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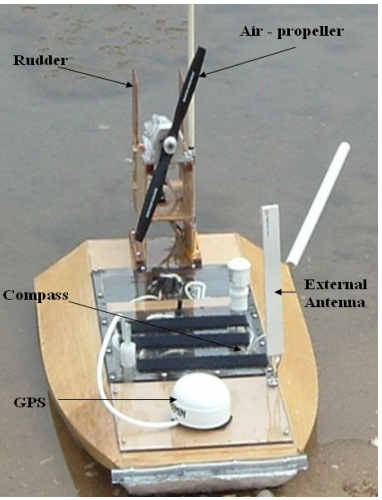
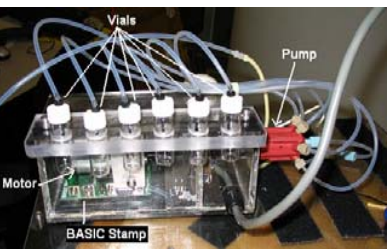
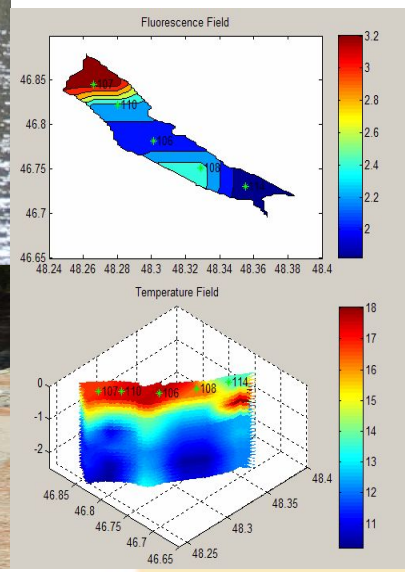
A Generic Multi-scale Modeling Framework for Reactive Observing Systems

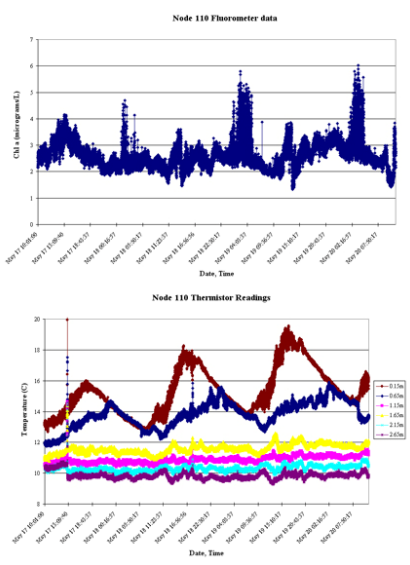
Focus on observing systems which are (a) *embedded* into environment, (b) include *stationary and mobile* sensors, and (c) *react* to collected observations by reconfiguring the system and adapting which observations to collect next.





Networked Aquatic Microbial Observing Systems (NAMOS)





10 Static floating buoys and a robot boat (deployment in Lake Fulmor CA)

Datasets: spatial patterns of chlorophyll and temperature and some unexpected fluctuations

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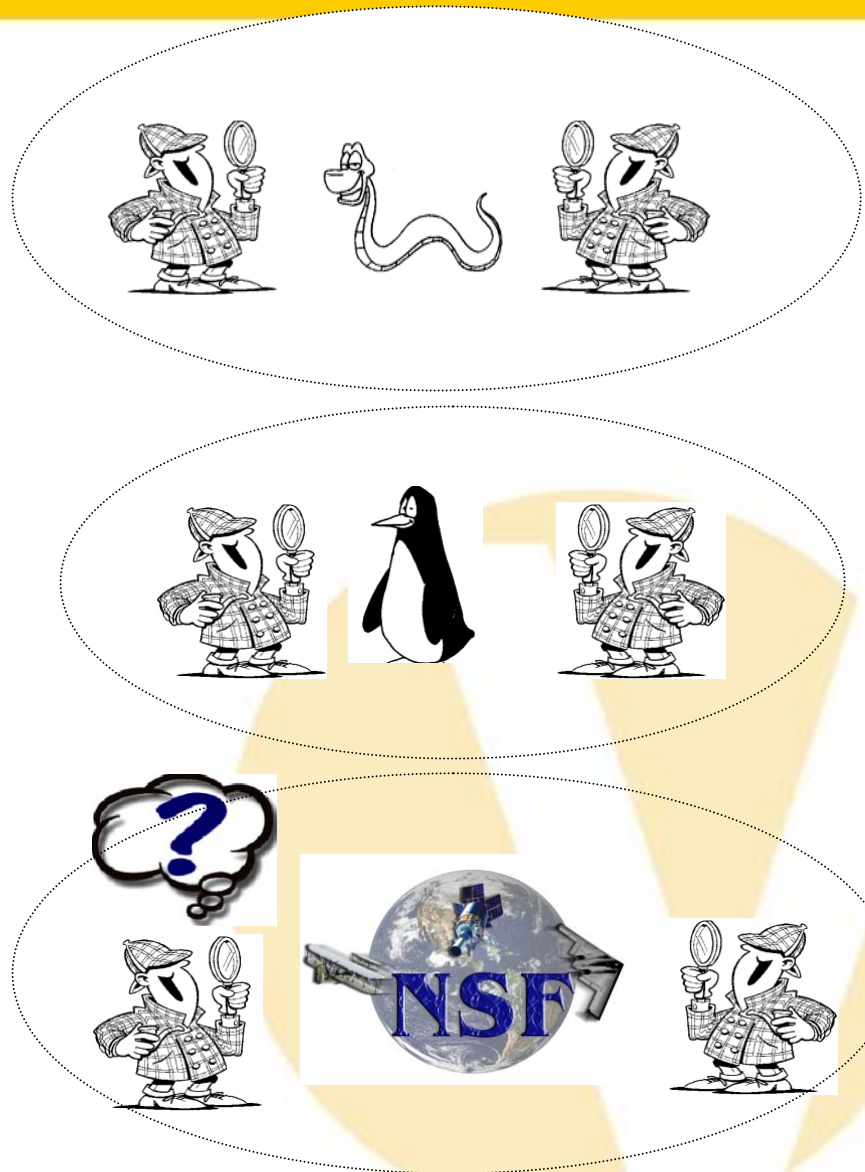
Similarity Tessellations

- **An example problem:**
  - Spatially "*tessellate*" the buoys into sets such that within each set, all buoys observe the "*same*" phenomenon
- **What is this useful for?**
  - Characterizing event(s) observed by the sensor network
  - Planing how to re-deploy sensing resources, or where to add redundancy
  - Detecting outliers (or faulty observations/sensors)



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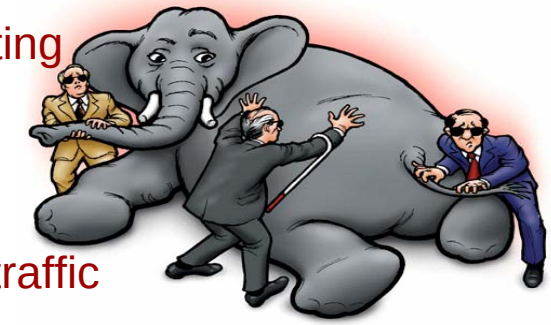
Challenges

- **Challenge- gathering information**
  - In the absence of a priori models/ signatures, detecting "similarity" is non-trivial
  - Individual sensors (buoys) may not be able to detect/characterize a phenomena
  - Infer concise models empirically to reduce network traffic
  - Our initial approach:
    - define similarity based on statistical models of sensed data where nodes exchange statistical models



- **Challenge- Adaptation**
  - Adapt spatial sampling density to achieve desired fidelity using available sensors
  - Adapt sampling frequency at individual sensors to utilize available bandwidth efficiently
- **Challenge- Tessellation**
  - Efficient distributed algorithm to compute the tessellation
  - Efficient distributed clustering of data into similarity groups

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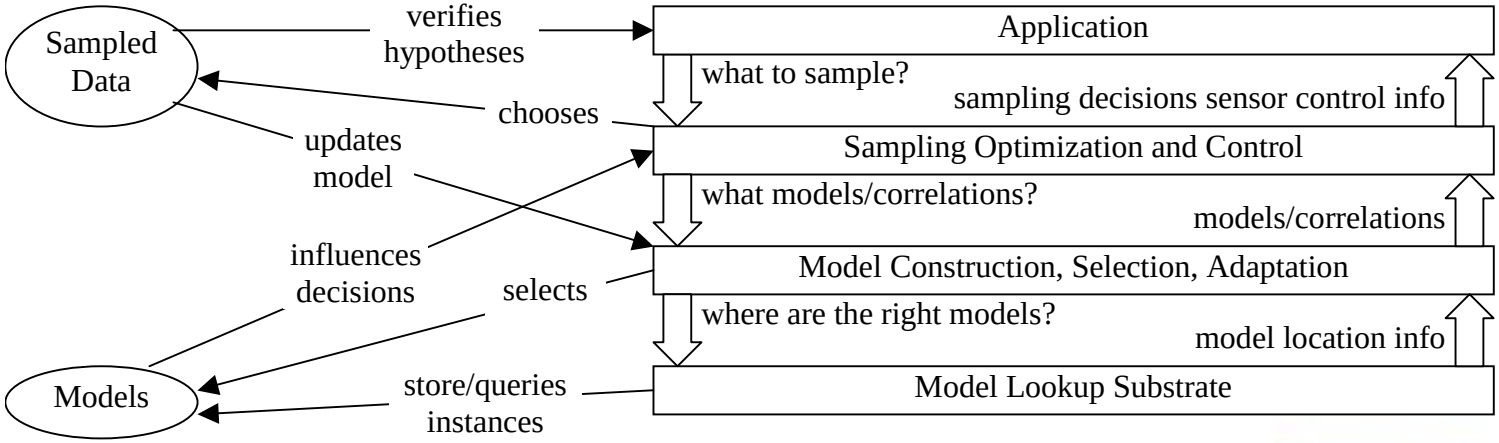
AMBROSia: Autonomous Model-Based Reactive Observing Systems



- **Main research thrusts:**
  - Model development and validation
  - Algorithms and system development for measurements optimization and control
  - Systems design and protocol development
- **Team:**
  - D. Caron (marine biology)
  - L. Golubchik (systems modeling & analysis)
  - R. Govindan (network routing & sensor networks)
  - D. Kempe (optimization algorithms)
  - G. Sukhatme (distributed robotics & mobile sensors)

- **Vision:**
  - AMBROSia will aid scientific research by facilitating observation, detection, and tracking of scientific phenomena that were previously only partially (or not at all) observable and/or understood.

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