Title: Spatio-temporal models for red pine decline

Red pine decline is characterized by expanding pockets of dead trees in plantations throughout the Great Lakes Region. Elucidation of exact mechanisms of pocket development and expansion remain elusive since a single site has never been observed over more than two years.

In the present study, we fit space-time models to a seven-year data set of annual investigation of all trees in a plantation. Each year, each of the 2,715 trees was examined for presence/absence of Ips spp., tree condition and the number of pitch tubes, each of which signifies colonization by a turpentine beetle. We attempt to answer the following questions:
How do we model the space-time progression of turpentine beetles, Ips colonized trees and the expanding pockets of dead trees?
Do turpentine beetles predispose trees to attack by Ips spp.?
Do Ips spp. kill the trees?

This is a joint research project with Kenneth F. Raffa and Brian Aukema, Department of Entomology, University of Wisconsin, Jun Zhu, Department of Statistics, University of Wisconsin, and my Ph.D.-student Jakob G. Rasmussen, Department of Mathematical Sciences, University of Aalborg.

In the talk I'll compare two different approaches based on a discrete-time model and a continuous-time model. In the discrete-time model the likelihood function depends on unknown normalizing constants, which need to be estimated when finding maximum likelihood estimates. Moreover, an unknown ratio of normalizing constants appears in the Hastings ratio when doing straightforward MCMC posterior simulations, and I'll show how a new auxiliary variable technique eliminates this problem. In the continuous-time model the full likelihood is tractable, but for the marginal likelihood we need to account for missing data, using again MCMC methods.