



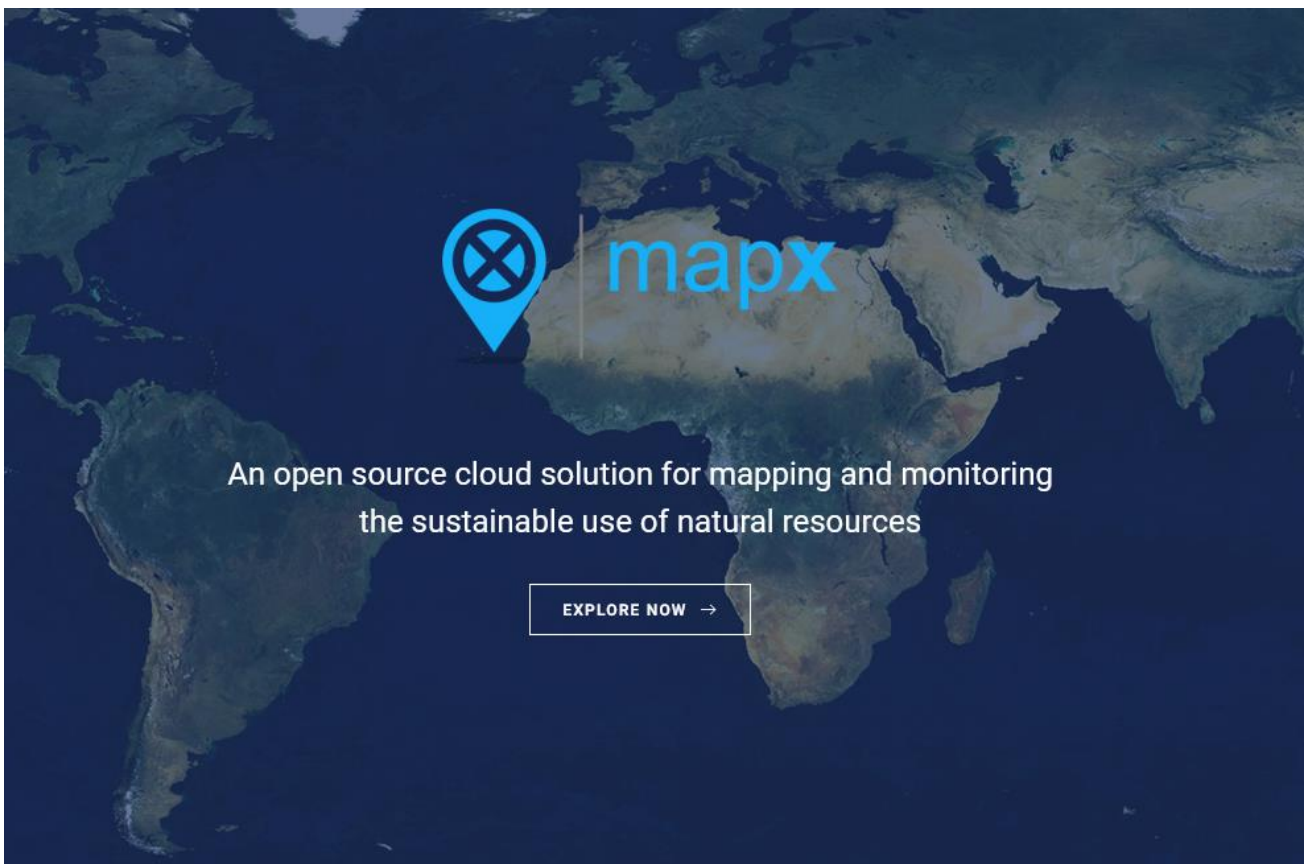
UNIVERSITÉ
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environment



mapx

Automating the integration of pollution data
into MapX (an open data platform for
mapping and monitoring the sustainable use
of natural resources)



Certificate in Geomatics

Internship report

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TABLE OF CONTENTS

Abstract.....	4
Résumé	4
1 Introduction.....	5
1.1 GRID – Geneva	5
1.2 MapX.....	5
1.2.1 Presentation.....	6
1.2.2 Data visualisation	6
1.2.3 Data interactivity.....	7
1.2.4 Data sources and integrity	9
1.3 Aim of the internship	10
2 Projects	11
2.1 Persistent Organic Pollutants.....	11
2.1.1 Presentation.....	11
2.1.2 Method.....	11
2.1.3 Results.....	15
2.1.4 Conclusions	24
2.2 African Chemicals Observatory.....	25
2.2.1 Presentation.....	25
2.2.2 Method.....	25
2.2.3 Results.....	27
2.2.4 Conclusions	30
2.3 Training material.....	30
3 Summary and conclusion of the internship.....	31
4 Bibliography.....	32
5 Acknowledgments	33
6 Annexes	34
Methodology developed by the UNEP and the GRID-Geneva	34
ChemObs data collected	34
Type of data at a national scale and its source	34
Organisation of the folders for Model builder – POP’s project	38

TABLE OF FIGURES

Figure 1: Visualisation of the modelled Exposures of PM2.5 - WHO layer in the home project.....	7
Figure 2: Baseline water stress layer is displayed here. When you click on the map, information about data is displayed.....	8
Figure 3: Dashboard of the ASGM sites in Eastern DRC showing the number of miners and the proportion of children and women in the mine.	8
Figure 4: Example of a slide from the WESR story map executive summary located in the project called "HOME".....	9
Figure 5 : Final model done to obtain the risk map of Mozambique.	17
Figure 6: Natural disasters in Mozambique according to the UNEP-GRID methodology.....	18
Figure 7: Natural and human related components of the model of Mozambique.	19
Figure 8: Remote environmental screening, also called risk map, in Mozambique.	20
Figure 9: Remote environmental screening published into MapX platform on the 24th of July 2019 and last modified on the 19th of November 2019.	21
Figure 10 : Dashboard for PCB sites in Algeria.....	23
Figure 11: Dashboard of PCB sites located in Lesotho.....	23
Figure 12: Senegalese population per region (Babacar, 2018).....	28
Figure 13: Pollutant layer showing the pesticides used in the agricultural domain (tones) over the years and the fertilizer consumption in g/day (FAO, 2018) as well as the mercury concentration in the environment (Gerson et al., 2018) and the lead used in the car battery at a national level in Senegal (Tür et al., 2016).	28
Figure 14: Senegalese air pollution layer showing the economic impact and the concentration of PM10 and PM2.5 in the air (WHO, 2016 and Roy and Rana, 2016).	29
Figure 15: Senegalese socio-economic layer showing the GDP distribution of pollutant industries (WTO, 2017), the Senegalese population per gender and age (DHS, 2016) as well as the diet in g/day (FAO, 2008).	29
Figure 16: Modified dashboards produced by Pure Earth for the region of Kedougou, Senegal.....	29

LIST OF TABLES

Table 1: Sources of the data used in the model developed by the Grid-Geneva to assess the environmental risk per country.	13
Table 2: Table representing on the first two columns how the FP* and Fe* where calculated and what they represent. The last two columns show which layers were published, what their names are and in which format. Abstracts and views are availabale in on MapX.	16
Table 3: Widget content and type of representation of the widget included in dashboards	22
Table 4: Resume of data inventoried in Kenya, Senegal and Tanzania	26
Table 5: Name of the layer published in MapX, the type of view, the read access group and the sources.	27

ABSTRACT

This report summarises the five months internship done at the GRID – Geneva in order to complete the geomatic certificate of the University of Geneva. It presents the three projects conducted during the internship that play a part to the growth of the MapX platform, an open data platform for mapping and monitoring the sustainable use of natural resources, by uploading processed data into the platform. These projects consist of the automatisisation of data processing and inventorying data linked to chemical pollution as well as the update of the teaching material.

RÉSUMÉ

Ce rapport résume le stage de cinq mois accompli au GRID - Genève afin de compléter le certificat de géomatique de l'Université de Genève. Il présente les trois projets effectués pendant le stage qui avaient pour but de contribuer à la croissance de la plate-forme MapX, une plate-forme de données ouverte pour la cartographie et le suivi de l'utilisation durable des ressources naturelles, en téléchargeant les données traitées sur la plate-forme. Ces projets consistent à l'automatisation du traitement de données et de l'inventaire des données liés à la pollution chimique ainsi que la mise à jour du matériel pédagogique.

1 INTRODUCTION

This report presents the missions realised for a five months internship, between July and November 2019, at the GRID (Global Resource Information Database) in Geneva and more particularly for the MapX platform. This internship is part of the complementary certificate in geomatics of the University of Geneva, a training of 30 ECTS which includes 18 ECTS devoted to courses and 12 for which research work or an internship must be carried out.

1.1 GRID – GENEVA

The GRID is a partnership between the United Nations Environment Programme (UNEP), the Federal Office for the Environment (FOEN) and the University of Geneva (UNIGE), created in 1998, whose main role is to convert data into information and knowledge in order to support decision-making on environmental issues.

The GRID is involved in several projects at different scales, the main environmental themes of which are biodiversity, climate change, water, energy, pollution, land cover, disaster risk reduction, mining and global boundaries. It produces multiple resources such as data, data platforms, publications, visual elements (maps, graphics, posters), storyboards or multimedia content using geospatial analysis tools such as remote sensing (SR) and statistical analysis, geographic information systems (GIS) integrated into spatial data infrastructures (SDI) (“UNEP - GRID,” 2019). The GRID has developed several platforms including MapX that is used to map and monitor the sustainable use of natural resources (“MapX,” 2019).

1.2 MAPX

Developed by the GRID-Geneva in partnership with UN Environment and the World Bank, [MapX](#) allows sharing, analysing and visualising spatial data within a framework of neutrality guaranteed by the United Nations. One of the aims of this platform is to help stakeholders in decision-making by clustering the necessary information and by providing technical solutions that helps to understand complex processes.

1.2.1 Presentation

Originally developed to help manage and ensure transparency in the use of natural resources, MapX has expanded its scope and is now part of a broader framework that concerns sustainable development, biodiversity, natural risk management and various environmental and humanitarian issues. MapX is currently involved in more than 300 projects and has approximately 2200 data layers.

MapX allows to visualise and analyse geospatial data which are registered into various projects, also known as dedicated environments. They consist in geographical areas such as world or a country, as well as programs such as UN Biodiversity Lab or Integrated Strategic Environment Assessment project that spread over many countries.

The geospatial data in MapX can be represented by vector or raster tiles, custom codes, custom styles, dashboards, time sliders, story maps. Additional features also include interactive tools such as dashboards, fixed or interactive dashboards that present data as widgets in parallel to the map, or story maps that are more complex and are a succession of slides mixing views, text and various multimedia contents for communication purposes.

MapX is an open access platform but, depending on the license, not all data are downloadable and modifiable. Indeed, the ability of a user to view and modify data depends on the rights the user has in a particular project. The several user statuses existing, public, member, publisher and administrator, guarantee an organized management as well as the confidentiality necessary for sensitive data.

1.2.2 Data visualisation

MapX allows the visualisation of geospatial data in an interface that is easily understood by a user with limited GIS skills. Data is visualised through views, based on source layers stored in the MapX database for vector data or from external sources for raster data. Each view has a style that can be modified by users with editing rights on the source layer.

In addition to public views, a user can load the prepared data layers into MapX and create views based on these layers. MapX supports many formats (GeoJSON, GeoPackage, SQLite, ESRI Shapefile, KMLDFX CSV, GPX) and layer loading is rapid as well as the creation and configuration of a view.

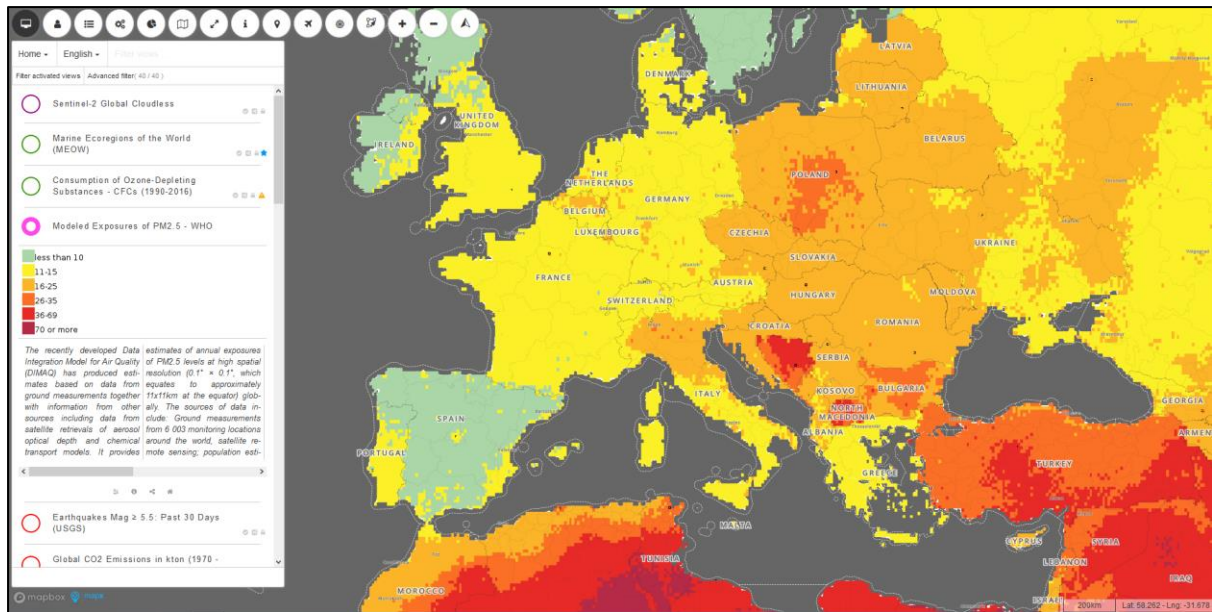


Figure 1: Visualisation of the modelled Exposures of PM2.5 - WHO layer in the home project.

1.2.3 Data interactivity

The MapX interface has a toolbar (top left), a legend box with the list of views (left), a scale and mouse position (bottom right). When the user clicks on the map, the data information is displayed at the selected location. The toolbar allows several operations such as displaying the list of views, displaying the toolbox, displaying dashboards, capturing the screen and other features.

Dashboards allow you to display additional information notably in the form of graphics, images, and textual information. These dashboards can be static or dynamic and are displayed when the user clicks on the map, or they can remain fixed. The creation of dashboards requires programming knowledge (JavaScript).

Story maps are presentations formed by a succession of slides, in which different types of content such as text, images or videos can be inserted. Coupled with the visualisation of data on the map, this information allows story maps to have a visual and dynamic impact. Story maps are used to present research projects, to inform the public about a specific issue or to support a presentation at conferences.

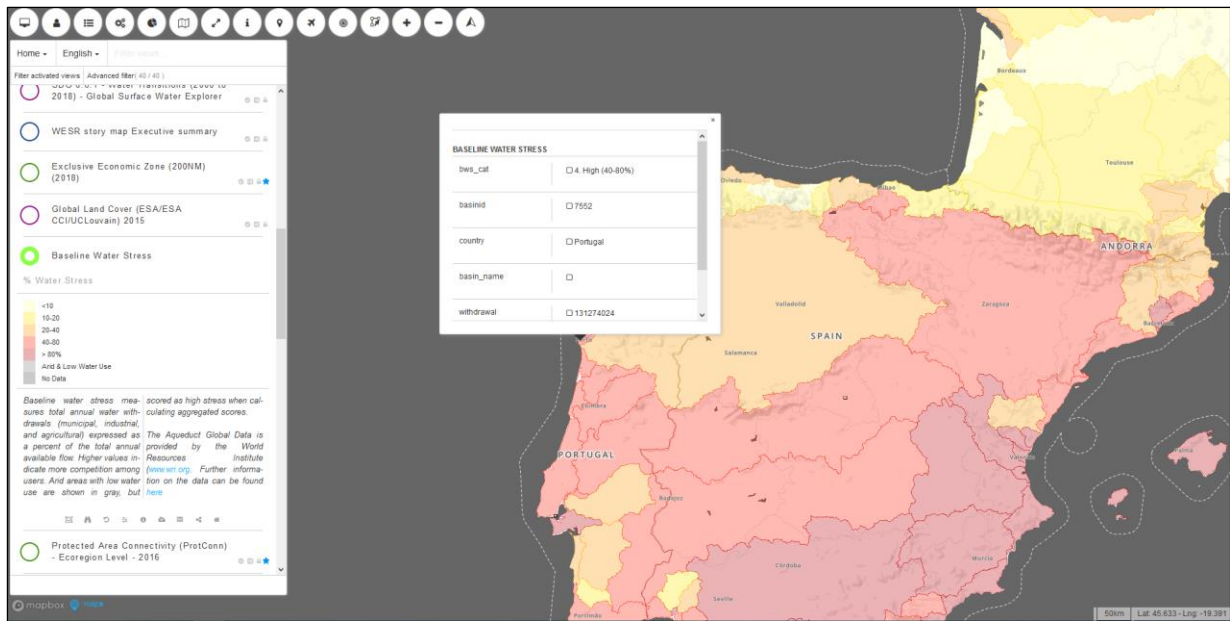


Figure 2: Baseline water stress layer is displayed here. When you click on the map, information about data is displayed.

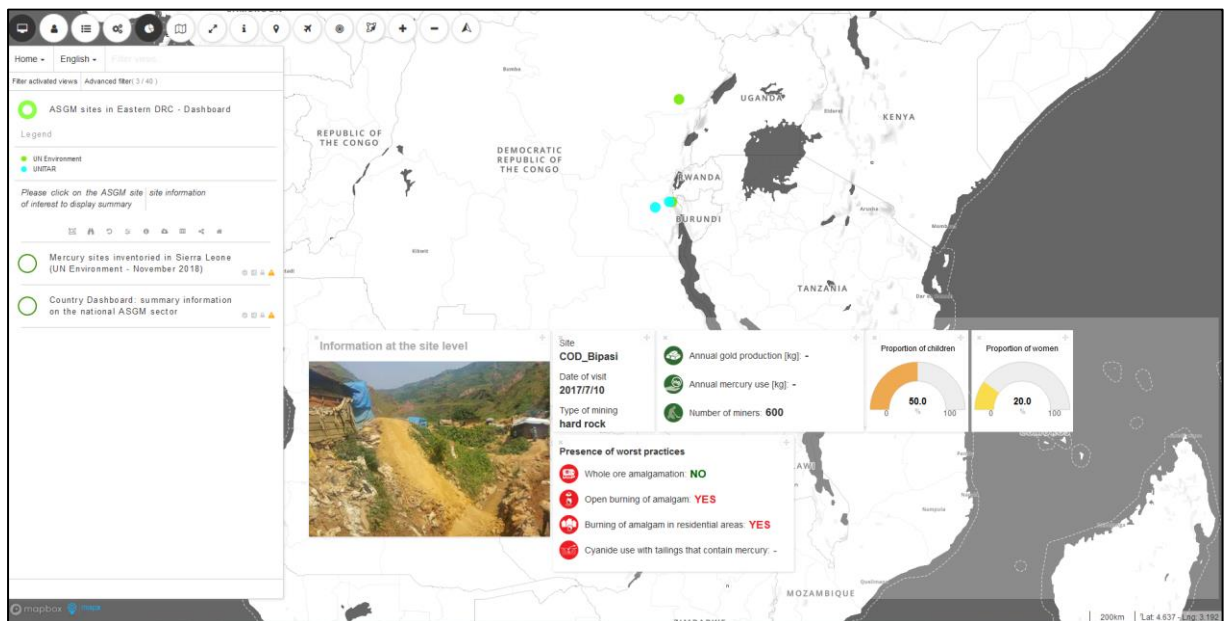


Figure 3: Dashboard of the ASGM sites in Eastern DRC showing the number of miners and the proportion of children and women in the mine.

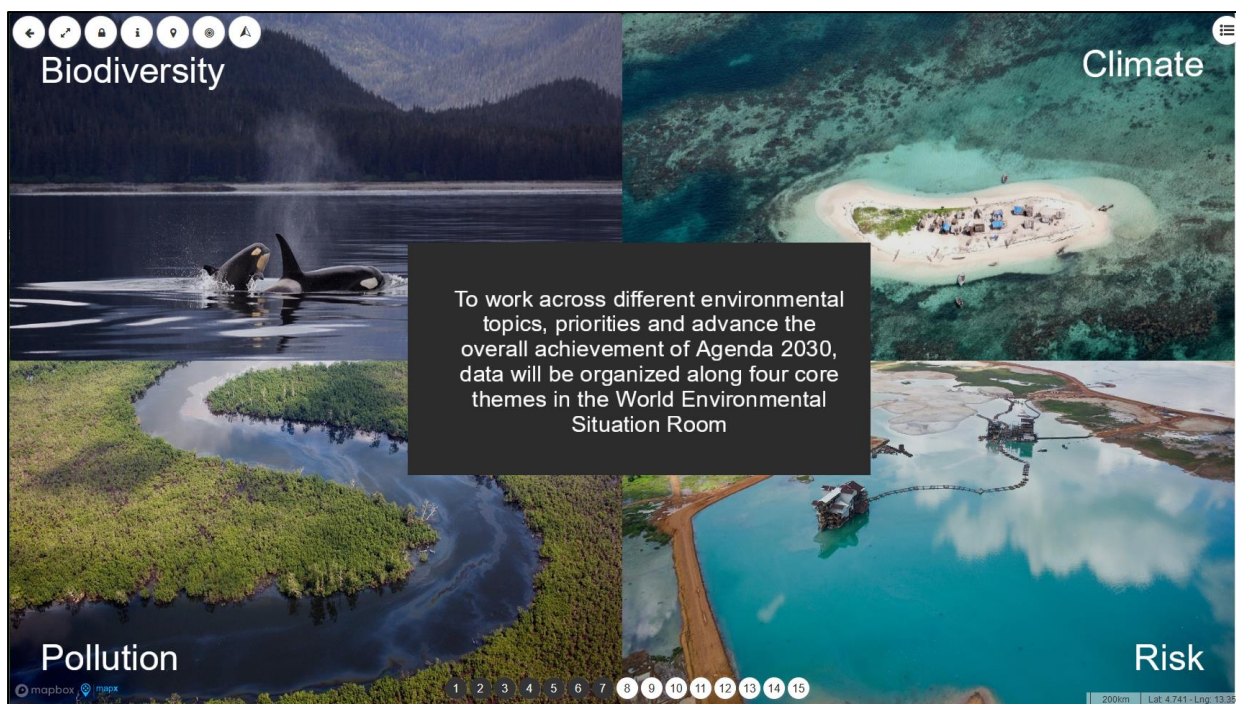


Figure 4: Example of a slide from the WESR story map executive summary located in the project called "HOME".

1.2.4 Data sources and integrity

The data sources published into MapX can be diverse. They may come directly from MapX's partners and clients (governments, non-governmental organisations, international authorities) or from other research, data collection and analysis institutions whose resources are freely accessible.

Data published into MapX must be evaluated by the Data Integrity Assessment Framework (DIAF) process. All layers that are then published in view form should ideally go through this process to ensure their validity, origin and relevance. Metadata must be manually filled in by the user who publishes the layers into MapX. In the case of a raster layer published by WMS, a link to the metadata must be provided.

All these steps are essential to ensure that the data published into MapX is accurate and supports political decision-making both within a country and internationally.

1.3 AIM OF THE INTERNSHIP

The objective of this internship is to put into practice the skills acquired during the complementary certificate courses in geomatics in various concrete projects led by GRID - Geneva and more particularly by the MapX team. With the multiplication of projects that MapX supports, it is necessary to be able to meet the needs of client institutions, which are often diverse and can evolve over time.

These needs fluctuate according to the level of mastery of the GIS tools of the people collaborating on these projects but can also vary according to their progress (data research, publication of the source layers, data processing and analysis, communication). This internship therefore allowed me to participate in several projects and carry out the various tasks mentioned above.

The first mission was devoted to the MapX Pollutants project containing the POP's subproject. The aim of this part of the project was to develop a model for the automatization of data processing that will help prioritise the elimination of PCB sites. The model was developed by implementing environmentally sensitive sites and combined into one large remote environmental screening (50 meters resolution) for each processed country.

The second mission was devoted to the African Chemical Observatory project that aims at developing an integrated guidance to build capacity necessary to set up an integrated health and environment observatory surveillance and information management system. To reach this objective, a data inventory was carried out for 3 countries. Then, data were adapted and prepared to feed the algorithm and at the end, data were published into MapX.

Finally, a part of this internship was devoted to publishing data and creating views in MapX for some projects, but also to translate tutorials for using MapX from English to French and update the pictures of the training material as the MapX platform is in constant change. These tutorials are used by the MapX team during "training sessions" with people who will use the platform.

2 PROJECTS

2.1 PERSISTENT ORGANIC POLLUTANTS

2.1.1 Presentation

The group of chemicals known as Persistent Organic Pollutants (POPs) is globally banned by the Stockholm Convention. The parties to the Stockholm Convention are committed to cease production and use of POPs, including polychlorinated biphenyl (PCB), dichlorodiphenyl trichloroethane (DDT) and perfluorooctane sulfonate (PFO). Specifically, they are required to eliminate the use of PCB in existing equipment by 2025 and ensure environmentally sound waste management of contaminated devices by 2028. To support the disposal and elimination of PCB and DDT, tools to facilitate prioritisation of intervention in storage sites is essential. The FAO developed a [Tool Kit for Environmental Management of Obsolete Pesticides](#) consisting in a set of indicators to assess environmental and pesticide risk associated with storage site and conditions. The information is collected at field level, aggregated in forms provided by the tool kit and processed using store-ranking calculation methods. Once completed, the new developed methodology allows a final site classification based on a combination of site risk level and prioritisation ranking as follows: lower-priority, problematic or critical.

GRID-Geneva, in close relation with the Chemicals branch of UNEP, used this toolkit in twenty-one countries¹ to help prioritising the elimination of pollutant storage sites. In contexts for which information was missing, the GRID-Geneva developed an alternative FAO-based workflow allowing the automation of environmental analysis of storage sites.

2.1.2 Method

The first step of this project was to elaborate a new methodology, based on the FAO methodology to prioritise PCB sites elimination. The FAO toolkit relies on the combination of two risk factors: 1) a Pesticide factor (Fp*) and 2) an Environmental factor (Fe*). The UNEP-GRID Geneva team had to develop a new methodology to assess environmental risk based on the FAO method when data were missing. This methodology resumes and adapts the calculation of the Pesticide factor (Fp*) into a Product factor (Fpr*) and a Quantity product factor (Fprq*) as well as the Environmental factor (Fe*) from the FAO in order to obtain a remote environmental site screening (called also Fe*) build only

¹ Albania, Algeria, Bosnia and Herzegovina, Botswana, Egypt, Eswatini, Ethiopia, Lebanon, Lesotho, Madagascar, Malawi, Montenegro, Mozambique, Morocco, Namibia, Seychelles, South Africa, Tanzania, Tunisia, Zambia, Zimbabwe.

with questions that have a geographical component which can be answered using GIS analysis. Then, due to the GIS-based aspects of this methodology, a strong data constraint has been taken into consideration and only questions for which good quality data exist at a resolution good enough can be used.

After a thorough data inventory done in 2018 based on the previously mentioned constraints, the remote environmental site screening developed by the GRID-Geneva relies on a subset of the original FAO questions. These questions are developed in the [UNEP-GRID methodology document](#) but can be resumed as:

- Natural disasters: Is the store located in a zone prone to natural disasters?
- Human settlement: Is there any human settlement within 500m?
- Urban area: is the store located in urban area?
- Public facilities: Is there public facilities within 500m?
- Water: Is the store located within 500m of a lake, pond, river?
- Crops: Is the store located in 250m of crops and pastures?
- National park: Is it located in a national park or recreational area?

Data were downloaded and processed in order to obtain a remote environmental screening that will replace the environmental risk assessment of the FAO. A model has been created with data obtained thanks to the work of several institutions and the work of UNEP-GRID members, see table 1 for the sources. To automate data processing, the model was created on ArcGIS 10.6.1 using Model Builder, a visual programming language for building geoprocessing workflows. The aim of using Model Builder is to avoid repeating each step of the process for every country and to be more efficient and convenient. Furthermore, a visual model is simpler to understand. The model details each tool used to obtain the final output that shows the level of environmental risk, which is composed of seven intermediate layers, one for each environmental condition. The method and tools used to calculate the risk of each of the selected seven environmental components are described in the [UNEP-GRID methodology](#).

Then, the PCB sites data, collected by the Chemicals branch of the UNEP, were geospatialised and associated with the remote environmental screening in order to obtain the characterisation of each store and the prioritisation of the elimination of PCB sites. The classifications are lower-priority, problematic or critical. Then, depending of the characterisation, the elimination of PCB sites can be planned.

Finally, the remote environmental screening and sites data were published into MapX platform using the conventional tools to upload data into the platform.

Table 1: Sources of the data used in the model developed by the Grid-Geneva to assess the environmental risk per country.

	Layers													
Country	Earthquakes	Cyclones	Hurricane Storms	Landslides Avalanches	Tsunamis	Fires	Floods	Country outline	Human settlements	Urban Areas	Public facilities	Water	Crops	Protected Areas
Albania, Algeria, Bosnia and Herzegovina, Botswana, Egypt, Eswatini, Ethiopia, Lebanon, Lesotho, Madagascar, Malawi, Mauritius, Montenegro, Mozambique, Namibia, Seychelles, Tanzania, Tunisia	UNISDR (october 2018)	UNISDR (october 2018)	NOAA (october 2018)	NASA (october 2018)	UNISDR (october 2018)	NASA (october 2018)	European Commission (october 2018)	UN border 2015 (october 2018)	European Commission (july 2019)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	World Database on Protected Areas - WDPA - (october 2018)
Morocco	UNISDR (october 2018)	UNISDR (october 2018)	NOAA (october 2018)	NASA (october 2018)	UNISDR (october 2018)	NASA (october 2018)	European Commission (october 2018)	UN border 2018 (agust 2019)	European Commission (july 2019)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	World Database on Protected Areas - WDPA - (october 2018)
Zambia	UNISDR (october 2018)	UNISDR (october 2018)	NOAA (october 2018)	NASA (october 2018)	UNISDR (october 2018)	NASA (october 2018)	European Commission (october 2018)	UN border 2015 (october 2018)	European Commission (july 2019)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	Humanitarian OpenStreetMap Team -HOT- (october 2019)	World Database on Protected Areas - WDPA - (october 2018)
Zimbabwe	UNISDR (october 2018)	UNISDR (october 2018)	NOAA (october 2018)	NASA (october 2018)	UNISDR (october 2018)	NASA (october 2018)	European Commission (october 2018)	UN border 2015 (october 2018)	European Commission (july 2019)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	Humanitarian OpenStreetMap Team -HOT- (october 2018)	Humanitarian OpenStreetMap Team -HOT- (october 2019)	World Database on Protected Areas - WDPA - (october 2018)
South Africa	UNISDR (october 2018)	UNISDR (october 2018)	NOAA (october 2018)	NASA (october 2018)	UNISDR (october 2018)	NASA (october 2018)	European Commission (october 2018)	UN border 2018 (october 2019)	European Commission (july 2019)	Humanitarian OpenStreetMap Team -HOT- (october 2019)	Humanitarian OpenStreetMap Team -HOT- (october 2019)	Humanitarian OpenStreetMap Team -HOT- (october 2019)	Humanitarian OpenStreetMap Team -HOT- (october 2019)	World Database on Protected Areas - WDPA - (october 2019)

2.1.3 Results

In total, the remote environmental screening, also called risk maps, was developed for 21 countries that can be divided into four groups. Even though risks maps were processed for the 21 countries, some of them were considered as indicators because the full FAO methodology was conducted for them such as for Algeria, Lebanon and Ethiopia, see table 2. Indeed, this table shows how the product factor and the environmental factor were developed and what they represent for each country. Table 1 illustrates that there is three different type of Fp being: pesticide risk factor (Fp*), quantity-based product factor (Fprq*) and the product risk factor (Fpr*). In Ethiopia only pesticide among other DDT were referenced and Fp* allows to rank the stores according to the level of risk associated with the pesticides contained in each store, their toxicity and their packaging conditions. The more pesticides contained in a store, the more toxic those pesticides are and/or the worse the condition of the packaging materials in terms of leakage, the higher the associated risk. In Algeria and Lebanon, the Fprq* is calculated using the weight of the equipment divided by the weight of the heaviest equipment inventoried in this country due to missing information related to the condition of the equipment. Then, for the other countries and each PCB sites, Fpr* was calculated using the leaking status score or the operational status of equipment score (when there was no leaking status indicated) as well as the weight of contaminated equipment. Table 2 points also that there is two ways of obtaining the Environmental factor. The first one is issued from the FAO methodology and the second one from the remote environmental screening developed by the UNEP-GRID Geneva.

As said in the methodology part, we used Model Builder assess the remote environmental screening the model that is composed of several steps described in detail in the UNEP-GRID methodology and pictured in figure 5. In this report, we wanted to focus more on the results than the methodology that was already developed in the other document. The first important result illustrated is the combination of all the natural disasters just before their union, see figure 6. Then, these layers have been merged with the union tool. In the other part of the model, there is also natural component such as waterbodies as well as environmental components related to human such as crops or protected areas but also more anthropogenic components such as human settlement, urban areas and public facilities. The combination of these places is illustrated in the map of the figure 7. At the end, a union of all the seven sublayers has been made to obtain a risk score using the following formula and illustrated in figure 8:

$$\begin{aligned} \text{Score risk}^* = & (\text{natural disasters} \times 10) + (\text{human settlement} \times 5) + (\text{urban areas} \times 5) \\ & + (\text{public facilities} \times 5) + (\text{waterbodies} \times 5) + (\text{crops} \times 3) + (\text{protected areas} \times 1) \end{aligned}$$

Table 2: Table representing on the first two columns how the FP* and Fe* were calculated and what they represent. The last two columns show which layers were published, what their names are and in which format. Abstracts and views are available in on [MapX](#).

				Name of published views	
		Fp	Fe	Vector	Raster
Ethiopia	Ethiopia	Fp*: Pesticide risk factor	Fe*: Environmental risk factor	-	
Mediterranean countries	Algeria	Fprq*: Quantity-based product risk factor	Fe*: Environmental risk factor	"Country" - PCB sites (UN Environment 2018)	"Country" – remote environmental screening (UN Environment - 2019)
	Lebanon				
	Albania			-	
	Bosnia and Herzegovina			-	
	Montenegro			-	
	Morocco			-	
SADC	Tunisia			-	
	Botswana	Fpr*: Product risk factor	Fe*: Remote environmental screening	"Country" - PCB sites (UN Environment 2019)	
	eSwatini				
	Lesotho				
	Madagascar				
	Malawi				
	Mauritius				-
	Mozambique				
	Namibia				
	Seychelles				
	Tanzania				
Zambia					
AFRO	Zimbabwe			-	
	South Africa			-	

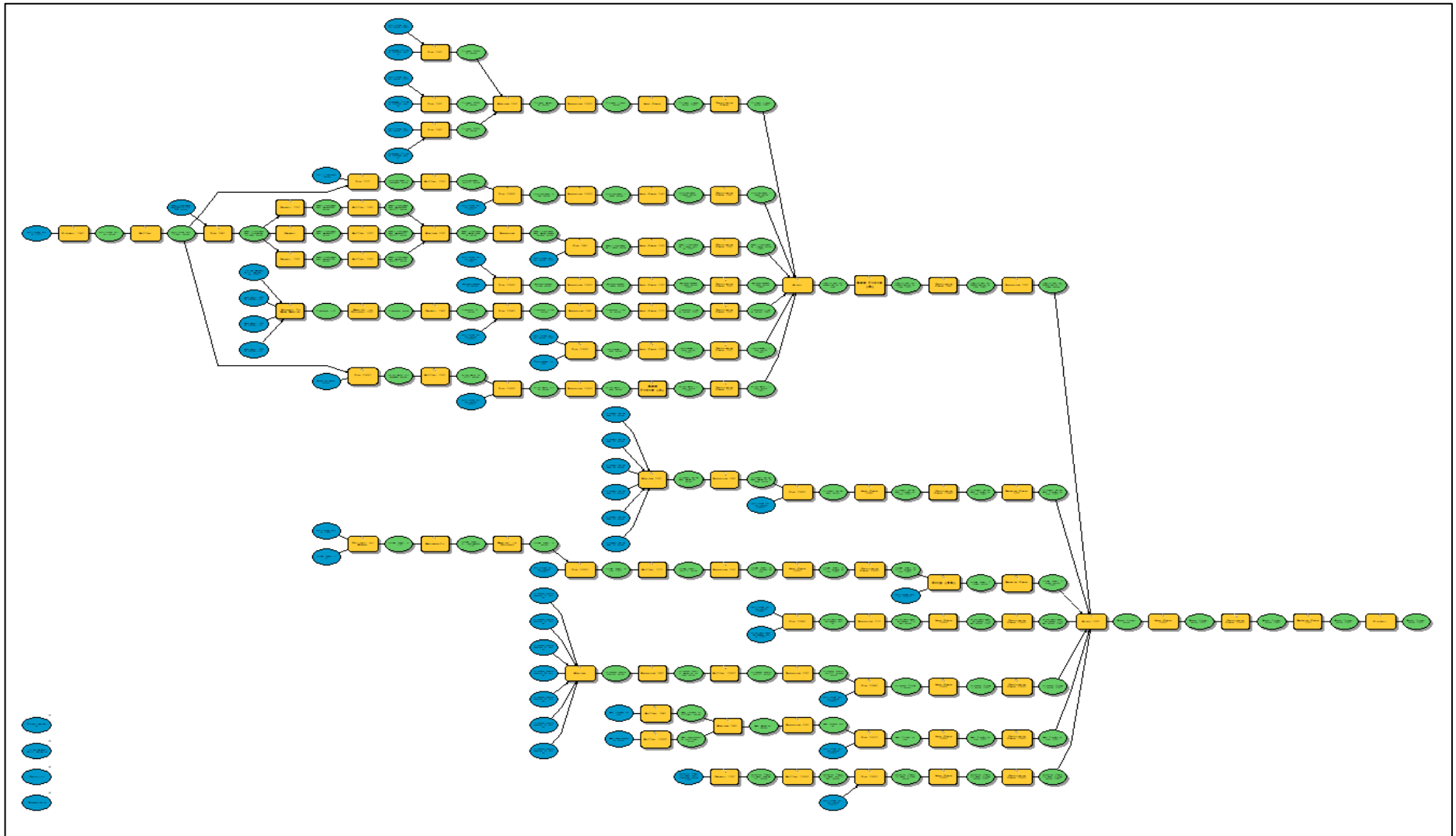


Figure 5 : Final model done to obtain the risk map of Mozambique.

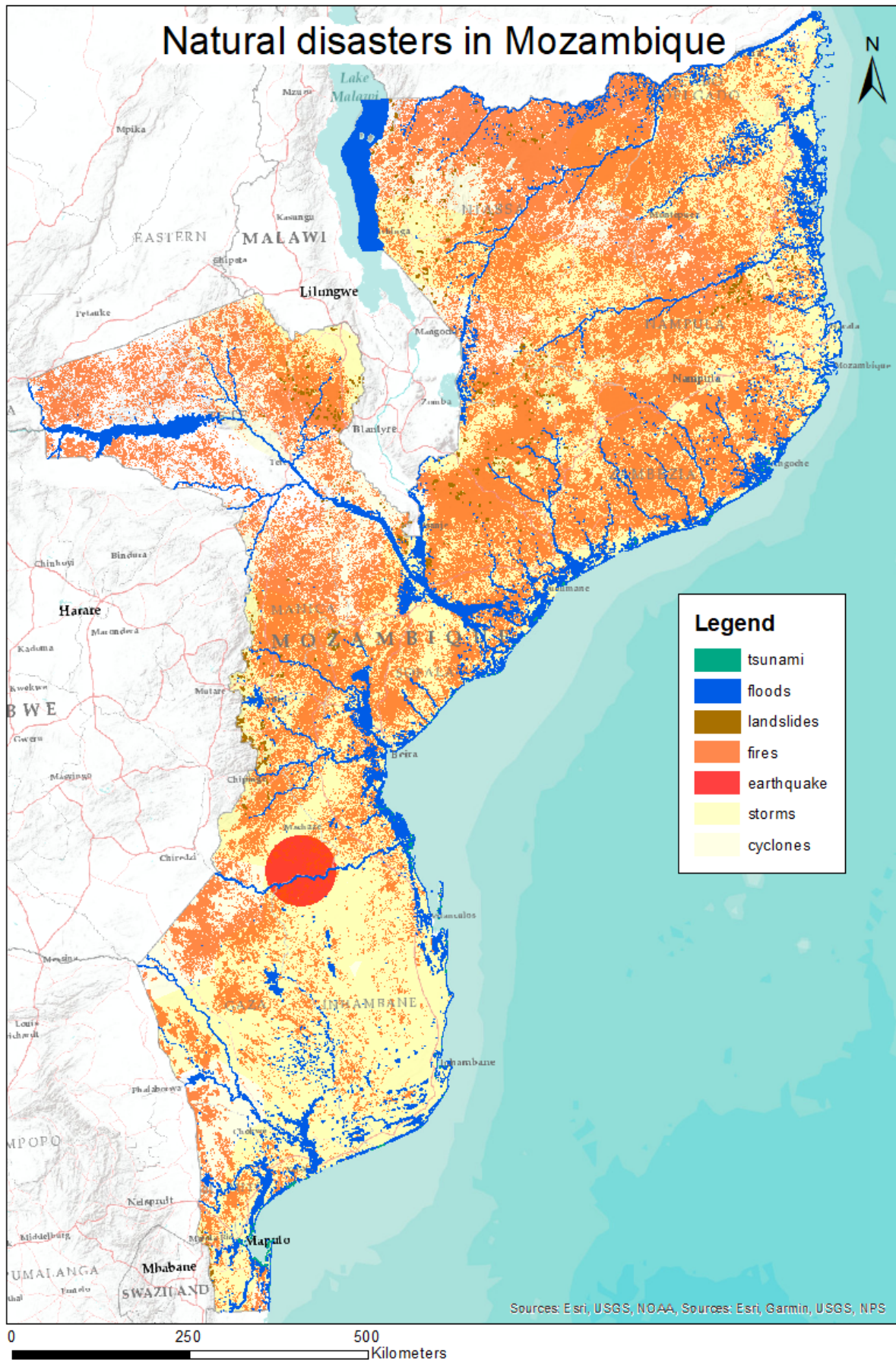


Figure 6: Natural disasters in Mozambique according to the UNEP-GRID methodology.

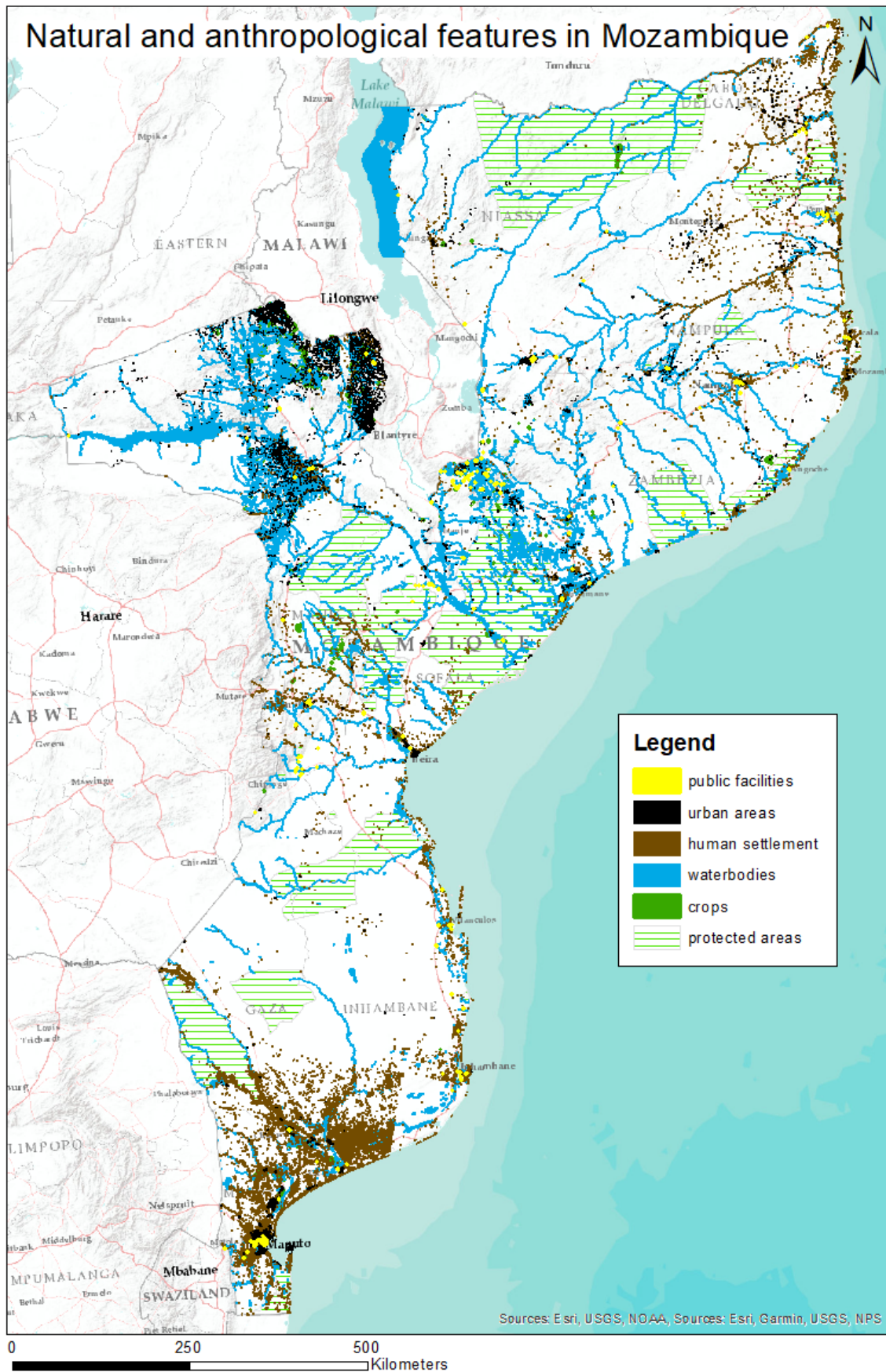


Figure 7: Natural and human related components of the model of Mozambique.

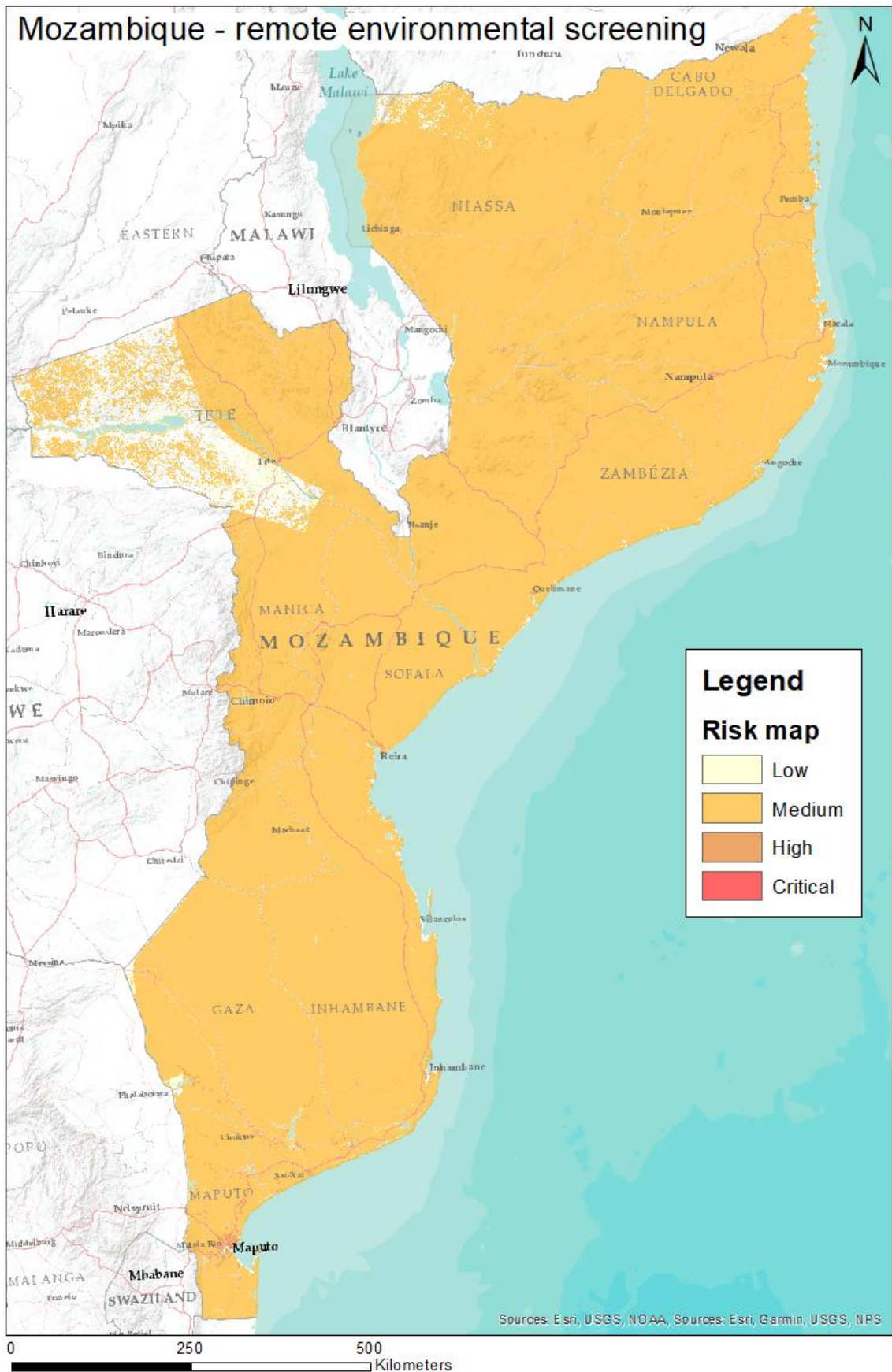


Figure 8: Remote environmental screening, also called risk map, in Mozambique.

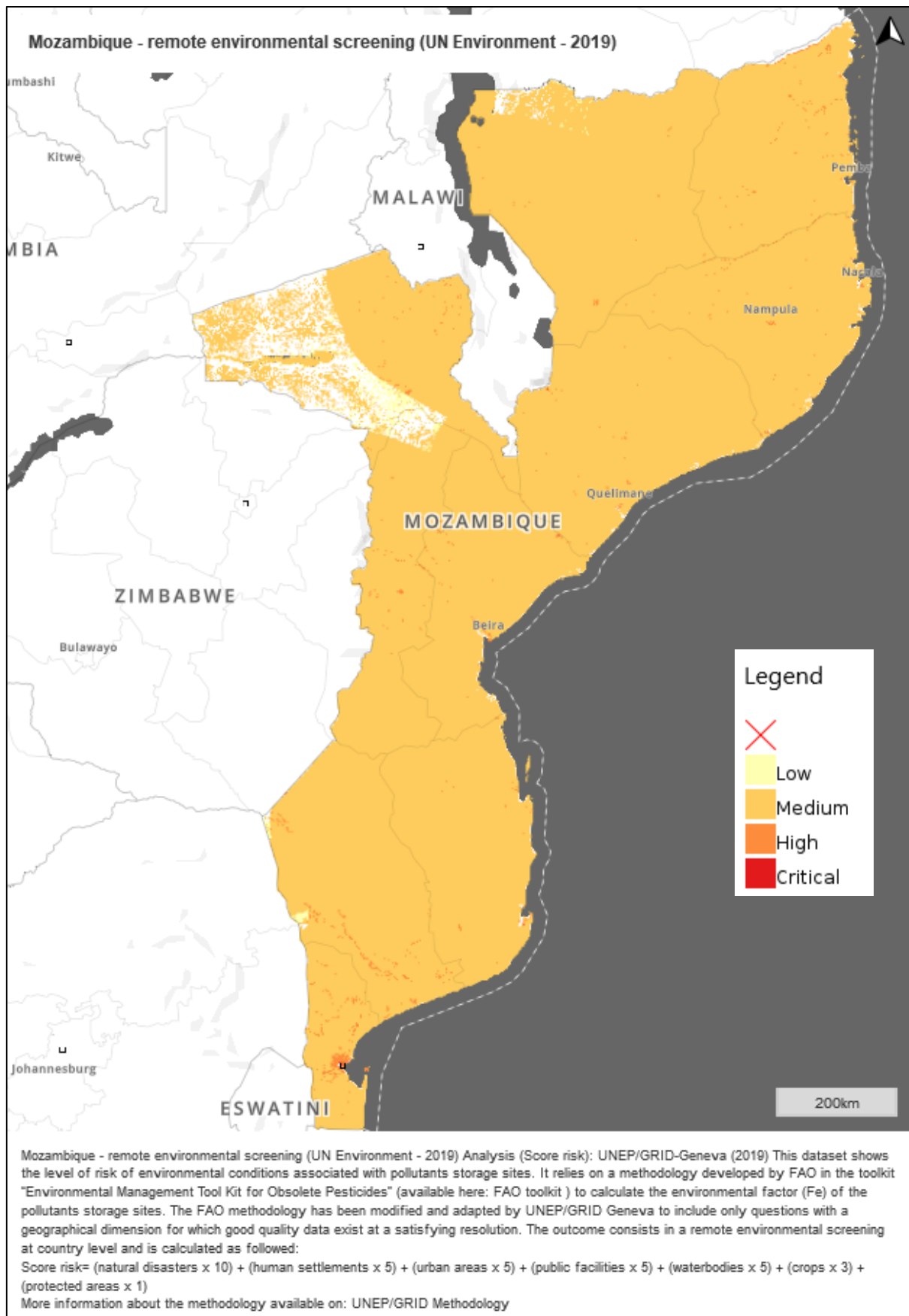


Figure 9: Remote environmental screening published into MapX platform on the 24th of July 2019 and last modified on the 19th of November 2019.

To publish data into MapX, the raster layers called “Country - remote environmental screening” had to be optimised first, see figure 9. After the optimisation, the geospatialised PCB sites were joined to the remote environmental screening in order to obtain the site characterisation that depends on the risk score developed in this new methodology and that are stored under "Country - PCB sites (UN Environment 2018/2019)". To upload a vector layer into MapX, a source needs to be added first and then a vector view can be created. To upload a raster layer, a raster view needs to be created and then when editing the view, the WMS tools can be display and the URL of the tile added that is stored in a geoserver. After creating the two types of views, abstracts were written, and metadata filled. The metadata of a vector tile can be filled directly into MapX while the metadata of a raster tile have to be filled in a catalogue called Geonetwork. Then, dashboards were developed for countries with vector layers described in table 2 and summarised in table 3. As you can see in table 3, two types of dashboards were developed. Dashboards for Algeria and Lebanon consist of three widget contents and dashboards for other countries consist of four widget contents, see figures 10 and 11.

Published views were updated several times in MapX when the abstract was being edited but also when new PCB sites information arrived. To update SADC countries vector layers, upstream work on excel has to be done by aggregating sites with the same coordinates, calculating Fpr and Fpr* and joining the new PCB sites and information to the remote environmental screening. Then, new sources layers need to be added and the source of the view changed. The amount of time required to update views depend on the amount of information that needs to be updated. To provide an indication, it took one day and a half to update views with nearly 30 new PCB sites information being new sites with all the information or missing information as GPS coordinates or weight of PCB equipment.

Table 3: Widget content and type of representation of the widget included in dashboards

Country	Widget content	Type of representation
Algeria and Lebanon	Site characterisation	Filter
	PCB supplementary information	Text
	Site characterisation Fe*/Fprq* graph	Graphic
Botswana, eSwatini, Lesotho, Madagascar, Malawi, Mozambique, Namibia, Seychelles, Tanzania, Zambia	Site characterisation	Filter
	Operational status of equipment	Filter
	PCB supplementary information	Text
	Site characterisation Fe*/Fpr*	Graphic

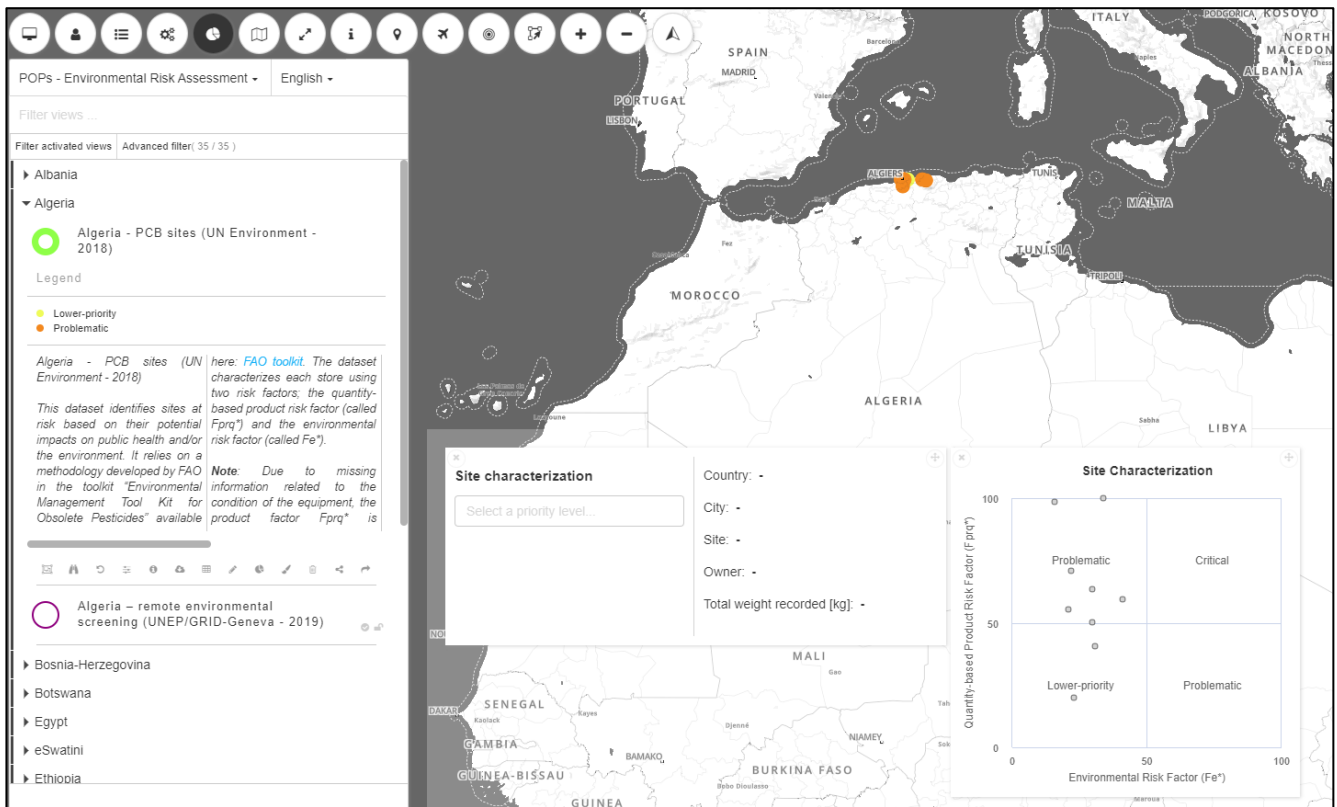


Figure 10 : Dashboard for PCB sites in Algeria.

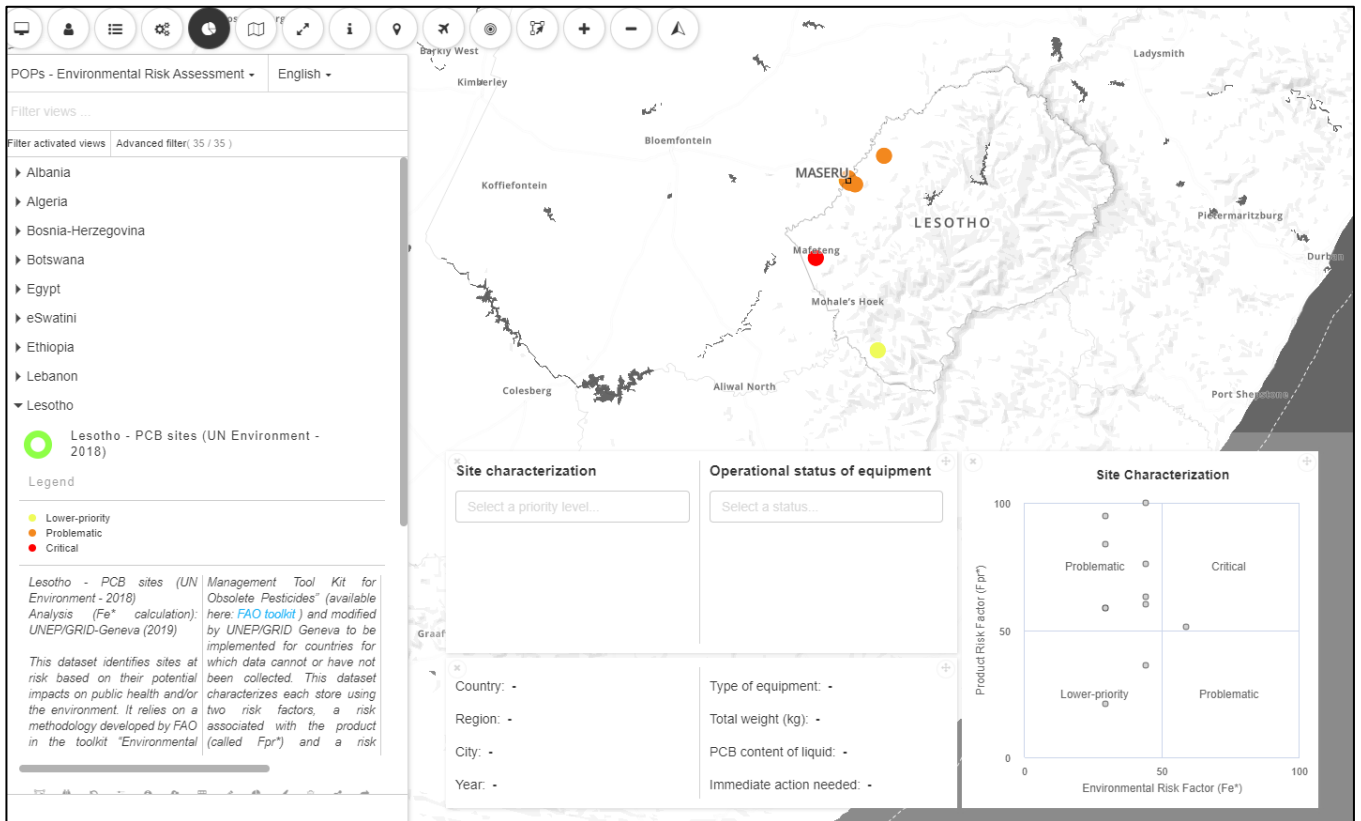


Figure 11: Dashboard of PCB sites located in Lesotho.

2.1.4 Conclusions

The aim of the project was to automate data processing with Model builder by developing a new methodology based on the FAO environmental management tool kit. Therefore this project provided the opportunity to develop the understanding of Model Builder but also its limitations.

The advantage of using Model builder is the rapidity of data processing, the large amount of data that can be processed at the same time and the repeatability of data processing. Because, the model processes a large amount of data, results of the geoprocess needed to be verified. Every steps of the model have been verified all along the process and for several countries. Additionally, the outputs have been verified step by step and tested for the country of Albania. Then, we verified all urban areas for all countries since changes in the datasets exist between countries. And finally, the mistakes that could appear such as the human settlement in Tanzania that was cropped by the country outline of Mozambique were corrected. As this methodology is based on geospatial data, some limitations, developed further, should be considered such as the quality of the data used for the model, the desired projection in accordance with the data and the developed methodology.

First, the quality of the results depends on the spatial resolution, the year and the accuracy of the data used to run the model. UNEP/GRID-Geneva conducted a thorough data inventory in 2018 to identify the best open data available. Therefore, the data used in the tool are not always the most recent ones nor available at a resolution good enough to compete with data collected on the field. It is important to note that results obtained are an estimation of reality and cannot replace a field inventory. Then, to perform geoprocessing involving distances (e.g. buffer), the data have been re-projected into the Universal Transverse Mercator (UTM) coordinate system. Such operations can generate margin of errors within a few meters in the dataset. Next, for Tanzania, Malawi, Madagascar Egypt and Algeria, it was not possible to use the entire model. For those countries, some steps of the geoprocessing work have been run manually (not automatically) in ArcGIS 10.6.1 or in ArcGIS Pro and the results have been added into the model.

To conclude, the remote environmental screening is a reliable environmental risk assessment, but the first improvement would be to adapt a new methodology taking into account data projection. Then, to resolve model bugs such as errors during the process of Tanzania, Malawi, Madagascar Egypt and Algeria, an alternative would be to test to run the model with python that is compatible with ArcGIS.

2.2 AFRICAN CHEMICALS OBSERVATORY

2.2.1 Presentation

The African ChemObs project aims at developing an integrated guidance to build capacity necessary to set up an integrated health and environment observatory surveillance and information management system. It aims at enabling African countries to establish evidence-based policies and make sustainable decisions on sound management of chemicals and related disease burdens. More specifically, it addresses the necessary improvements to be made in the fields of awareness, knowledge, information management and communication on chemicals to support and provide an enabling framework for measures and actions to be taken.

This project is a collaboration between the UNEP, NGOs Pure Earth and Pan UK and the GRID-Geneva. In this project, the aim is to visualise the health and environment observatory with the help of dynamic maps and dashboards on MapX in three countries; Kenya, Senegal and Tanzania. To provide maps, data were inventoried and, then, prepared to feed the algorithm that will give the information needed to establish policies and make sustainable decisions.

2.2.2 Method

The first step was to select the type of data we wanted to have. During the study, scientific papers or report from organisation such as Food and Agriculture organisation of the United Nations or National Bureau of Statistics were selected. At first, only papers and report equal or older to 2015 were targeted but due to the lack of information, the limit was extended to 2000 and exceptions were made for necessary data that were missing. As said before, three countries were investigated and data were found at three different scale; national, regional and local. The focus was done on four pollutants being mercury, lead, pesticide and dioxin (arsenic, chromium and uranium), socio-economic parameters such as population, diet and construction material and the air pollution, see table 4.

The second step was the preparation of the data inventoried to feed the algorithm. Indeed, data were collected by pollutants and per country in an excel file under different sheets classified by variable and media. Then, some data were published at a national level in MapX and in parallel, the algorithm was run by the pure earth team.

Table 4: Resume of data inventoried in Kenya, Senegal and Tanzania

Pollutants	Variable	Media	
Mercury	Biological concentration (= chemicals concentration in human beings)	Blood Urine Hair	
	Exposed groups concentration/ Non-exposed groups concentrations Exposure pathway (concentration in fish)	Vegetables Air Soil Sediments Water	
Lead	Biological concentration (= chemicals concentration in human beings)	Blood Nail Hair	
	Soil/Dust concentration	Dust Soil	
	Environmental aspects (concentration in air, water etc)	Water Sediments Air	
	Plants/animals	Vegetables Meat Fish	
	Size of the lead-polluting industry (aka cars, ewaste etc) Car battery/E waste etc (#)		
Pesticides	Inventories of pesticides (see the PSMS FAO*) MapX PCB and DDT sites		
	Biological concentration (= chemicals concentration in human beings)		
	Food concentration (vegetables, fish etc)		
	Environmental concentrations (concentration in air/soil/water/)		
	Pesticides used by sector/by type of crops **		
Socio-economic	Population (country, region etc)		
	Diet		
	Construction material or house composition		
	Composition of population (age, gender etc)		
Dioxin inventory in Africa	Chromium	Fish Water Soil Plant Cigarettes	
		Arsenic	Fish Vegetables Water Sediments Soil Plant
			Uranium
	Air pollution	Air pollution 2.5	
		Economic impact	

2.2.3 Results

The final table illustrating all data obtained can be seen in a table summarising all data and available on [this link](#). Not all collected data were used to feed the algorithm and the selected areas to run the algorithm are represented in [this table](#) with the source(s) of each data.

To illustrate data into MapX, only national data were selected except for the population that is divided per region. Table 5 shows the published layers, the type of view and the sources simplified from [the previous mentioned table](#). As you can see on table 5 and figures 12 to 15, the population per region and country was published as well as several dashboards were computed by the GRID team. Figure 16 illustrates the layer produced by the Pure Earth team after processing the provided data.

Table 5: Name of the layer published in MapX, the type of view, the read access group and the sources.

	Layer	Type	Readers	Source
Kenya	Pollutant overview	Dashboard	Public	FAO, 2018 Gerson et al., 2018 Tür et al., 2016
	Final cost Estimation - Preliminary Results	Vector	Public	Pure earth, 2019
	Population per County (2009)	Vector	Public	KNBS, 2009
	Air pollution Overview	Dashboard	Public	WHO, 2016 Roy and Rana, 2016 WTO, 2017
	Socio-economic Overview	Dashboard	Public	KIHBS, 2016 KNBS, 2019
Senegal	Pollutant overview	Dashboard	Public	FAO, 2018 Gerson et al., 2018 Tür et al., 2016
	Final cost Estimation - Preliminary Results	Vector	Public	Pure earth, 2019
	Population per Region (2017)	Vector	Public	Babacar, 2018
	Air pollution Overview	Dashboard	Public	WHO, 2016 Roy and Rana, 2016 WTO, 2017
	Socio-economic Overview	Dashboard	Public	Babacar, 2018 DEEC, 2016
Tanzania	Pollutant overview	Dashboard	Public	FAO, 2018 Gerson et al., 2018 Tür et al., 2016
	Final cost Estimation - Preliminary Results	Vector	Public	Pure earth, 2019
	Population per Region (2012)	Vector	Public	TNBS, 2016
	Air pollution Overview	Dashboard	Public	WHO, 2016 Roy and Rana, 2016 WTO, 2017
	Socio-economic Overview	Dashboard	Public	DHS, 2016 FAO, 2008

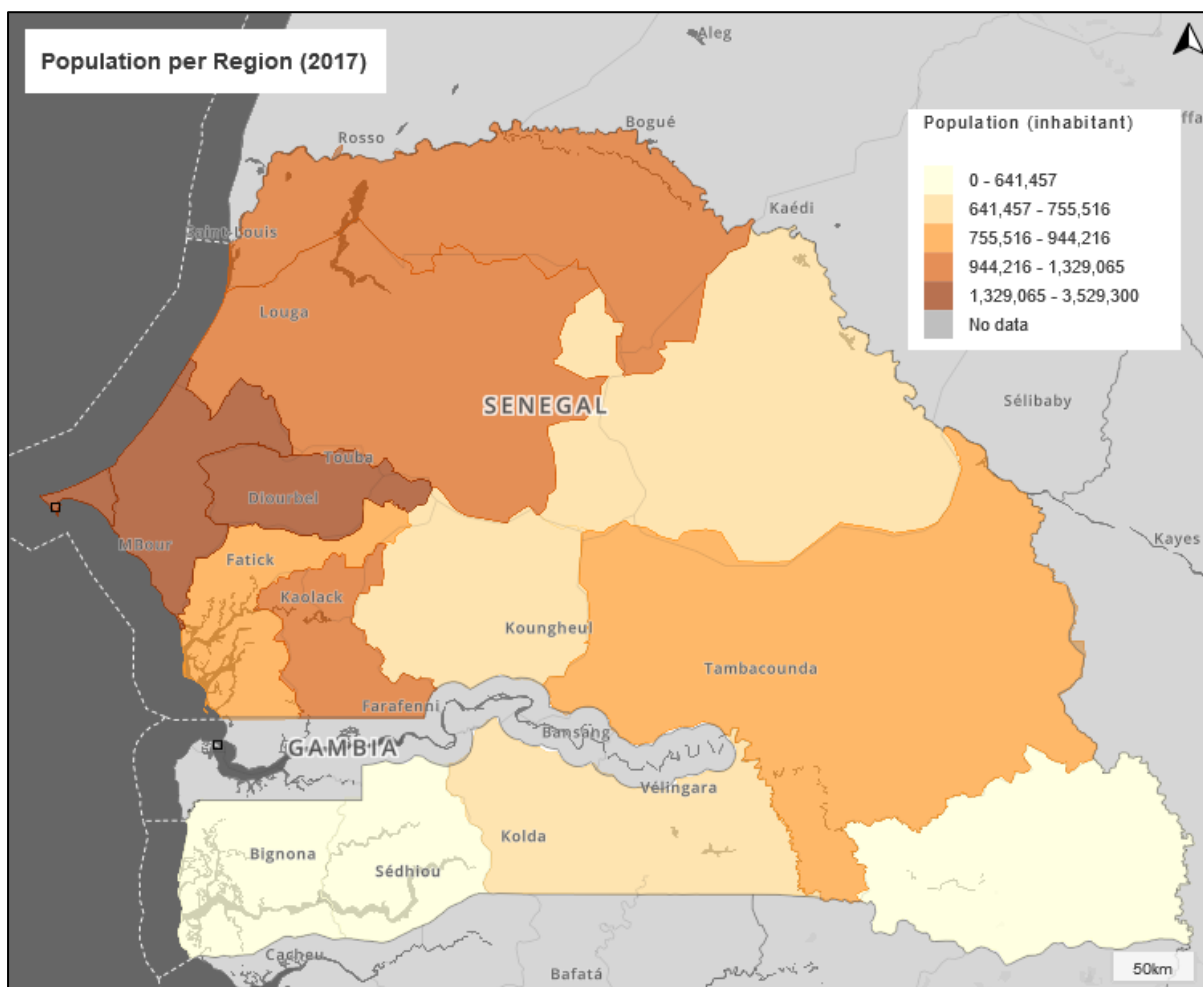


Figure 12: Senegalese population per region (Babacar, 2018).

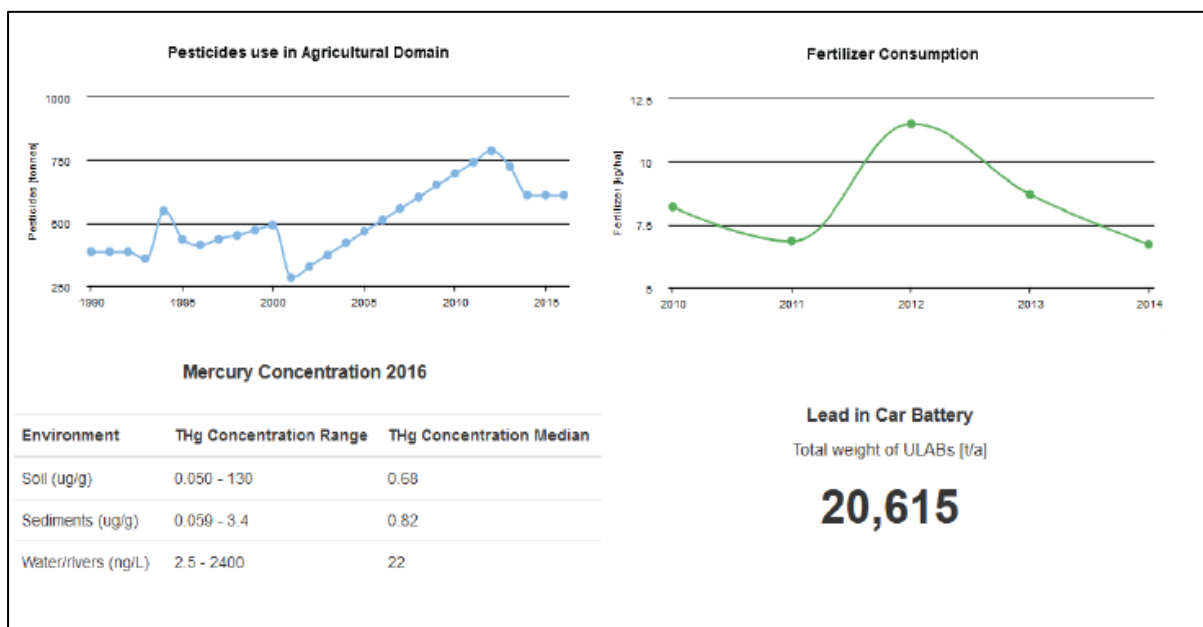


Figure 13: Pollutant layer showing the pesticides used in the agricultural domain (tonnes) over the years and the fertilizer consumption in g/day (FAO, 2018) as well as the mercury concentration in the environment (Gerson et al., 2018) and the lead used in the car battery at a national level in Senegal (Tür et al., 2016).

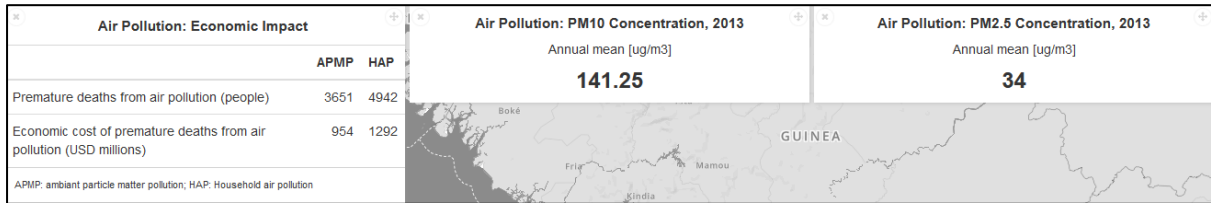


Figure 14: Senegalese air pollution layer showing the economic impact and the concentration of PM10 and PM2.5 in the air (WHO, 2016 and Roy and Rana, 2016).

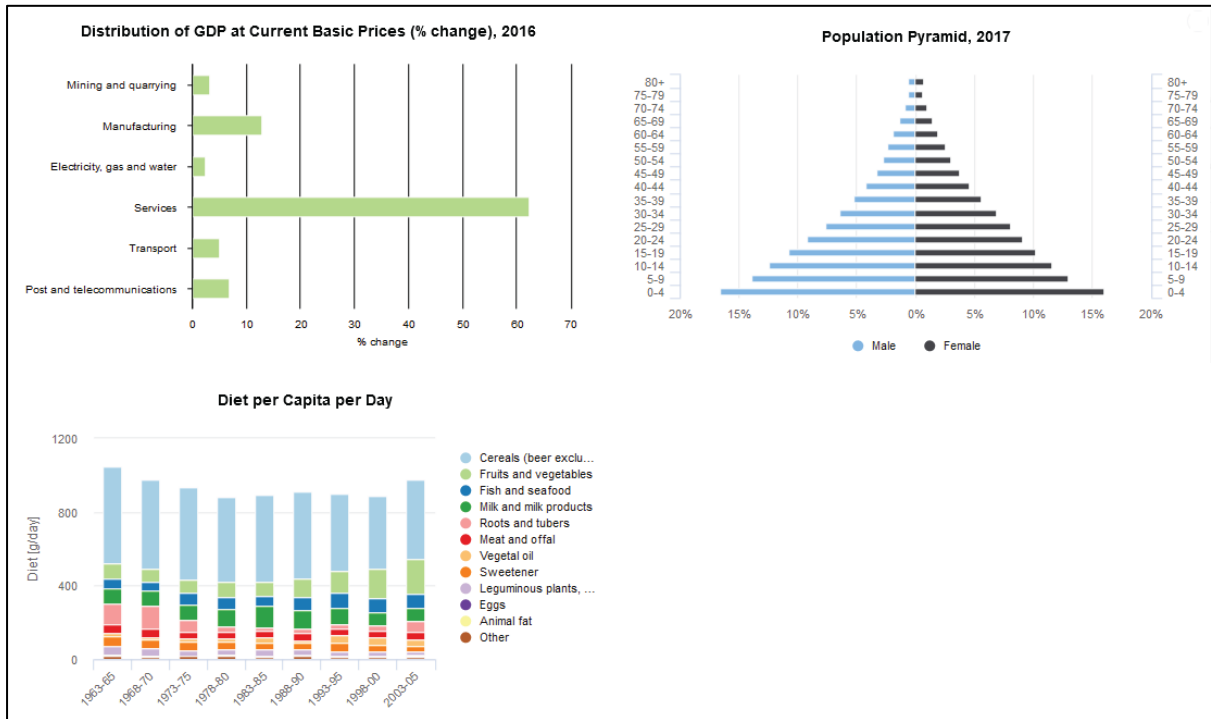


Figure 15: Senegalese socio-economic layer showing the GDP distribution of pollutant industries (WTO, 2017), the Senegalese population per gender and age (DHS, 2016) as well as the diet in g/day (FAO, 2008).

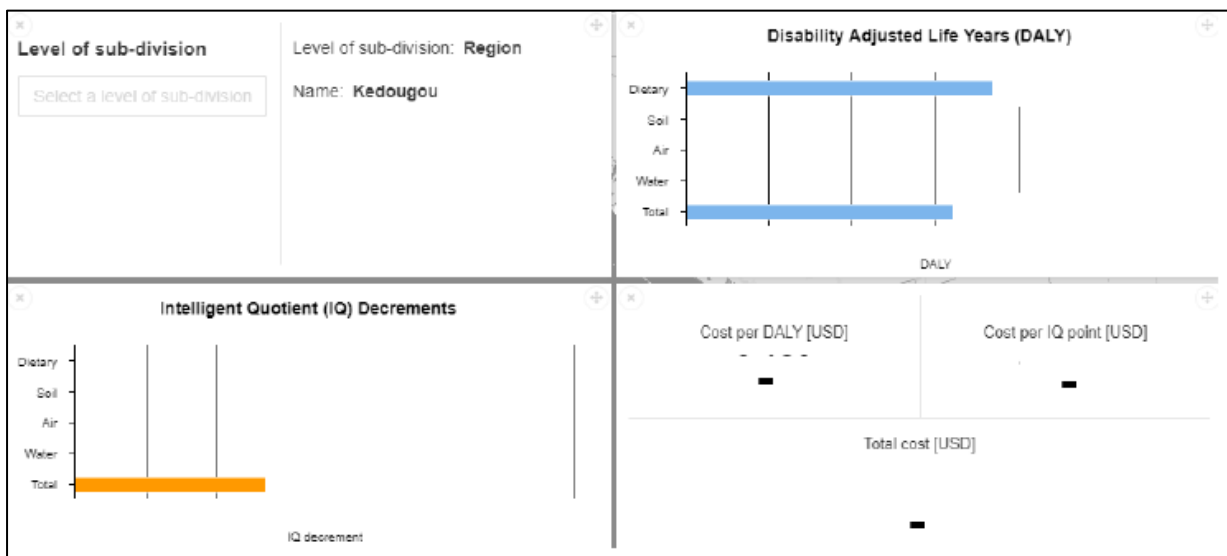


Figure 16: Modified dashboards produced by Pure Earth for the region of Kedougou, Senegal.

2.2.4 Conclusions

The aim of this project was to collect data for Kenya, Senegal and Tanzania in order to show other African countries the necessity of a chemicals inventory and the opportunity given by this inventory. In this part of the project a significant amount of data was collected by the UNEP and GRID-Geneva teams according to selection criteria given by the Pure Earth team. MapX helped to the visualisation of the inventory and the table summarising the inventory was used to develop a stronger collaboration with African countries.

A lot of data were collected thanks to the reports from the national and international organisations and the scientific papers, but some information was missing such as the biological concentration of Mercury in Kenya. To resolve this kind of issue, the data need to be collected on the field or by people that have more access to the selected data. To conclude, as this project is still going on, the only limitation for now is the access to the data for the inventory.

2.3 TRAINING MATERIAL

The last project was to update MapX training material that serves to teach how to use the platform. The material consists of several power point presentation and word documents. As MapX has been updated recently, the material had to be revised. The revisions consist in describing the new tools as well as traducing the document from English to French. Moreover, the material has to be documented and illustrated by pictures. Screenshots of the new interface with specific examples were taken. The revision of the training material has been done in several times and at different moments because the other projects were prioritised. I mostly worked on traducing and taking screenshot on documents 0 to 3 and taking screenshots on documents 4a. To resume, part of the new developed tools is:

- Filter views
- New interface and tools
- “Themes” were aborted when editing views
- Organisation of the different view in the same project

3 SUMMARY AND CONCLUSION OF THE INTERNSHIP

The internship at the GRID – Geneva gave me the opportunity to practice and expand the theoretical knowledge learned during the classes of the geomatic certificate as well as develop my skills in data processing, using and visualising spatial data.

Evolve and work in collaboration with a department that has a positive impact on environmental problems is extremely interesting because of the growing concern of the environment and climate problematic. The various projects I had the chance to participate to were concrete and are used for helping stakeholders in decision-making in order to better the future.

The preparation and processing of data followed by visible results is gratifying. Furthermore, participate to the evolution of MapX projects by feeding the platform with important data on environmental subjects is a unique experience.

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ChemObs

Please refer to [this table](#) or to the annex.

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6 ANNEXES

METHODOLOGY DEVELOPED BY THE UNEP AND THE GRID-GENEVA

The methodology for the environmental risk assessment is available [here](#).

CHEMOBS DATA COLLECTED

The table summarising final data collected for the ChemObs project is available [here](#).

TYPE OF DATA AT A NATIONAL SCALE AND ITS SOURCE

The sources of data collected at a national scale are available on [this table](#) or resumed here:

Ambient air pollution: A global assessment of exposure and burden of disease, 2016. . World Health Organization.

Bose-O'Reilly, S., Drasch, G., Beinhoff, C., Tesha, A., Drasch, K., Roider, G., Taylor, H., Appleton, D., Siebert, U., 2010. Health assessment of artisanal gold miners in Tanzania. *Science of The Total Environment* 408, 796–805. <https://doi.org/10.1016/j.scitotenv.2009.10.051>

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ORGANISATION OF THE FOLDERS FOR MODEL BUILDER – POP’S PROJECT

Name	Date modified	Type	
Albania	29/07/2019 11:38	File folder	
Albania_valid	03/09/2019 14:40	File folder	
Algeria	29/07/2019 14:23	File folder	
Bosnia_and_Herzegovina	24/07/2019 15:19	File folder	
Botswana	24/07/2019 15:19	File folder	
Egypt	31/07/2019 12:26	File folder	
Eswatini	24/07/2019 15:19	File folder	
Ethiopia	19/08/2019 10:36	File folder	
Final_treatments	26/11/2019 15:17	File folder	
Global	14/08/2019 11:40	File folder	
Lebanon	13/08/2019 16:34	File folder	
Lesotho	24/07/2019 15:19	File folder	
Madagascar	24/07/2019 15:20	File folder	
Malawi	24/07/2019 15:20	File folder	
Mauritius	19/08/2019 09:44	File folder	
Montenegro	14/08/2019 09:29	File folder	
Morocco	15/08/2019 10:02	File folder	
Mozambique	17/07/2019 11:36	File folder	
Namibia	24/07/2019 15:20	File folder	
old_Montenegro	24/07/2019 15:20	File folder	
Seychelles	29/07/2019 09:39	File folder	
South_Africa	29/10/2019 08:19	File folder	
Tanzania	30/07/2019 14:16	File folder	
Tunisia	19/08/2019 15:39	File folder	
Zambia	20/08/2019 13:50	File folder	
Zimbabwe	20/08/2019 09:33	File folder	
cyclones	03/07/2019 15:44	File folder	
earthquakes	03/07/2019 15:44	File folder	
fire	03/07/2019 15:51	File folder	
floods	03/07/2019 15:52	File folder	
human_settlement_glob	23/10/2019 17:02	File folder	
Input_layers	14/08/2019 11:40	File folder	
landslides	03/07/2019 16:01	File folder	
Preprocessing	21/08/2019 14:15	File folder	
storm	03/07/2019 16:04	File folder	
tsunami	03/07/2019 16:04	File folder	
Preprocessing	18/07/2019 11:07	ArcGIS Toolbox	209 KB

 crops	22/07/2019 12:07	File folder	
 Final_layers	19/11/2019 14:27	File folder	
 floods	08/07/2019 15:17	File folder	
 hum_set	15/07/2019 10:07	File folder	
 Intermediary_layers	19/11/2019 13:47	File folder	
 outline	04/09/2019 11:48	File folder	
 pre_publication	26/11/2019 15:34	File folder	
 protected_areas	15/07/2019 15:08	File folder	
 public_facilities	31/07/2019 15:30	File folder	
 urban_areas	04/09/2019 11:48	File folder	
 water	23/07/2019 10:47	File folder	
 Processing	23/07/2019 10:47	ArcGIS Toolbox	2.154 KB