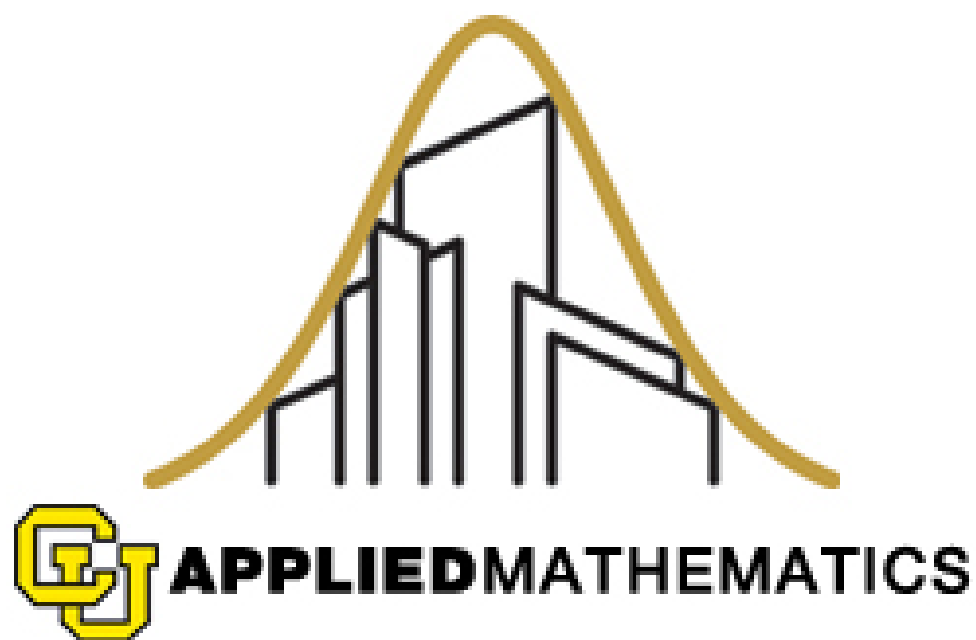# Applied Mathematics Mathematical Biology

PI: D.M. Bortz

Research Overview

Our group studies problems at the intersection of applied mathematics and mathematical biology, with an awareness of the intrinsic statistical issues. The specific applications are typically motivated by questions of biological, environmental, and medical significance.

- http://mathbio.colorado.edu

Model Selection

For systems with unknown/unidentified phenomena, selection criteria can help identify the mathematical and statistical models which best describe data.
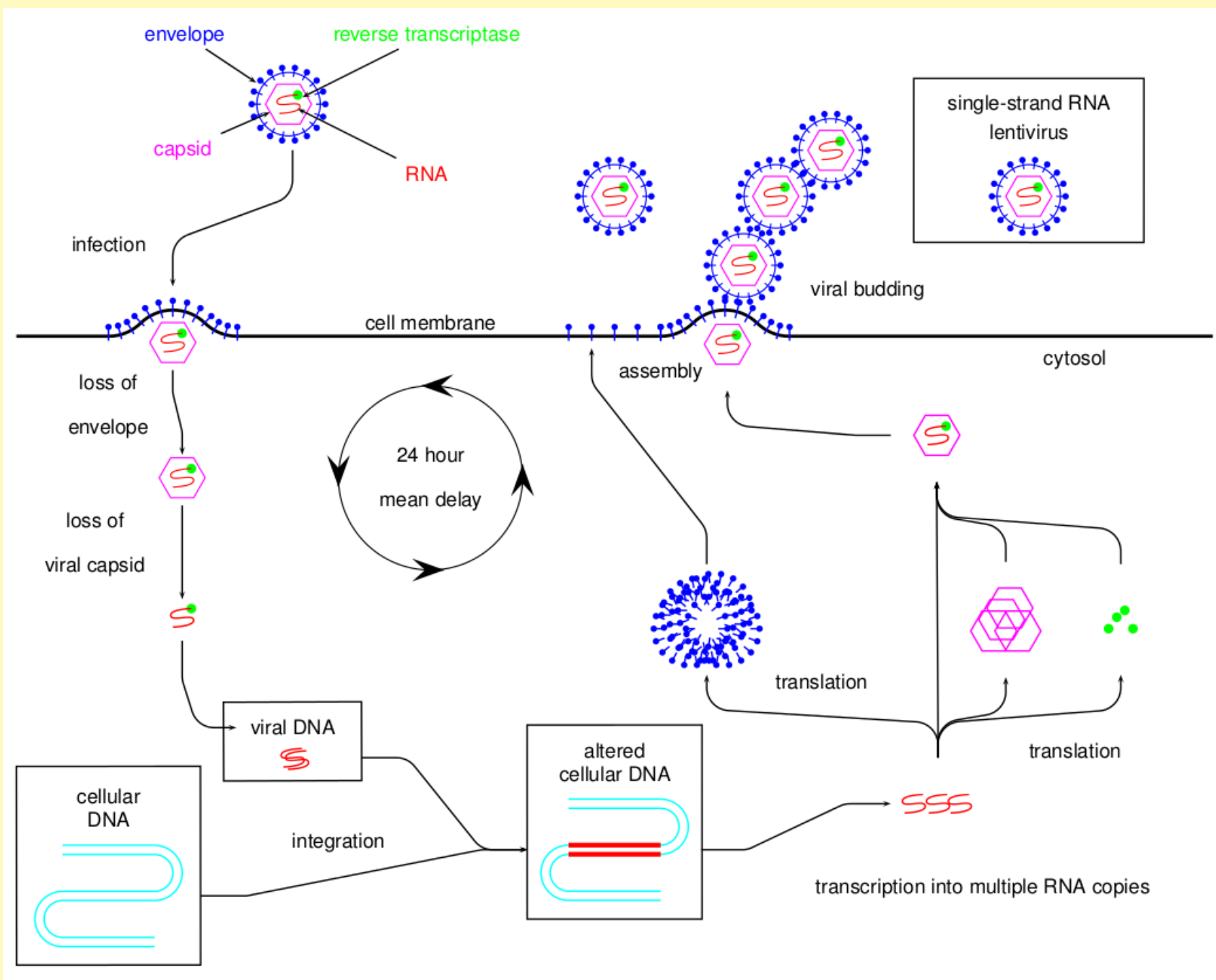
- Model Seletion show that HIV models must include a delay between CD4 T-cell infection and viral production.

Immune Complement Cascade

The immune complement cascade a cornerstone of the immune system and its ability to distinguish between healthy host cells, apoptotic cells, and foreign microbes.
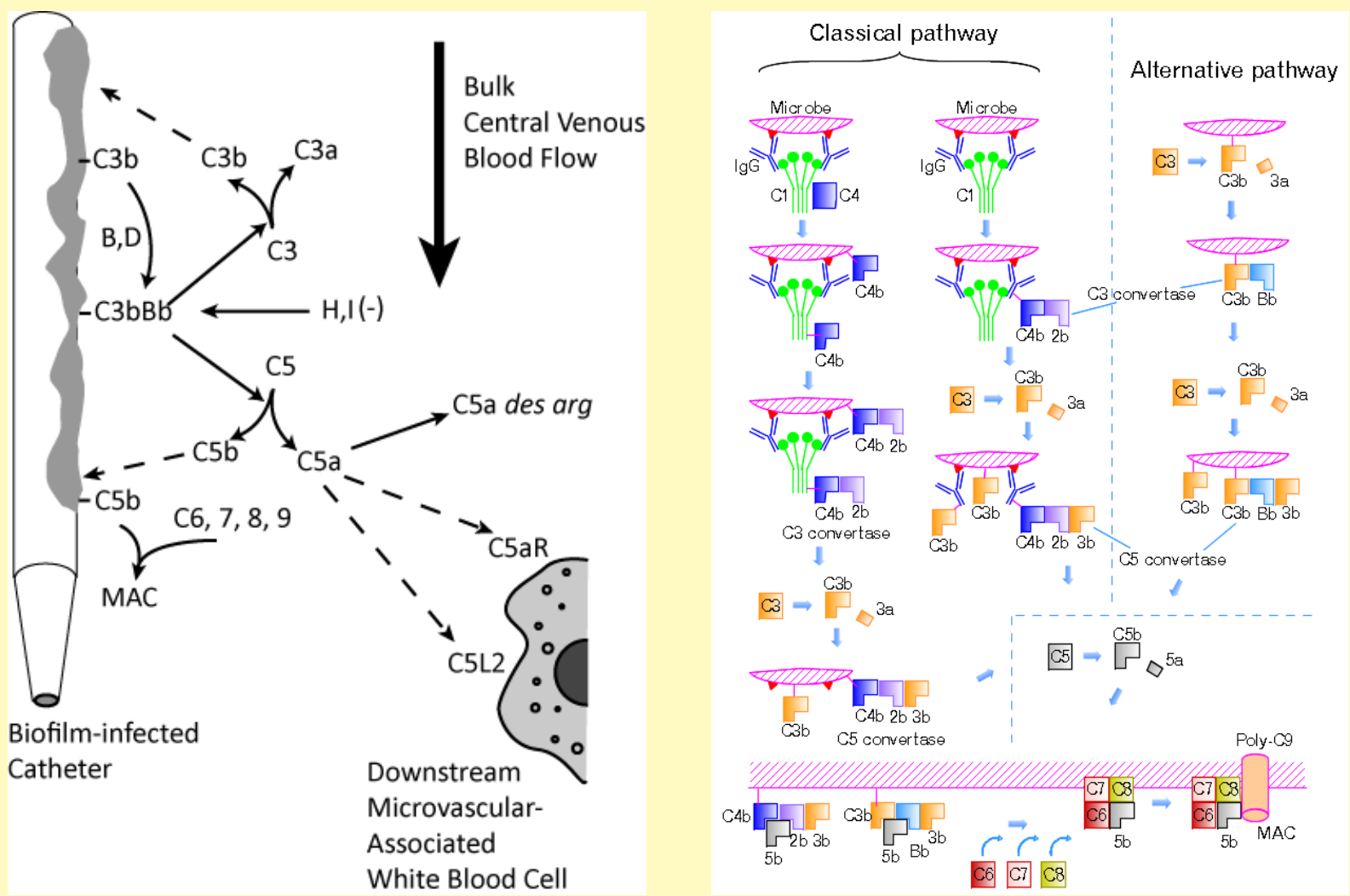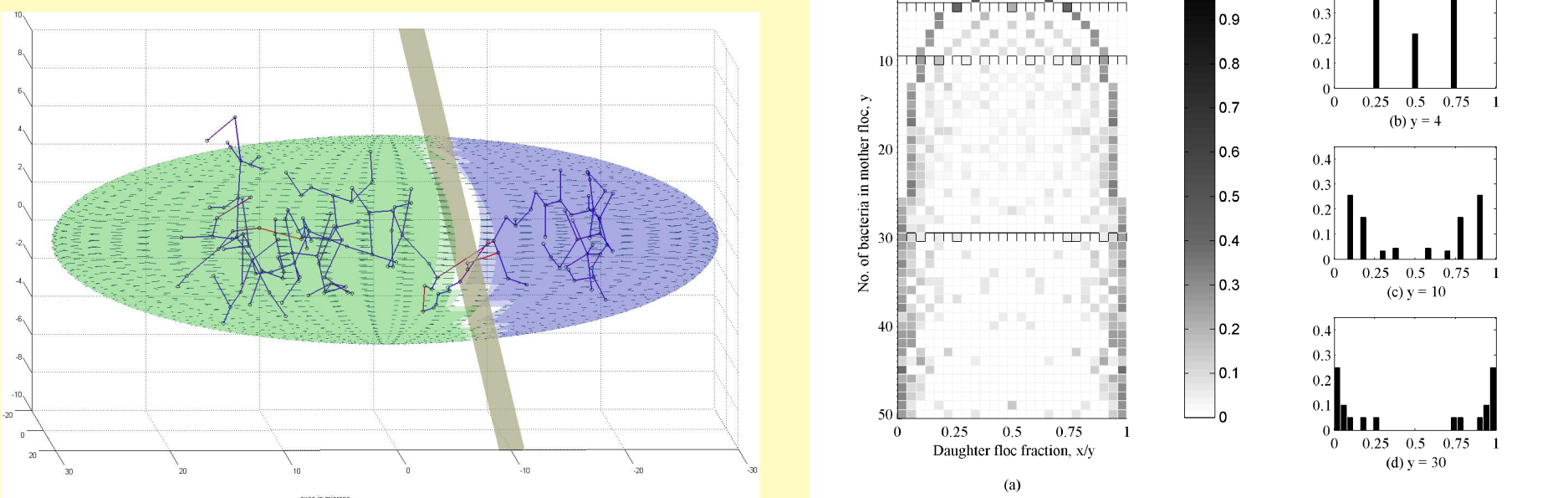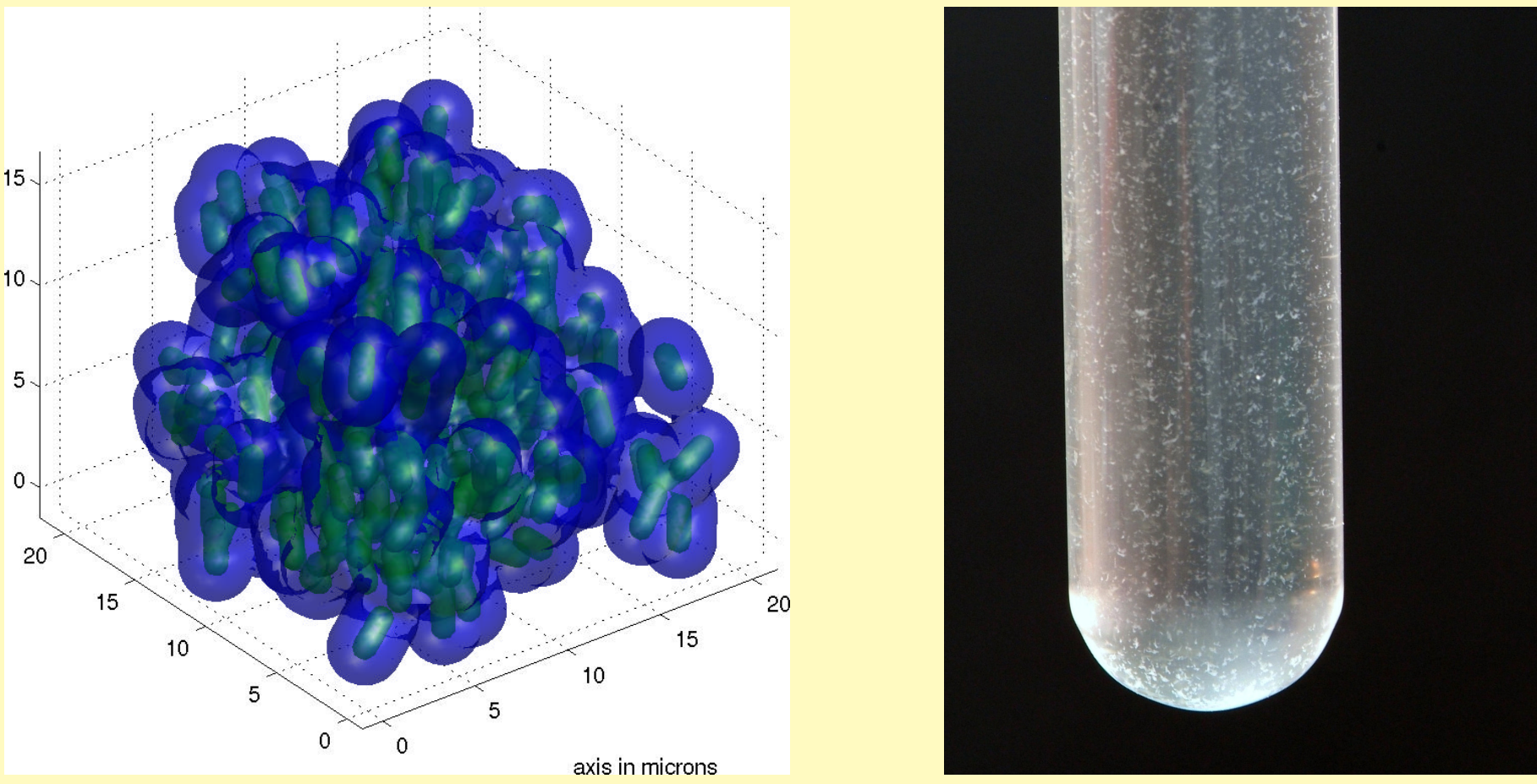

- Incorporation of spatial reaction-diffusion chemistry suggests novel sepsis-bacteremia treatment strategies.

Funding

Microbial Flocculation

Flocculation is the process whereby clusters of particles fragment and aggregate.

- Correct flocculation models are essential for understanding blood-borne infections and cancer metastices as well as designing bioreactors and wastewater treatment facilities.
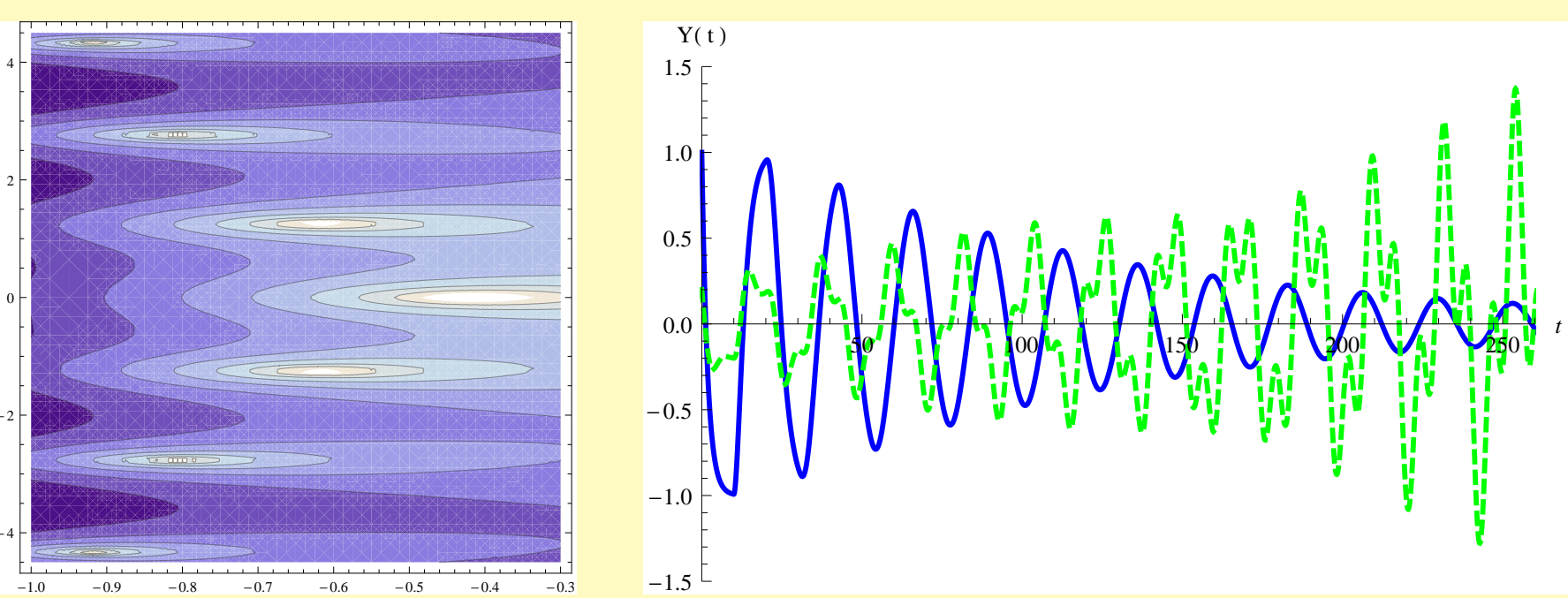

City of Boulder wastewater treatment tanks.

Structured Population Models

Delay differential equations form the core of many mathematical biology models describing the dynamics of populations with gestation and/or latent periods.
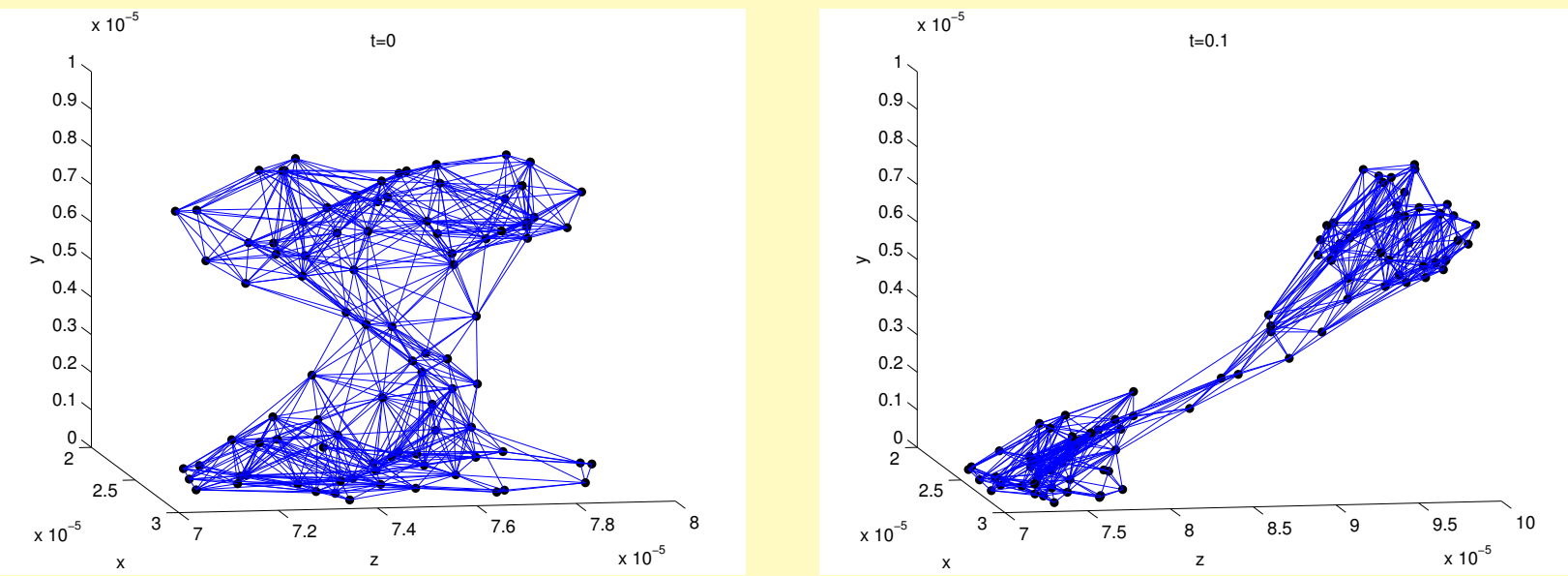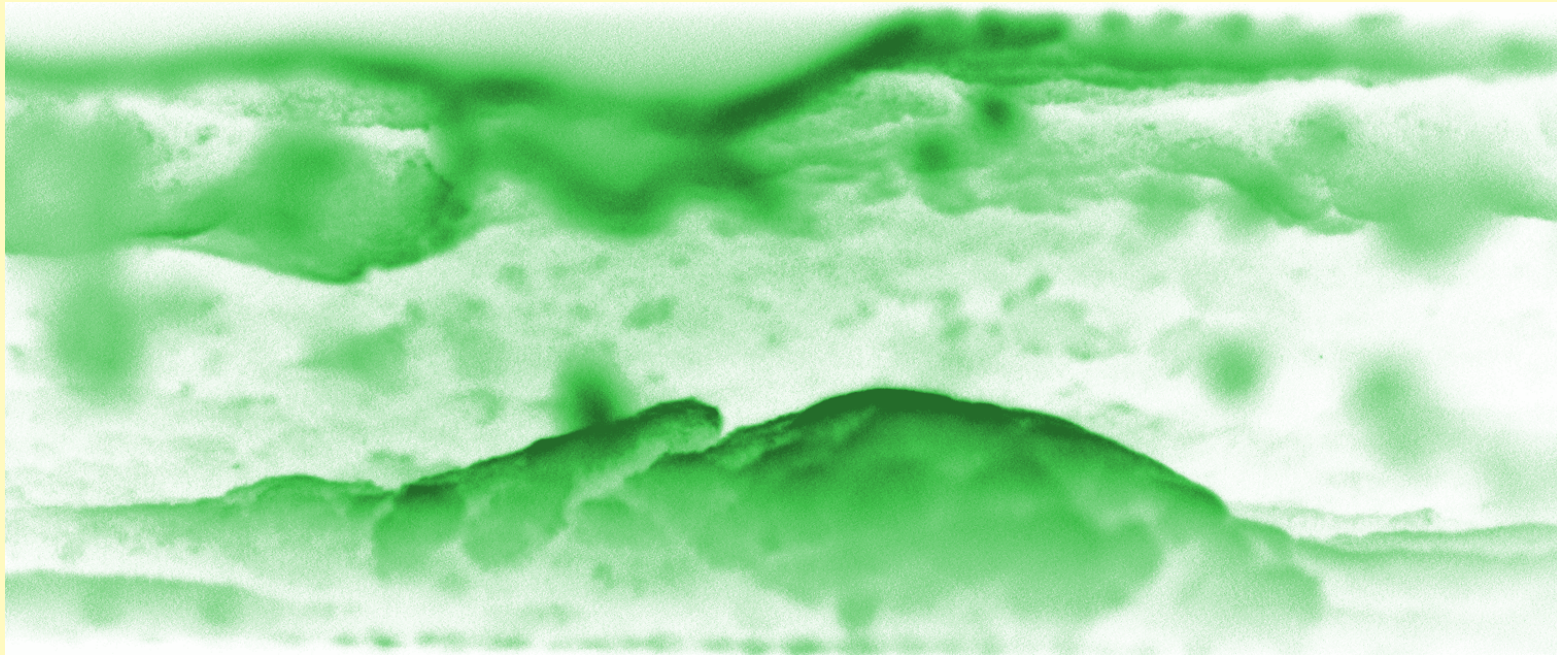
$$\dot{x}(t) = \alpha x(t) + \beta x(t - \tau_1) + \gamma x(t - \tau_2)$$

- Mathematical analytical predicts the long term sustainability of a population.

Biofilm Fragmentation

The prediction of shear-induced fracture of bacterial biofilms is a highly active research area requiring the development of novel numerical algorithms and extracellular matrix deformation response models.
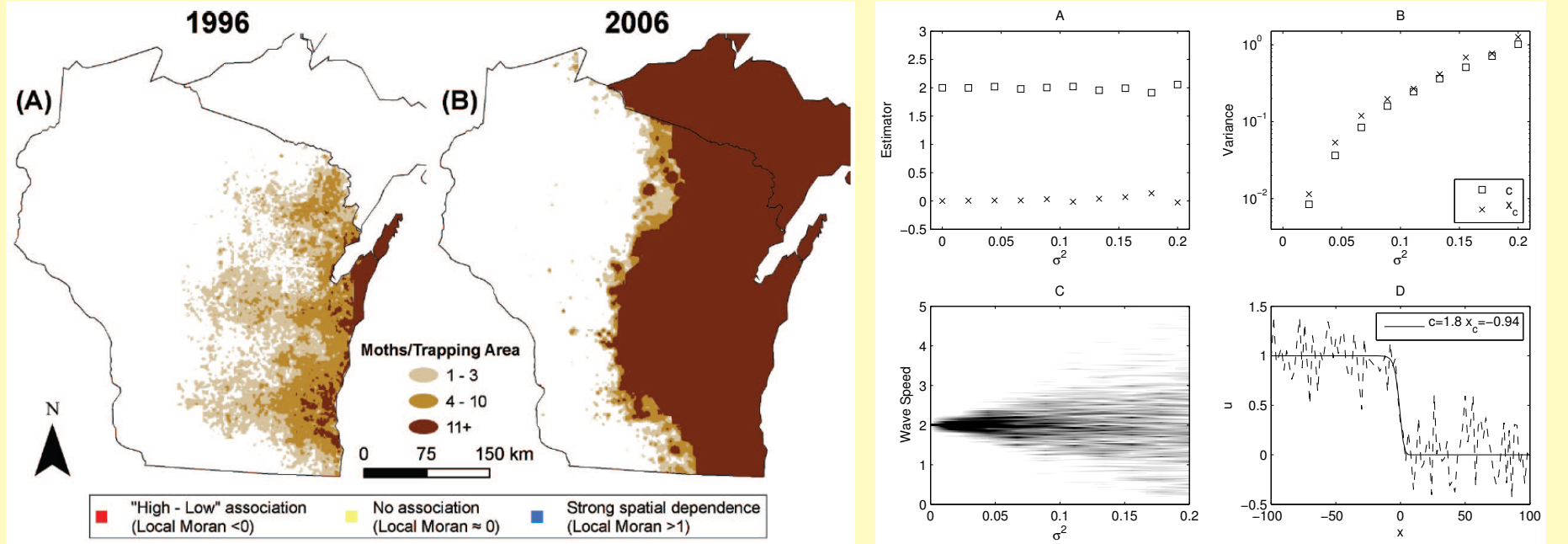

Experimental Design

Statistically informed design of experiments improves statistical power of conclusions as well as promotes efficient use of resources.
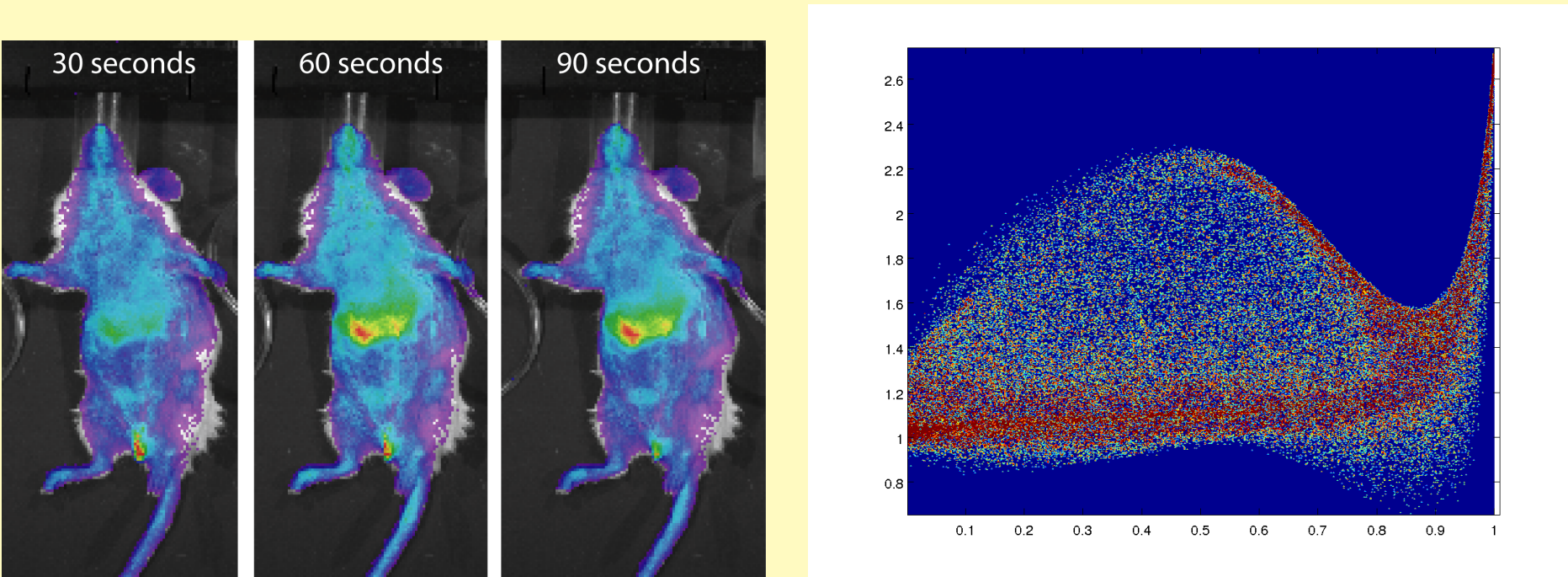
- Saves mice!
- Novel algorithms for GPUs and other massively multicore architectures.

Ecological Invasions

Invasive species can have a dramatic impact upon local ecosystems and economies

- Solutions to invasion models infer wave speed and direction, guiding effective responses.

Group Members

| D.M. Bortz PI | A. Broido Ph.D. | C. Curtis Postdoc | J. Hammond Ph.D. | S. Hsu B.S. | D. Keck Ph.D. | S. Sircar Postdoc | N. Tell B.A. |