Nonstationary spatial covariance modeling through spatial deformation

Practicum

Paul D. Sampson --- Wendy Meiring
Univ of Washington --- U.C. Santa Barbara

Pan-American Advanced Study Institute on Spatio-Temporal Statistics
Búzios, RJ, Brazil
June 16-26, 2014

In this practicum we guide you to through the fitting of thin-plate spline based deformation models for nonstationary spatial covariance structure using software for

(a) bending energy penalized weighted least squares fitting available in the EnviroStat package, and
(b) functions for L1 regularized maximum likelihood fitting using a partial warps parameterization of the thin-plate splines.

You will fit and visualize the spatial deformation models using provided R code.

You will have your choice of datasets to consider. We suggest consideration of one or more of the following three datasets, all made available on the PASI data and softward page http://www.stat.washington.edu/peter/PASI/data.html

1. The French 10-day rainfall data at 39 sites in the Longueduc-Roussillon region of southern France. The practicum "main" R code refers to these data.
2. The California NO2 data on 42 sites in southern California ("Small scale spatio-temporal data set")
3. The spatio-temporal dataset simulated from a true deformation model with observations on a regular grid of 100 points ("Simulated Data 2").

The model fitting requires only a sample site-site covariance matrix from a space-time dataset and rectangular (Euclidean) coordinates of the sites at which data are observed. Note that there are varying amounts of missing data in the real datasets. The current fitting assumes the calculation of a covariance matrix computed from the available monitoring data, dealing with, but not accounting for, the missing data. For example, covariances may be computed from all pairwise-complete data.

You will need to install and load the R packages:

```
EnviroStat
MASS
```

You will also source the following files for additional R functions:

```
source("deformloglik.l1.R")          # L1-penalized log-likelihood code
source("visualize.tps.warps.R")      # Visualization of thin-plate-splines
source("draw2.R")                    # to replace a function in EnviroStat
```

Follow the code in `Deformation.practicum.R`. You will likely want to modify this code to your liking to try different parameters in the fitting.