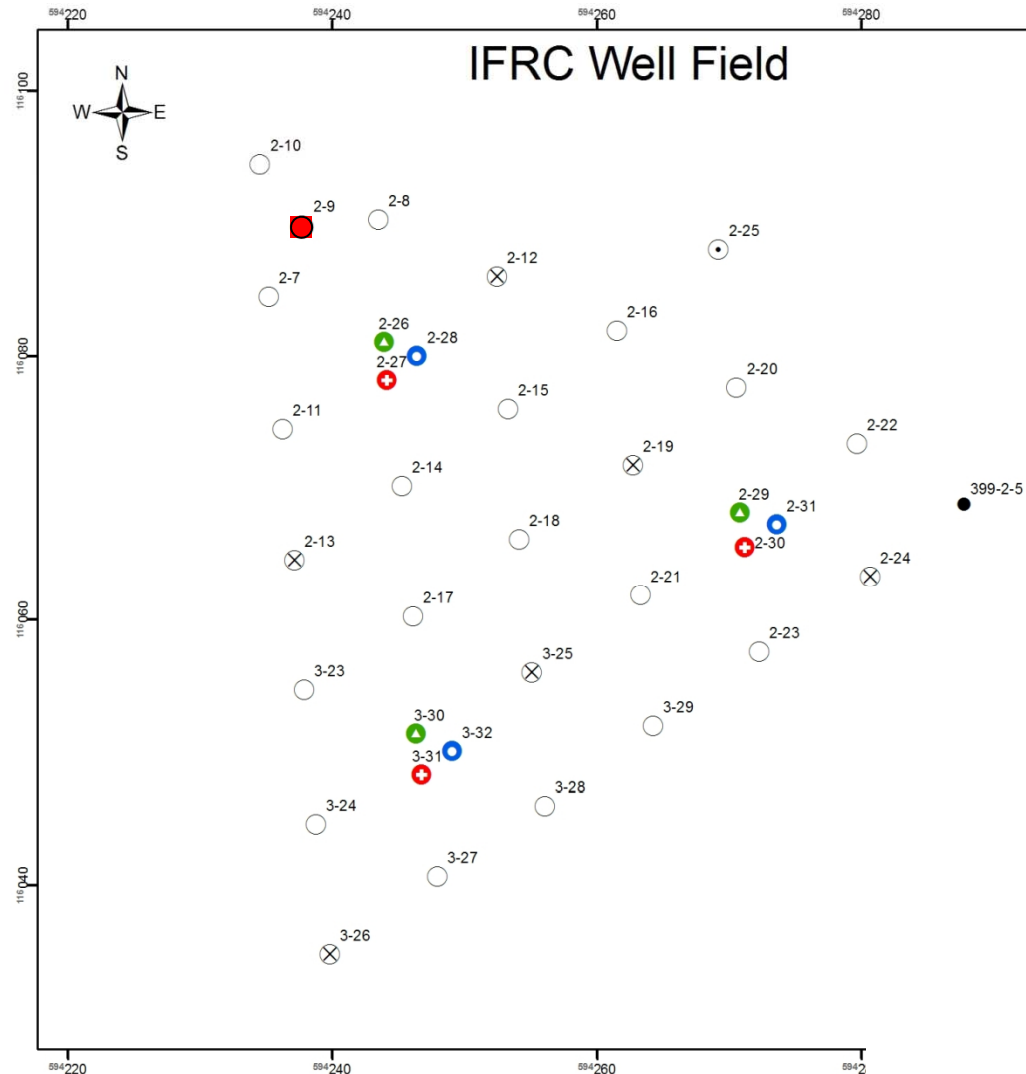
- ▶ Operational parameters for November 2008 tracer test
- ▶ Model parameterization
- ▶ Observed and simulated results
- ▶ Summary and conclusions



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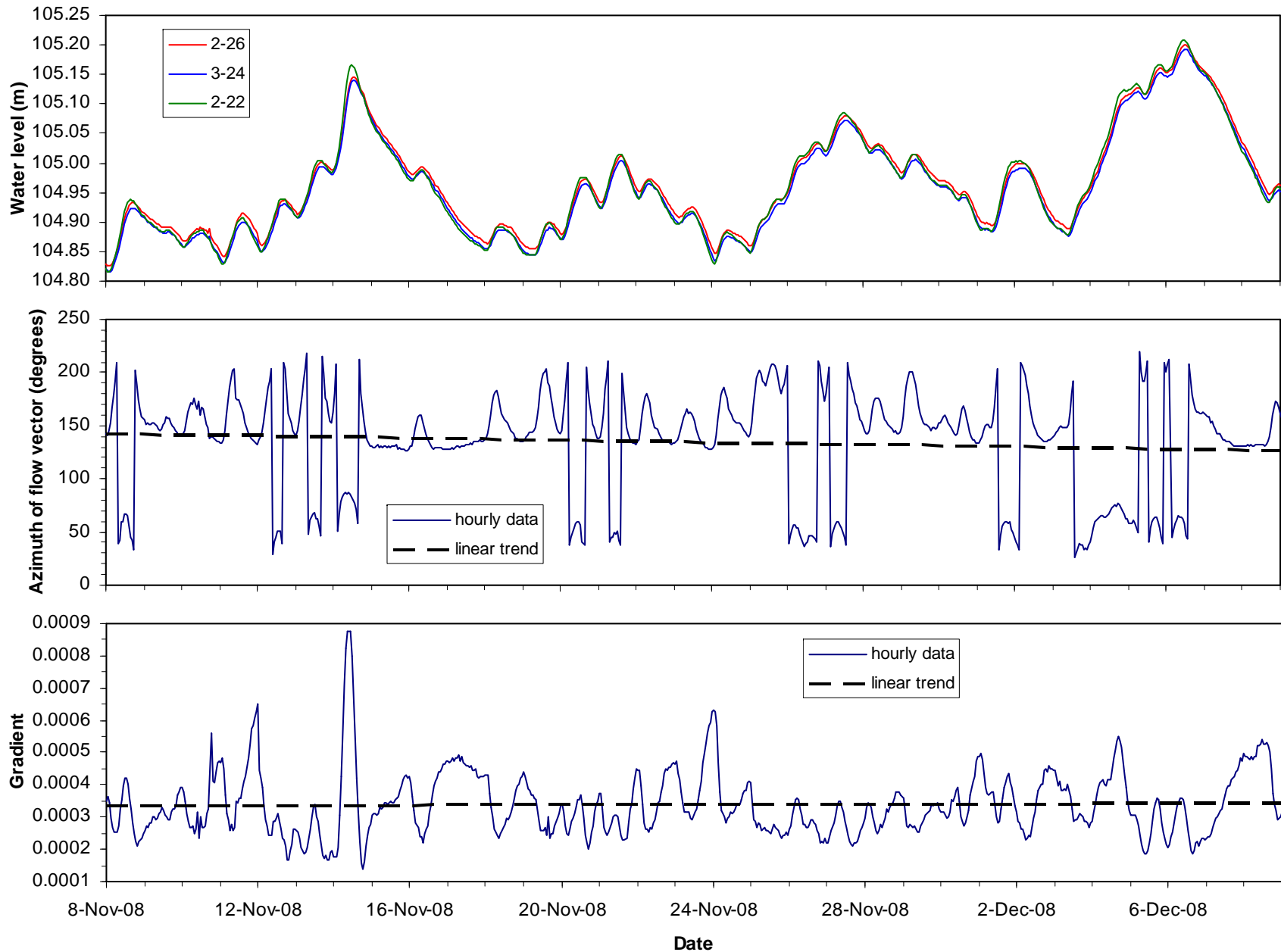
Operational parameters



Coordinate System: Washington State Plane South, NAD83; in meters

- ▶ Injection well: 399-2-9
- ▶ Injection volume: ~160,000 gal
- ▶ Injection rate: 180 gpm
- ▶ Injection duration: ~900 min (15 hr)
- ▶ Avg. Br- concentration: 56 mg/L
- ▶ Experimental duration: Nov. 11 – Dec. 8, 2008

Observed Water Levels and Computed Flow Directions and Gradients



Model parameterization

▶ Case 1

- EBF-based K field
- empirical $\phi(\gamma\text{-log})$ correlation
- simple kriging

▶ Case 2

- inverse parameter estimation using PEST
 - scaling cdf of EBF-based $\ln(K)$
 - variogram model parameters
 - Local K value adjustments in low-K region (2-28)
- empirical $\phi(\gamma\text{-log})$ correlation
- universal kriging

▶ Case 3

- geophysical log-based parameterization
- universal kriging

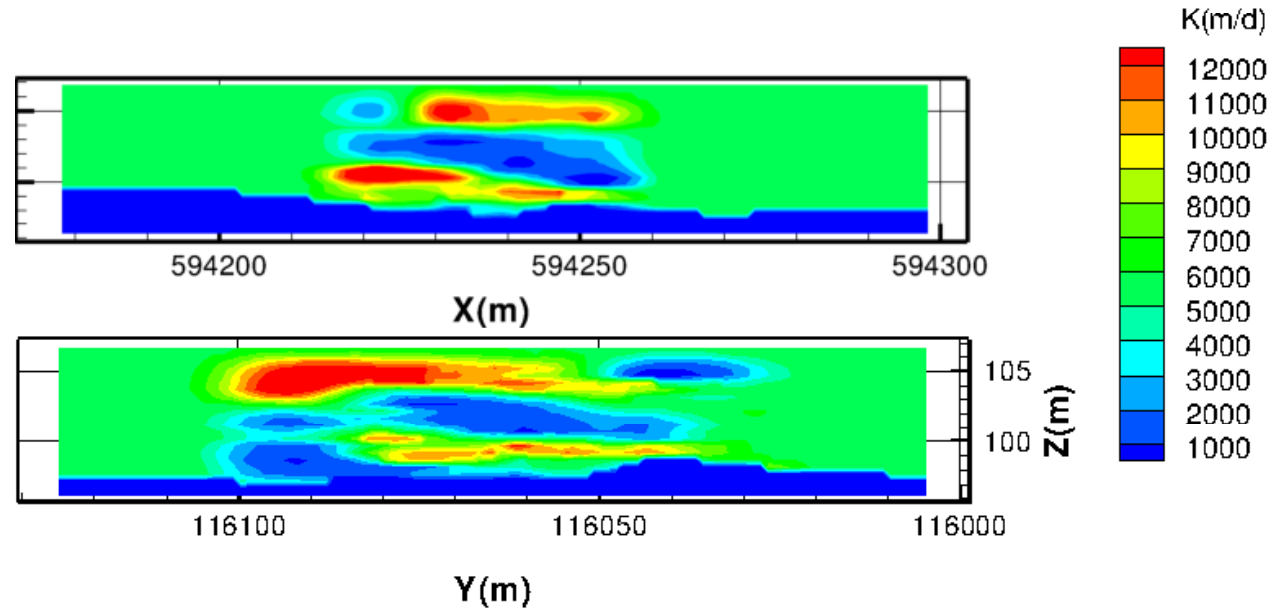


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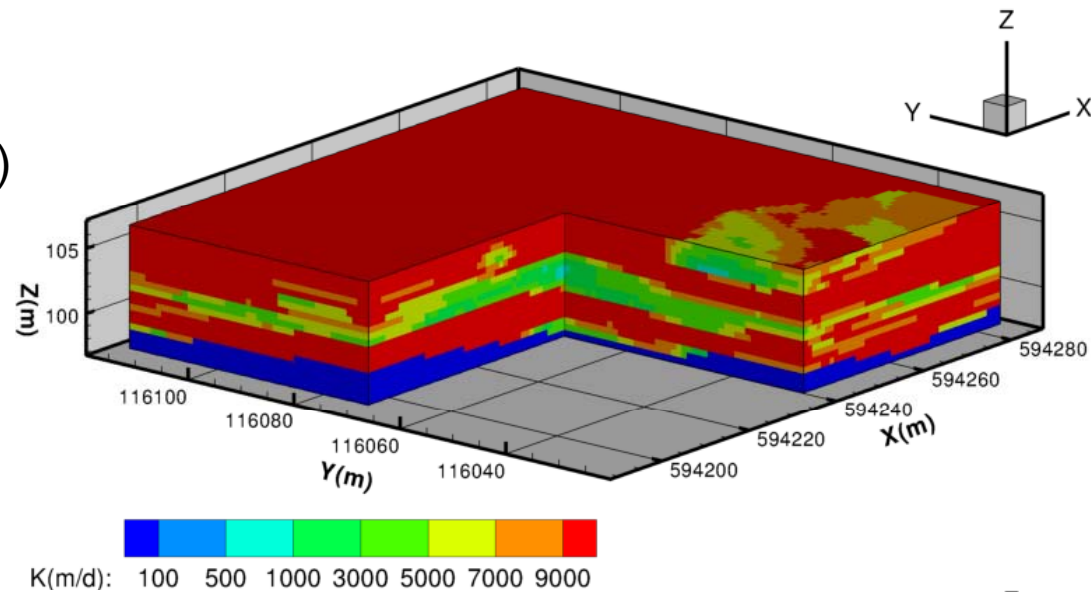
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K-field examples

Case 1
(simple kriging)



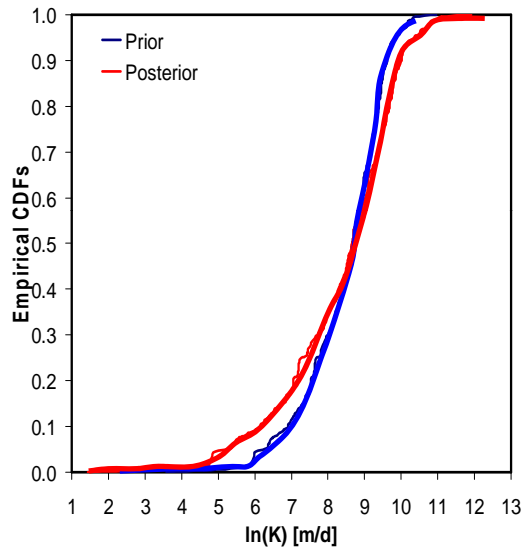
Case 2
(ordinary kriging)



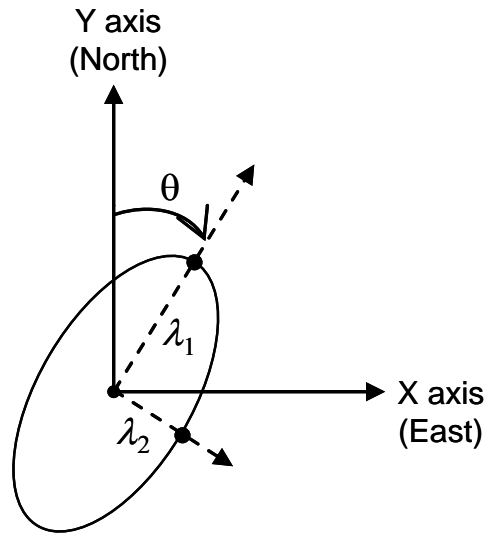
Case 2 - Inverse Parameter Estimation

Estimated parameters (7)

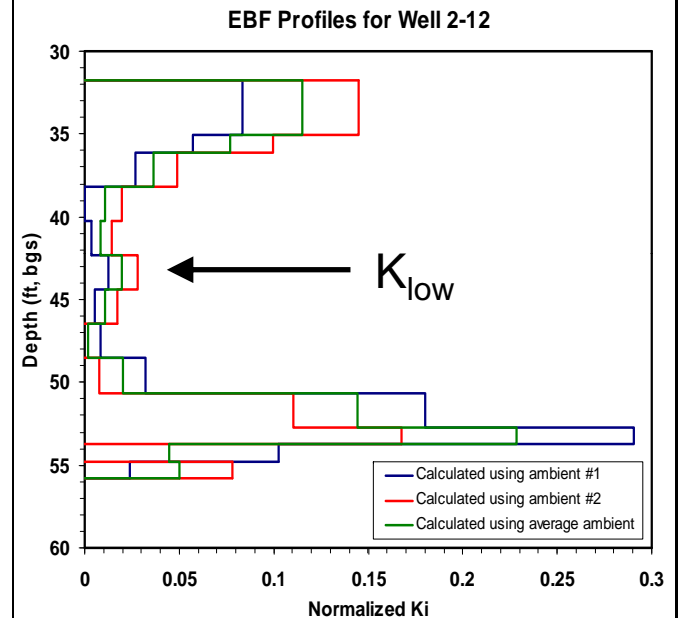
Mean [ln(K)], Var [ln(K)]



$\lambda_1, \lambda_2, \lambda_3, \theta$



K_{low}



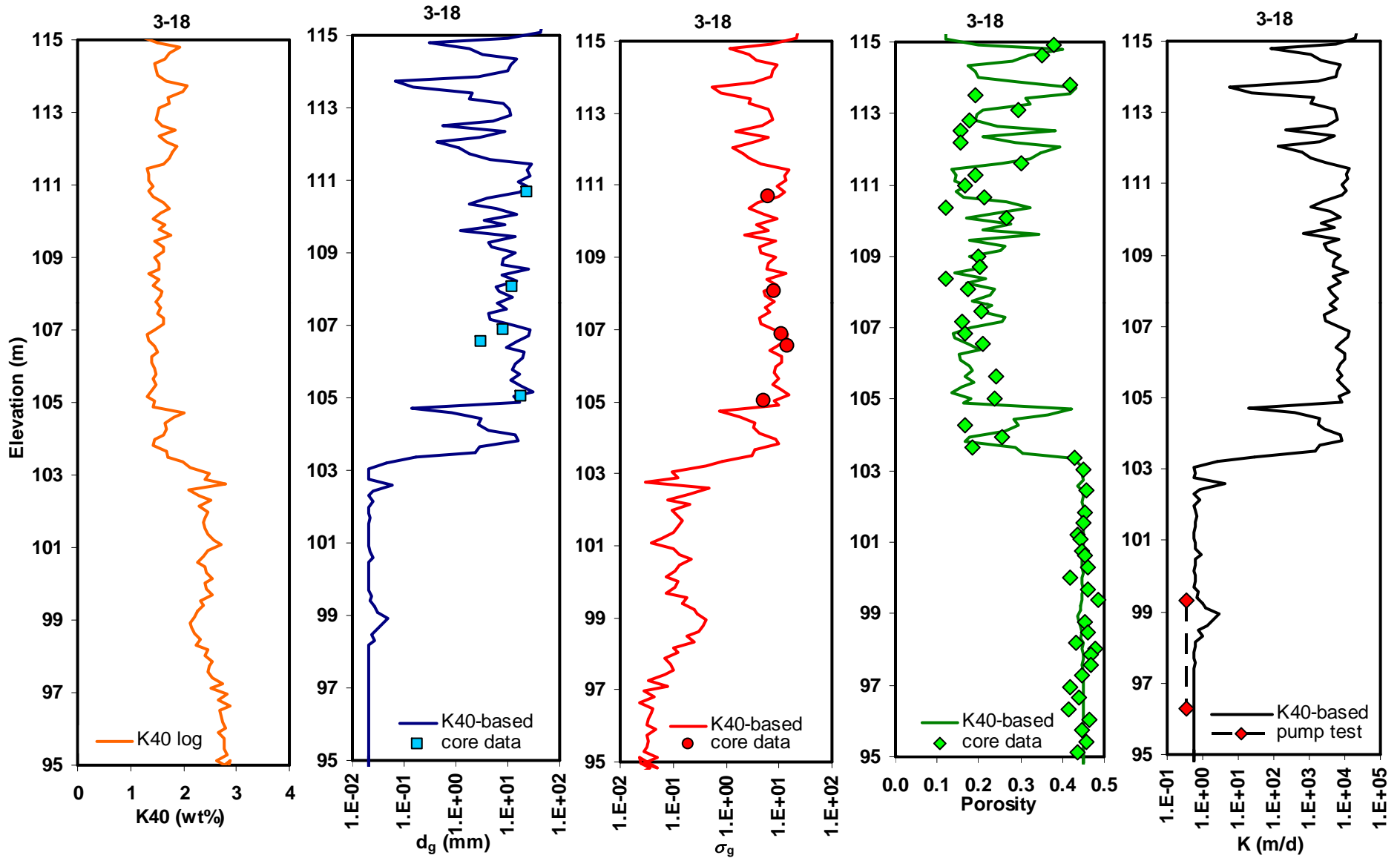
Hypothesis / Justification

EBF K data are smoothed representations of actual heterogeneity due to flow bypass through sand pack

Horizontal variograms not well-defined at lags shorter than avg. well spacing (10 m)

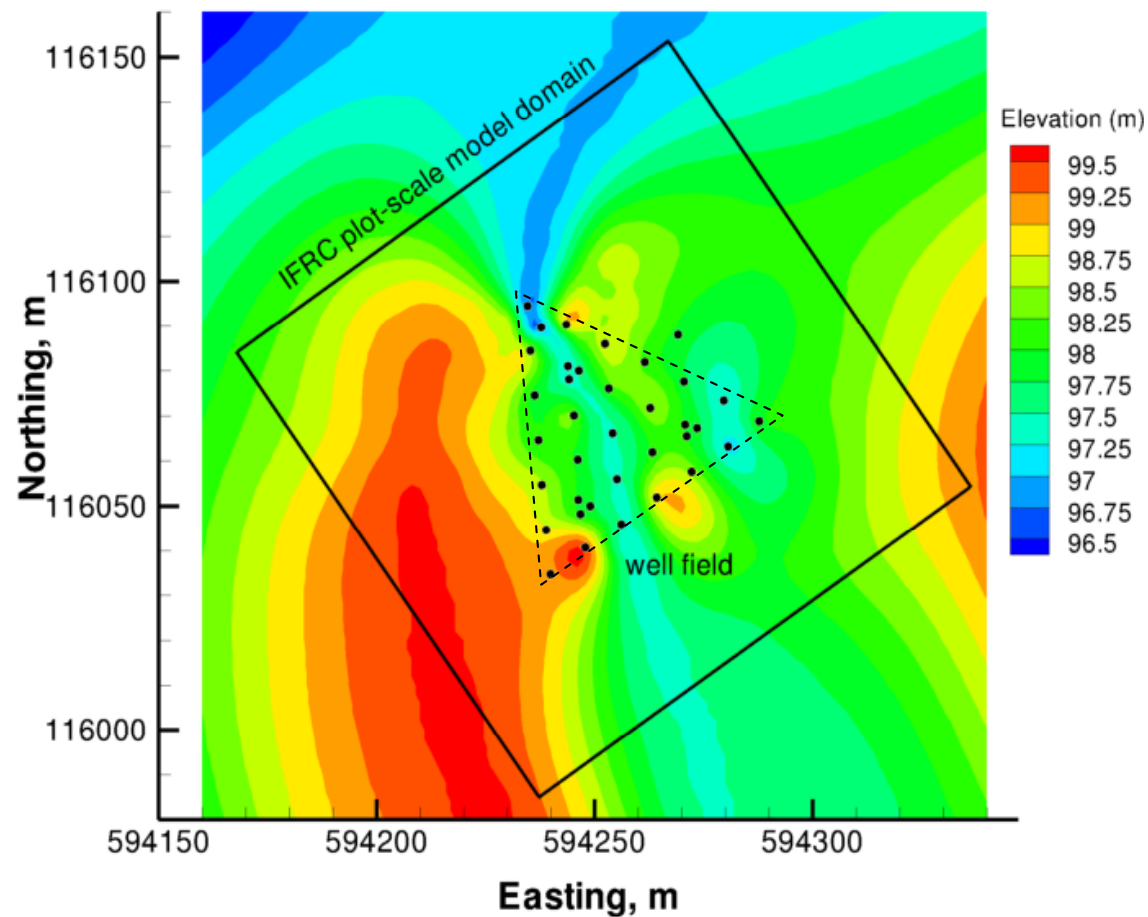
Largest mismatch between obs. and sim. tracer test results is for intermediate depth screened wells

Case 3 – Geophysical Log-Based Parameterization

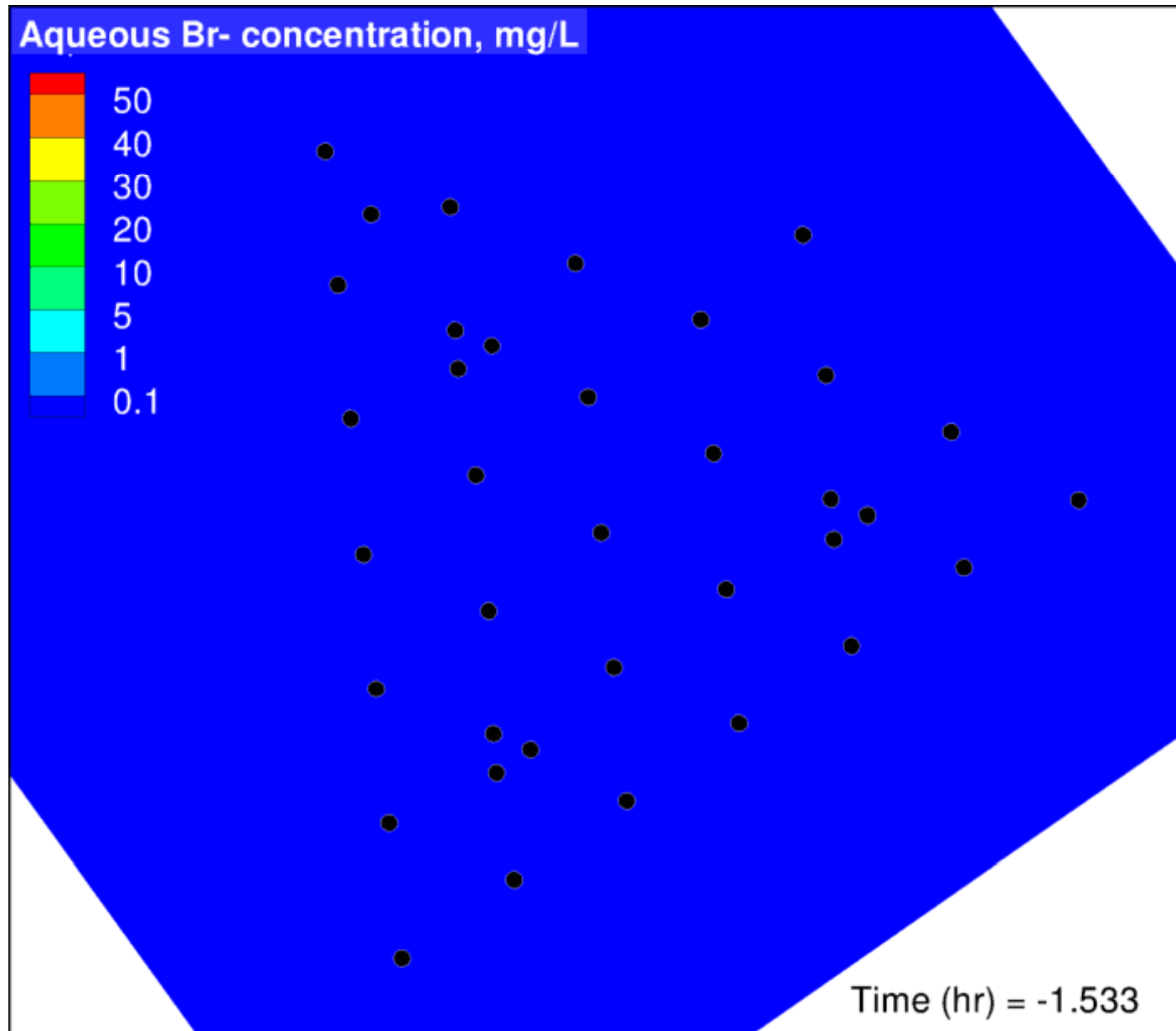


Grid specs

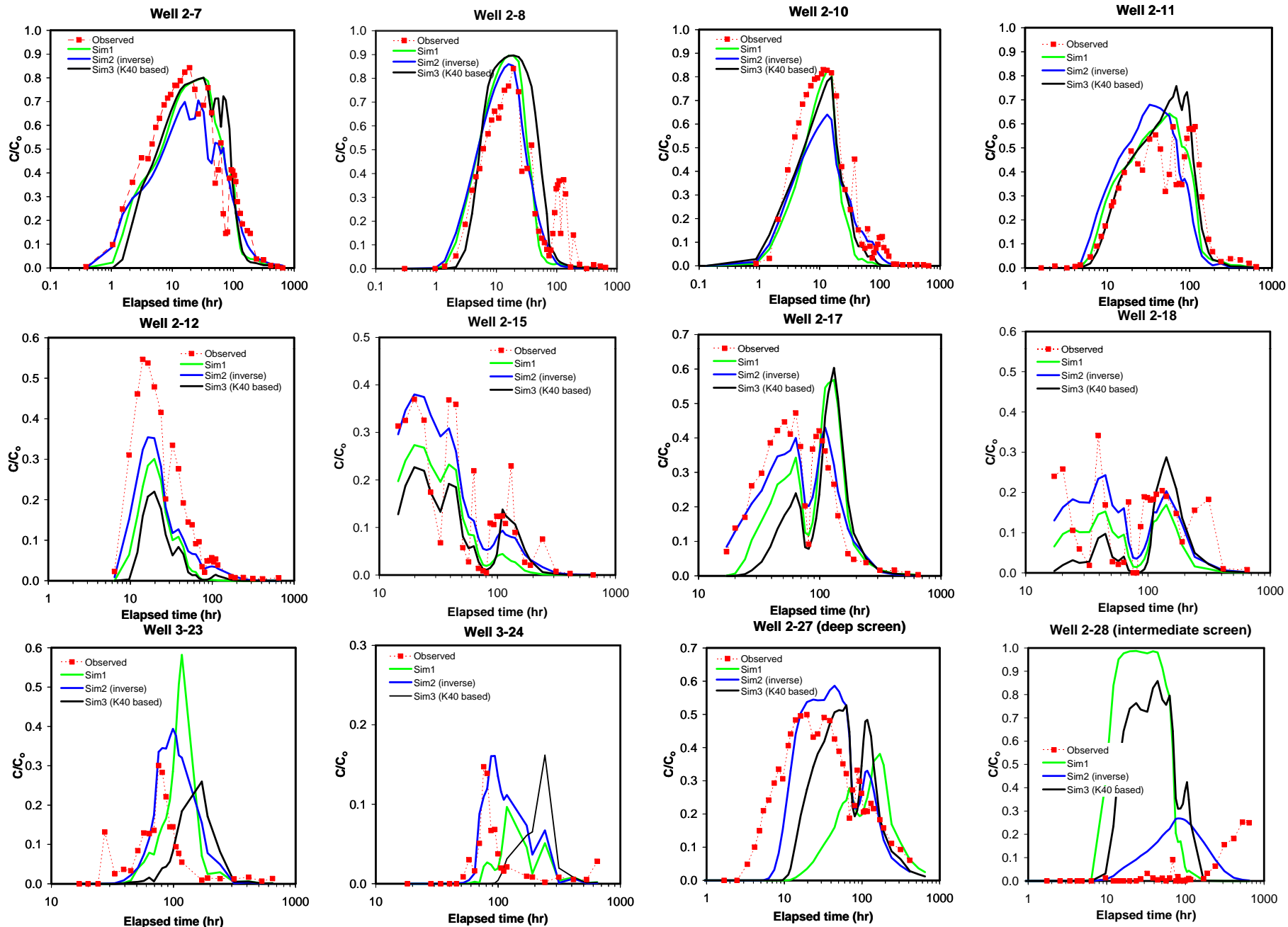
- ▶ 91 x 91 x 20 grid blocks (165,520 total)
- ▶ Uniform 1-m spacing in x-y, uniform 0.5-m spacing in z



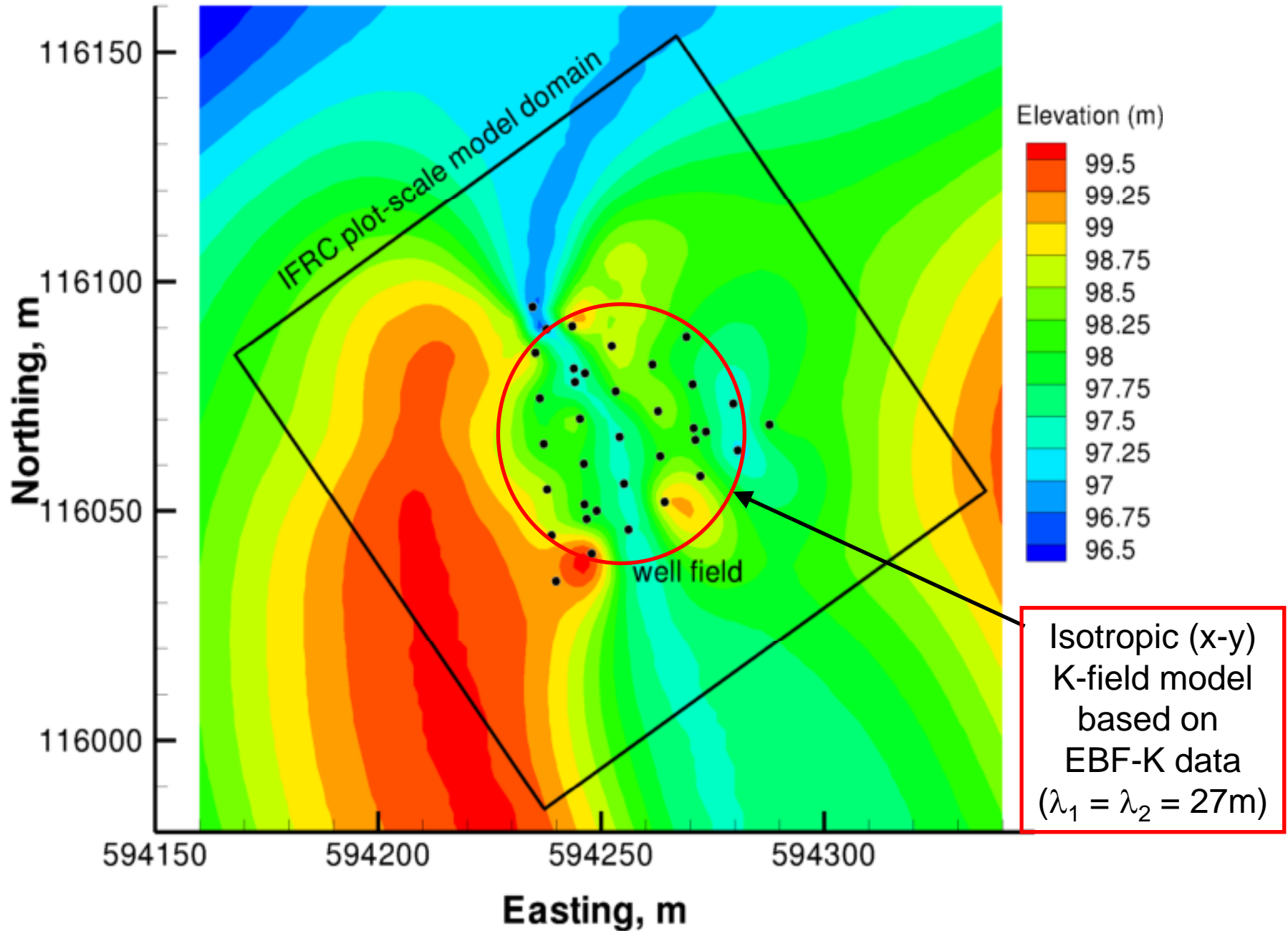
Animation for Simulation Case 1



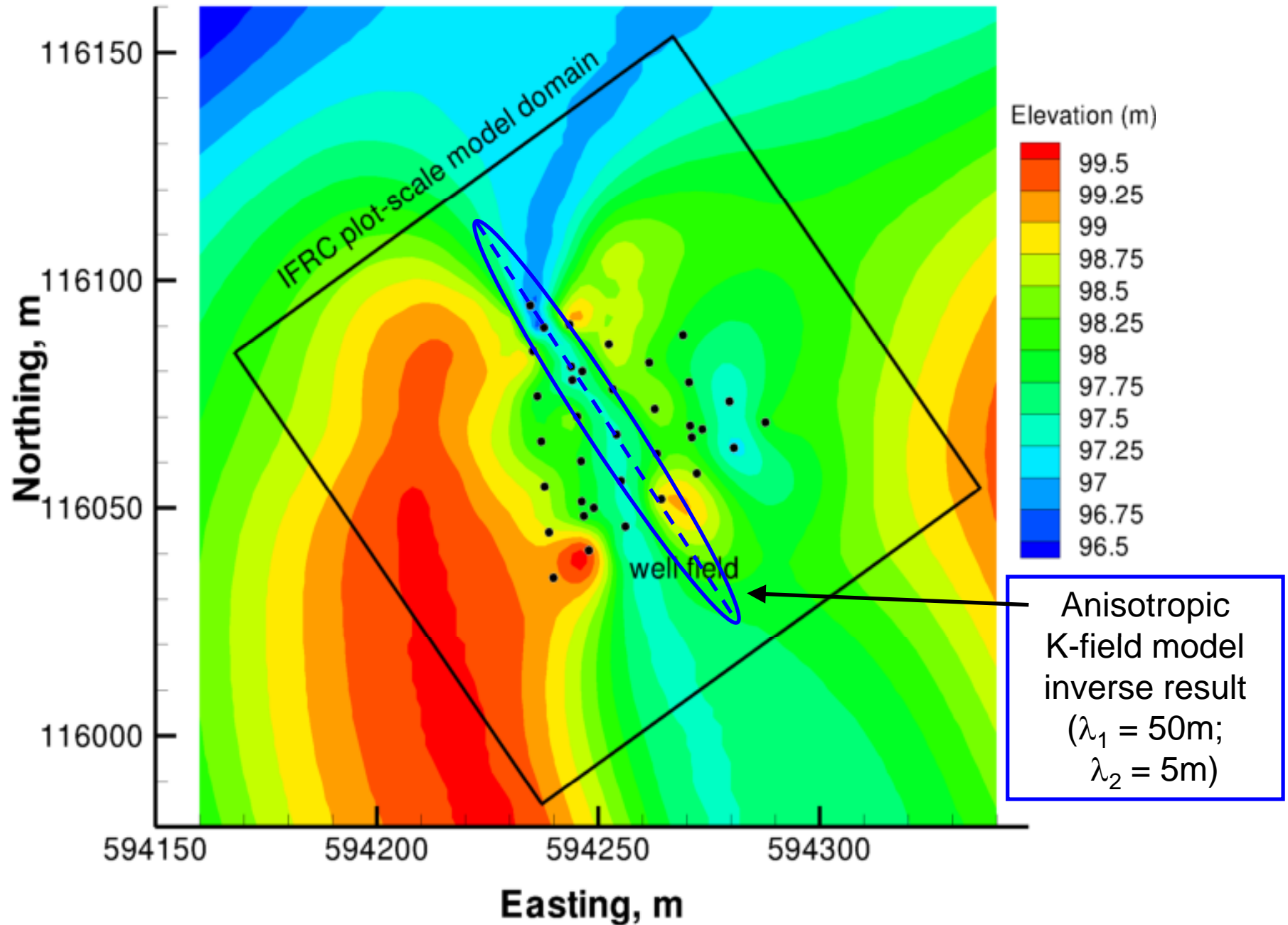
Observed and Simulated Tracer BTCs



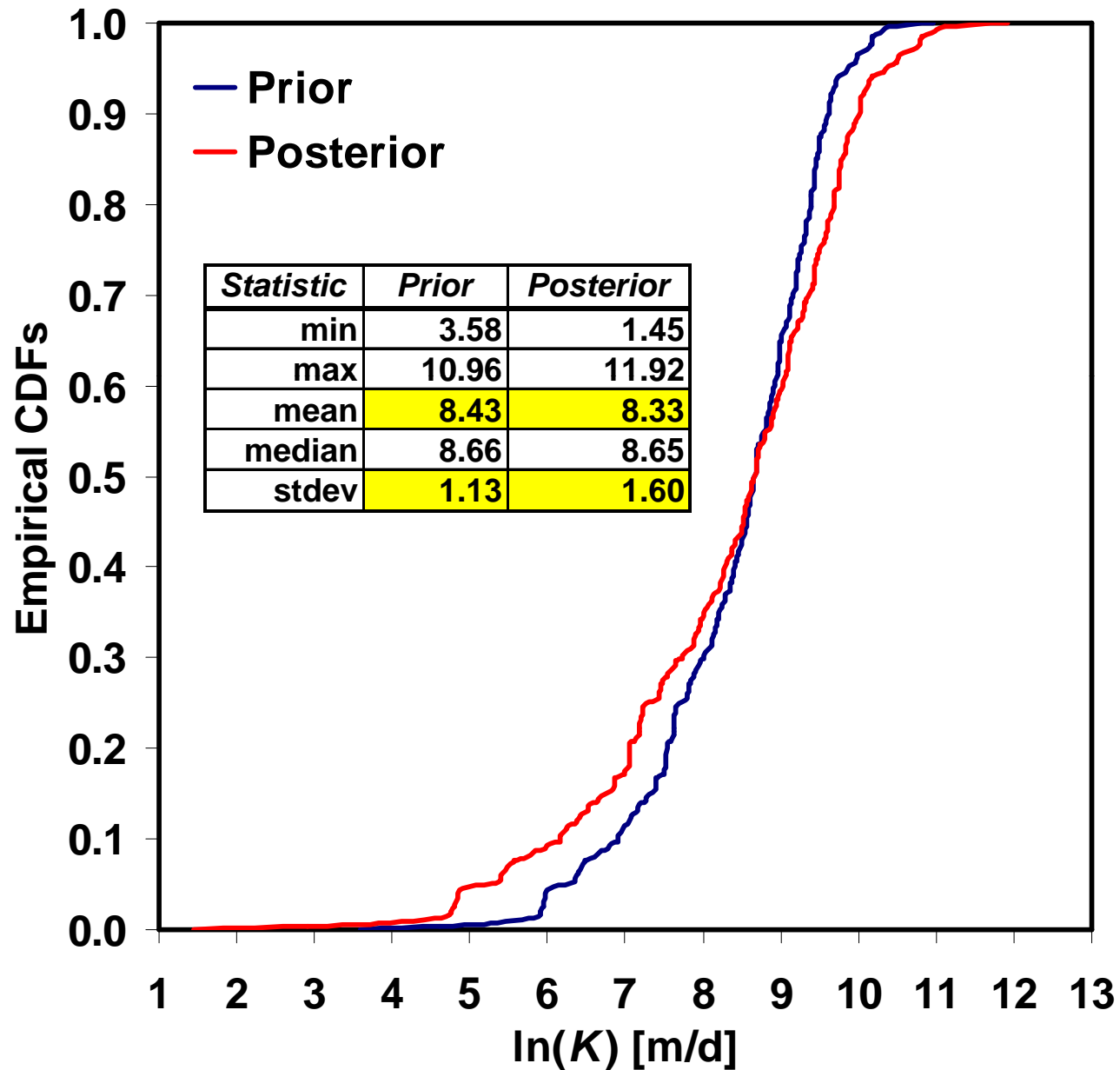
Interpreted Elevation of Hanford-Ringold Fm contact



Interpreted Elevation of Hanford-Ringold Fm contact



Prior and posterior distributions of $\ln(K)$ for Case 2



Summary

- ▶ Site characterization, monitoring, and modeling challenges
 - Very coarse and heterogeneous sediments
 - Highly dynamic flow conditions (especially during Nov 08 tracer test)
 - Significant wellbore flow effects
 - Boundary conditions

- ▶ Simulation case summary
 - Neither EBF-based (Case 1) or geophysical-log based (Case 3) parameterizations yielded good matches between observed and simulated BTCs for intermediate (low-K) depth screened wells
 - Inverse modeling yielded some improvement in fits – also suggests strong influence of paleochannel on tracer migration

- ▶ Future improvements
 - Use of electrical geophysical measurements with inverse modeling
 - New corner-point wells for improved boundary conditions and added characterization data
 - Well mitigation to reduce or eliminate wellbore flow effects

