INTERNATIONAL SCHOOL FOR GEOSCIENCE RESOURCES (IS-Geo)
KOREA INSTITUTE OF GEOSCIENCE AND MINERAL RESOURCES (KIGAM)

# PUBLIC CUSTOMIZED TRAINING COURSE ON
# Environmental Geostatistics

The **International School for Geoscience Resources** of KIGAM presents an intensive training course on **Environmental Geostatistics**. The course will take place at the Ara room of International School for Geoscience Resources of KIGAM in Daejeon (Korea) in **July 16 to 18, 2014** and will include the following topics.

| Topics | Date | Instructor |
|---|---|---|
| **Day 1. Introduction to geostatistics** | July 16 | Dr. Pierre Goovaerts (PGeostat, LLC) |
| **Day 2. Advanced topics in spatial prediction** | July 17 | |
| **Day 3. Modeling local and spatial uncertainty** | July 18 | |

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Ministry of Science, ICT and Future Planning

# COURSE INFORMATION

- ## Agenda
  - This course will introduce a suite of geostatistical methods for the spatial analysis of environmental data, including the computation and modeling of variograms, spatial interpolation using kriging techniques, cross-validation and jackknife, probability mapping and stochastic simulation, and geographically-weighted regression. Lectures will alternate with analysis of environmental data using the BioMedware software SpaceStat.

- ## Course Covered
  - Introduction to application of geostatistics to environmental data
  - Methods for analysis of spatial patterns, spatial interpolation (univariate kriging and kriging accounting for secondary information), modelling of local and spatial uncertainty (parametric and non-parametric methods), and local regression analysis.
  - Exercises for exploratory spatial data analysis, spatial interpolation, uncertainty modelling, stochastic simulation, and geographically-weighted regression.

- ## Course Requirements: Prerequisite
  - Basic knowledge of probability and statistics is desired but not required.
  - Experience with geographical information systems is desired.
  - Course language will be English.

- ## Who should Attend?
  - Instructors and faculty members
  - Geophysicists and Geologists
  - Agricultural Engineers and Scientists; Agronomists
  - Environmental Consultants, Regulators, and Scientists
  - Environmental Epidemiologists
  - Soil and Water Scientists, students
  - Others seeking training in GIS and geospatial science

- ## Summary of topic contents and learning objectives

  The Participants will learn how to apply geostatistics for the description of spatial patterns and identification of scales of variability, spatial interpolation, modeling of local and spatial uncertainty, and exploration of local relationship between variables.

- ## Day 1. Introduction to geostatistics

  The first day will be devoted to an introduction to the basic steps of a geostatistical analysis and their application to environmental data using the software SpaceStat. An exploratory spatial analysis of the data (e.g. histogram, location maps) will be followed by a characterization of the spatial correlation among variables using correlograms and semivariograms. We will learn how to model experimental semivariograms and to capitalize on that correlation to predict variables at unsampled locations using kriging.

  - Introduction
  - Exploratory Spatial Data Analysis (Lab)
  - Concepts of correlogram and semivariogram
  - Semivariogram modelling (Lab)
  - Concept of kriging
  - Spatial interpolation (Lab)

- ## Day 2. Advanced topics in spatial prediction

  The second day will provide a more detailed account of geostatistical techniques for spatial interpolation. First, we will learn how kriging can be used to estimate variables over spatial supports (e.g. blocks, points) that are different than the measurement support (upscaling, downscaling, and side-scaling). Then, several interpolation techniques will be introduced to incorporate secondary information in the prediction of environmental attributes. Last, the non-stationarity in the relationship between variables will be explored using geographically-weighted regression that conducts regression within local windows.

  - Change of spatial support with kriging
  - Block kriging (Lab)
  - Residual kriging and kriging with an external drift
  - Mapping using secondary information (Lab)
  - Geographically-weighted regression
  - Mapping local correlations between rainfall and elevation (Lab)

- **Day 3. Modelling local and spatial uncertainty**

  The last day will be devoted to the critical issue of uncertainty assessment. Parametric (multiGaussian kriging) and non-parametric techniques (indicator kriging) will be introduced to model the uncertainty prevailing at unsampled locations. In particular, these methods will be used to map the probability that specific environmental thresholds are exceeded. Uncertainty about the spatial distribution of attributes (multi-point uncertainty) will then be modelled using stochastic simulation that aims to generate equally-probable maps reproducing the spatial variability inherent to the data, avoiding the smoothing effect of interpolation techniques introduced the first two days.

  - Parametric modelling of local uncertainty
  - MultiGaussian kriging (Lab)
  - Non-parametric modelling of local uncertainty
  - Indicator kriging (Lab using AUTO-IK)
  - Modeling spatial uncertainty
  - Stochastic simulation (Lab)

## About the instructor – *Professor Pierre Goovaerts*

Dr. Pierre Goovaerts studied at the Catholic University of Louvain-la-Neuve (Belgium) and at Stanford University, where he wrote the textbook entitled Geostatistics for Natural Resources Evaluation published by Oxford University Press in 1997. After five years on the Faculty at the University of Michigan, he became in 2002 Chief Scientist for the R&D Company, Biomedware, Inc, and he created his own consulting company, PGeostat, LLC. Dr. Goovaerts has authored more than 160 refereed papers in the field of theoretical and applied geostatistics, and he is a reviewer for 50 international journals. He has taught short courses in the US and Europe, which were attended by academics, consultants and federal employees. He has also been teaching in India, China, South Korea, Colombia and Niger. He acts as a consultant for the Environmental Protection Agency, the Nuclear Regulatory Commission, several international agencies and he is bringing his expertise to numerous projects dealing with the characterization of air, soil and water pollution and its impact on human health. For the last five years, Dr. Goovaerts has been a Courtesy Associate Professor at the University of Florida, Soil and Water Science Department. Since 2009 he is also an off-site employee for the international company CSC (Computer Sciences Corporation), providing expertise on the geostatistical modeling of contaminated sediments in rivers and lakes. In 2009, he was appointed Associate Editor of the international journal Mathematical Geosciences. Dr. Goovaerts was the 2013

Distinguished Lecturer of the International Association for Mathematical Geosciences. For more information about Dr. Goovaerts, visit his home page at: goovaerts.pierre.googlepages.com.