USGS
science for a changing world

SPARROW: A key step in the ongoing evolution of approaches to the analysis of surface-water quality data

Robert M. Hirsch
Associate Director for Water, USGS
October 29, 2002

Historical Stages

- Concentration: mean and variability
- Concentration trends
- Advanced methods for trend analysis
- Transport estimates
- Multisite analysis
- SPARROW
- Enhanced SPARROW

USGS

Statistical issues considered during this evolution

- Seasonality
- Variation due to flow
- Censored samples
- Non-normal distributions (non-parametric tests and log-transforms)
- Bias of regression estimates
- Serial and cross correlation
- Multi-site analysis

USGS

Concept of SPARROW

- **Water Quality = function of**
  (Geology, topography, soils;
  Climate, weather;
  Point & non-point sources;
  Transport & reaction)
- **Use empirical data, the watershed geometry & statistical methods to model this relationship**

USGS

SPARROW Concept - 2

- Transport at a node is the sum of contributions from all upstream watershed segments, with:
- Source-specific land-to-water delivery coefficients, and
- In-stream losses as a function of travel time and reach characteristics

USGS

Reasons for SPARROW

- Estimate conditions throughout the river network
- Identification of reaches of concern
- Estimate uncertainty
- Estimate flux throughout the river network - identify key source areas
- Estimate likely downstream impact of various control strategies

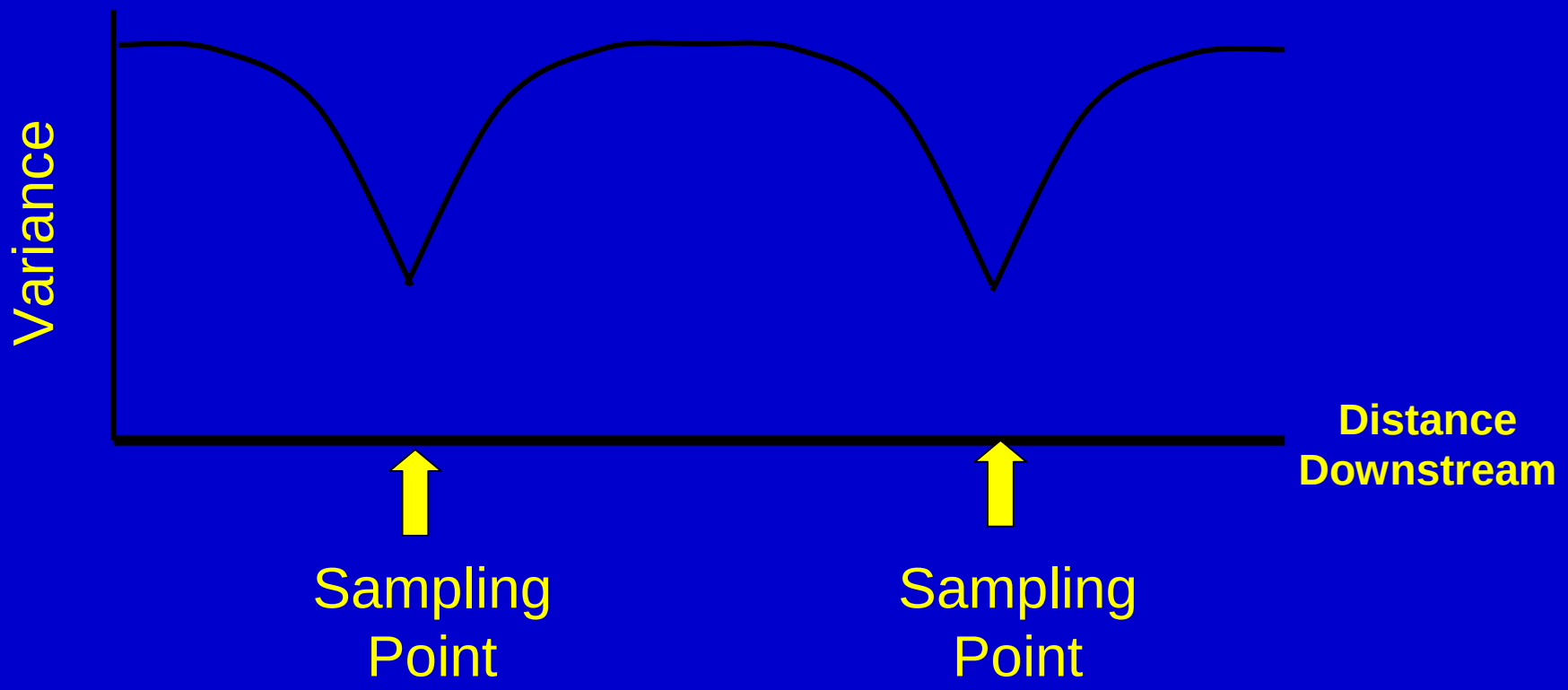
USGS

SPARROW and Uncertainty

- Combine point information with model estimates
- Feedback to sampling design
- How does it relate to 305b concept of river miles or river reaches assessed

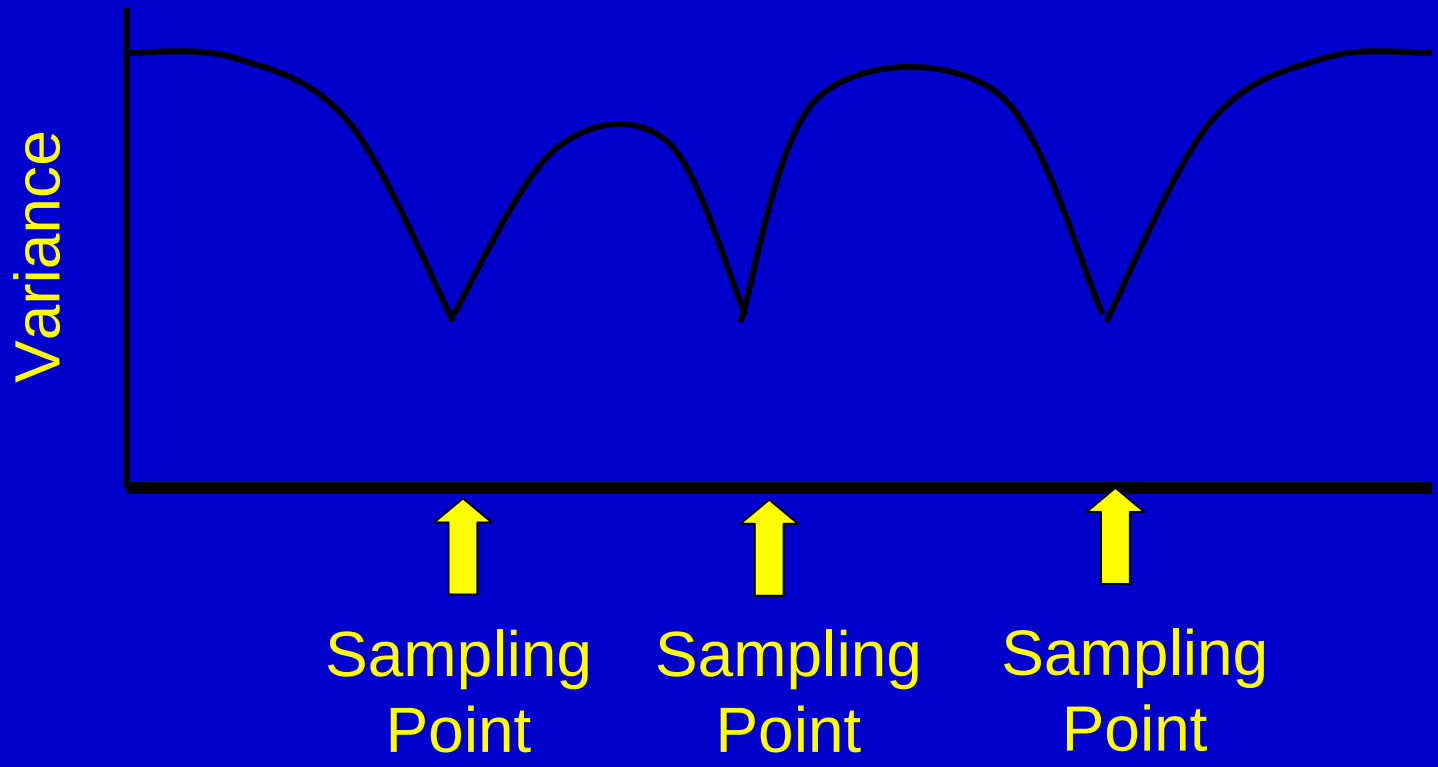
USGS

Variance of Estimates: Base case



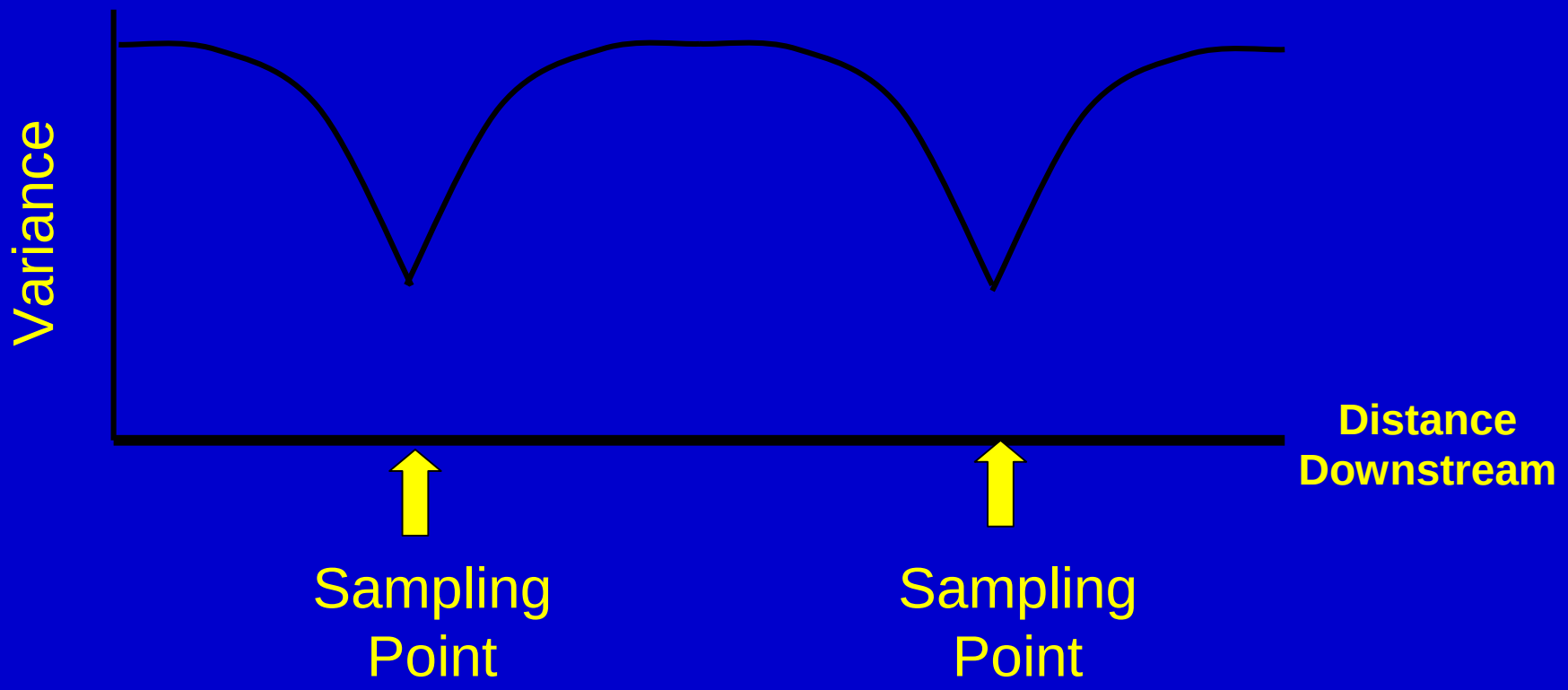
USGS

Variance of Estimates: Add a sampling point



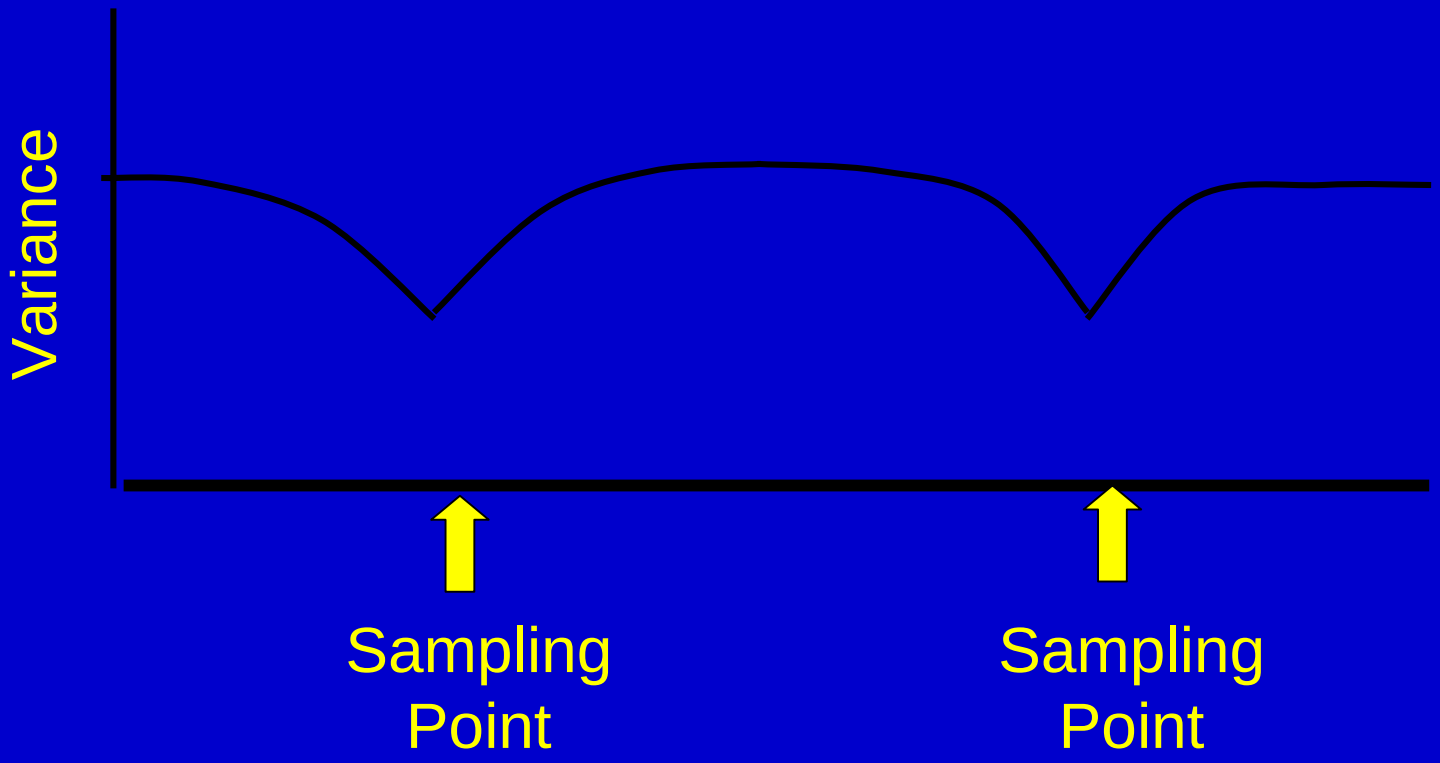
USGS

Variance of Estimates: Base case



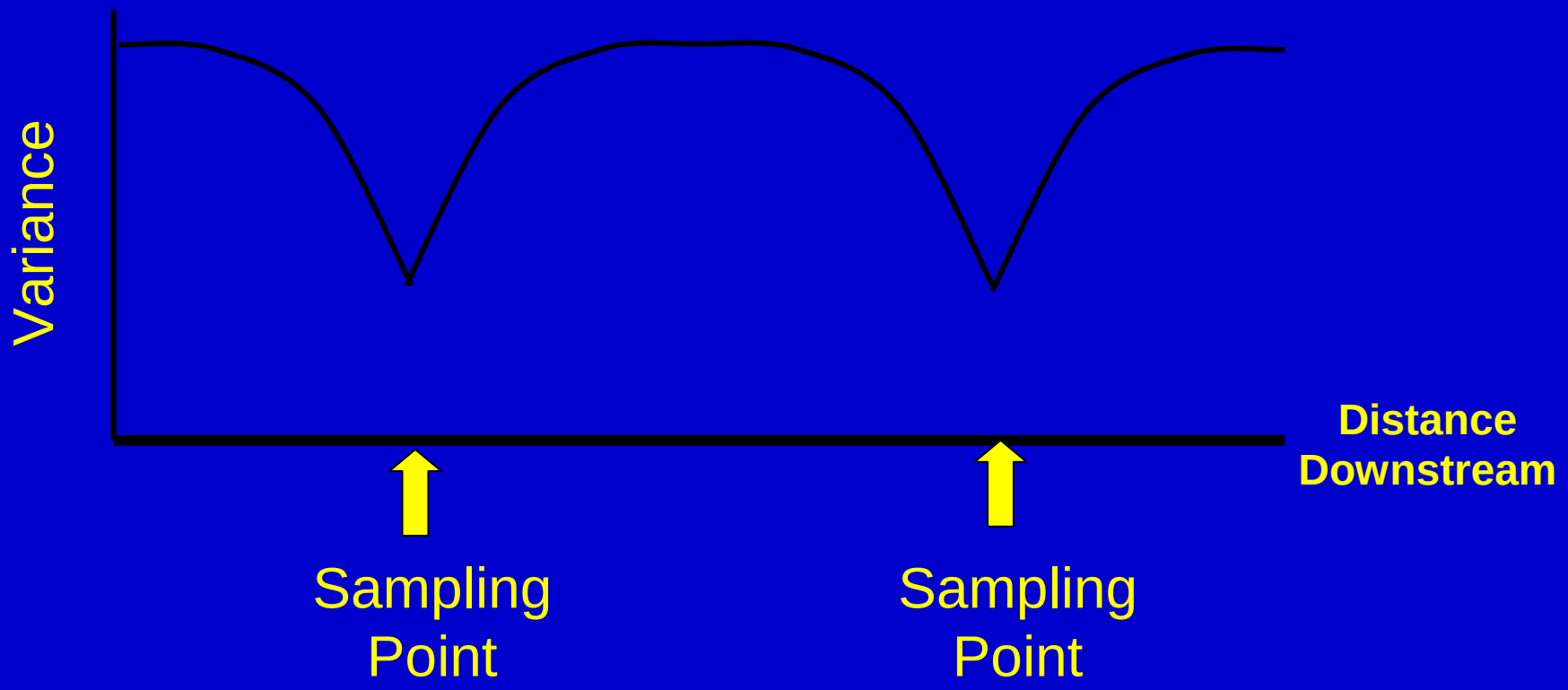
USGS

Variance of Estimates: Improve the SPARROW model



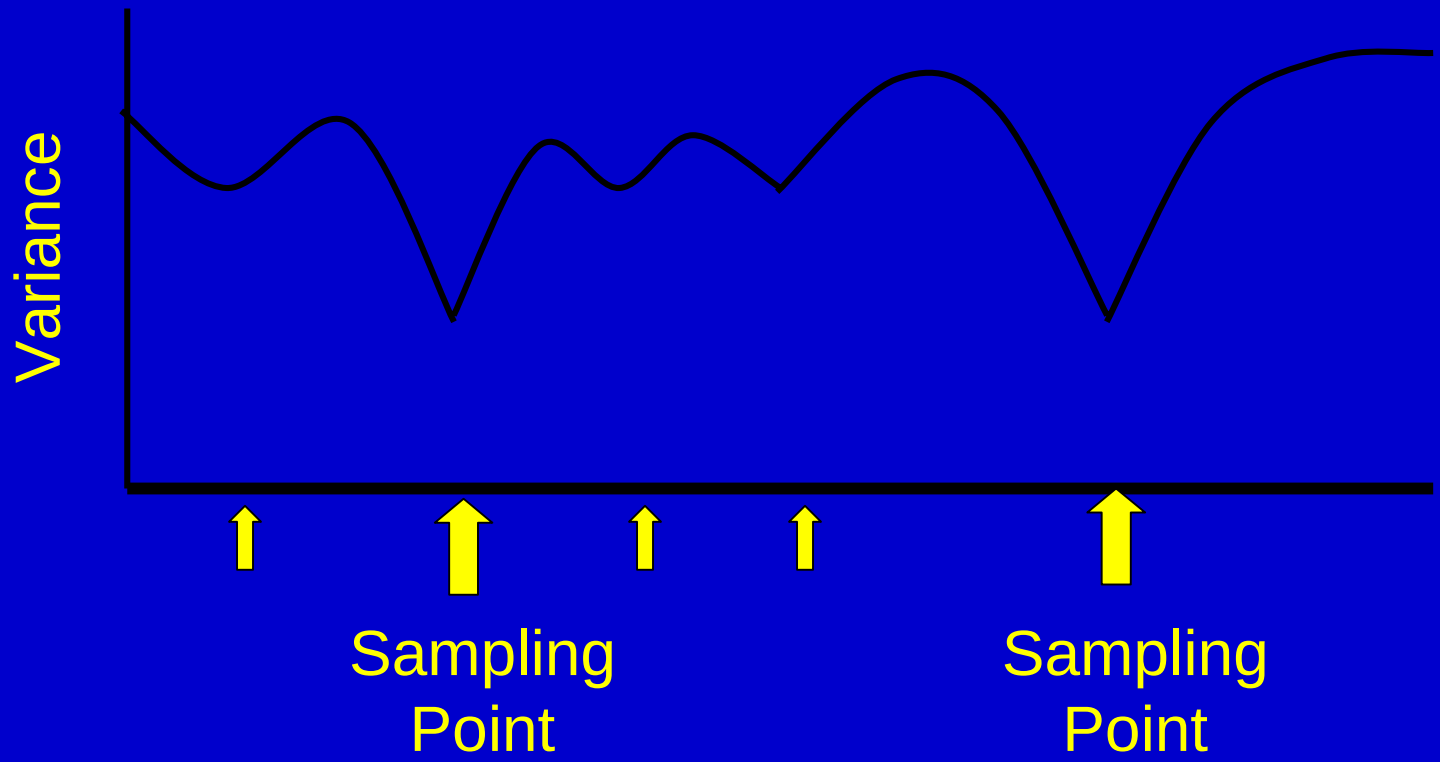
USGS

Variance of Estimates: Base case



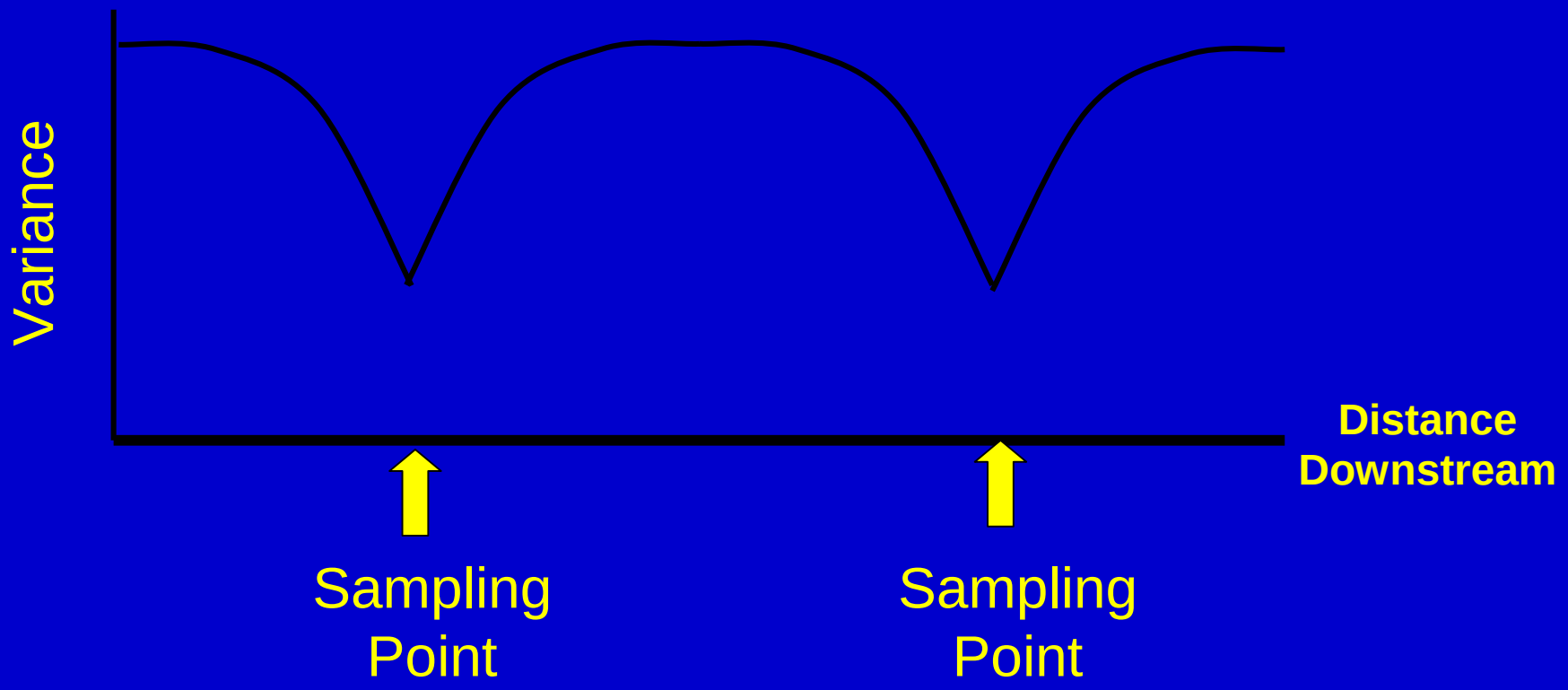
USGS

Variance of Estimates: add limited sampling at many points



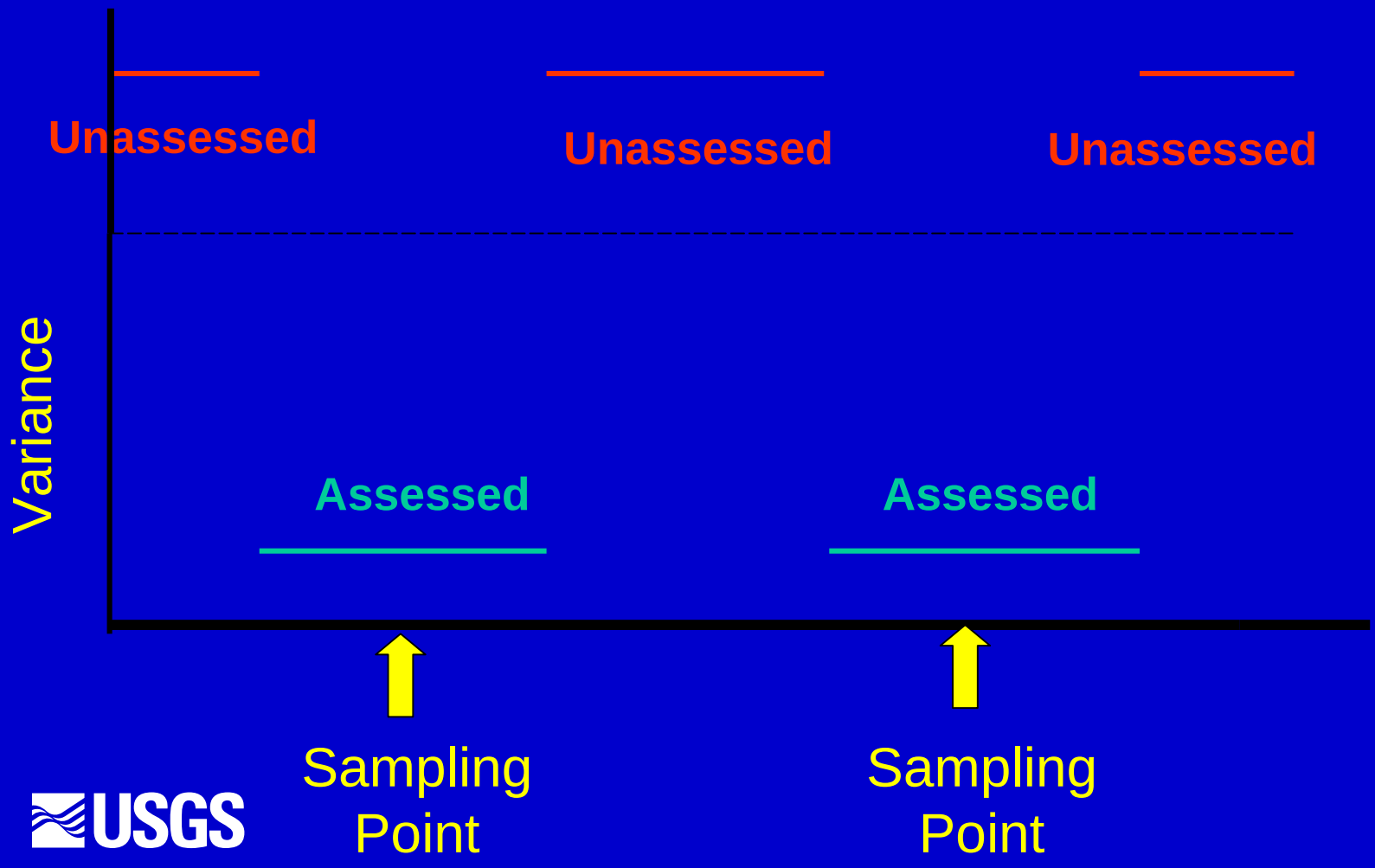
USGS

Variance of Estimates: Base case



USGS

Variance of Estimates: 305b Concept



The future of SPARROW

- Simplify ability to query the model
- More dynamic: decadal, seasonal, event; consideration of lag times
- More focus on uncertainty
- Interaction with water quality network design
- Empirical tests of its predictive ability for BMPs

USGS

SPARROW Evolution

Current Applications

- Coefficients are estimated from observed transport and source terms
- Data represent a "snapshot in time"

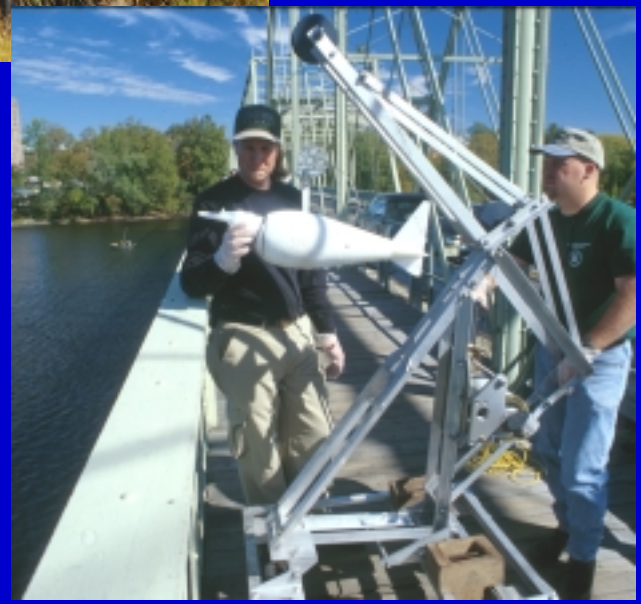
Trend Application

- Data are a sample over space & time
- Estimates of spatial extent of impaired waters over time
- More reliable predictions of outcomes of future management actions

USGS

Don't Forget: It can't happen without

- Good flow data
- Good water quality data
- High-resolution geospatial framework



USGS