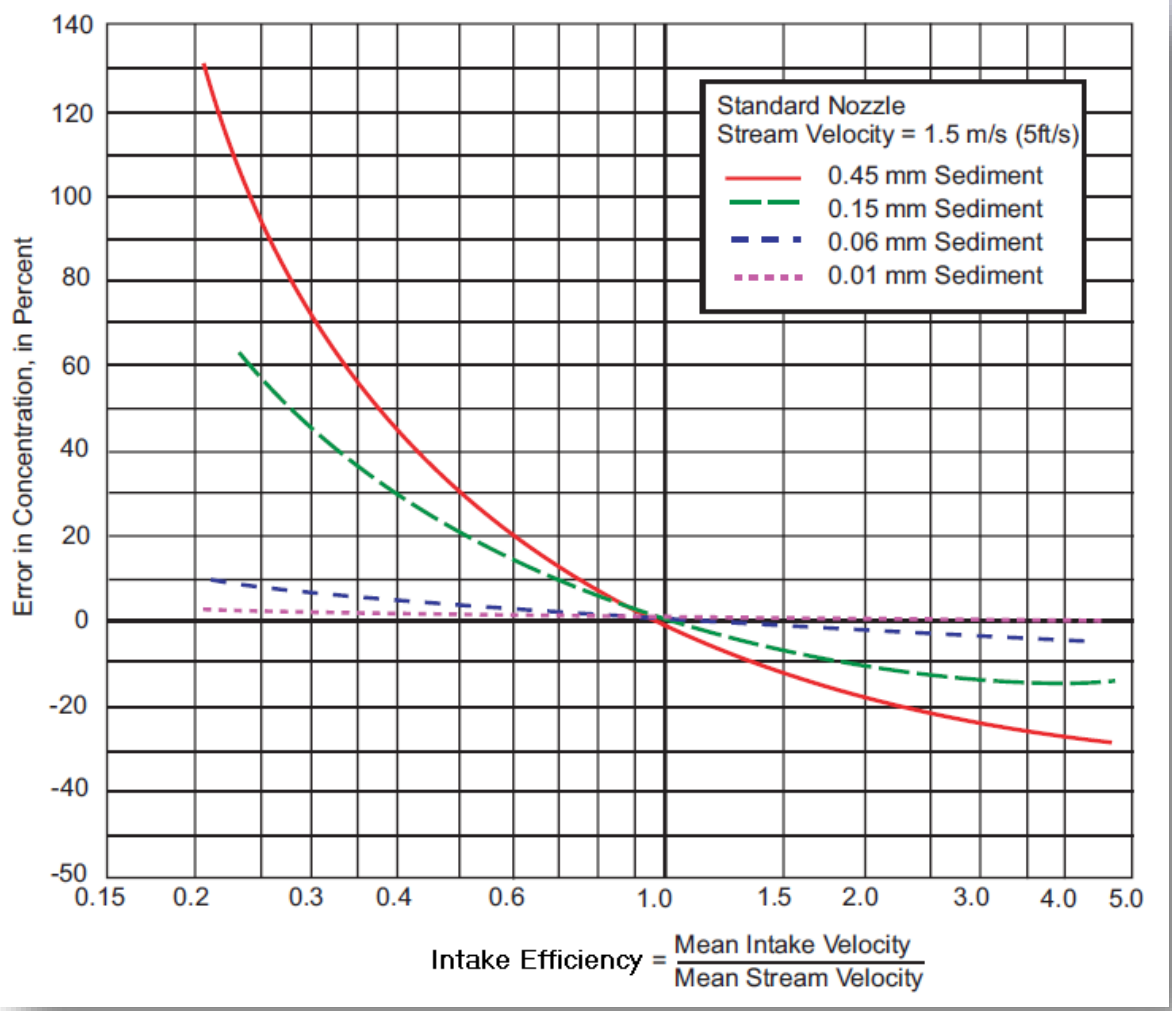
Computational Fluid Dynamics Analysis of Suspended-Sediment Sampler Efficiency – Phase II

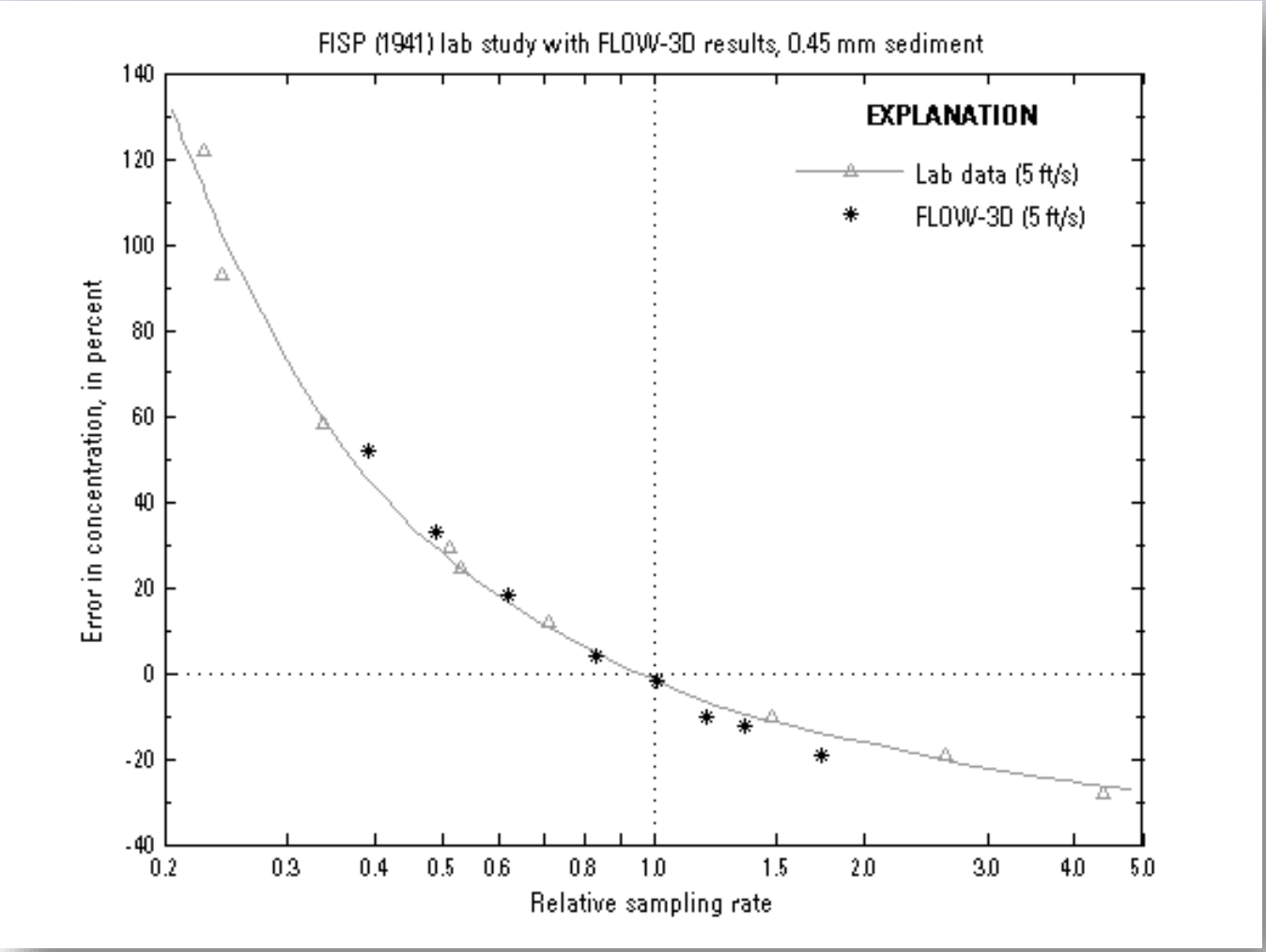
Justin A. Boldt

USGS
science for a changing world

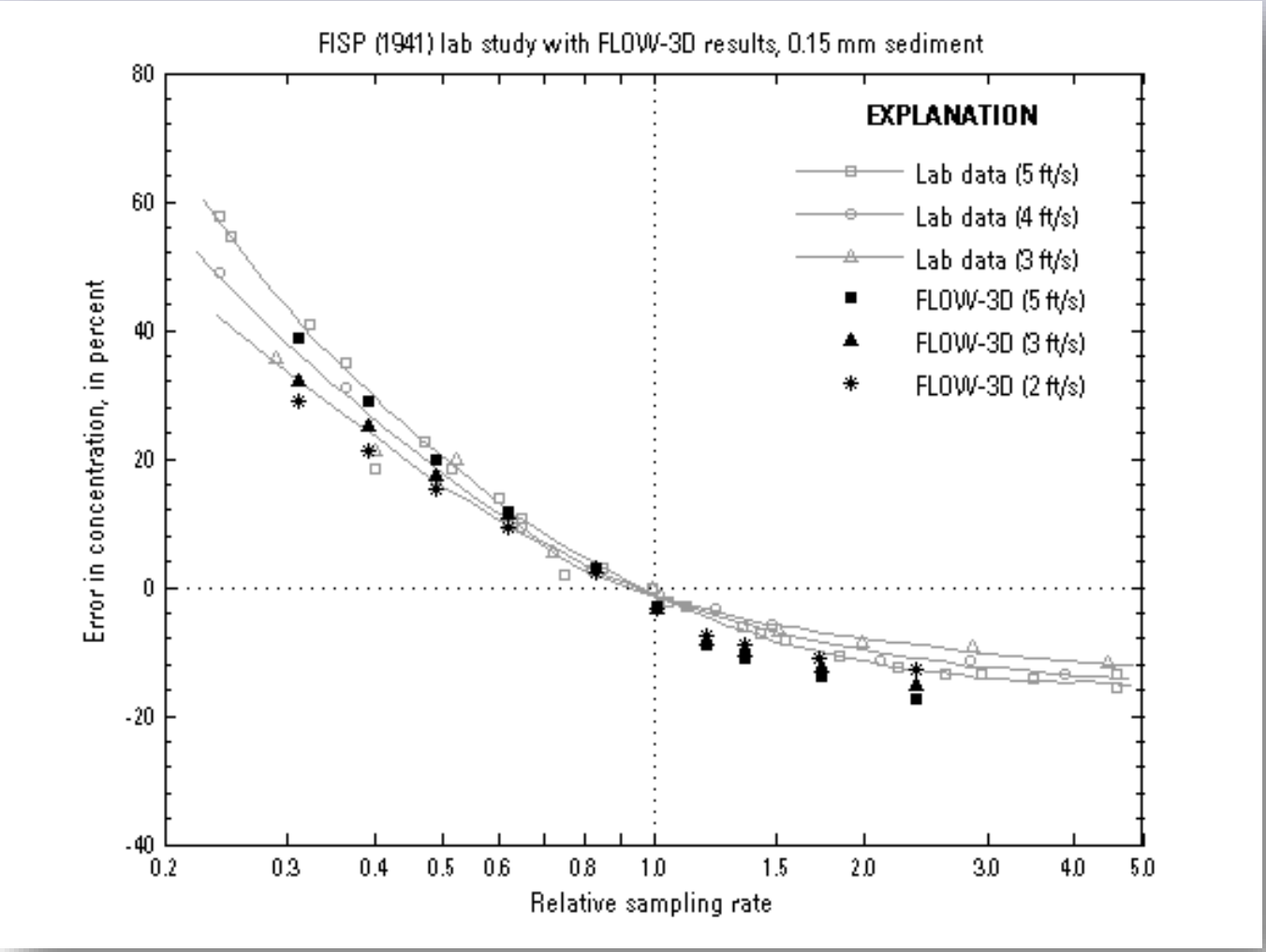
Errors in SSC for non-isokinetic sampling



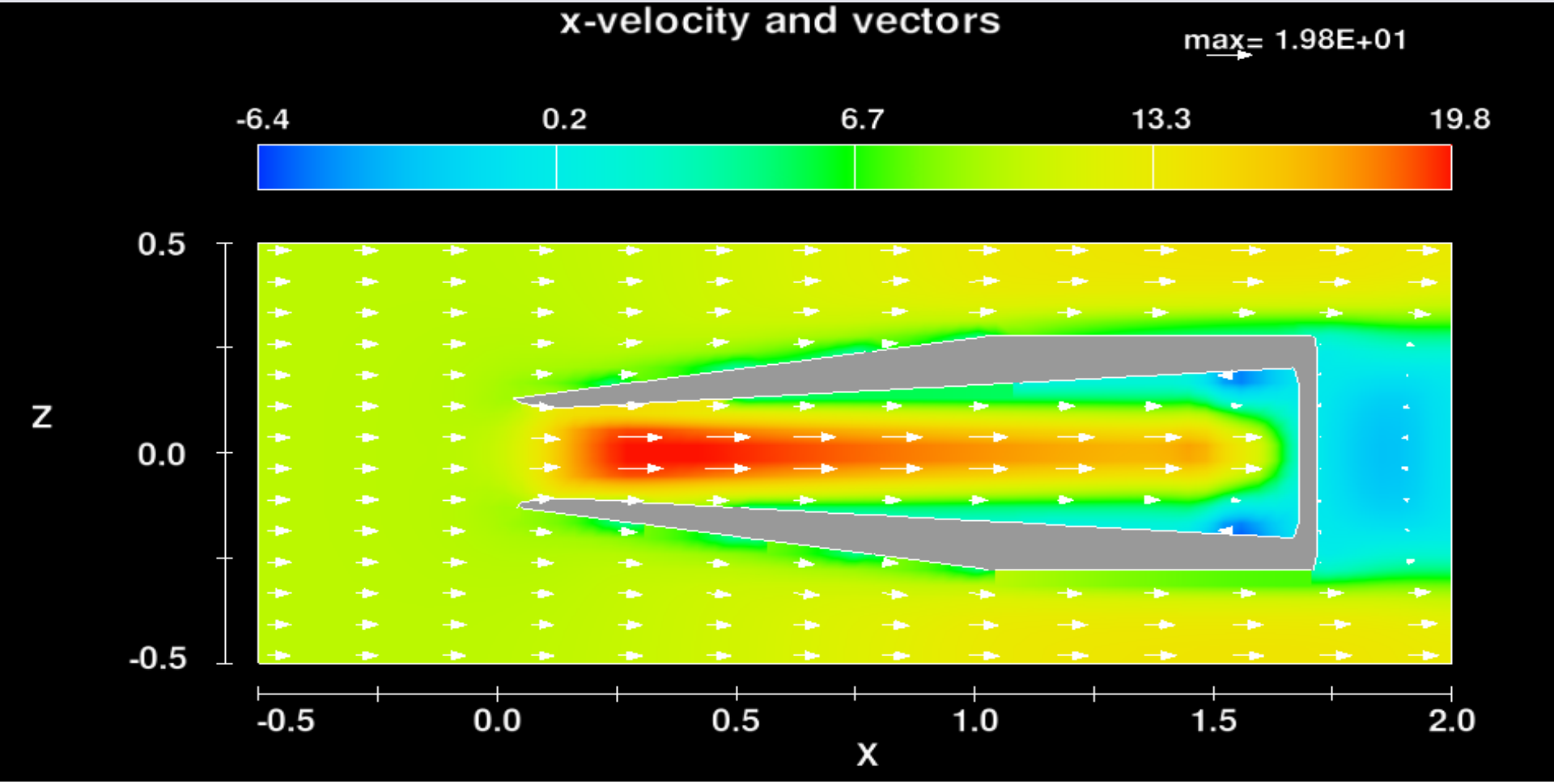
Errors in SSC for non-isokinetic sampling



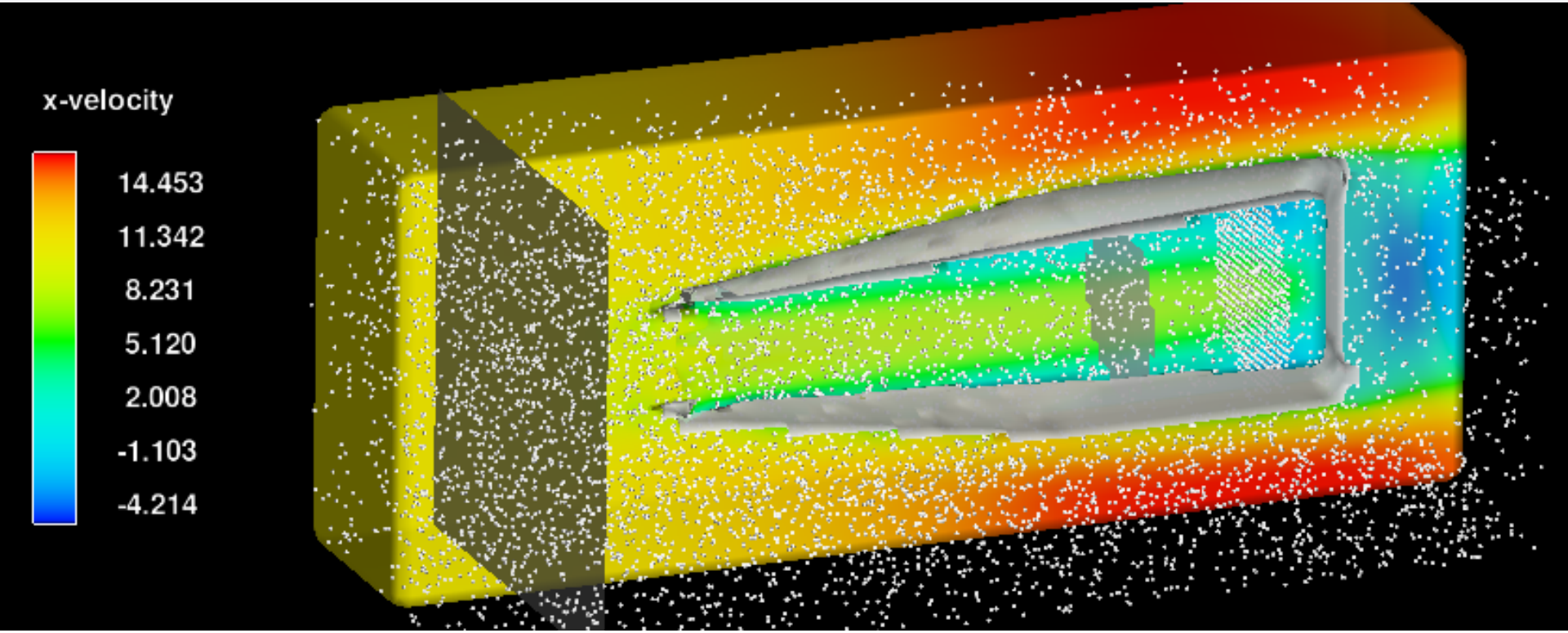
Errors in SSC for non-isokinetic sampling



FLOW-3D model



FLOW-3D model



2015 Proposed Simulations

A. Testing D-77 nozzle[1]

Sim. #	Intake Eff.	Velocity (ft/s)	Sediment size (mm)
1–8	0.4–1.7 (8 pts)	2	0.45
9–16	0.4–1.7 (8 pts)	5	0.45
17–24	0.4–1.7 (8 pts)	2	0.15
25–32	0.4–1.7 (8 pts)	5	0.15

[1]valve control (as in FY2014 simulations)

B. Testing D-77 nozzle[1]

Sim. #	Intake Eff.	Velocity (ft/s)	Sed. dist.*
33–40	0.4–1.7 (8 pts)	3	A
41–48	0.4–1.7 (8 pts)	3	B
49–56	0.4–1.7 (8 pts)	3	C

*sediment distributions will be selected in collaboration with the FISP

[1]valve control (as in FY2014 simulations)

2015 Proposed Simulations

	*Sediment distributions A, B, C			
	Particle size (mm)	**A: 25% fines**	**B: 50% fines**	**C: 75% fines**
fines	**0.01**	0.10	0.25	0.40
fines	**0.06**	0.15	0.25	0.35
sand	**0.15**	0.35	0.25	0.15
sand	**0.45**	0.40	0.25	0.10

2015 Proposed Simulations

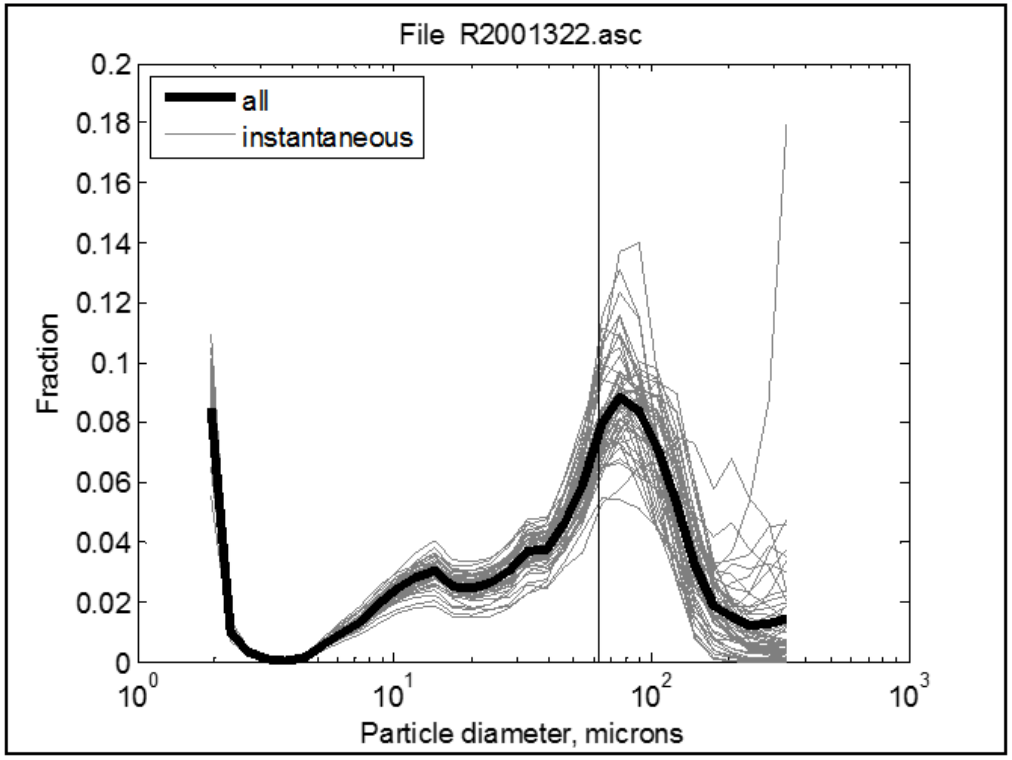


Fig. 4. LISST particle-size distribution for Puyallup River, 7/19/2011.

Particle size (mm)	Frac.
0.01	0.10
0.03	0.10
0.06	0.30
0.09	0.35
0.15	0.10
0.45	0.05

2015 Proposed Simulations

C. Testing natural fill conditions[2]

Sim. #	Depth (ft)	Velocity (ft/s)	Sed. dist.*
57–64	1–100 (8 pts)	3	A
65–68	10	2–5 (4 pts)	A
69–76	1–100 (8 pts)	3	B or C
77–80	10	2–5 (4 pts)	B or C

[2]pressure boundary (replaces valve control)

2015 Proposed Simulations

81–90	D. Simulations to investigate macro-turbulence and/or vertical velocity effects.

The simulations in Table D will investigate macro-turbulence and/or vertical velocity effects. The idea here is to create highly chaotic flow to see how well the sampler measures in those conditions by comparing the variability between repeat samples and simulations. In order to create this flow condition in the model, we may specify a synthetic inflow velocity or place obstructions in the flow to cause large secondary flow vectors.