*Applications des méthodes géostatistiques pour l'étude environnementale de la mer d'Aral (Asie centrale)

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The Aral sea, located between Kazakhstan and Uzbekistan in Central Asia, has been subject to intense drought since the 70s due to extensive human activity in its hydrographical basin. At the present time, the sea has lost more than 80% of its water volume. Negative consequences on the environment have not been long in appearing. They include an increase of water salinity from 10% to 23%, a major decrease in biodiversity, depletion of air and water quality, lowering of the water table leading to the drying of most wells, exposure of highly contaminated sea sediments to wind, etc. It has also largely been assumed that climate changes have occurred in the area surrounding the Aral sea in response to its intense shrinking. However, evidence for this last assumption, has never been found.

Our University is in possession of numerous data on the Aral sea area, that were acquired during an earlier project. A part of them were never analysed, so the aim of this work was on the one hand, to take advantage of this data and on the second hand, to develop new research projects on the Aral sea. Two objectives were developed on the base of the available data:

- to study the distribution of cadmium in the Aral sea sediments
- to use the meteorological data to search for evidence of climate changes.

The analysis of the cadmium distribution was carried out using different spatial analysis methods, including deterministic methods (inverse distance, Cressman, Barnes and Achtemeier) and stochastic methods (ordinary and Bayesian kriging). Results were then compared using error computation to determine the best predictive map and method. Finally results were imported in a Geographical Information System (GIS) for synthesis. In this way, we were able to establish that the cadmium found in the sediments of the Aral sea has been mostly transported by the two rivers that flows into the sea (i.e. the Syr Darya and the Amu Darya). Our conclusion is that the sediment are highly polluted in cadmium and that its potential sources are phosphated fertilizers, Pb/Zn mining in the Tien Shan mountains, sewage sludge and industrial pollution. Short term consequences on the environment is contamination of aquatic fauna and cultivated land. Indirectly, this could lead to an intoxication of the population through food.

The analysis of the meteorological data was made only on what we believed were the more relevant factors of climate change, that is air temperature and air humidity. Spatial analysis was carried out using classical geostatistic methods (deterministic interpolation, kriging) as well as new developments like Bayesian kriging and machine learning algorithms (Multi-Layer Perceptron network). Time-series data processing was also computed to find evidence of yearly changes in temperature and humidity. Several maps illustrating spatial data evolution were created for sampling periods between 1966 and 1989 (the most recent data we possess). Finally, all the results were imported in a GIS so that they can be superimposed on topographical maps and other geographical information. Our main conclusion is that we could not find any evidence of climate change except for one aspect: if temperature of the hot season have remained stable through the period studied, the cold season's ones seem to have stabilized during the last decade. This last statement is in contradiction

with the fact that the Aral sea is slowly disappearing (usually lakes interact as buffer and prevent the occurrence of extreme temperatures). Moreover, local humidity seem not to have been affected by the disappearance of the greatest part of the sea. Media carries a lot of information about the environmental state of the Aral sea area. However this work shows that scientific examination of local data can contradict what is usually read in newspapers. So our final conclusion is that, in order to make a good and valuable environmental statement, there is a real need to carry out more scientific researches on this area.