Geo-spatial methods for global health applications

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The ultimate goal of global health science is to improve health conditions for all people worldwide. In an increasingly interconnected world, tackling the emergence of disease outbreaks requires solutions that transcend national borders. To this end, understanding the spatial variation in disease risk and the exposure to environmental hazards has become increasingly important.

In this course, we introduce start-of-the-art methods in disease mapping, a sub-branch of spatial statistics whose focus is on the prediction of health outcomes and exposures within a geographical area of interest. These methods have found application in public health problems both in developing and developed countries.

In low-resource settings, disease registries are geographically incomplete or non-existent and, therefore, household surveys are a fundamental tool to quantify the disease burden. In the first two days of the course, we shall focus our attention on case studies of tropical disease epidemiology in Africa. More specifically, we will introduce geostatistical methods and show how this can be used to identify disease hotstops, i.e. areas where the disease risk reaches levels that may represent a major public threat.

In developed countries, disease registries provide detailed information on individuals with a specific disease or condition. However, in order to protect confidential information, data are only available at spatially coarser scale than the location of residence. In the second part of the course, popular approaches to disease mapping from areal data will be reviewed. Bayesian modeling will be introduced and justified. Specific extensions to active surveillance and high risk area profiling will be discussed.

PROGRAMME

Day 1

- The class of geostastical problems.
- Exploring spatial correlation in the data: the variogram.
- The linear geostatistical model.
- Geostatistical prediction.

Day 2

- The binomial geostatistical model.
- Monte Carlo maximum likelihood.
- Prevalence mapping.

Day 3

- Spatial areal data
- Historical review of Disease Atlases
- Principles of Disease Mapping

Day 4

- Bayesian approaches to Disease Mapping
- Using Posterior Quantities
- Bayesian Ranking
- High Risk Areas Profiling