DSS Component: The Hydraulic Model

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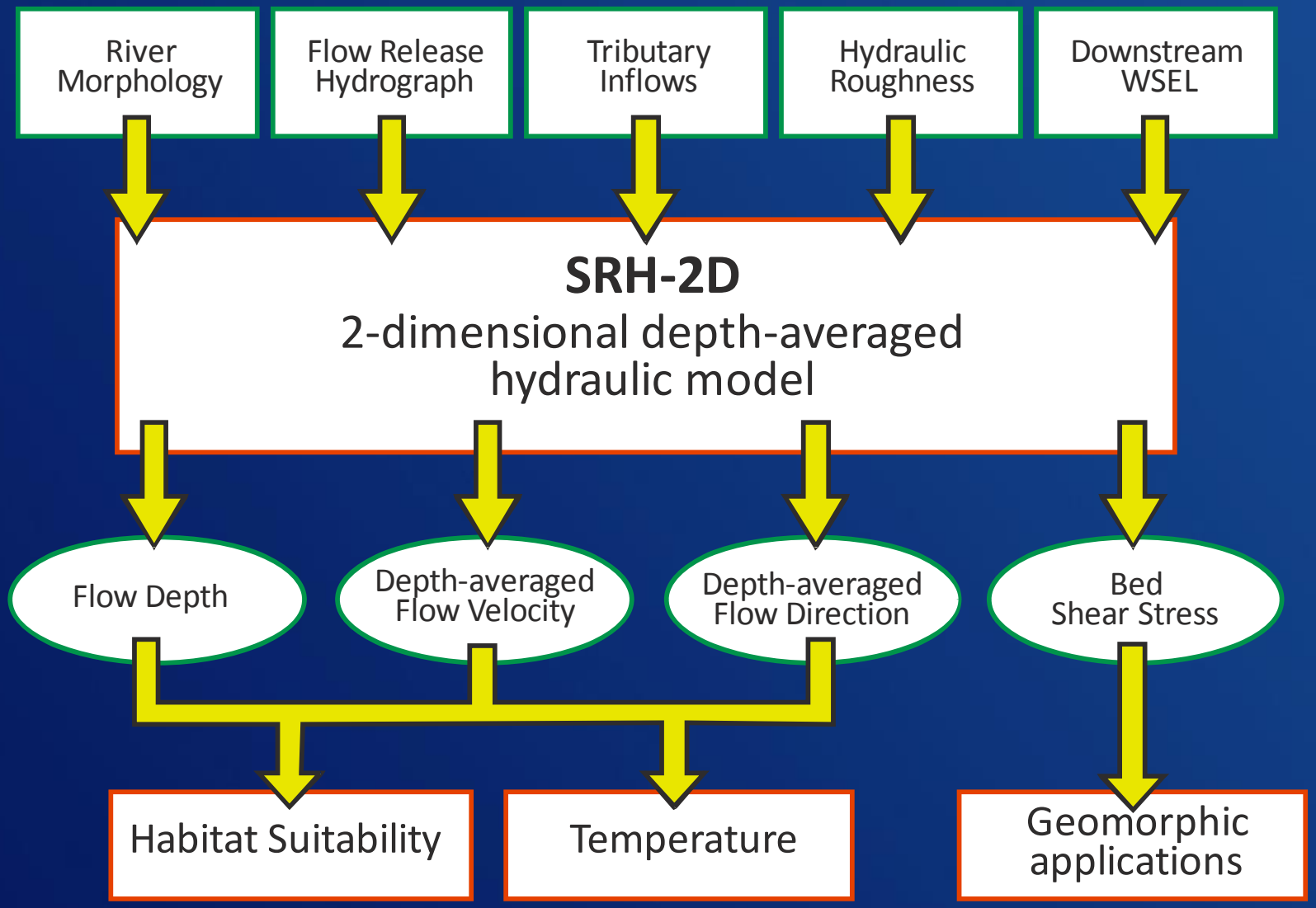
Inputs and Outputs



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Governing Equations
Depth-averaged Navier-Stokes equations

$$\frac{\partial h}{\partial t} + \frac{\partial hU}{\partial x} + \frac{\partial hV}{\partial y} = 0$$

$$\frac{\partial hU}{\partial t} + \frac{\partial hUU}{\partial x} + \frac{\partial hVU}{\partial y} = \frac{\partial hT_{xx}}{\partial x} + \frac{\partial hT_{xy}}{\partial y} - gh\frac{\partial z}{\partial x} - \frac{\tau_{bx}}{\rho}$$

$$\frac{\partial hV}{\partial t} + \frac{\partial hUV}{\partial x} + \frac{\partial hVV}{\partial y} = \frac{\partial hT_{xy}}{\partial x} + \frac{\partial hT_{yy}}{\partial y} - gh\frac{\partial z}{\partial y} - \frac{\tau_{by}}{\rho}$$

Governing Equations

Bed shear stress

$$(\tau_{bx}, \tau_{by}) = \rho U_*^2 \frac{(U,V)}{\sqrt{U^2+V^2}} = \rho C_f \sqrt{U^2+V^2}(U,V)$$

$$C_f = gn^2/h^{1/3}$$

Turbulence closure

$$T_{xx} = 2(\upsilon + \upsilon_t)\frac{\partial U}{\partial x}$$

$$T_{xy} = (\upsilon + \upsilon_t)\left(\frac{\partial U}{\partial y} + \frac{\partial V}{\partial x}\right)$$

$$T_{yy} = 2(\upsilon + \upsilon_t)\frac{\partial V}{\partial y}$$

$$\upsilon_t = C_t U_* h$$

$$C_t = 0.7$$

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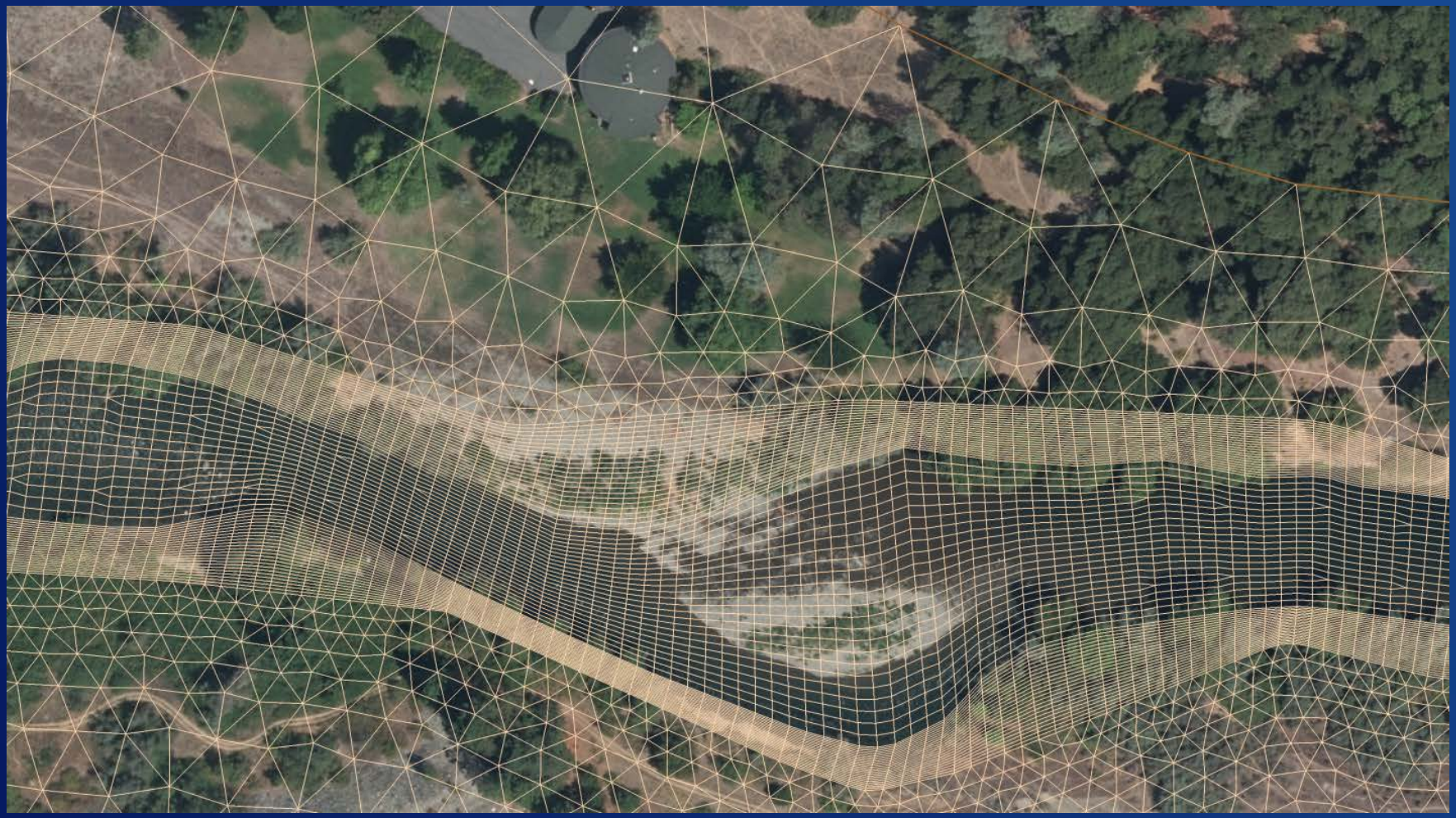
Finite Volume Numerical Solution on Unstructured Mesh



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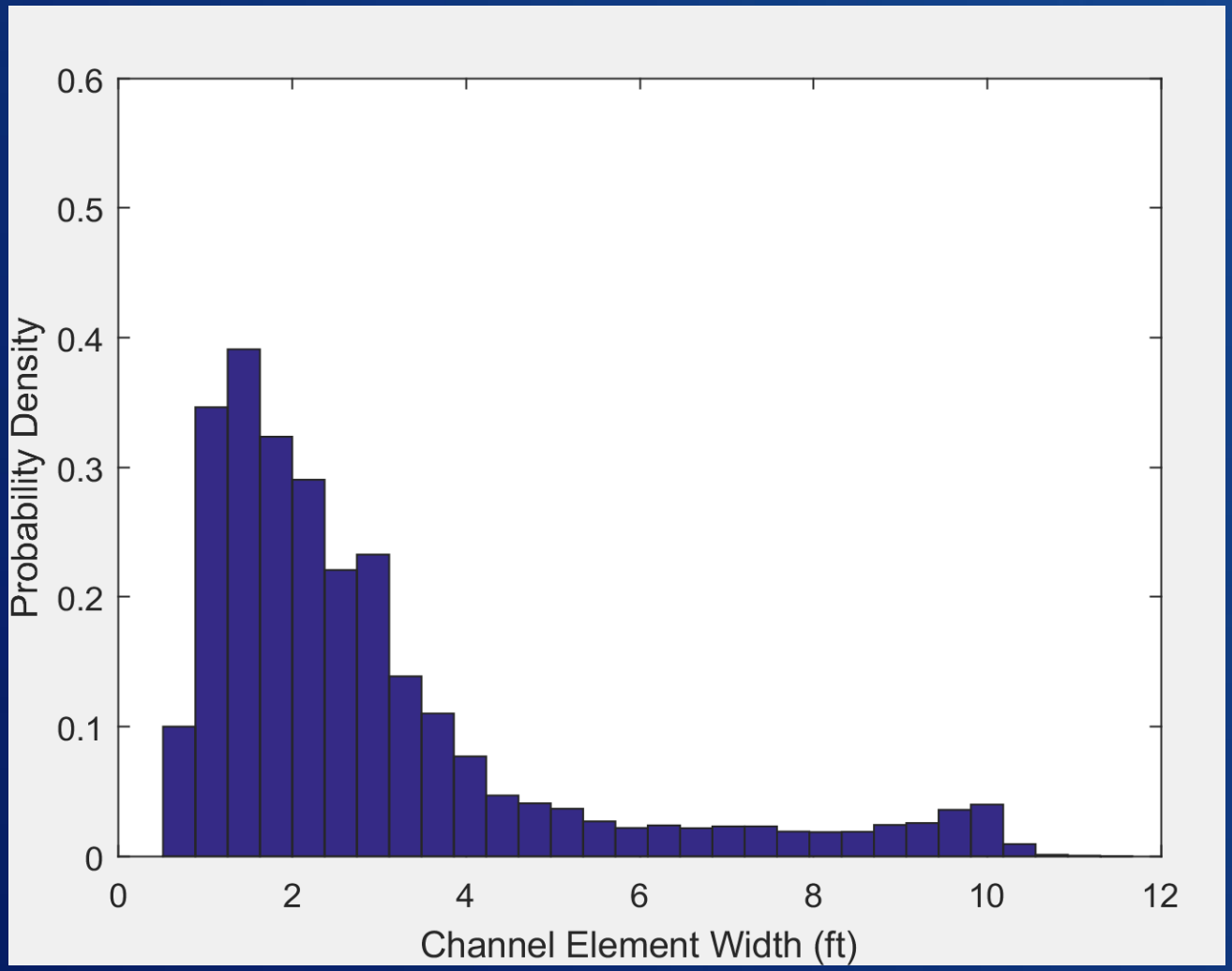
Mesh Element Size



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16 Dam Releases Simulated with Variable Tributary Accretions

Release from Lewiston (cfs)	
300	1750
450	2000
550	2500
700	5500
800	6000
950	8500
1100	11,000
1250	
1500	

Winter baseflow (300 cfs) simulated with a range of tributary discharge percentiles	
12.5th (dry)	62.5th (wet)
25.0th (dry)	75.0th (wet)
37.5th (dry)	87.5th (wet)
50.0th (normal)	

Summer baseflow (450 cfs) simulated with wet year (80th percentile) tributary input

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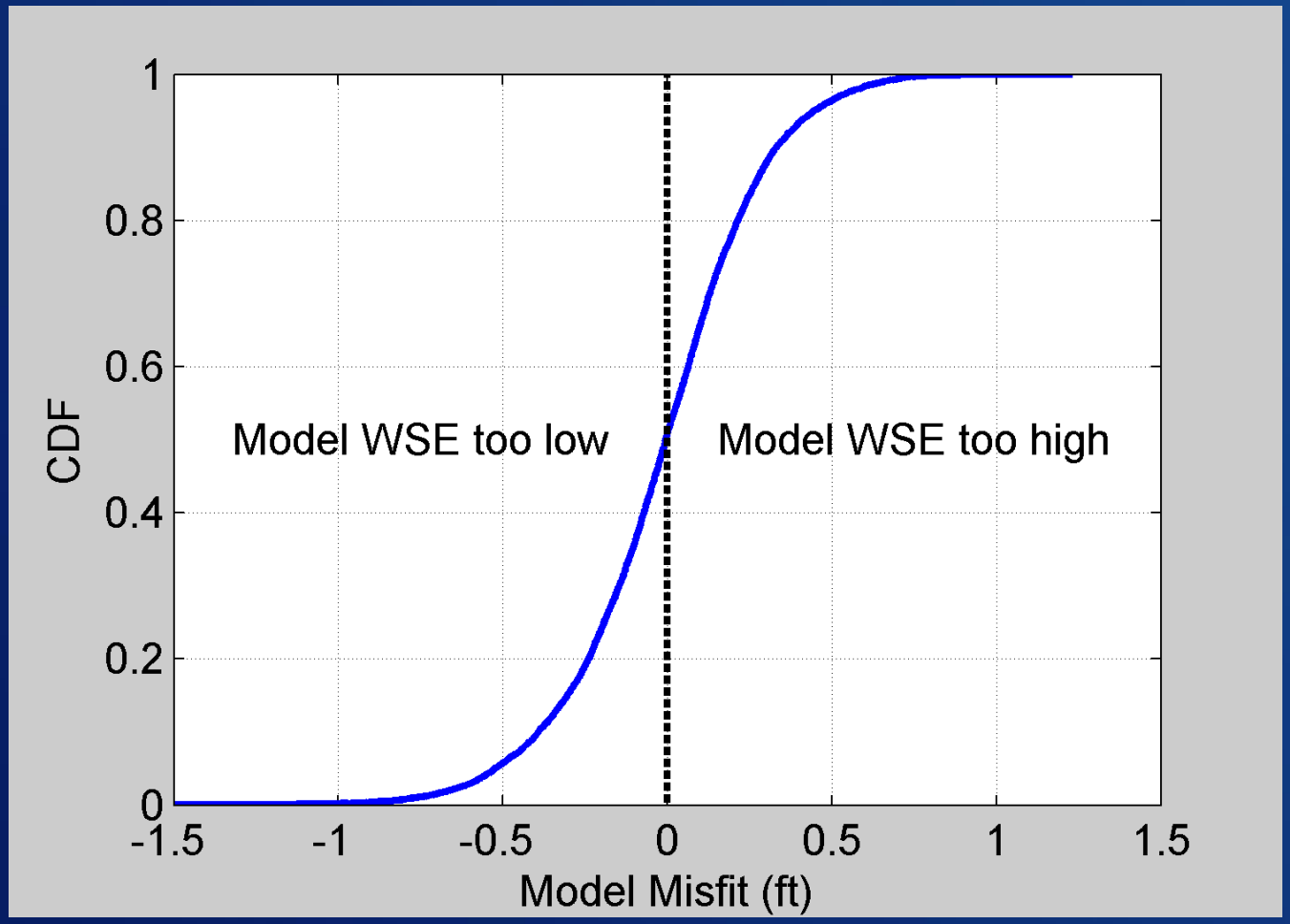
Modelled Water Surface Elevations Within 0.5 ft of measured



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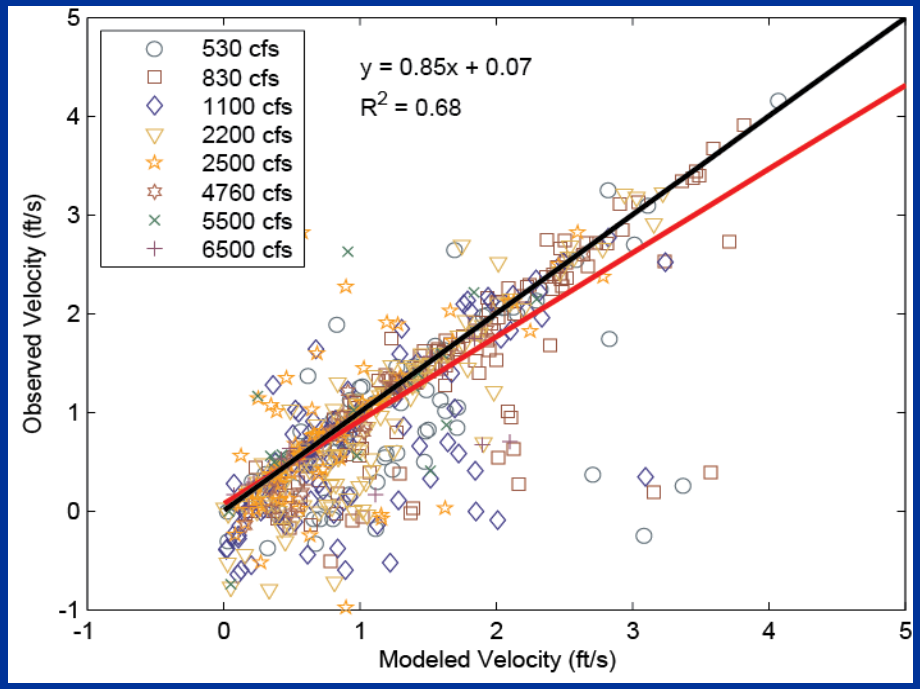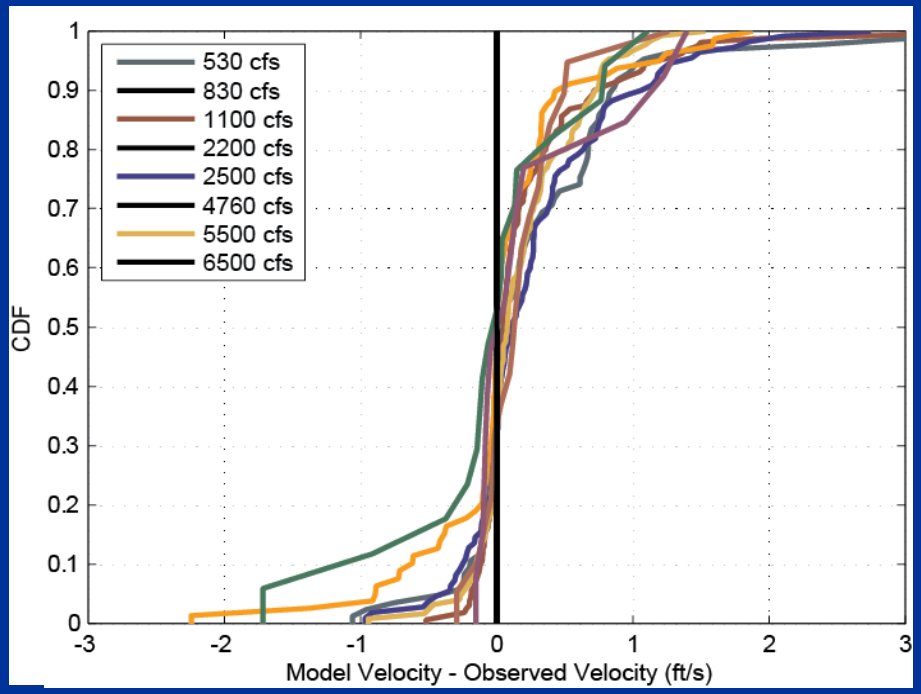
Modelled Flow Velocity Errors
Approx. 50% within 0.5 ft/s