

# Hierarchical Bayesian Spatio-Temporal Models with Application to Birds Population Spread

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**Abstract:** Many researcher in environmetrics are interested in modeling evolution of certain variables, such as wind, temperature, moisture, population, and the associated inference methods. Observations on the variables are often with spatio-temporal features. Extending the diffusion-reaction partial differential equation (PDE) in the literature (e.g. Wikle 2003), we formulate the population bird spread using advection-diffusion-reaction partial differential equation (PDE) in a hierarchical Bayesian framework. The model can account the existence of possible trend and give the diffusion process of birds under this trend. We consider a Poisson response with the trend coefficients and spatially varying diffusion coefficients. Moreover, the increasing term is assumed to follow an advection-diffusion-reaction PDE. This mimics realistically the birds population spread process. We illustrate the approach via both simulation and a set of real data.