# Hierarchical Spatial Modeling of Multiple Soil Nutrients in Heterogeneous Patches of Land Use


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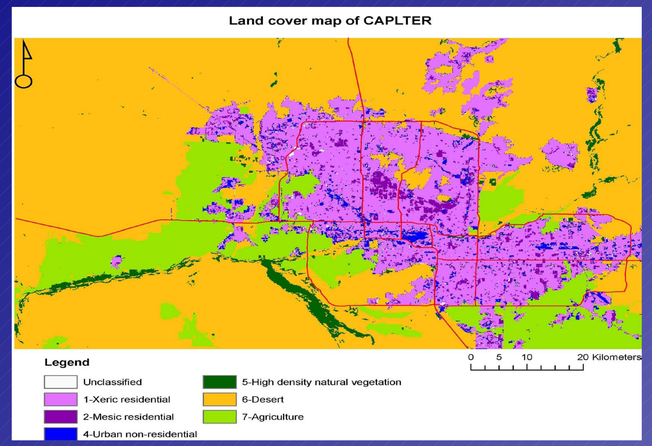
**(With Jason Kaye, Corinna Gries, Alexander Buyantuyev, Diane Hope, Nancy Grimm)**


**Land-use map of Phoenix 2000**




- **Org C - energy available for soil food webs.**
- **Inorg C - longterm water and salt balances.**
- **Soil - stores a large fraction of global C**
- **Nutrient pool sizes affect plant productivity**
- **Soils are a sink for anthropogenic nutrient pollution**

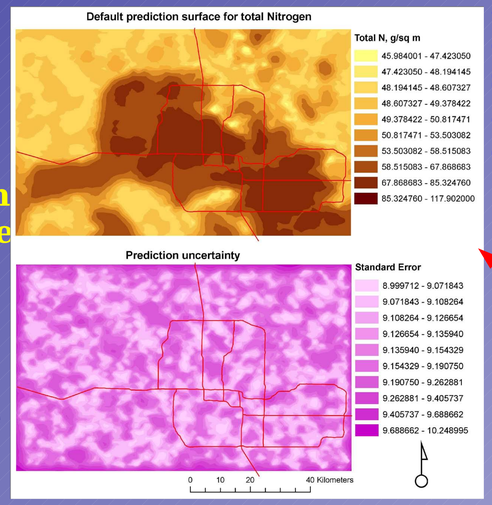
**Dependent variables: Tot N(TN), Organic C(OC), Inorganic C(IOC), Phosphorous(P)**

**Regressor variables: Spatial in nature.**
**Include a host of bio-physical and socio-economic covariates**

**Regressors significant in our model:**
**land-use, 0-1 variable whether ever in agriculture, %lawn, % impervious area, elevation**

**Landuse types: Urban residential, Urban non-residential, mixture, Agricultural, Water,Desert etc (8 categories)-**
**200 samples**

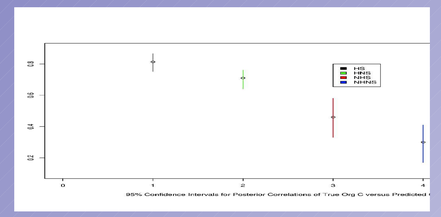
**Hierarchical Modeling: Used when parameters are connected by some way of the problem. Usually when one wants to model latent processes. In our problem, we use hierarchy as a way to reduce dimensionality of the multivariate spatial structure.**

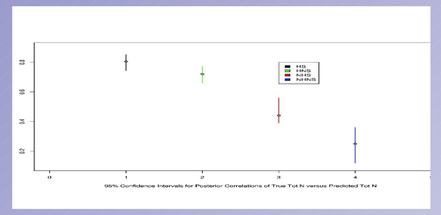



**Previous research on soil nutrients: multiple regression, ANOVA, no attempt to integrate all land-use or spatial structure, no attempt to model association of soil nutrients, no issue of prediction or model comparison**

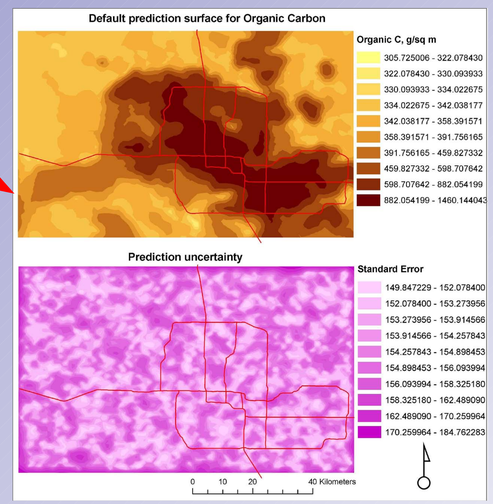
**Challenges met in our model: Multivariate Spatial structure, Heterogeneity of land-use patches, dimensionality, model comparison, missing data layers needed for prediction at new points.**

**Confidence interval of Correlation between Real and Median Predictions; log (Tot N) and log(Org C) under Hierarchical Spatial, Hierachical Non-spatial, Non-hierarchical Spatial, and Non-hierarchical Non spatial Models**

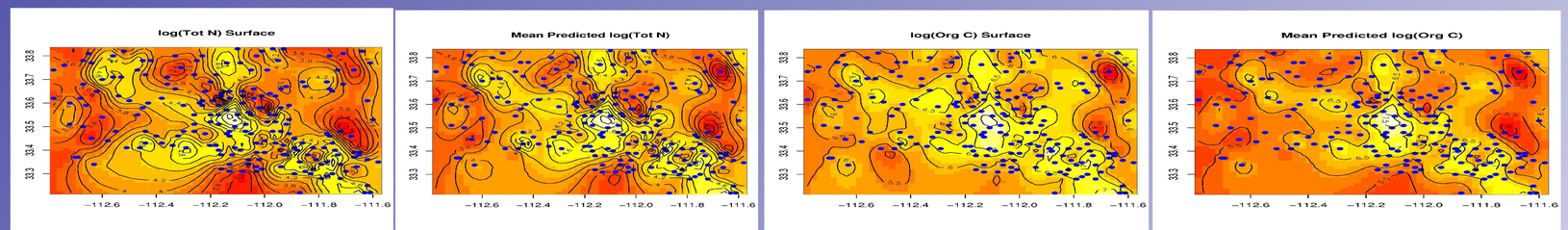



**Based on the model we generated values at 5000 new points. The surface maps are given (Tot N and Org C):**




## Real and Predicted Surfaces of log(Tot N) and log(Org C)

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