Intégration des Systèmes d'Informations Géographiques (SIG) et de méthodes géostatistiques: Applications à la cartographie de pollutions radioactives dans l'environnement

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The aim of this Ph.D. thesis is the evaluation and the development of methods and tools for the mapping of radioactivity following an accidental atmospheric release. Geographic Information Systems (GIS) are tools that are well known to efficiently store, handle and display spatial data but they do not currently offer adequate functions for the statistical analysis of the measurements. Inversely, geostatistical software are efficient for the estimation of the values taken by the variable of interest at locations where measurements have not been made but they do not provide the users with the essential tools that are required to project, validate and interpret the results. By identifying the main interactions between GIS and geostatistical methods, this work could show the large potential that would be provided when working in an environment where both tools would be integrated. An illustration of such a potential is the use of non-Euclidean distances defined by a 3D model of an external drift to analyse the spatial structure of the variable. This method could show an impact of the terrain model on the spatial distribution of the radioactive deposition that could not be identified by more classical methods. The organisation of an international spatial interpolation comparison (SIC97) exercise allowed to show that geostatistical methods performed better than other methods even if the analysed variable shows strong local variations within more larger spatial structures. These methods do, however, require the definition of many subjective decisions that strongly influence the results. On the basis of all these observations, it has been possible to develop a new GIS prototype which integrates advanced geostatistical functions. Subjective Bayes kriging, in particular, has shown to be able to improve the estimates when additional knowledge is provided in the form of measurements made in regions that are close to the investigated area. The applicability of the various mapping techniques to the monitoring of radioactivity in the environment in routine and emergency situations are finally discussed.