# SAMSI
# Panel Discussion on Environmental/Ecological Models

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# **Goals**

- Review interesting research topics at the interface between environmental modelling and statistics or applied mathematics.

- Stimulate the discussion about topics to be attacked in working groups during this SAMSI program.

- Prepare the formation of working groups in the afternoon.

# Structure

- Short (!) introductory talks by Steve Sain and Ken Reckhow about their view of interesting problems.

- Summary of ideas and suggestions by Peter Reichert.

- Open discussion.

- Identification of groups for the discussion in the afternoon.

# Statistical/Applied Mathematical Problems (not exclusively) in Environmental Modeling

**A. Modeling**

1. How to identify the adequate model complexity (getting qualitatively correct trajectories)?

2. How much approximation error can we accept to gain efficiency?

3. Parameterization of physical processes.

4. Extend models to meaningful (e.g. relevant to decision makers) endpoints.

# Statistical/Applied Mathematical Problems (not exclusively) in Environmental Modeling

**B. Statistical inference**

1. Inferences of all parameters in a complex model vs. use of the model to identify relevant subsystems/submodels for inference and subsequent combination.

2. Use of heterogeneous information and information from different sources for statistical inference (data points, distributions, bounds, etc.).

3. How to address input and model structural errors? State estimation. Multi-model approaches. Use of mismatch between simulation and data to improve model structure.

4. Formulation of adequate likelihood functions (normality, correlation, sources of uncertainty, etc.)

# Statistical/Applied Mathematical Problems (not exclusively) in Environmental Modeling

**C. Computational Issues**

1. Global optimization (particularly if simulations are computationally expensive).

2. Improving the efficiency of MCMC algorithms, particularly for multi-modal posterior distributions (adaptive proposal distributions, function approximation).

3. Dealing with very high dimensional problems.

4. How to use new computing architectures (e.g. massively parallel machines).

# Statistical/Applied Mathematical Problems (not exclusively) in Environmental Modeling

**D. Conceptual Issues**

1. Adequacy of calculating pdfs in case of poor model structure (sets of pdfs?).

2. „Translating" pareto sets into uncertainty in multi criteria optimization.

3. How to deal with multiple time/space scales?

4. Environmental decision support.

5. Reduction of uncertainty (experimental design, use of all available information).

# Options for Working Groups

**Working groups**:

- Dealing with statistical/applied mathematical problems in an application field (in environmental modelling).

- Descriptions/tasks are preliminary; they can/should evolve during the year.

- Need of interest by SAMSI postdocs, graduate students, other local persons.

- Need of a local leader (weekly meetings at SAMSI).

- External members can join through phone-/video-conferencing, email, stays at SAMSI, participation at workshops.

# Options for Working Groups

**Climate Modeling**:

Subscale process parameterization, experiment design, model structure, statistical assumptions (e.g. normality).

**Terrestrial Models:**

Effect of global climate (GCM) through regional weather on the (terrestrial) biosphere.

**Hydrological Modeling:**

How to deal with input and model structural error? Try to identify adequate mechanistic/statistic descriptions.

**Water Quality Modeling:**

Uncertainty in catchment-scale water quality models.

**Environmental Decision Support:**

Elicitation of knowledge, simplified decision-oriented models.