



Model Uncertainty: Useful/Usable/Reliable Results

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CWEMF Modeling Protocols

- ▶ Sources of uncertainty
 - ▶ Inputs
 - ▶ Observational data
 - ▶ Forecast data
 - ▶ Model
 - ▶ Structure and Representation
 - ▶ Parameterization
 - ▶ Propagation in modeling frameworks
- ▶ Acceptable level of uncertainty is a function of **project objective**
- ▶ Today: total uncertainty

Protocols for Water and Environmental Modeling

November 19, 2021

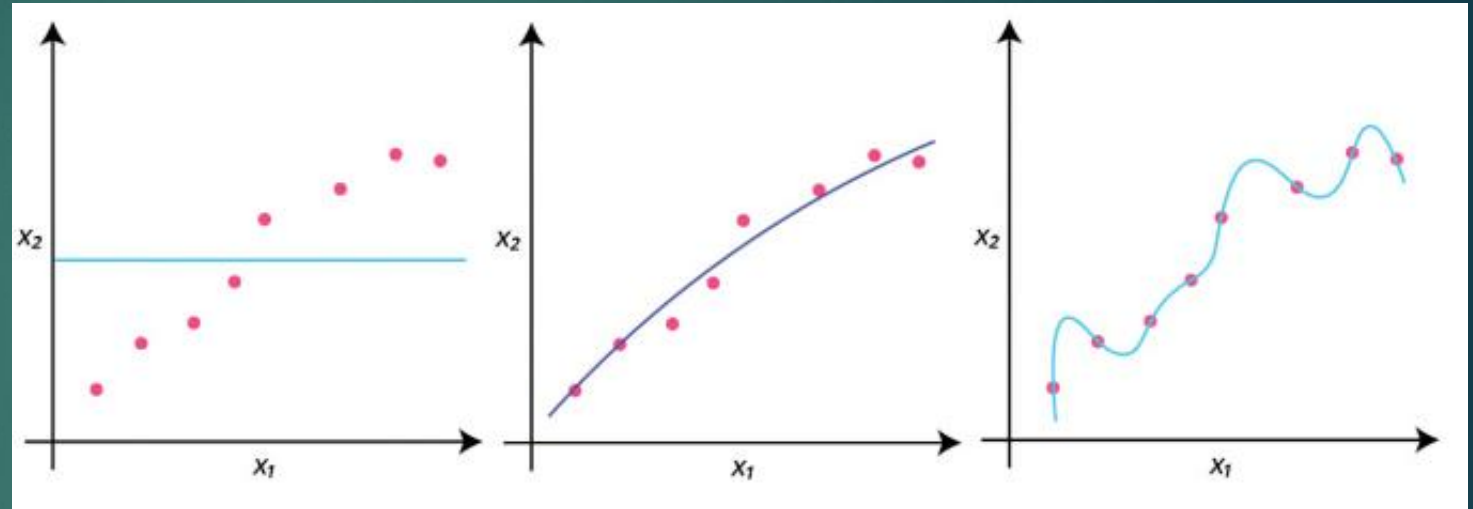


CWEMF

California Water & Environmental Modeling Forum

Matching Models to System Complexity

- ▶ Goal: Match model to system complexity
- ▶ Model fitting (**blue** line) to observed data (**red** points)
- ▶ Examples ->



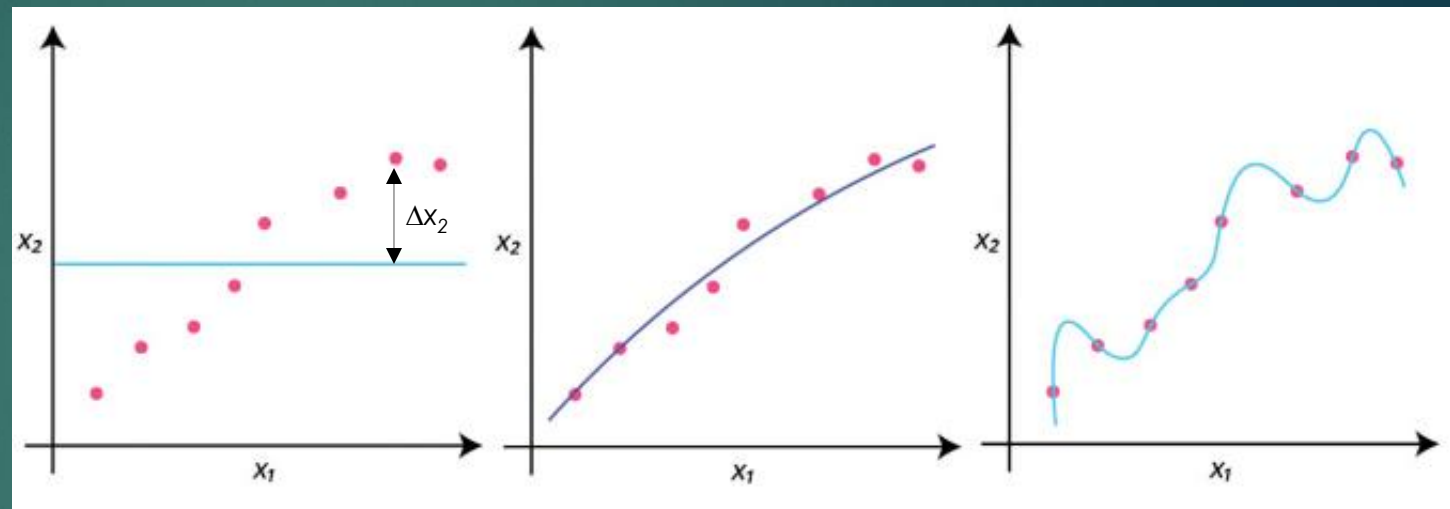
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(b) "good"
match

(c) Overfitting
(e.g., many model
coefficients)

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- ▶ **Example performance statistics**



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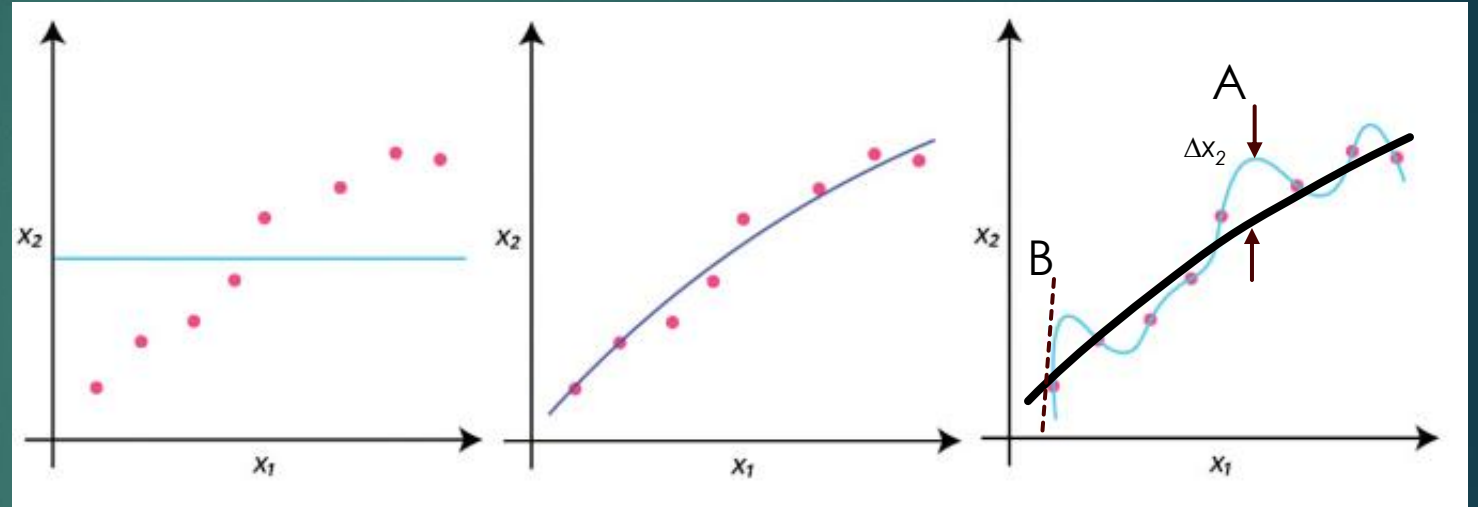
Mean Bias: 0.0
MAE: 2.5
RMSE: 4.8

Mean Bias: -0.1
MAE: 0.5
RMSE: 0.8

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Matching Models to System Complexity

- ▶ Goal: Match model to system complexity
- ▶ Model fitting (blue line) to observed data (red points)
- ▶ Examples ->
- ▶ Example performance statistics
 - ▶ Statistical (A)
 - ▶ System response (B)



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RMSE: 4.8

Mean Bias: 0.1
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Mean Bias: $\neq 0.0$ (?)
MAE: ≥ 0.0 (?)
RMSE: ≥ 0.0 (?)

Considerations

- ▶ Consider
 - ▶ **Modeling objective**
 - ▶ Available data and quality
 - ▶ Knowledge, experience, familiarity with system and model
 - ▶ Model structure and representations (right tool for the job)
 - ▶ Model performance
- ▶ Error is inherent in modeling
 - ▶ Not always as obvious as the examples
 - ▶ Too simple a model can lead to erroneous results
 - ▶ Overfitting can lead to erroneous results and false confidence
 - ▶ Q: Are results sufficient to support decision-making (i.e., objective)?
- ▶ Communicate uncertainty and appropriate model use to decision-makers