# Data Collection and Sampling Patterns

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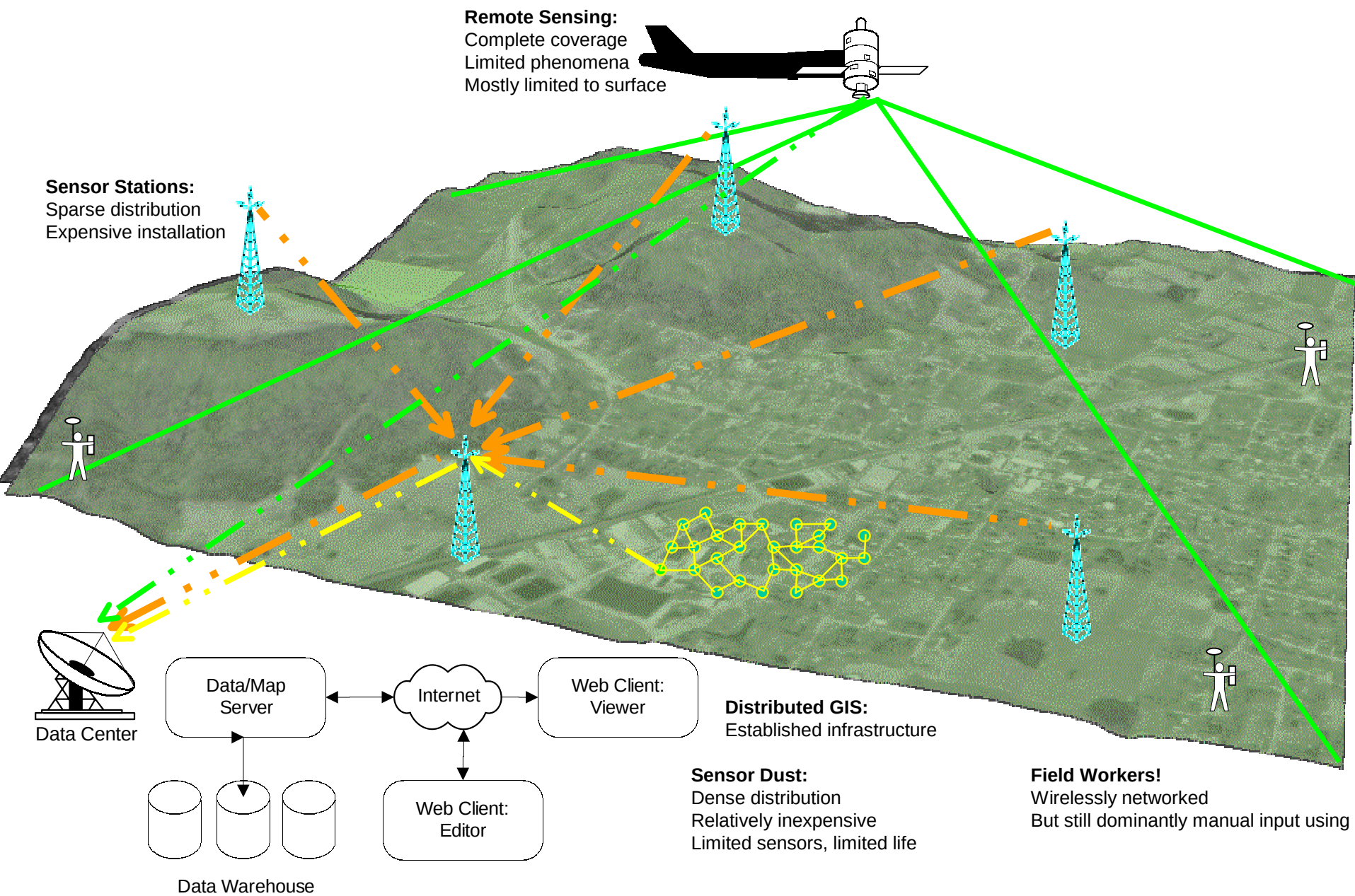
# *Environmental Data: What do we want to know?*

- Pattern
- Process
- Change

- Description
- Classification
- Monitoring

- Macro-scale
  - resource inventory
  - species census
  - system loading

- Micro-scale
  - boundary change
  - detect disturbances
  - local relationships




# The Sensor Web

# *The Paradox of Self-Evaluation*

- We can only ‘know’ the ecosystem by the sampling itself
- ‘Truthing’ limited by the very techniques we wish to test
- Paradox strength increases with system complexity

# *How To Assess Field Sampling Strategy?*

- Statistical design assumptions often violated in complex systems
- Field investigation difficult
  - Physical resource demand
  - System may be changing in time

- Which gives the best answer?
  - Three watches, all running slow

# *A Simulation Approach*

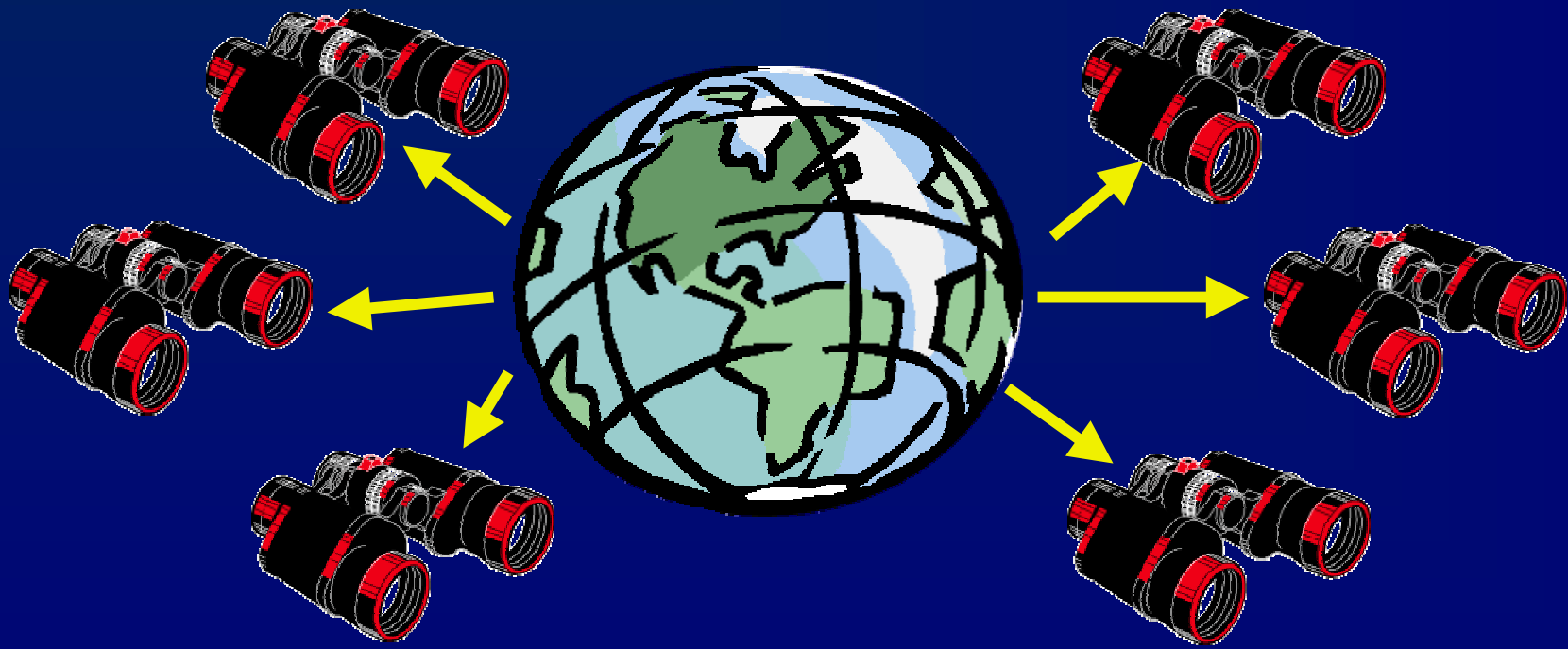
**Replace the real world...**

**… with a simulated world.**

- Ensure analogous behaviour to real system
- *ENTIRE* state is known at *ALL* times

# *Simulation Experiments*

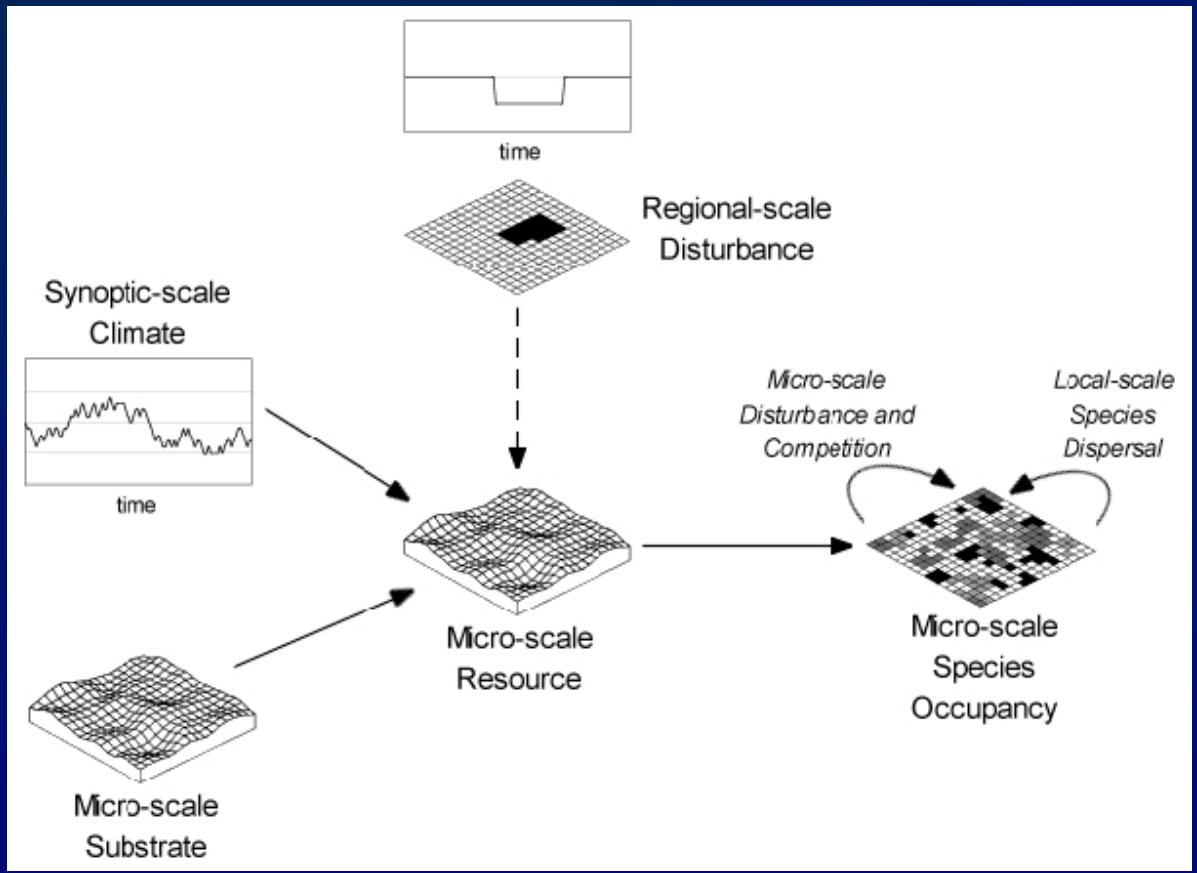
- Derive data from multiple sampling schemes
- Compare descriptions to actual system state
- Repeat for many random initial conditions



# *Some Experiments*

- **Problem Domain**
  - Resource Inventory
  - Species Census
  - Habitat Relationships
  - Disturbance Detection
  - Process Model Prediction
- **Sampling Strategy**
  - Measurement accuracy vs. spatial density
  - Random vs. uniform spatial pattern
  - Measurement vs. positional accuracy
  - Area (RS) vs. point (GPS) approach

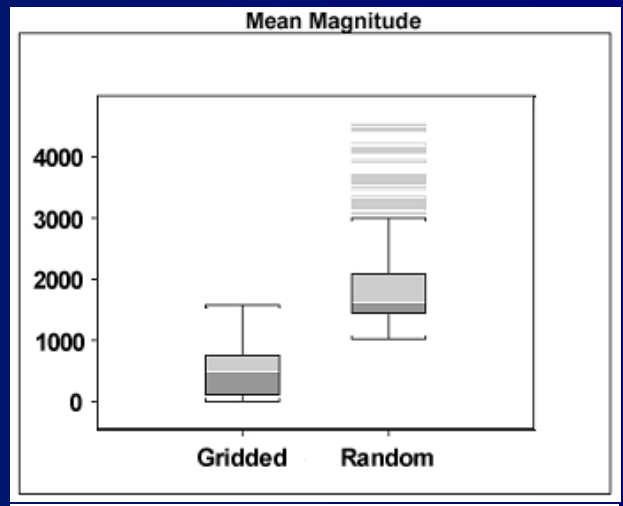
# *The Measurement Tradeoff: Density or Accuracy?*

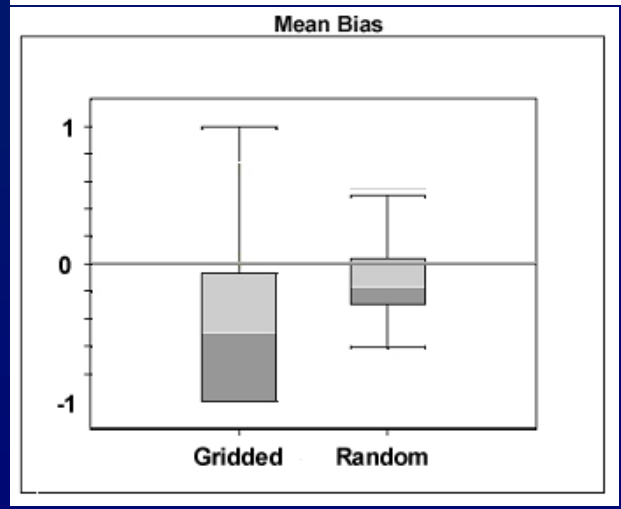



- Current
  - Resource Inventory
  - Species Census
- Future
  - Habitat Relationships
  - Disturbance Detection
  - RS Classification

# *Resource Inventory Effects*

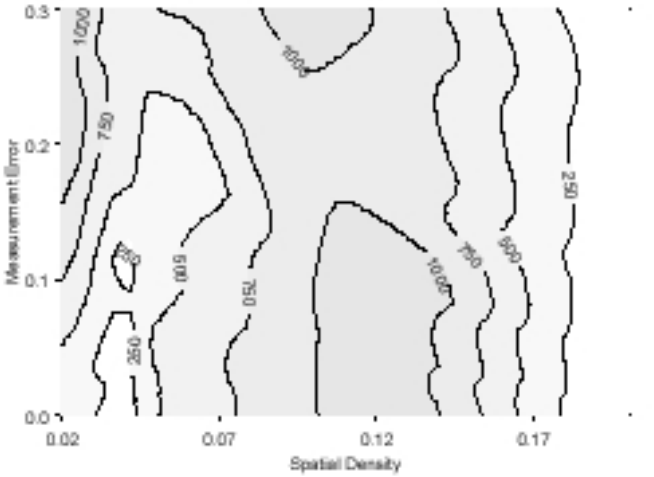
- Spatial pattern matters!
- What if you are wrong?
  - Error: trend identification
  - Bias: health and safety thresholds
- Spatial density has a major effect
- Measurement error has minimal effect



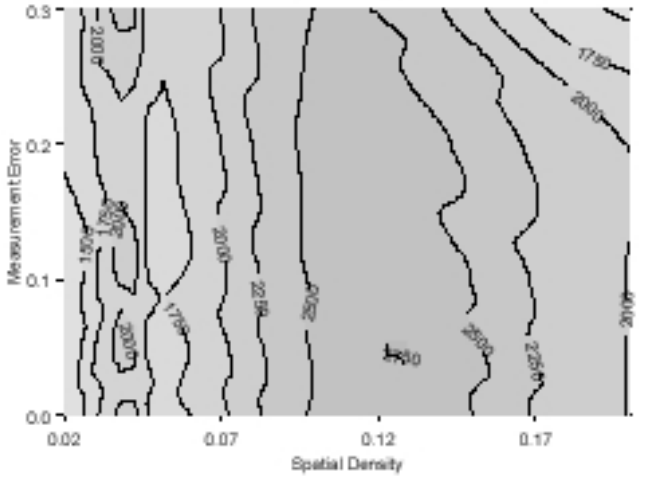



## Inventory - Mean Magnitude - Spatial Density vs. Measurement Error

### Gridded Pattern




### Random Pattern

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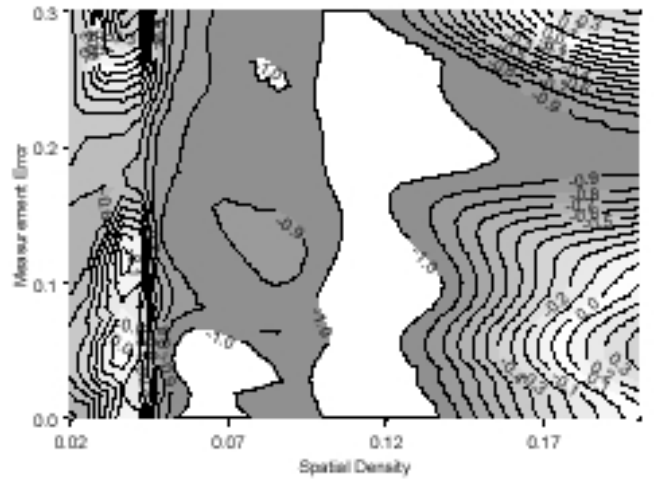


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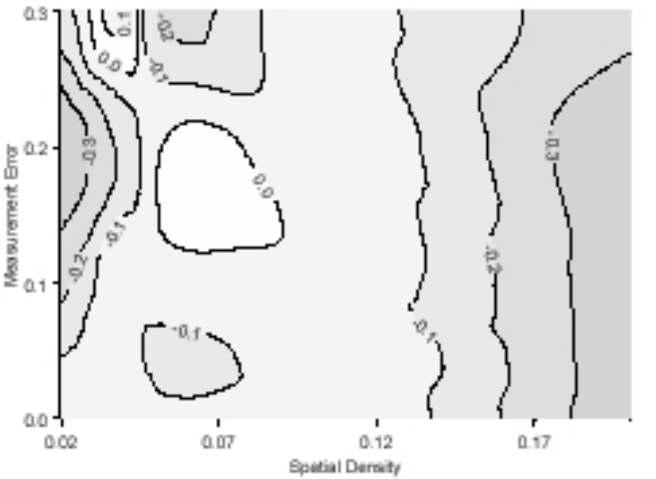
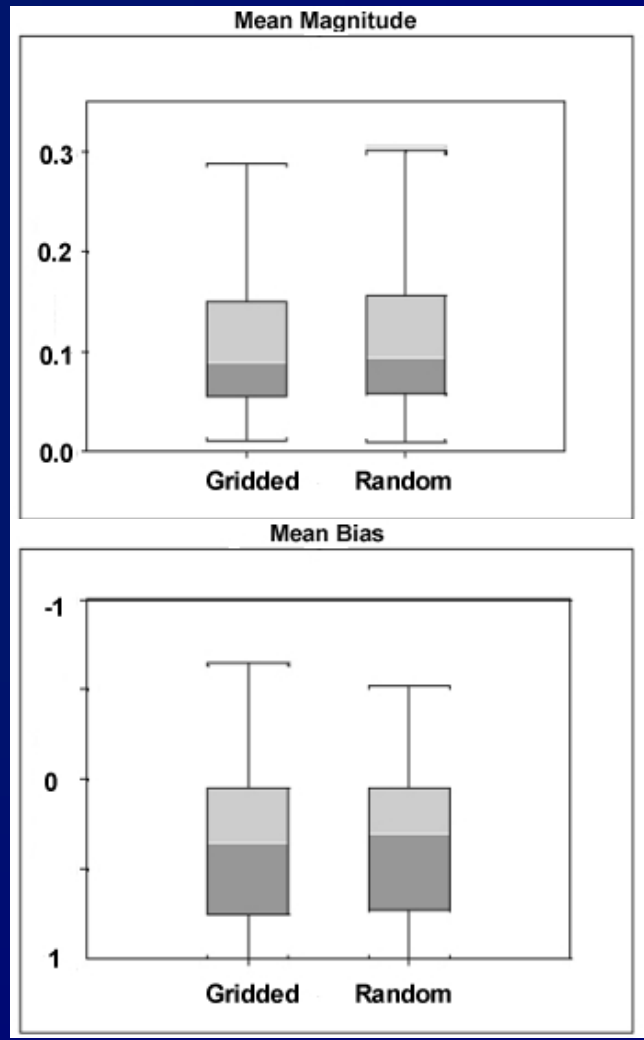
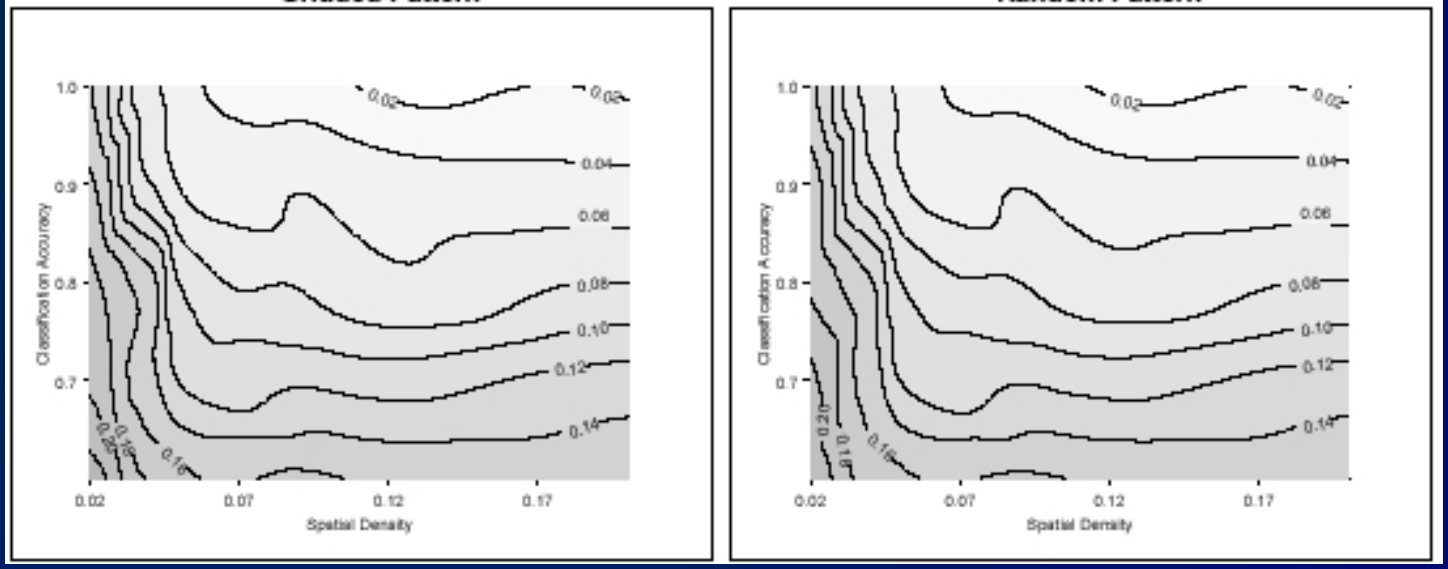


# *Species Census Effects*

- Spatial pattern does not matter!
- Strong species frequency dependence
- Spatial density has a major effect
- Classification accuracy has minor effect except for very dense samples



## Census - Mean Magnitude - Spatial Density vs. Classification Accuracy - Species 1

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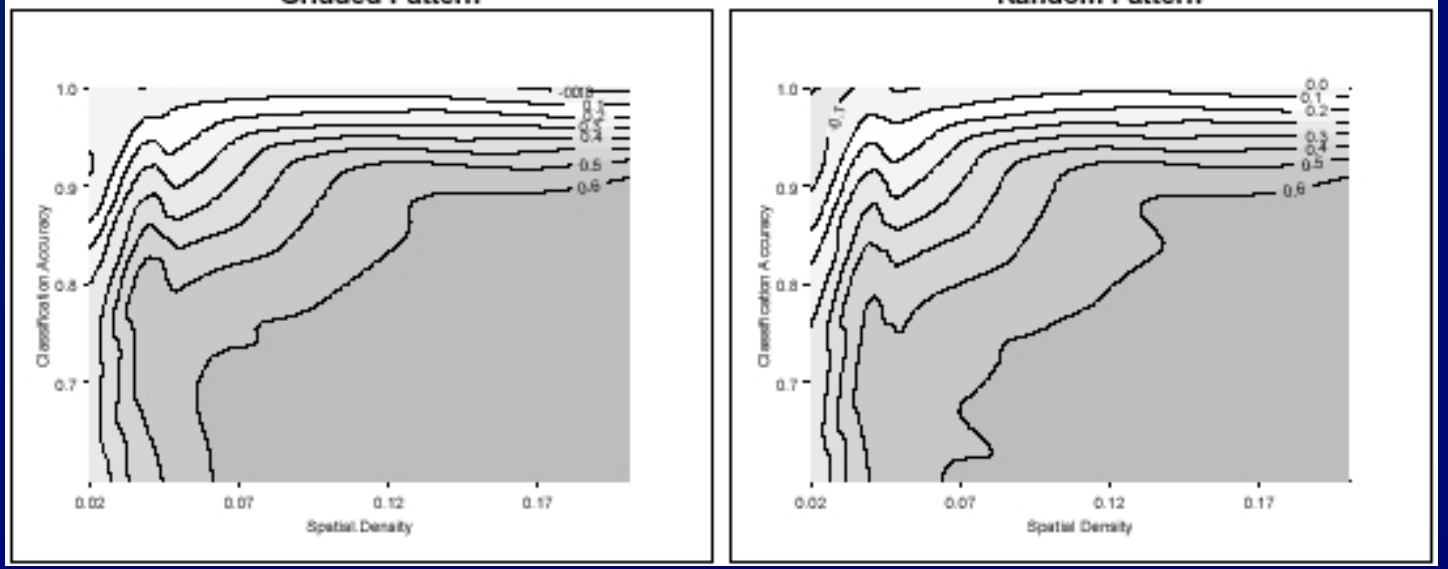
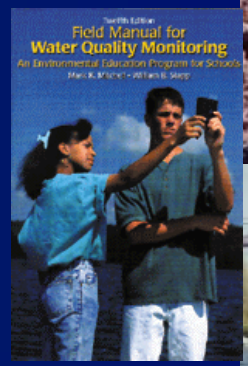


# *Take-Home Message: Data Strategy*

- Public participation
  - Christmas Bird Count
  - Grand River Water Quality Monitoring Program




- Data sharing & integration
  - Central service, cooperatives
  - ***Caution: appropriate use***
  - Metadata: sources, accuracy

# *Take-Home Message: Data Acquisition*

- General-purpose data sets are tricky but possible
  - What types of questions must be addressed?
  - Pattern – Process – Change
  - Macro-scale – Micro-scale
- Rapid and flexible collection
  - mobile computers, GPS, GIS
  - inexpensive, reliable sensors
  - multiple, co-operating units
  - data & metadata warehouses

***New technology CAN get better data - IF you're careful AND you know what you want to ask.***

***Thank you.***

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