Hierarchical Modeling for Spatio-temporal Data

Andrew O. Finley
Department of Forestry & Department of Geography, Michigan State University, Lansing Michigan, U.S.A.
October 30, 2013

Spatio-temporal Models

- Separable form:
  \[ C(s - s', t - t') = \sigma^2 \rho_1(s - s'; \phi_1) \rho_2(t - t'; \phi_2) \]

- Nonseparable form:
  - Sum of independent separable processes
  - Mixing of separable covariance functions
  - Spectral domain approaches

Dynamic spatiotemporal models

Measurement Equation

\[ y(s, t) = \mu(s, t) + \epsilon(s, t); \quad \epsilon(s, t) \stackrel{ind}{\sim} N(0, \sigma^2_\epsilon). \]
\[ \mu(s, t) = X(s, t)' \beta(s, t). \]
\[ \beta(s, t) = \beta(t - 1) + \eta(t). \]

Transition Equation

\[ \beta_t = \beta_{t-1} + \eta_t; \quad \eta_t \sim N_p(0, \Sigma \eta). \]
\[ \beta(s, t) = \beta(s, t - 1) + W(s). \]