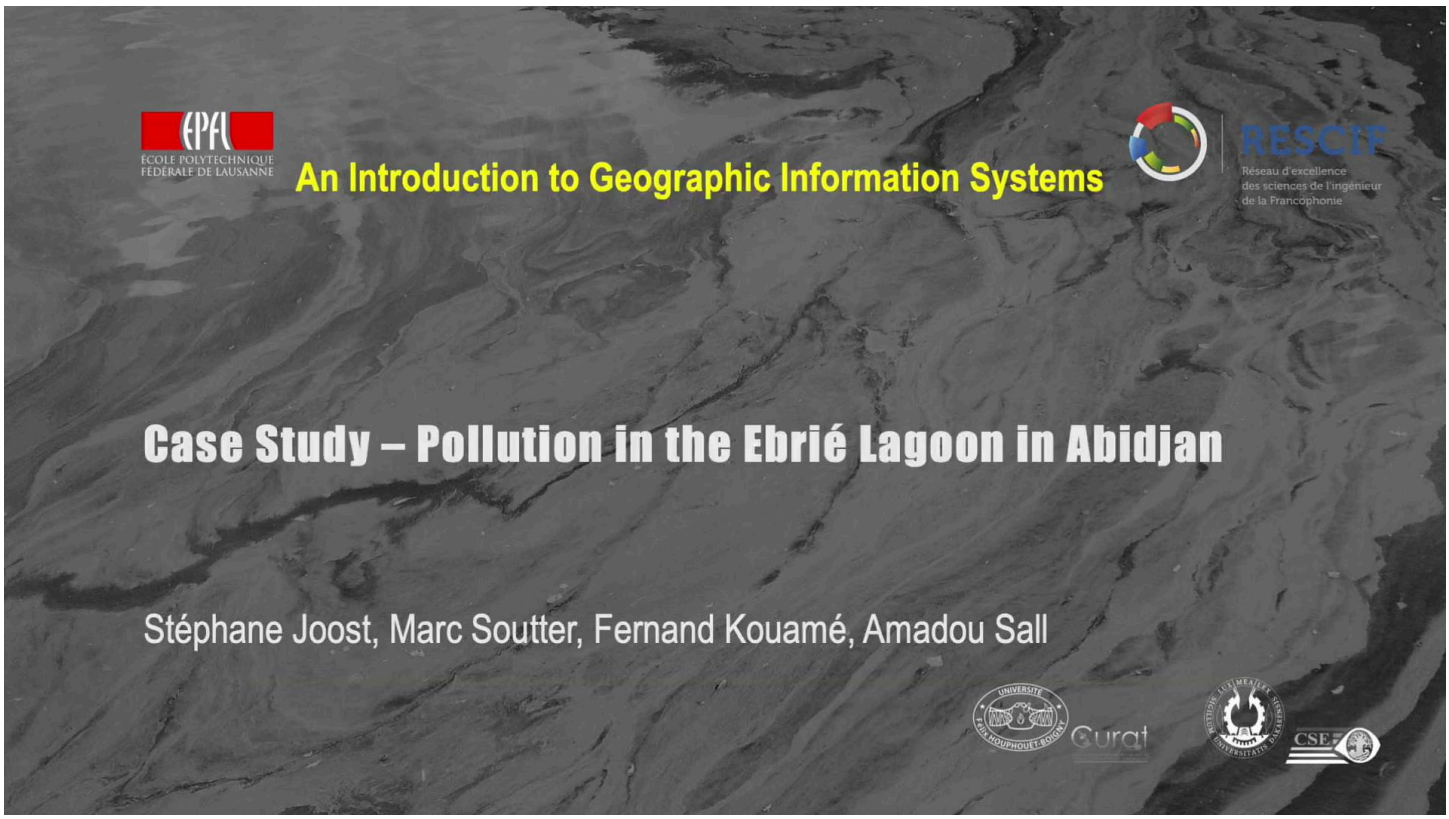

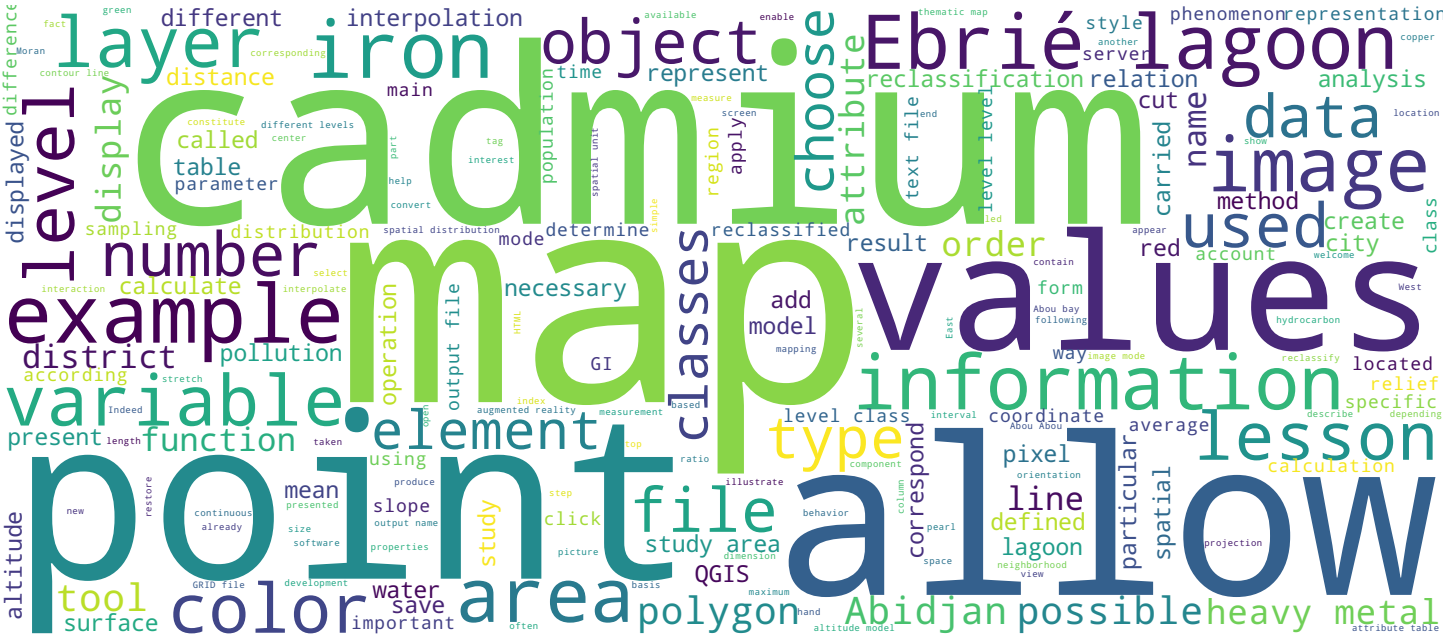

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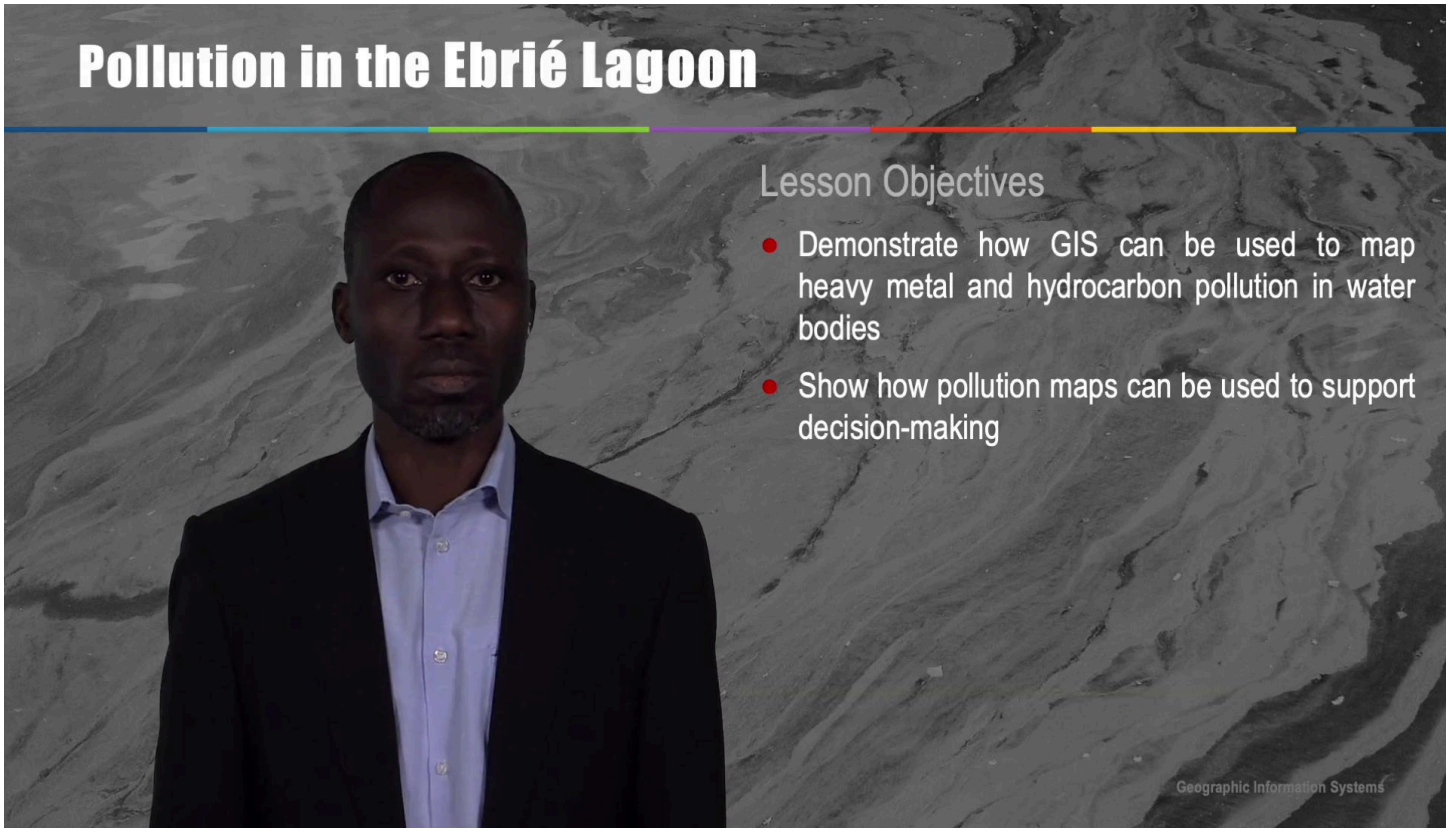
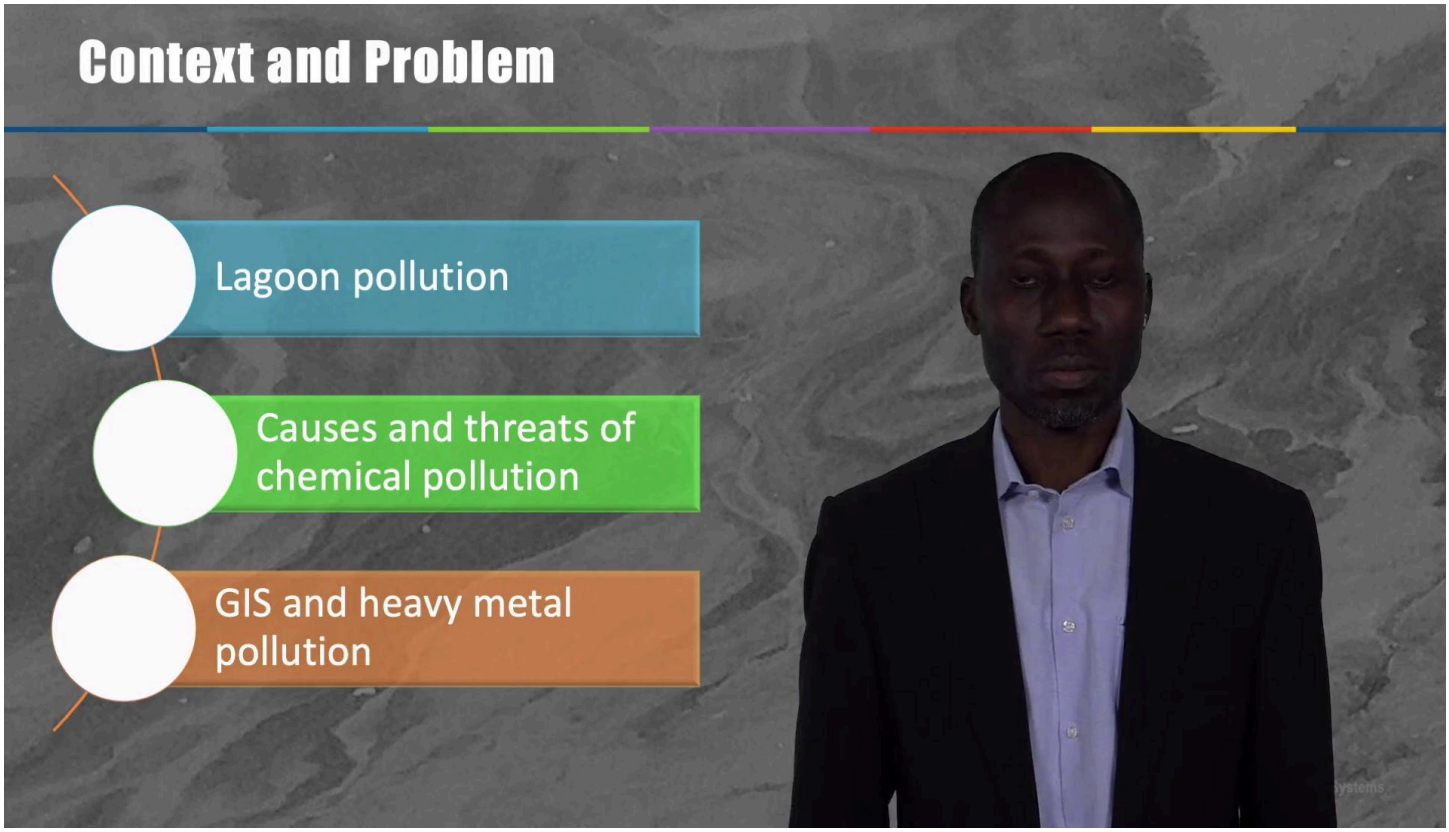


Hello and welcome to this lesson which will be on the pollution of the water plan of the Ebrié lagoon system and more specifically on the area that surrounds the agglomeration of Abidjan that has been subjected for some years to uncontrolled and increasing domestic and industrial wastes. This lesson which is a case study, shows how the tools here can be exploited or how to map the pollution levels by heavy metals of a lagooned stretch of water which presents a sanitization deficit. In this specific case that we present to you we use the results of geochemical analysis of sediments collected on the ground in 2001 by the Professor Affian and his team of marine geosciences of CURAT and one of the current challenges of the ivorian authorities is the restoration of this stretch of water in order to regain its previous state from before the 70s which had the name of "pearl of the lagoons." This lesson is structured into 4 main points.

Notes

Summary

0m 21s



First, the contextual framework and the problems of pollution. Then, the geographical presentation of the Ebrié lagoon. Third, the methodology of the use of sites for the mapping of the pollution indices. And finally, the results obtained and the exploitation for the decision-making. The contextual framework of the study is the water pollution. We will develop successively the lagoon pollution problems, the causes and the threats asa well as the interest of GIS in the study of the pollution.

Notes

Summary

1m 15s

Context and Problem

View of lagoon from M'pouto (plateau district in the background).
Source : *Liévre*

Pollution in the Ebrié lagoon

- **Pollution : degradation and deterioration** of the aquatic environment
- **Important in Abidjan** because the Ebrié lagoon system is affected by various different types of pollution
- **Types of pollution** (physical, chemical, organic and microbiologic)
- **Must reverse current tendencies** and restore this waterbody

Geographic Information Systems

Pollution expresses a state of degradation and deterioration of the aquatic environment. This is a topical subject in Abidjan because the Ebrié lagoon system undergoes various types of pollution. Formerly called the pearl of the lagoons, this vast area of water which surrounds the city of Abidjan has suffered for a few decades of a degradation of the quality and a silent death. What are the types of pollution which affect this stretch of water? They can be classified in 4. Physical pollution, when the limpidity and the temperature are changed. Chemical pollution, the nitrates, the heavy metals and other micro-pollutants are released into the water. Organic pollution when there is an over-consumption of oxygen. Microbiological pollution, the bacteria and parasites. The city of Abidjan continues to expand. The lagoon pollution problems are becoming more and more worrying. The most importante pollution load is that of the waste water, domestic waste whose theorical throughput of about 37,000 tonnes per year. Measures have already been taken but the situation requires a concrete and immediate intervention if we don't want it to become irreversible in order to restore the ecosystems and be able to call the Ebrié lagoon system the "pearl of the lagoons" again.

Notes

Summary

1m 53s

Context and Problem

View of lagoon from M'pouto (plateau district in the background).
Source : *Lièvre*

Pollution in the Ebrié lagoon

- **Pollution : degradation and deterioration** of the aquatic environment
- **Important in Abidjan** because the Ebrié lagoon system is affected by various different types of pollution
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Geographic Information Systems

On this picture, a view of the lagoon from the M'pouto neighborhood shows the waste and the proliferation of aquatic plants which give an idea of the pollution.

Notes

Summary

3m 03s

Context and Problem

Waste accumulated on the lagoon bank in the Plateau neighbourhood.
Source : *Aurélie Fontaine pour J.A*

Sources of chemical pollution

- Industrial waste (Cd, Pb, Hg, Mn,…)
- Oil spills
- Discharge of untreated sewage and household waste (paper, food waste, plastic, rubber)
- Mechanical erosion and inflow of pesticides and agricultural pollutants

Geographic Information Systems

It is necessary to reverse the trend and to restore this stretch of water which bathes the Abidjan agglomeration. We approach in this study the specific case of the chemical pollution of the Ebrié lagoon in Abidjan. This pollution is due to the release of industrial waste that is to say heavy metals such as cadmium, lead, mercury, manganese, copper of hydrocarbon, of untreated waste water from household waste and pesticides of agricultural pollutants from the mechanical erosion of cultivated soils.

Notes

Summary

3m 14s

Context and Problem

Piles of garbage on the bank (Blokhaus neighbourhood, near the Ivory hotel).
Source : *Aurélie Fontaine pour J.A.*

Poses multiple threats to

- environment
- biodiversity
- health
- the food chain
- tourism
- the fishing industry
- etc…

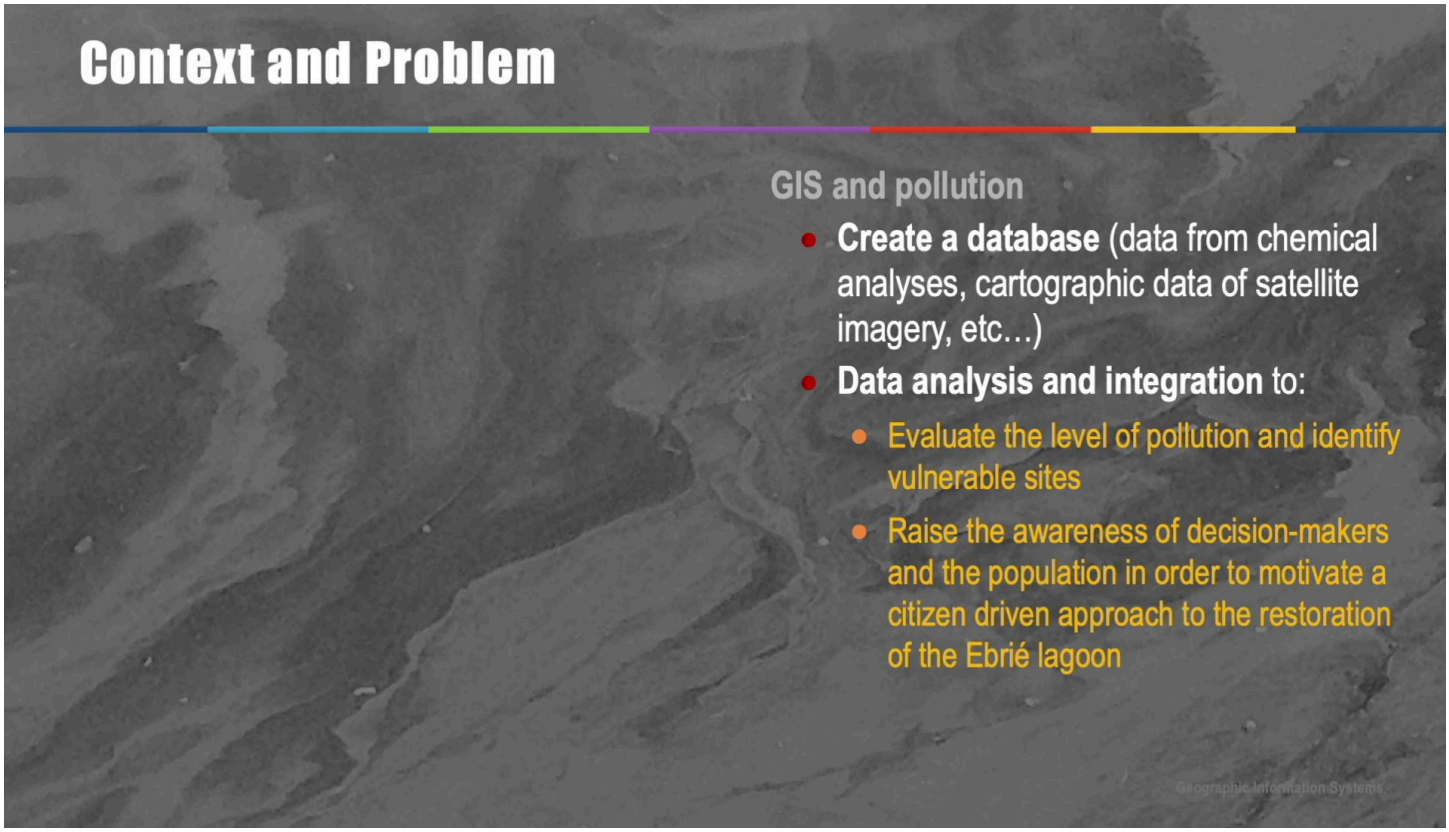
Geographic Information Systems

This pollution threatens the integrity of the environment, affects the biological diversity, health, the food chain, the tourism, fishing, and so on. This poses a real integrated management problem of water resources to which the ministry in charge of water resources and that of the environment are trying to find a solution.

Notes

Summary

3m 49s

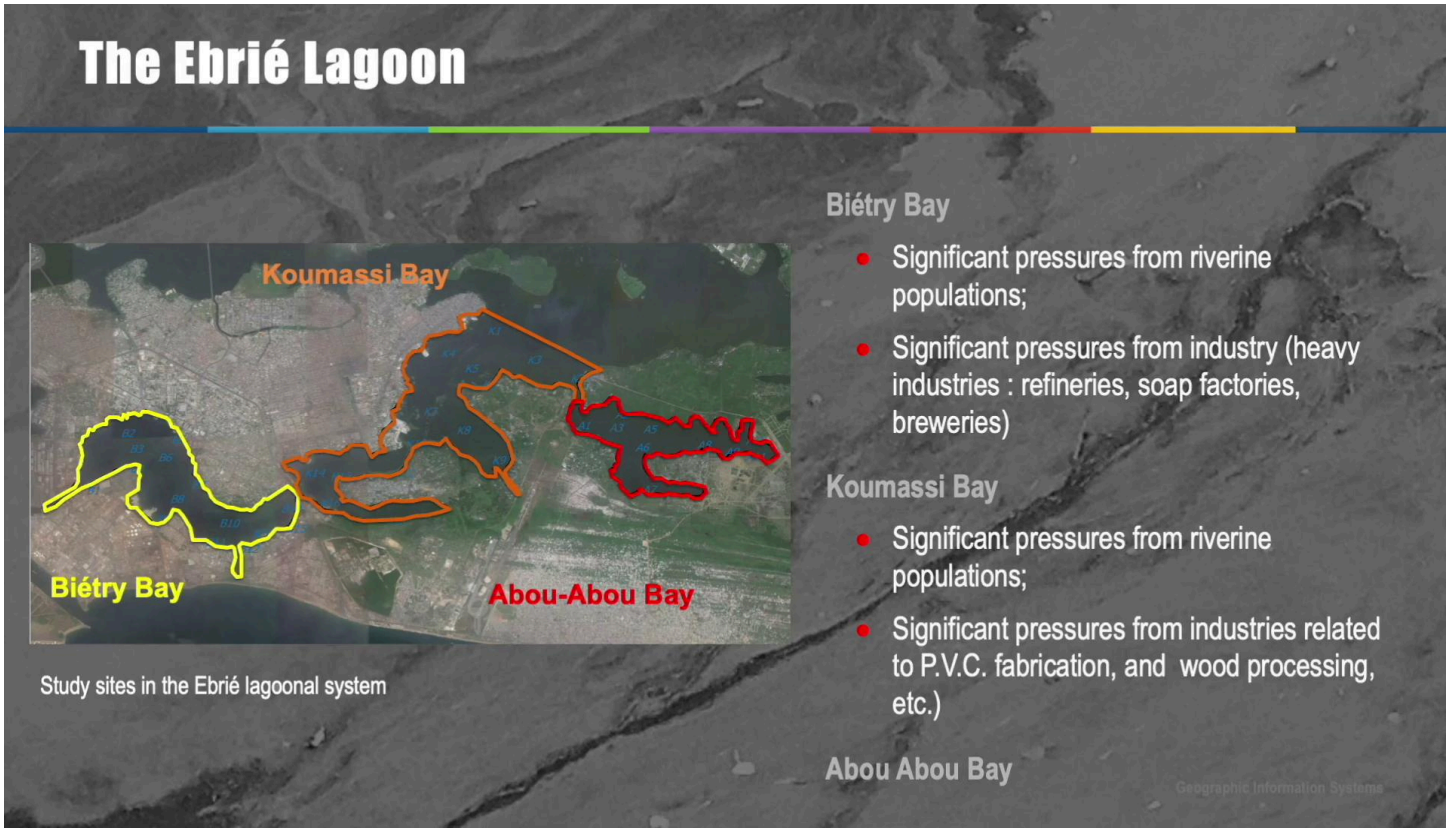


The GIS tools allow to establish a database of chemical analysis of cartographic or satellite data, to analyze, combine data and pictures in order to locate the level of pollution and determine vulnerable sites, to raise the awareness of the decision-makers and populations to adopt a citizen behavior to restore the Ebrié lagoon system.

Notes

Summary

4m 15s

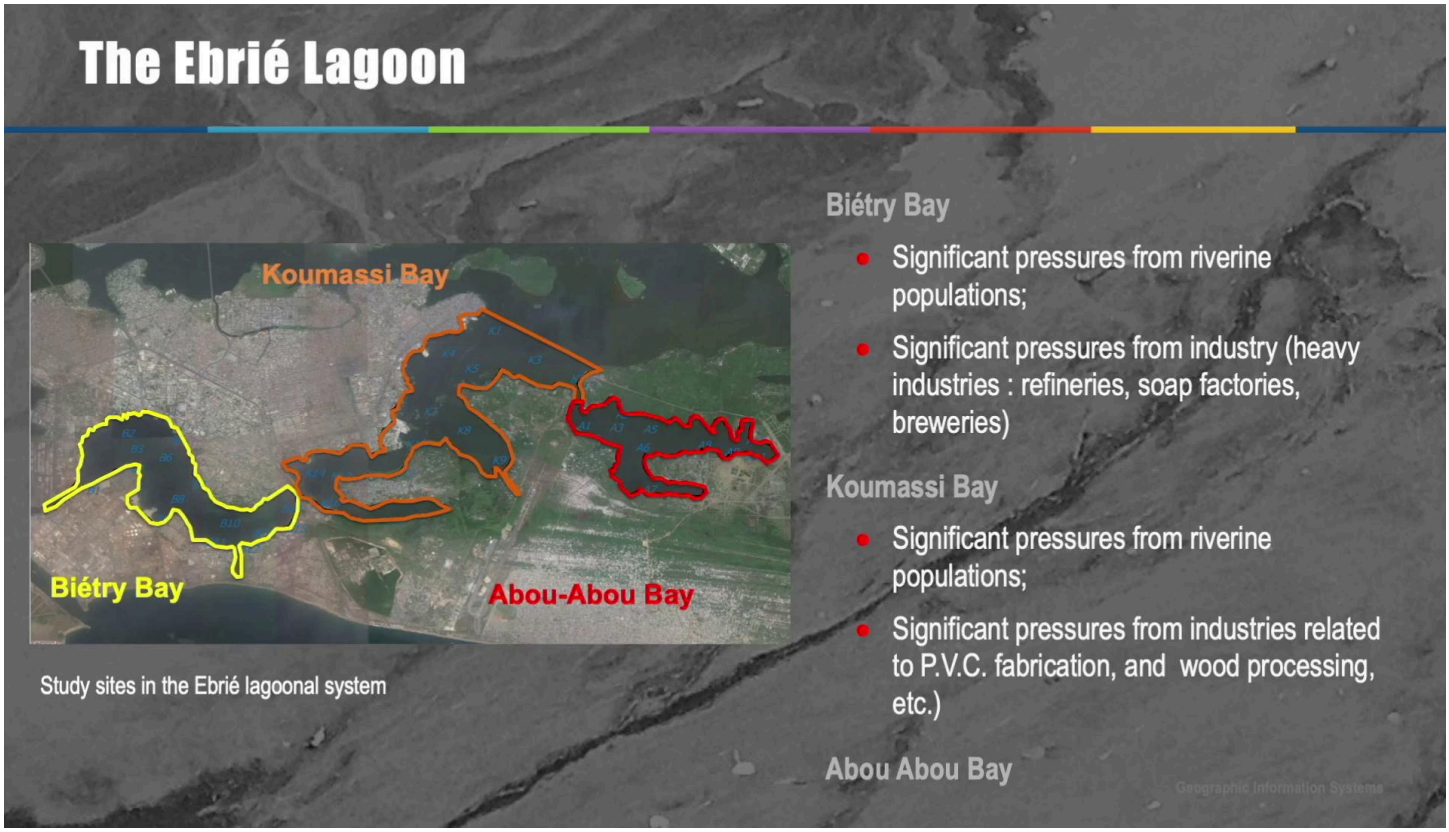


Now, let's describe the Ebrié lagoon around Abidjan. The selected study site crosses the Abidjan agglomeration from West to East. The remarkable economic development of the Ivory Coast has been accompanied since the 60s by a strong urbanization which has not spared the economic capital of Abidjan which is built on the banks of the Ebrié lagoon. This urbanization, which led to a high concentration of population around the Ebrié lagoon system led the public authorities to propose a master plan for the development of the city of Abidjan which led to the occupation of the land. Outside of the Banco national park, all the banks of the Ebrié lagoon system are used by humans. There are agricultural developments, pastures, lowland crops, cash crops, urban development, houses, road networks and constructions of... companies and factories. This study was accentuated on 3 bays of the Ebrié lagoon. To the West, the Biétry Bay, in the center the Koumassi bay and to the East, the Abou-Abou bay. These were chosen for their sensitivity to the strong pressure of the population and the various industrial activities developed around them. Near the Biétry bay there are heavy industries such as refinery soap factories, breweries and so on.

Notes

Summary

4m 53s

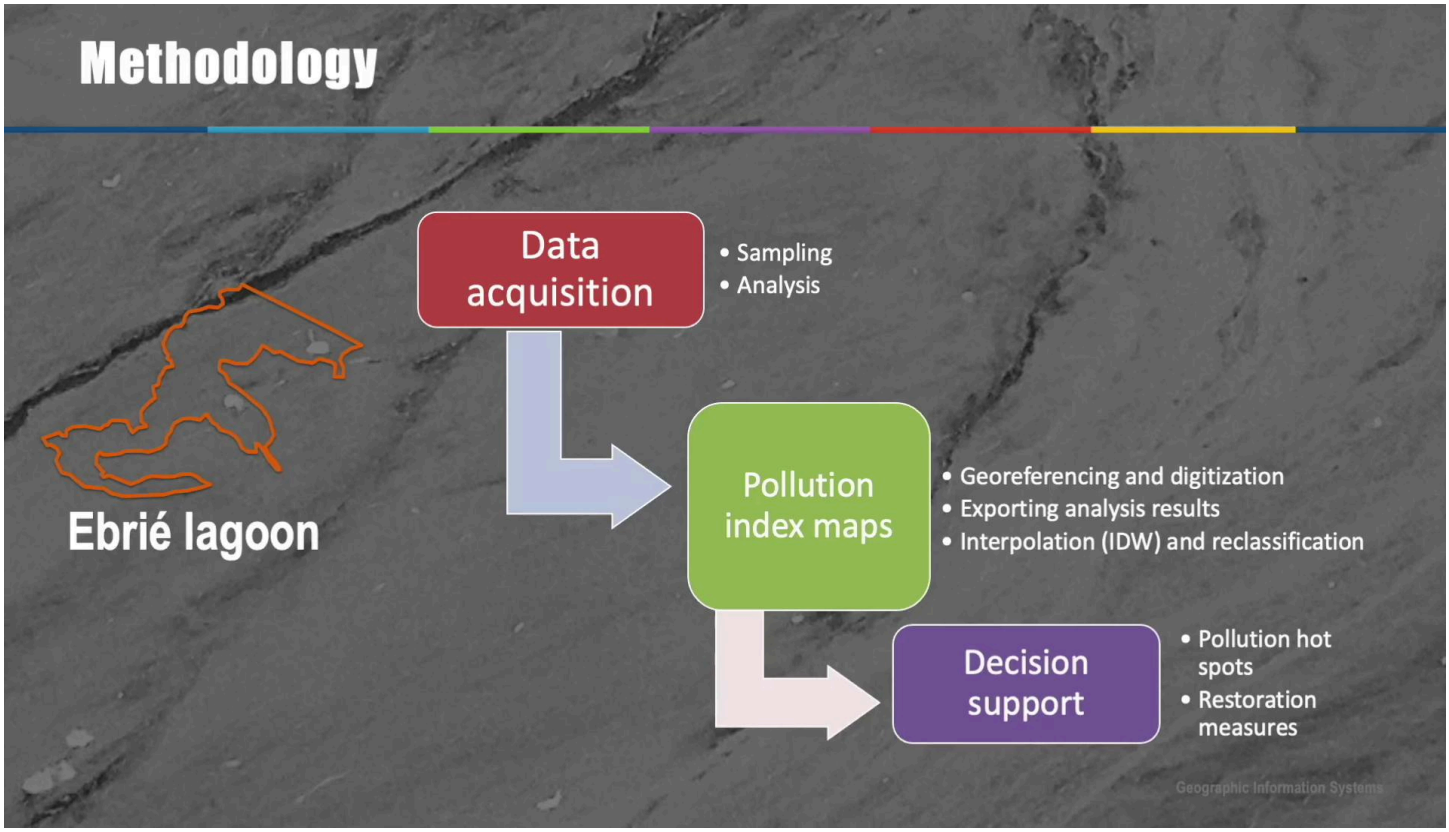


In the case of the Koumassi bay, there are small industries and companies manufacturing PVC, processing wood and so on. The Abou-Abou bay remains the least industrialized and more inhabited.

Notes

Summary

6m 30s

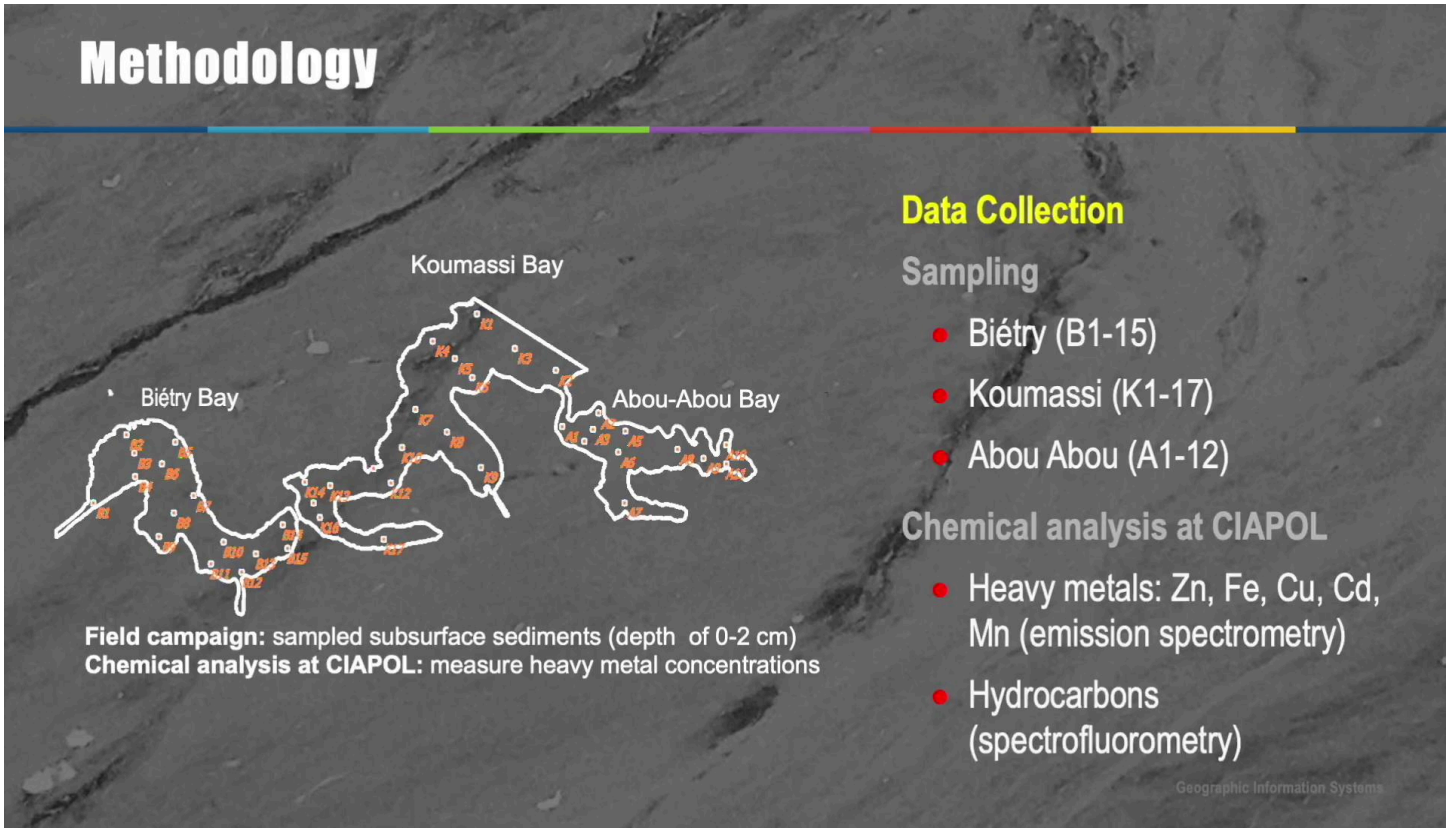


It is surrounded by mangrove and coconut plantations. The methodological approach adopted consists of three steps. First, the data acquisition. Second, the development of pollution maps. Thirdly, help in decision making.

Notes

Summary

6m 45s



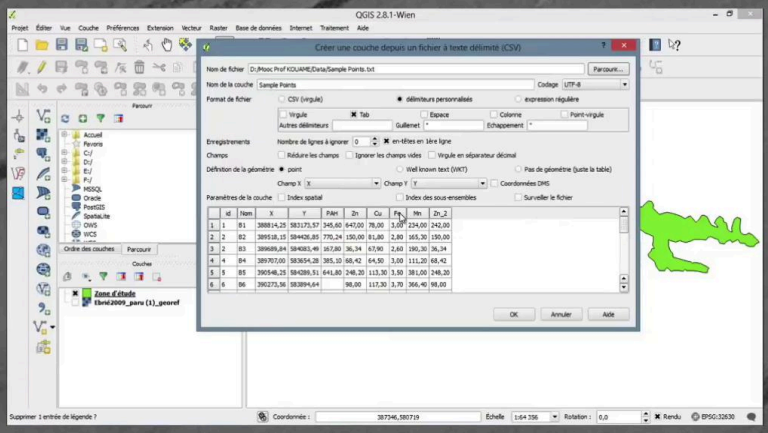
These different steps will be described in the following sections. In 2001, sub-surface samples of 0 to 2 cm were collected around domestic waste and industrial activities sites in the 3 bays, that is to say the Biétry, Koumassi and Abou-Abou bays. The different positions of the samples XY are recorded using a GPS. In the chemical laboratory of the Anti-Pollution Ivorian Center CIAPOL, samples are processed and the measurement of the concentration of the different metals is done by ICP emission spectrometry. The measured parameters are the zinc, the iron, the copper, the cadmium and the manganese. As for the chemical analysis of hydrocarbons it was carried out by spectrofluorimetry.

Notes

Summary

7m 17s

Methodology



Exporting Excel file with results from chemical analysis

Mapping pollution indices

- Georeferencing and digitization (study boundaries)
- Exporting data files from chemical analysis
- Interpolation (IDW) and reclassification

Geographic Information Systems

The use of GIS for the development of pollution index maps includes several steps. First, we must georeference the map of the Ebrié lagoon in Abidjan by the defining the projection system, WGS 84, zone 30 North, and entering the X and Y coordinates of the points on the map. This phase is essential so that all the data used project and overlap themselves perfectly. Then, we digitalize the contours of the study area, in particular the Ebrié lagoon in Abidjan. This is necessary for the interpolations not to be carried out beyond the study area. Another very important step is the exploitation of the analysis files. Thus, by using the X and Y coordinates of the various points and the concentrations of heavy metals associated with them, it is possible to interpolate the variables and develop maps.

Notes

Summary

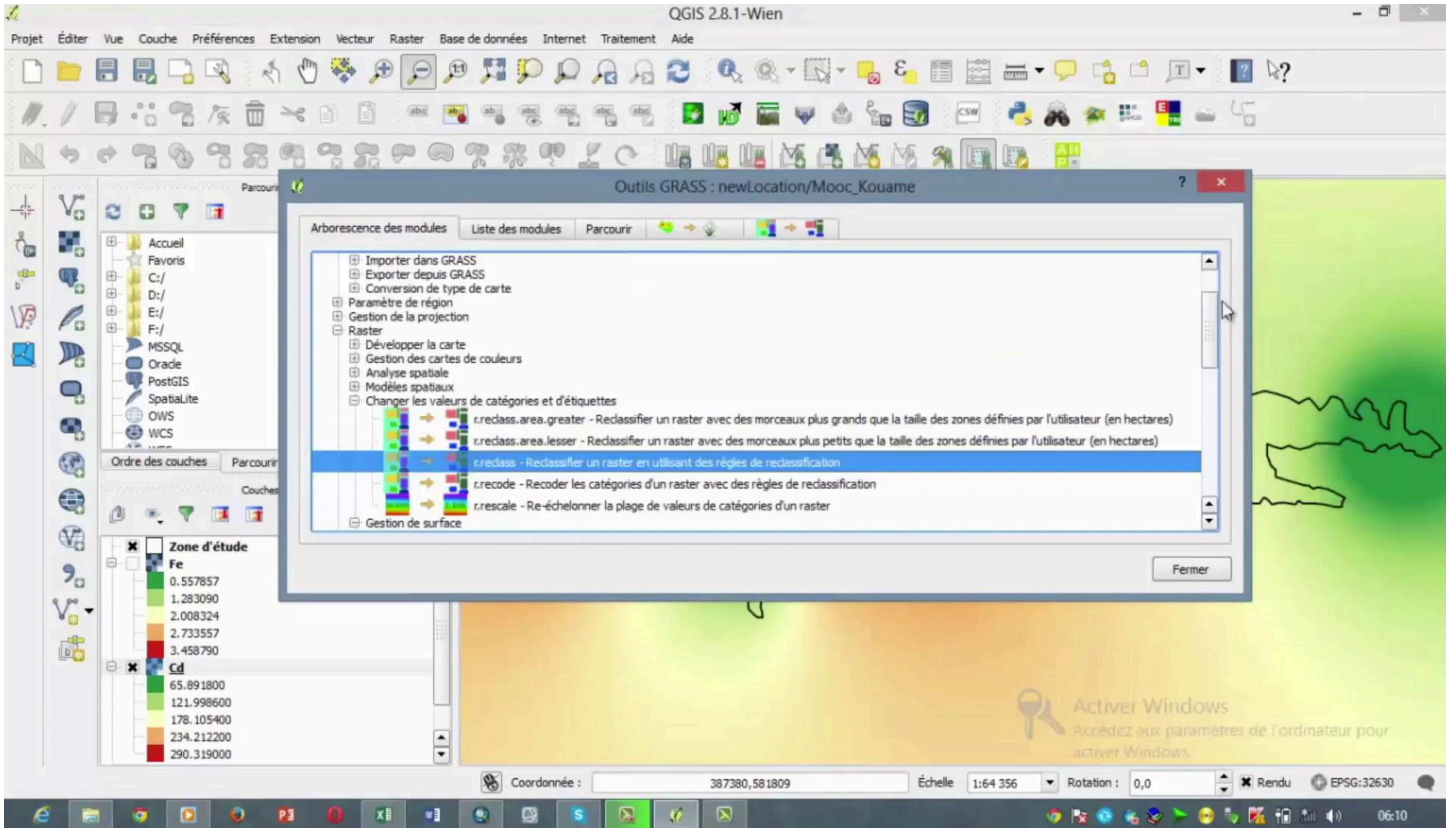
8m 13s

Why interpolate and why reclassify? The data are interpolated to illustrate the geochemical spatial tendency in the lagoon. Thus, given the density distribution of the collected points sowing in the lagoon, the method reverses the distances and hence I,D and W, which relies on the 3 closest points within the study area and that suits best was used. Why reclassify? It is question of defining pollution levels which are linked to heavy metal contents and which are recorded in the water. 4 levels or classes have been defined. The level 1 expresses very low levels of heavy metals. Level 2, 3 and 4 correspond respectively to low, high and very high levels of heavy metals. These levels correspond to significant levels in the natural variation observed within each parameter. These 4 values thus defined do not obey an international standard.

Notes

Summary

9m 15s

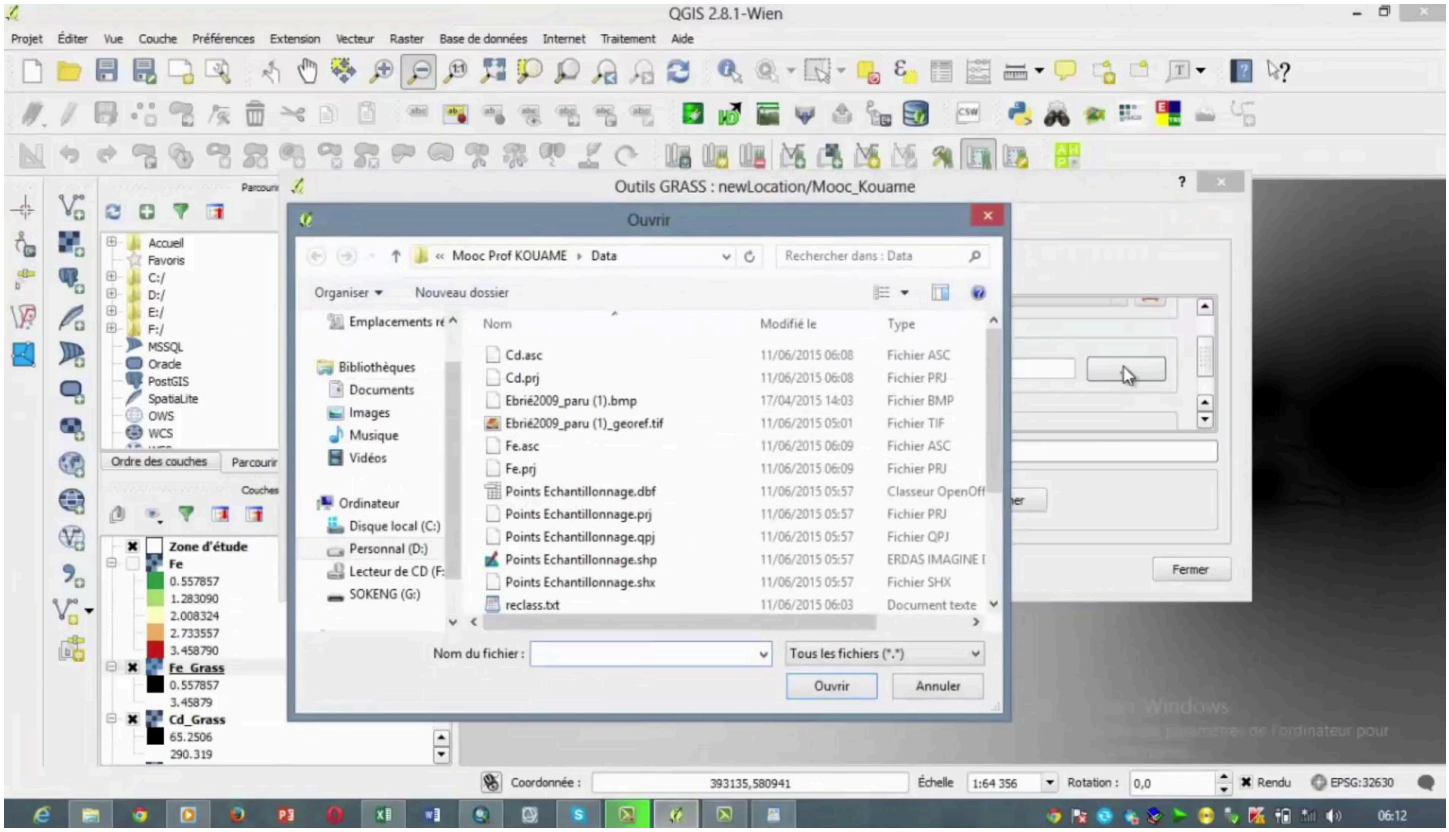


They have a purely local character whose interest is to compare the bays with each other. From QGIS, we have exported the attribute tables and you see the values of cadmium, copper and iron. And this table will therefore be used to interpolate from the inverse distance method. So we choose cadmium and we add it. We are dealing with cell size parameters and we give a name to save the map resulting from the interpolation. And the interpolation has just been carried out. In the tool, the same tool, we will do the same exercice so that you to understand it well with iron. Always ensure that you have chosen sizes for the sampling which is set here at 50 m. And we do the same interpolation to do it. So we have maps that have been established and we will take the iron map to display it in different grids levels or in color. Here, we display it in color. We also take the cadmium map which we also display in color. You will see that we always reverse so that the high rates are displayed in red. So here are the interpolation maps from the attribute table which we imported from our GIS software. So we are going to reclassify.

Notes

Summary

10m 20s

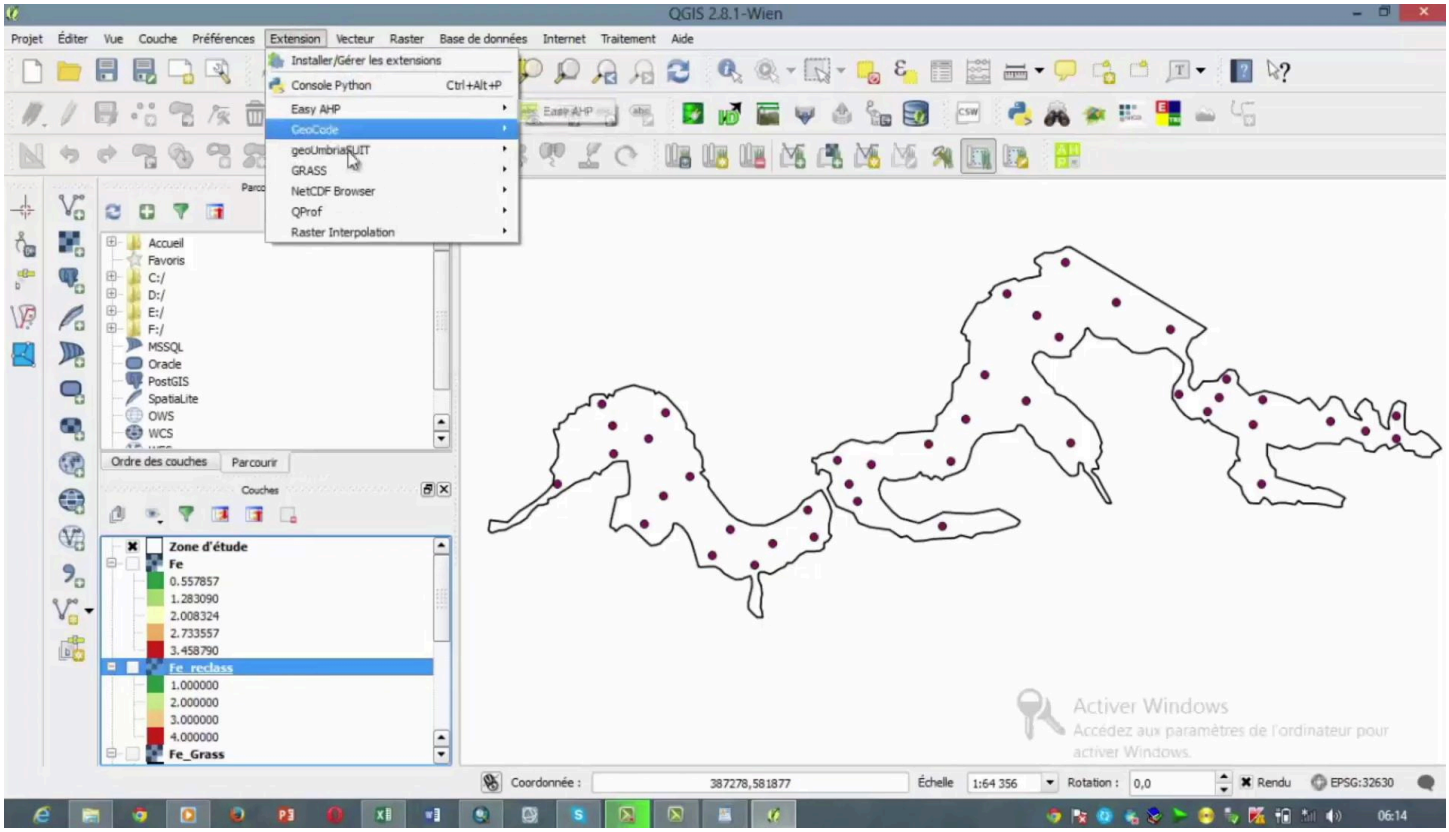


And for this, for the reclassification, we will choose the reclassification tool and before that, we must import the file to convert it into a GRID file And so we will take the cadmium and convert that cadmium. But, before that for the reclassification, we need a file by giving the output name and we need a file which is a text file. Here we have just done the conversion of the cadmium. We will do the same for the iron and so we give an output file name to convert it to a GRID file that is to say in a matrix file. After that, we have the 2 maps obtained that is to say the iron and the cadmium. We are going to use this table which is a reclassification table. You see here the iron component and the cadmium composition as well as the other metals. And so we have 4 levels, level 1, 2 and 3, and to do that, we need to use, as I said earlier, a file with decision rules so we choose the iron. For the decision rules, we need a text file and these text files, we will create them. It is a text file which includes all the values from the table I showed you earlier that is to say for the iron, from 0 to 1, it is the level 1 class, from 1 to 2, it is the level 2 class and from 2 to 2, it is the level 3 class from 3 to 4, it is the level 3 class.

Notes

Summary

11m 59s

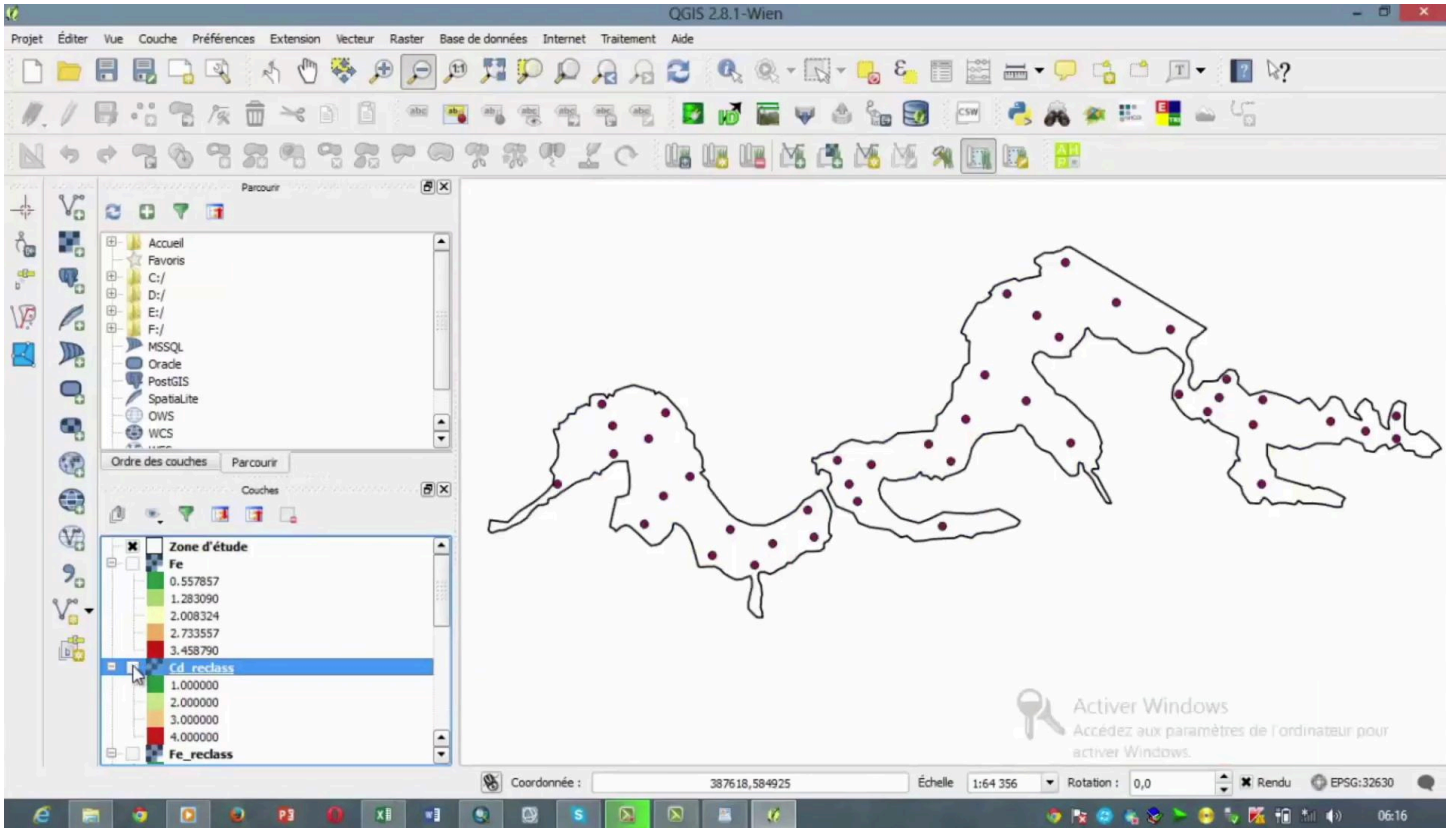


So we have these different levels that we will use for the reclassification of our map. We will give an output name, so the iron. So we have the output file name where to give the image not yet reclassified. So we have reclassified the iron. And we will execute the operation and so we have finished doing the reclassification which consisted of using different... the different intervals defined to assign a level of pollution to each class. Level 1 being the very low level. Level 2, 3 and 4 being the low high and very high levels. And here we go back to the cadmium. But before that, we will open the map that we have just reclassified which is the reclassified iron. We will display it in colour and with the Pseudo table in a flat strip and we will always reverse to put the highest level in red. We have to make sure that the mode that is used to generate the color palette is the mode that concerns the equal intervals. So, we have 4 classes and we classify the images to have these different levels. The map has just been built. We apply it and that will allow us to have the map of reclassified iron levels with the different levels that you see 1, 2, 3, and 4.

Notes

Summary

13m 59s

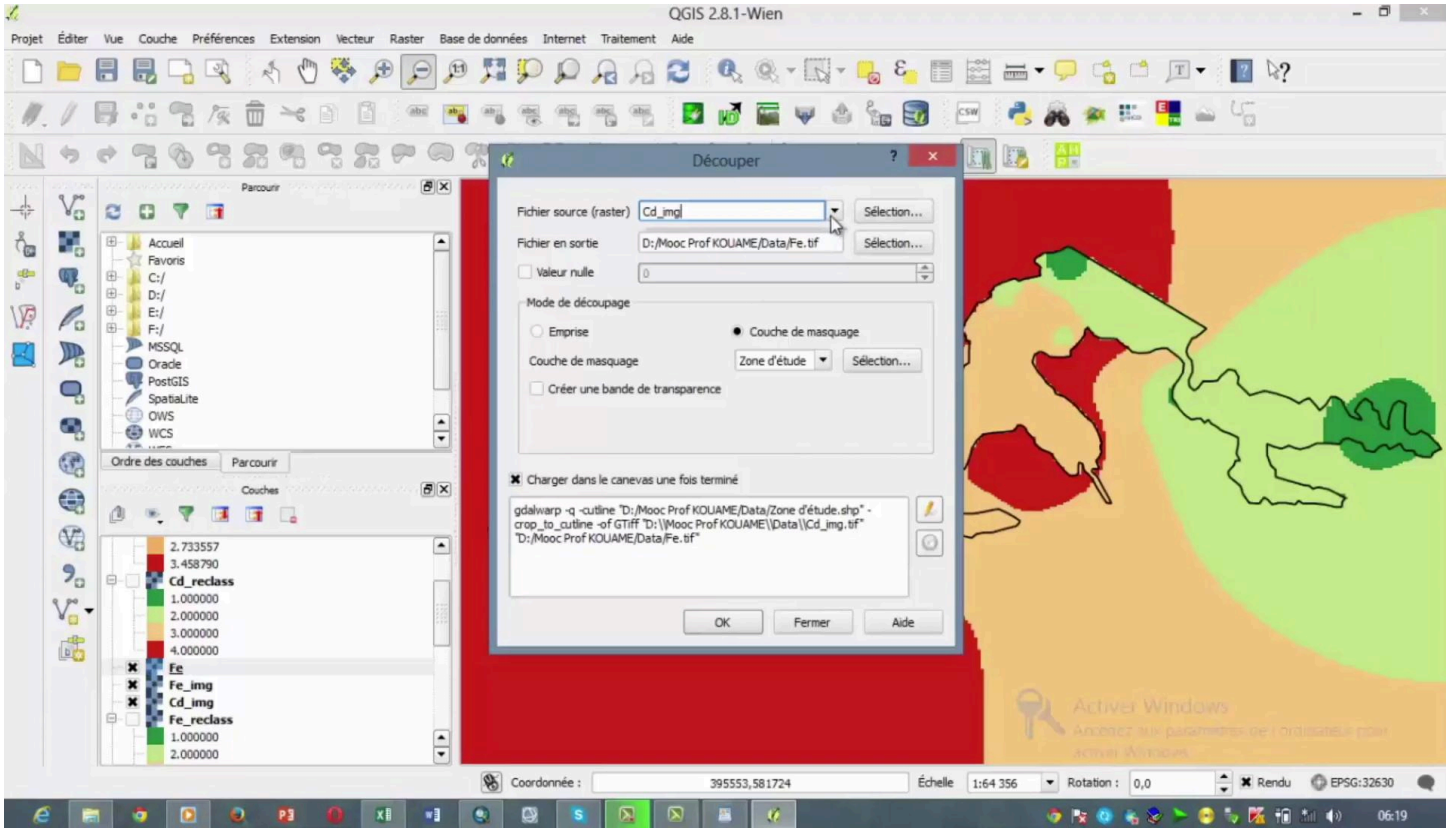


We take the same exercise, here we will apply it for the cadmium. We will choose the cadmium. We will give the output name for the reclassification. For the cadmium, you have the intervals that are provided here and that we will introduce. So we will have 100, from 0 to 100 from 100 to 170, and so on, so we fill it to have the values of the thresholds that correspond to the levels that we have displayed which are the level 1, level 2, level 3, level 4 which correspond to different thresholds fixed for the reclassification of the cadmium. These elements are used to classify the different heavy metals that we had to analyze at the level of... at the level of the region of Abidjan. And so we have reclassified the cadmium. We can also display it by grid level as it now appears but we can display it using a color table. And it is the pseudo color. So we will use this table. Equal intervals. We bring it to 4. Always remember to reverse the colors to put the strongest class in red. We then click on OK. We have just reclassified the cadmium. You see that the interpolation goes beyond the area, that is to say beyond the lagoon so we have to cut that is to say we have to circumscribe the interpolation areas to the Ebrié lagoon only and not in the continental domain.

Notes

Summary

16m 02s

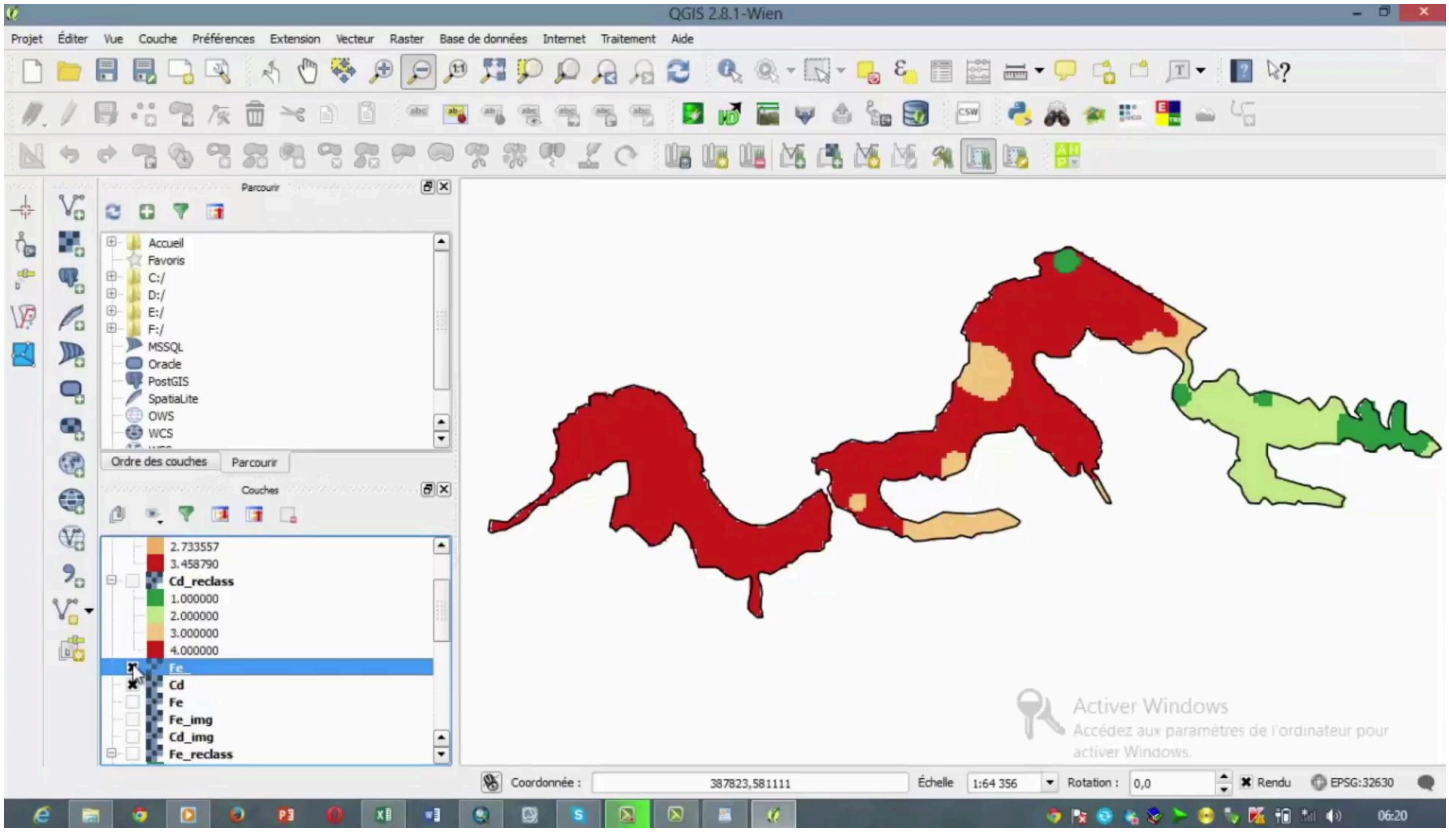


For this reason, we will choose the reclassified pictures but these images must be converted beforehand into a file... as an image file so we will save these new images, which have been saved into image file, into GRID files which will allow us to cut afterwards. And here we look for the directory in which we can save these images and this is the case of the cadmium in image, in image mode and so it is in TIFF or GeoTIFF that we save these information. After the cadmium, we do the same for the iron. We save the iron which is converted into a TIFF format in the work directory. We also save those data that we just have and we will add these different maps that is to say the cadmium and the iron converted into picture mode in our display plan. We can see how these diffferent concentrations evolve applying mainly on the iron and the cadmium and we will now cut for example the iron or cadmium map, the cadmium. The output file is given as an example. We will name the output file. We use a masking layer which is the study area which has been digitized and we apply this study area which allows to cut the area and to have only the lagoon plan with the pollution rate.

Notes

Summary

18m 17s



We repeat the same operation for the second element which is the cadmium. And that way we cut out the pictures. And this treatment must be carried out for all the metals that have been analyzed that is to say, on top of the cadmium and the iron, we must also do it for the manganese, the zinc, the copper and for the hydrocarbon content. So we have cut our area and we have different concentrations that we can see which vary according to the items. The two examples taken are the iron and the cadmium which have allowed to have the spatial distribution of the different maps.

Notes

Summary

21m 15s