# An introduction to geostatistical analysis of spatio-temporal data with R

## METMA IX

Montpellier, 13-15 June 2018

9th Workshop on Spatio-temporal modeling

MENU

- Home
- Invited speakers
- Program
- Important dates
- Conference venue
- Submission
- Registration
- Social events
- Practical information
- Scientific committee
- Organizing committee
- Sponsors and partners

### PROGRAM

**The full program is available here (external link):**

Full program

The scientific program will feature sessions with talks on the latest advancements in theory, methods and applications. It will include keynote presentations, invited presentations and contributed papers and posters.

The scientific program of Friday (June 15) will be co-organized with the LEFE-Cerise project and will focus on topics relevant to this project.

A satellite event will be held on June 12, 2018 (Tuesday): a workshop providing an introduction to geostatistical analysis of spatio-temporal data with R, given by members of INRA's RESSTE network. The registration fee for this workshop is 50€. **Registration for the workshop is done through the registration form to the conference (soon available). Participating in the workshop requires being registered for the conference.**

**Short course:**

**An introduction to geostatistical analysis of spatio-temporal data with R**

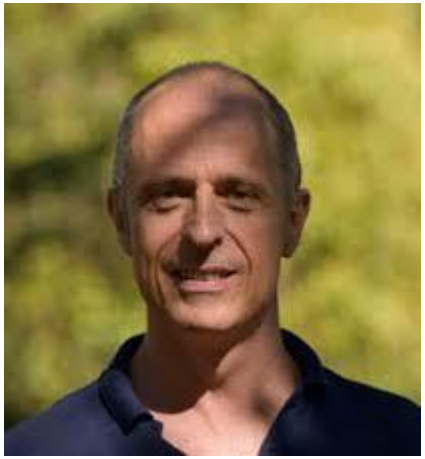
Organizers: Denis Allard, BioSP, INRA; Liliane Bel, AgroParisTech; Edith Gabriel, Université d'Avignon; Thomas Opitz, BioSP, INRA; Eric Parent, AgroParisTech

# The organizers

Eric Parent,
AgroParisTech, Paris

Liliane Bel,
AgroParisTech, Paris

Edith Gabriel,
University of Avignon



Denis Allard,
BioSP, INRA (Avignon)

Thomas Opitz,
BioSP, INRA (Avignon)

# Why this workshop ?

- Space-time models and methods are essential in modern statistics with applications in:

- Wildfire occurrence,air quality, plant disease, climate data,sea surface temperature,disease mapping, unemployment data, flash floods, ….

➢ **But, space-time statistics is perhaps a bit intimidating at first**

# Some particular points about Space-Time statistics

- ✓ Involves (very) large datasets: difficult to store, to read, to manipulate, to analyse
- ✓ We don't know how to explore the data for choosing a model/method
- ✓ Spatio-temporal or tempo-spatial?
- ✓ Likelihood (almost) impossible to compute
- ✓ Are there R packages? Which one should we use? Are there important features missing?
- ✓ Etc…

- ✓ We identified the need to illustrate the geostatiscal analysis of spatio-temporal data
- ✓ On a realistic dataset the whole workflow
- ✓ From reading the data to do predictions and validate the model

# Organization of the short course

- Session 1: Handling and importing large spatio-temporal data using structured objects; projection coordinate systems for geolocated data.

  (Eric Parent)
- Session 2: Visualizing data according to their temporal, spatial or spatio-temporal structures.

  (Edith Gabriel)

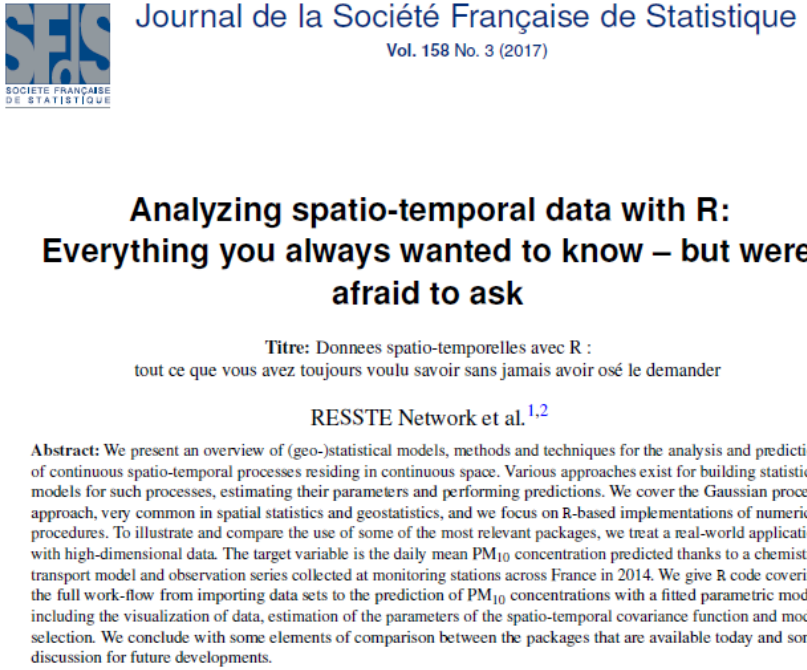
Lunch

- Session 3: Statistical inference for spatio-temporal models: method of moments; maximum likelihood, pairwise composite likelihoods.

  (Thomas Opitz)
- Session 4: Prediction and validation.

  (Liliane Bel)

# Review paper in the « Journal de la Société Française de Statistique »



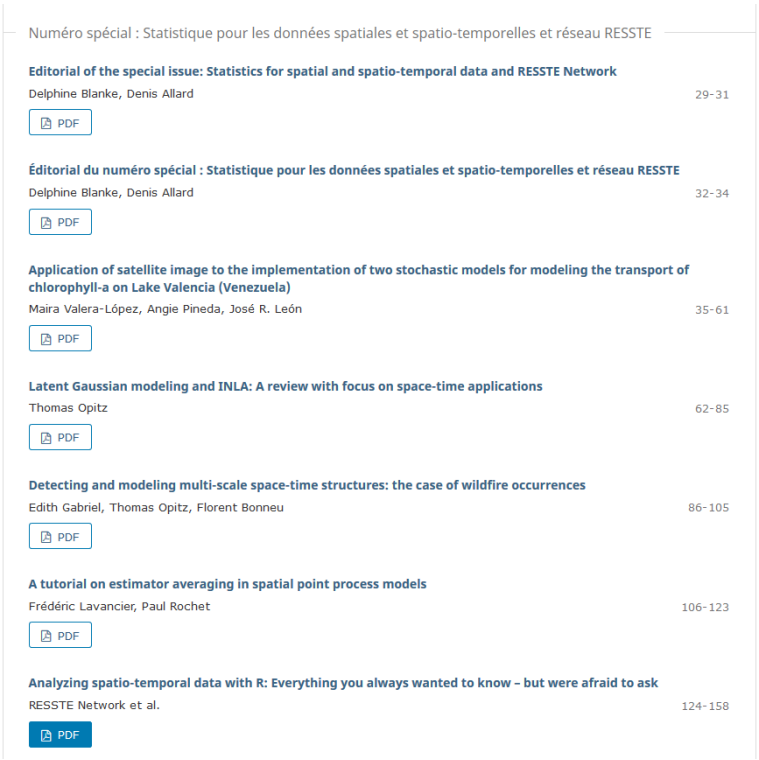
Journal de la Société Française de Statistique
Vol. 158 No. 3 (2017)

## Analyzing spatio-temporal data with R: Everything you always wanted to know – but were afraid to ask

**Titre:** Donnees spatio-temporelles avec R :
tout ce que vous avez toujours voulu savoir sans jamais avoir osé le demander

RESSTE Network et al.[1,2]

**Abstract:** We present an overview of (geo-)statistical models, methods and techniques for the analysis and prediction of continuous spatio-temporal processes residing in continuous space. Various approaches exist for building statistical models for such processes, estimating their parameters and performing predictions. We cover the Gaussian process approach, very common in spatial statistics and geostatistics, and we focus on R-based implementations of numerical procedures. To illustrate and compare the use of some of the most relevant packages, we treat a real-world application with high-dimensional data. The target variable is the daily mean $PM_{10}$ concentration predicted thanks to a chemistry-transport model and observation series collected at monitoring stations across France in 2014. We give R code covering the full work-flow from importing data sets to the prediction of $PM_{10}$ concentrations with a fitted parametric model, including the visualization of data, estimation of the parameters of the spatio-temporal covariance function and model selection. We conclude with some elements of comparison between the packages that are available today and some discussion for future developments.



Numéro spécial : Statistique pour les données spatiales et spatio-temporelles et réseau RESSTE

**Editorial of the special issue: Statistics for spatial and spatio-temporal data and RESSTE Network**
Delphine Blanke, Denis Allard 29-31
PDF

**Éditorial du numéro spécial : Statistique pour les données spatiales et spatio-temporelles et réseau RESSTE**
Delphine Blanke, Denis Allard 32-34
PDF

**Application of satellite image to the implementation of two stochastic models for modeling the transport of chlorophyll-a on Lake Valencia (Venezuela)**
Maira Valera-López, Angie Pineda, José R. León 35-61
PDF

**Latent Gaussian modeling and INLA: A review with focus on space-time applications**
Thomas Opitz 62-85
PDF

**Detecting and modeling multi-scale space-time structures: the case of wildfire occurrences**
Edith Gabriel, Thomas Opitz, Florent Bonneu 86-105
PDF

**A tutorial on estimator averaging in spatial point process models**
Frédéric Lavancier, Paul Rochet 106-123
PDF

**Analyzing spatio-temporal data with R: Everything you always wanted to know – but were afraid to ask**
RESSTE Network et al. 124-158
PDF

**http://publications-sfds.math.cnrs.fr/index.php/J-SFdS/issue/view/69**

# RESSTE Network

## http://informatique-mia.inra.fr/resste

# One of the outputs: review of R packages

TABLE 5. *Most important* `R` *packages for spatio-temporal analysis, along with their main features and limitations.*

| Packages | Data. | Cov models | Estimation | Kriging | Big *N* |
|---|---|---|---|---|---|
| `gstat` | `STDF`, `STSDF` or `STIDF` data structure from `spacetime`. | 4 classes: *Separable, Product-Sum, Metric, Sum Metric.* Geom. anisotropy | `fit.StVariogram` Weighted Least Sq. only. | `krigeST` Linear model for the trend. No `NA`s. | Moving Neigh only. |
| `CompRandFld` | Space × Time data design. No `NA`s at all. | Many classes: *Separable, Product-Sum, Porcu, Gneiting, ...* | Weighted Least Sq. Comp. Lik. Hypothesis testing. | `Kri` No trend model. Tapering. Chordal and Geodesic dist. | Pairwise Comp. Lik., Tapering., Use of `spam` |
| `RandomFields` | `RFsp`: extension from `sp` package | Comprehensive: *Product-Sum, Gneiting, Porcu, mixtures, ...* | `RFfit` Weighted Least Sq., Max. Lik. | `RFinterpolate` incl. trend modeling | Use of `spam` Tapering |

# And now ?

We will make all material avalailable

- Access to the full dataset & workshop presentations & J SFdS paper

  http://informatique-mia.inra.fr/resste

- Send email to denis.allard@inra.fr to be added to the RESSTE mailing list for updates & news