MODELISATION OF ATMOSPHERIC POLLUTION DISPERSION REPORT

Strictly confidentiel

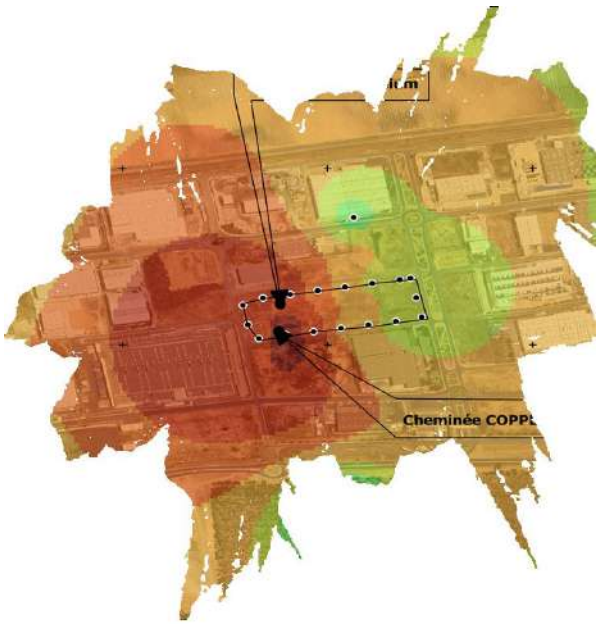
samta mines

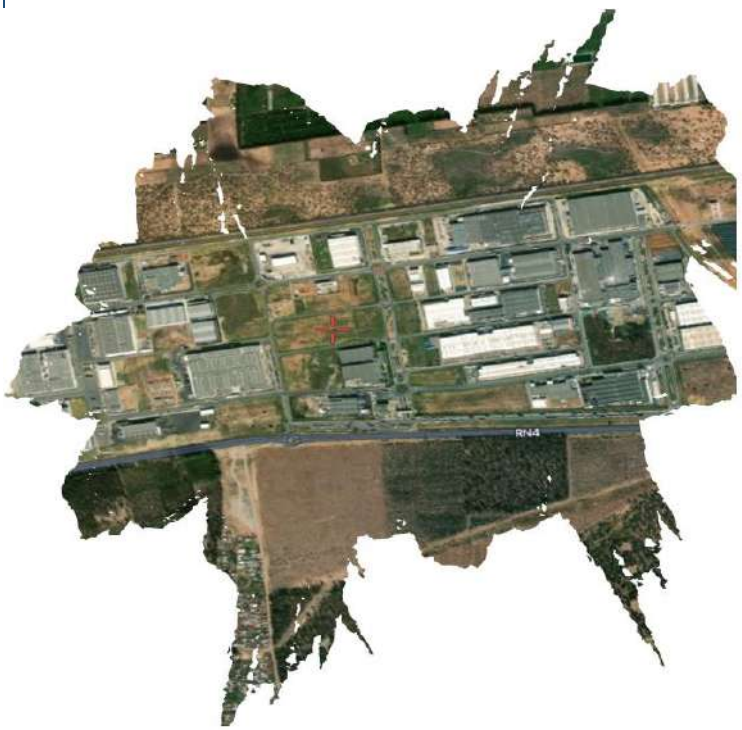
Client
SAMTA MINES.

Operator
SAMTA METALS & ALLOYS S.A

Typology
Projet de construction d'une unité industrielle de production de métaux.

Localisation
ATLANTIC FREE ZONE de KENITRA.





CASABLANCA, 20/02/2024

Bureau D'études Techniques Agrée

EL ADDAD
Bureau d'étude technique agréé

Autorisation : BR/06
217, BD Brahim ROUDANI, 2éme étage App n°4, CASABLANCA
ec.siege@gmail.com
06 77 261 642 / 07 08 777 414

EXCLUSIVE CONSTRUCTIONS
INGENIERIE, CONSEILS ET EXPERTISE

CONTENTS

I. OFFICE MISSIONS

1. Field of intervention

Object

*The company SAMTA MINES asked us to carry out the environmental impact study of its project called "**SAMTA METALS & ALLOYS** – **INDUSTRIAL UNIT FOR PROCUDING METALS**", located in the Kenitra free zone "**ATLANTIC FREE ZONE**" .*

Expertise and environmental impact study

We limit ourselves to establishing our expert reports on our experience in environmental impact studies and on the possible basis of reports provided by our approved collaborators and experts in quality control of environmental components and analyzes (ambient air; groundwater, geology and geotechnics, materials, etc.). Consequently, the assessment of the state, conditions or projections is made under the following conditions:

- ***Collection of data provided by the customer regarding the type of emission sources, dimensions, heat and speed of emission; substance emitted, initial concentration,***

- ***Collection of meteorological data necessary for modeling and forecasting the impact of the source of pollution on the atmosphere,***
- ***Use of internationally known calculation methods and computerized applications for modeling and mapping results,***
- ***Interpretation and verification of results within the corresponding normative framework,***
- ***Conclusion and summary of references and regulations.***

Independence – Conflicts of interest

We have not identified any conflicts of interest regarding the mission you have entrusted to us.

Limitation of use and right of communication

Our report is drawn up solely within the framework of the operation mentioned above. It cannot therefore be used for other purposes, or communicated to third parties, without the prior authorization of the BET

Limit of liability

Since the data must be evaluated based on the results, hypotheses or conclusions provided by the client, environmental experts or approved analysis laboratories, our liability cannot under any circumstances be engaged before any court.

Ownership and distribution of our reports

Our reports become the property of our clients upon full payment of our fees, subject to any usage limitations defined below. Our reports may only be distributed to third parties in their entirety, including annexes, unless our company's agreement to the distribution of extracts is obtained. They may neither be cited nor mentioned to third parties in any document intended to be published without the written consent of the BET, as to the form and circumstances in which they may appear.

Planes and Surfaces

We carry out our evaluations based on the surface areas of the land and buildings as they result from the information and documents provided to us (subject to verification and certification by an expert surveyor). We do not carry out any tests if this service is not included in our mission letter.

Property titles

Our mission does not include the examination of property titles, nor the control of the compliance of existing buildings with the legislation on Building Permits. Our conclusions therefore assume that the goods are in a legal situation with regard to the laws and regulations in force.

Lack or non-communication of information

It is the client's responsibility to provide us with all the relevant information necessary for our expertise.
If, for example, no modification, easement or hidden defect likely to disturb the envelope of the appraised works is reported to us, we presume its absence.

Use of data or documents communicated by the customer

Our intervention consists of identifying in these data or documents the information relevant to our evaluation. We do not carry out a full reading of the documents communicated, and even less an audit of these documents, the responsibility of which falls to other professionals.

References

- *Project to extend the Calcium carbonate production unit: Installation of the new production line, ZI Nouaceur /SAPINO; Province of Nouaceur, commune of OULAD AZZOUZ, Grand CASABLANCA.*

- *Project to extend the operation of an open-air quarry for the extraction of limestone rocks, presented by the Company, CARBONATE BEN AHMED, SARL, Municipality of Ain Dorbane Lahlaf, Province of Settat, Casablanca-Settat Region.*

- *Project to build the wastewater treatment plant in the center of Ouled Farès,*
- *Project to extend the operation of an open-air quarry for the extraction of limestone rocks (Ard Trik), presented by the Company YAJABI ET JAMAL, Municipality of Ain Dorbane Lahlaf, Province of Settat, Casablanca-Settat Region.*
- *Project to extend a food product production unit (biscuits, wafers, and sponge cake), Commune of Had Soualem, Province of Settat, Casablanca-Settat Region.*
- *Project to extend the operation of an open-air quarry for the extraction of limestone rocks (Blad Talaa), presented by the Company CARBONATE CHAOUIA, Municipality of Sidi Dahbi, Province of Settat, Casablanca-Settat Region.*
- *Carrying out an environmental assessment according to the terms of reference of law 49-17, of the project of the company Varun Beverages (PEPSI).*
- *Carrying out an environmental assessment according to the terms of reference of law 49-17, of the ALHALABI FOODS manufacturing unit project (AlHalabi foods industries and Trade).*
- *Production of an annual report for the year 2021 on the environmental situation of the shale extraction quarry by La Société Ciments de l'Atlas (CIMAT).*
- *Project to create a poultry slaughtering and white meat processing unit in the territorial commune of Settat.*
- *Carrying out (10) environmental impact studies of service stations and hydrocarbon distribution.*

Intervention teams

- *Ms. Fatima Zahra HIMRI: State engineer expert in Environment and Water engineering: 12 years of experience.*
- *Ms. Soukaina BARAKKAT: State engineer in environmental and climatic engineering: 11 years of experience.*
- *Mr. Adnane BENBARAKA: State engineer in water and environmental engineering: 13 years of experience.*
- *Mr. Zouhair FARHAT: State engineer in energy and environmental engineering: 07 years of experience.*
- *Mr. Mounaim EL ADDAD: State engineer in civil engineering, buildings and public works: 15 years of experience.*
- *Mr. Nacim ABDI: Professor and State Engineer in civil engineering, buildings and public works: 15 years of experience.*

II. MODELLING OF AIR DISPERSION OF POLLUTANTS

1. Procedure and approach to the intervention

The first step in assessing the air quality impact of the proposed project is to assess the spatial extent of air emissions from the future industrial unit in relation to the current situation.

The methodology used for the air quality impact assessment includes the following steps:

- ***Definition of the study area,***
- ***Presentation of the dispersion model,***
- ***Description of the modelling parameters,***
- ***Comparison of the results obtained by the chosen model with national and international standards.***

a) Definition of the study area

The study area, for the purposes of the impact study and the modelling of the dispersion of pollutants, corresponds to an area of 25 km2 around the future installation of the industrial metal production unit located at the Kenitra free zone "Atlantic Free Zone". This area extends 5 km from north to south and east to west from the site of the industrial unit.

The figure below shows the location of the industrial unit and the perimeter of the study area:

Delimitation of the area of the industrial unit subject to the impact study

b) Dispersion model used (AERMOD model)

The U.S. Environmental Protection Agency (U.S. EPA) recommends the use of several models of atmospheric dispersion of pollutants. ***The UNAMAP (User's Network for Applied Modelling of Air Pollution****) network is made up of about thirty models that apply to different topographies and modelling situations.*

The AERMOD (AERMIC Model), jointly developed by the U.S. EPA and the American Meteorological Society (AMS), is the optimal choice for assessing the dispersion of pollutants related to stacks.

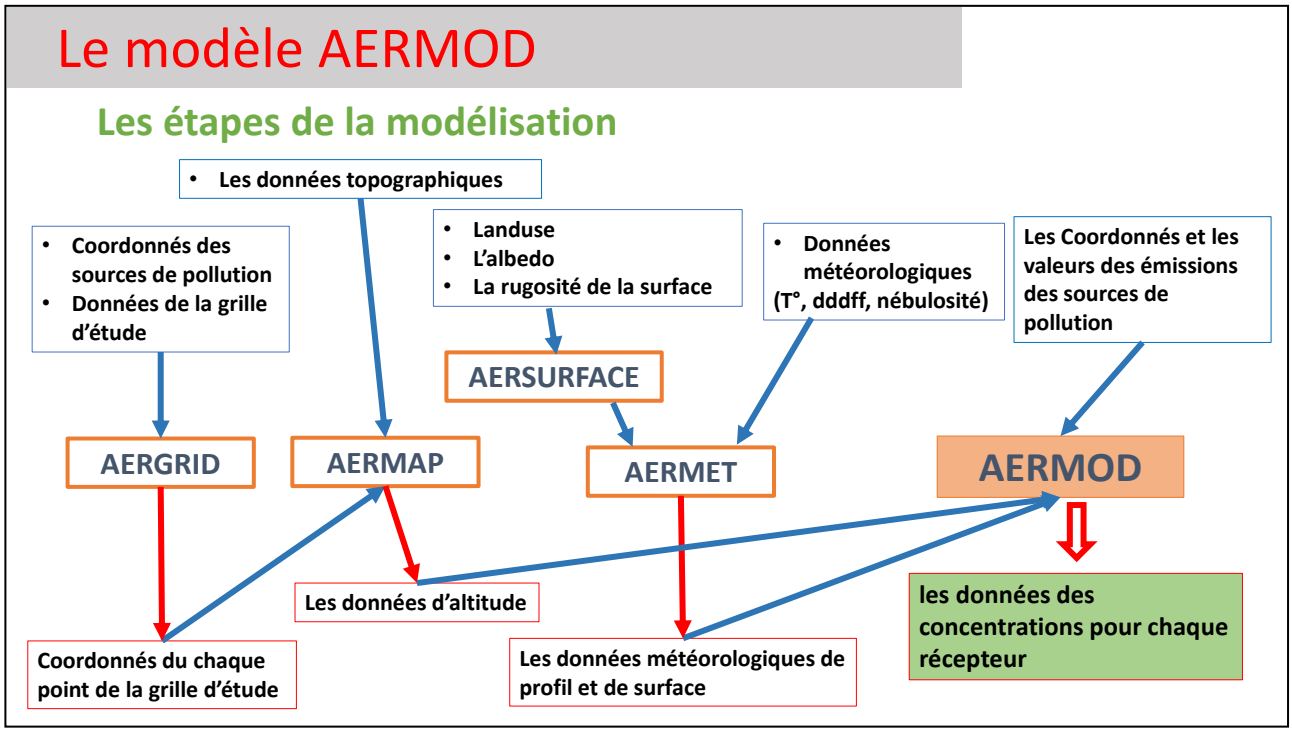
This second-generation Gaussian model of atmospheric dispersion is particularly suitable for industrial sources and has been developed for this purpose. It is able to take into account the influence of neighbouring buildings and the topography of the site, and can be used to model sources as diverse as chimneys, lines, volumes, etc.

***AERMOD** is now recognized by the scientific community and is widely used in the United States and Europe in cases of dispersion of pollutants related to industrial sources.*

The modeling system consists of:

- *A main programme (AERMOD)*
- *Preprocessors:*
  - ***AERGRID** (determination of field of study by creating a grid);*
  - ***AERMAP** (prepares topographic data from the digital terrain model);*
  - ***AERSURFACE** (prepares parameters such as albedo, surface roughness, etc.) for the module **AERMET** from land cover maps);*
  - ***AERMET** (prepares from ground parameters and meteorological data (T°, wind, cloud cover) other meteorological data (sensitive heat flux, friction velocity, convective velocity, potential temperature gradient, mixing height, etc.) organized into two profile and surface files for the AERMOD module).*

*The following figure shows the flow and processing of information in **AERMOD**:*



c) Modelling parameters Description of the modelling parameters,

The purpose of this section is to present the technical data necessary for the operation of the AERMOD model. Modelling parameters fall into three categories: emission source data, meteorological data, and receiving grid data.

- ***Data related to emission sources***

The emission sources considered in this project are the point emission sources corresponding to the two copper and aluminum stacks (see figure).

Data related to emission sources include everything related to stack dimensions, the physical characteristics of flue gases, and air emissions of pollutants. Tables 1 and 2 show the characteristics of the two emission sources of the future industrial unit.

GEOGRAPHICAL LOCATION OF SOURCES		***COPPER PLANT CHIMNEY***	***ALUMINIUM PLANT CHIMNEY***
SOURCE POSITIONS	*C. géographic X(°)*	***34,300931***	***34,300399***
	C. géographic Y(°)	***-6,396878***	***-6,396943***
	UTM29 X(m)	***739567,00***	***739571,00***
	UTM29 Y(m)	***3798532,00***	***3798591,00***

SOURCE CHARACTERISTICS		COPPER PLANT CHIMNEY	ALUMINIUM PLANT CHIMNEY
CARACTERISTICS	Height (m)	30	25
	Chimney diameter (m)	1,9	1,9
	Ejection speed (m/s)	3,50	13,00
	Maximum ejection temperature (°C)	120	120
	Actual flow (m3/h)	32 000	130 000
	Z(m)	20	19

The pollutant fluxes selected for the project are presented in the following table (Table 3):

EMITTED SUBSTANCES		COPPER PLANT CHIMNEY	ALUMINIUM PLANT CHIMNEY
DOSAGE OF EMISSIONS / FLOW OF SOURCES (MG/M3)	Dioxyde de soufre (SO2)	178,00	30,72
	Oxydes d'azote (Nox)	370,00	42,7
	Fluoride (F)	4,00	0,276
	Chlorure d'hydrogène (HCl)	-	5,75
	Arsenic (As)	0,800	0,0304
	Plomb et ses composés (Pb)	3,00	0,214
	Etain et ses composés (Sn)	4,00	0,04
	Cadmium et ses composés (Cd)	0,100	0,0093
	Chromium et ses composés (Cr)	0,800	0,00457
	Poussières (MPS)	16,00	13,07
	Antimoine et ses composés (Sb)	3,000	-

- ***Weather data***

The most important parameters for air pollution-related problems are temperature, wind speed and direction, stability of the atmosphere, and height of the mixing layer.

These parameters, which vary in time and space, result from the superposition of large-scale atmospheric phenomena (cyclonic or anticyclonic regime) and local phenomena (influence of roughness, land cover and topography).

For this reason, it is necessary to look for meteorological chronicles that are sufficiently long, complete and representative of the climatology of the site. In the case of modelling, the objective of which is to represent the chronic exposure of populations to different pollutants, five years of meteorological data are essential.

The need to consider five years of meteorological data is specified in the ***U.S. EPA's Appendix W to Part 51 – Guideline on Air Quality Models. Indeed, below five year****s, the modelling is not statistically representative of the real conditions of the site, and beyond five years, the modelling does not gain in accuracy.*

The meteorological data used in this project comes from the Weather Research and Forecasting ***(WRF) weather model for the period from 2019 to 202****3. Meteorological parameters are five-year hourly data (43,824 records) of air temperature at 2 metres, wind speed and direction at 10 metres, and cloud cover (cloudiness) (****see Appendix 1****).*

Other meteorological data are prepared by the AERMET module (sensitive heat flux, friction velocity, convective velocity, potential temperature gradient, mixing height...) organized into two profile and surface files and are used as input data for AERMOD (see Appendix 2).

The compass rose for the period 2019-2023 over the Kenitra Free Zone shows that the prevailing winds blow from the northwest sector with a frequency of 36% (7.2+9.4+11.3+8.4) and at a lesser frequency from the west-southwest sector. Wind speeds range from 0.5 to 2.1 m/s at 43.5%, 2.1 to 3.0 m/s at 35.4%, and .0 to 5.7 at 16.2%.

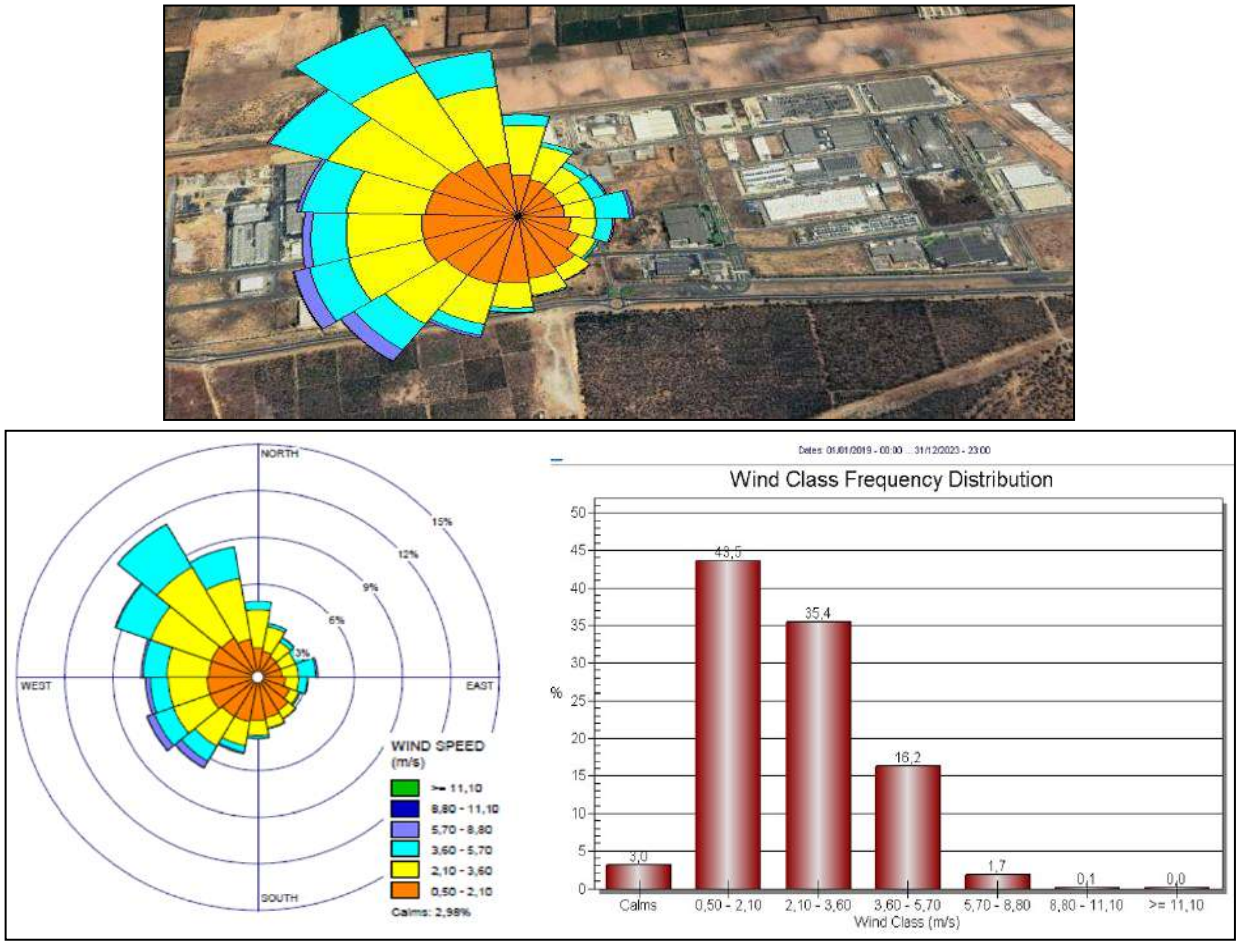
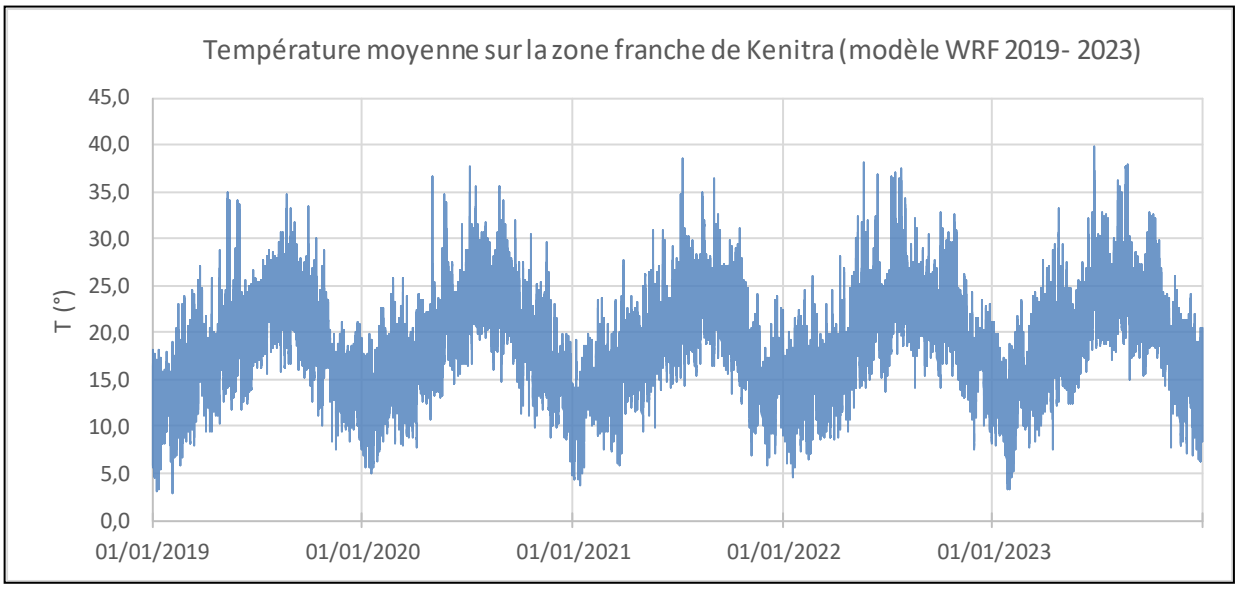


Figure: Wind Rose and Frequency of Wind Speeds

The figure below shows the hourly evolution of the average temperature over the Kenitra Free Zone simulated by the WRF model for the period 2019-2023. The values vary between 2.9°C recorded on 04/02/2019 and 39.8°C recorded on 26/06/2023.

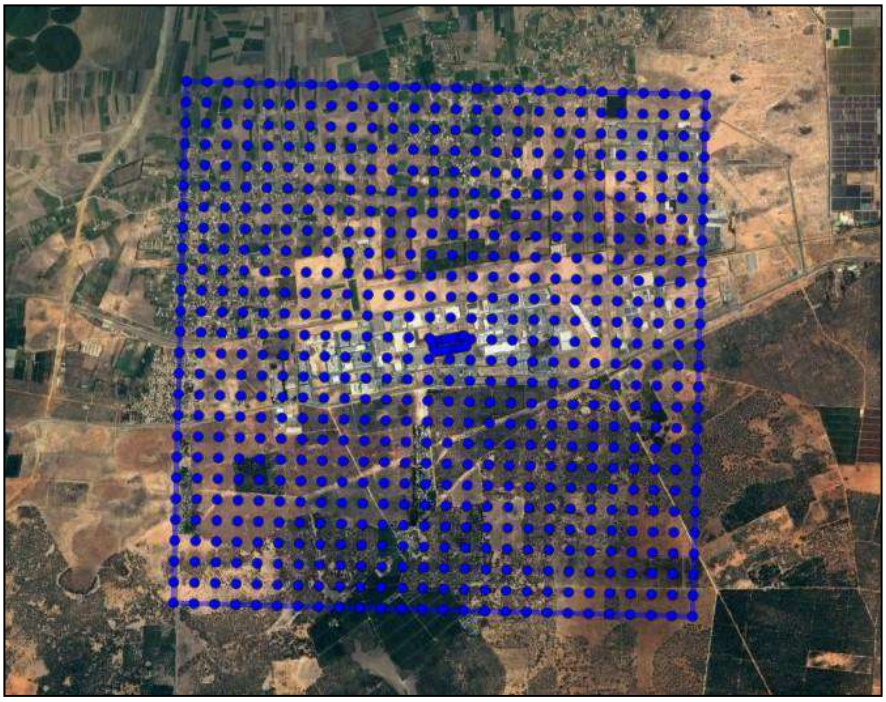


- ***Data related to the receiver grid***

The AERMOD model simulates the concentrations of different pollutants at user-defined points (sites), these points can be organized as a regular Cartesian or polar grid.

The grid used in this project is centered on the Kenitra Free Industrial Zone, it is a regular grid of 25km2 (5km x5km) with a spatial resolution of 200 meters.

The calculation grid is made up of 675 grid points in addition to 17 points around the perimeter of the future industrial unit (see figure below)



III. Results of pollutant dispersion and baseline modelling

This section presents the results of dispersion modelling of the main air quality indicator pollutants, namely sulphur dioxide (SO2), nitrogen dioxide (NO2), particulate matter (PM10), hydrogen chloride (HCl), arsenic (As), lead and its compounds (Pb), cadmium and its compounds (Cd), tin and its compounds (Sn), chromium and its compounds (Cr), antimony and its compounds (Sb) and fluoride (F). It also presents the results of the air quality measurement campaign by the mobile truck used as a reference state.

1. *Air Quality Standards and Thresholds*

Air quality standards are limit values that must not be exceeded and that set the level of concentration of polluting substances in the air for a specified period of time.

Moroccan regulations and European Union directives have set air quality standards and thresholds not to be exceeded (see table below):

***EU(European Union)/ MA(Morocco)* = origins of values**

DIOXYDE d'AZOTE (NO_2)		
Valeur limite pour la protection de la santé	50 µg/m³ **(MA)**	en moyenne annuelle
	200 µg/m³ **(MA)**	centile 98 des moyennes horaires
Valeur limite pour la protection de la végétation	30 µg/m³ **(MA)**	en moyenne annuelle
Valeur limite pour la protectionde la santé	200 µg/m³ **(UE)**	en moyenne horaire à ne pas dépasser plus de 18heures par an
	40 µg/m³ **(UE)**	en moyenne annuelle
Niveau critique pour la protection de la végétation	30 µg/m³ **(UE)**	en moyenne annuelle d'oxydes d'azote
Seuil d'information	250 µg/m³ **(MA)**	moyenne mesurée en une heure
Seuil d'alerte	400 µg/m³ **(MA)**	moyenne mesurée en une heure
Seuil d'alerte	400 µg/m³ **(UE)**	moyenne horaire pendant 3 heures consécutives
PARTICULES (PM_{10})		
Valeur limite pour la protection de la santé	50 µg/m³ **(MA)**	centile 90.4 des moyennes journalières
Valeur limite pour la protection de la santé	50 µg/m³ **(UE)**	en moyenne journalière à ne pas dépasser plus de 35jours par an
	40 µg/m³ **(UE)**	en moyenne annuelle
Seuil d'information	150 µg/m³ **(MA)**	moyenne mesurée sur 24 heures
Seuil d'alerte	200 µg/m³ **(MA)**	moyenne mesurée sur 24 heures
PARTICULES ($PM_{2,5}$)		
Valeur limite pour la protection de la santé	25 µg/m³ **(UE)**	en moyenne annuelle
DIOXYDE de SOUFRE (SO_2)		
Valeur limite pour la protection de la santé	125 µg/m³ **(MA)**	centiles 99.2 des moyennes journalières
Valeur limite pour la protection des écosystèmes	20 µg/m³ **(MA)**	en moyenne annuelle
Valeur limite pour la protection de la santé	350 µg/m³ **(UE)**	en moyenne horaire à ne pas dépasser plus de 24heures par an
	125 µg/m³ **(UE)**	en moyenne journalière à ne pas dépasser plus de 3jours par an
Niveau critique pour la protection des écosystèmes	20 µg/m³ **(UE)**	en moyenne annuelle et en moyenne sur la période du 1er octobre au 31 mars
Seuil d'information	350 µg/m³ **(MA)**	en moyenne horaire
Seuil d'alerte	550 µg/m³ **(MA)**	en moyenne horaire pendant 3 heures consécutives
OZONE (O_3)		
Valeur limite pour la protection de la santé	110 µg/m³ **(MA)**	moyennesur une plage de 8 heures
Valeur limite pour la protection de la végétation	65 µg/m³ **(MA)**	moyenne journalière ne devant pas être dépassée plus de 3 jours consécutifs
Valeur cible pour la protection de la santé	120 µg/m³ **(UE)**	maximum journalier de la moyenne sur 8 heuresà ne pas dépasser plus de 25 jours par an (en moyenne sur 3 ans)
Seuil d'information	200 µg/m³ **(MA)**	en moyenne horaire
Seuil d'alerte	260 µg/m³ **(MA)**	en moyenne horaire

MONOXYDE de CARBONE (CO)			
Valeur limite pour la protection de la santé	10 mg/m³ soit 10 000 µg/m³ **(MA) (UE)**		pour le maximum journalier de la moyenne glissantesur 8 heures
BENZÈNE (C_6H_6)			
Valeur limite pour la protection de la santé	10 µg/m³ **(MA)**		en moyenne annuelle
Valeur limite pour la protection de la santé	5 µg/m³ **(UE)**		en moyenne annuelle
MÉTAUX LOURDS			
Valeur limite pour la protection de la santé	**Plomb (Pb)**	1 µg/m³ **(MA)**	en moyenne annuelle
		0,5 µg/m³ **(UE)**	
	Cadmium (Cd)	5 ng/m³ **(MA)**	
Valeur cible	**Arsenic (As)**	6 ng/m³ **(UE)**	en moyenne annuelle du contenu total de la fraction PM10
	Cadmium (Cd)	5 ng/m³ **(UE)**	
	Nickel (Ni)	20 ng/m³ **(UE)**	
DIOXYDE d'AZOTE (NO_2)			
Valeur limite pour la protection de la santé	50 µg/m³ **(MA)**		en moyenne annuelle
	200 µg/m³ **(MA)**		centile 98 des moyennes horaires
Valeur limite pour la protection de la végétation	30 µg/m³ **(MA)**		en moyenne annuelle
Valeur limite pour la protectionde la santé	200 µg/m³ **(UE)**		en moyenne horaire à ne pas dépasser plus de 18heures par an
	40 µg/m³ **(UE)**		en moyenne annuelle
Niveau critique pour la protection de la végétation	30 µg/m³ **(UE)**		en moyenne annuelle d'oxydes d'azote
Seuil d'information	250 µg/m³ **(MA)**		moyenne mesurée en une heure
Seuil d'alerte	400 µg/m³ **(MA)**		moyenne mesurée en une heure
Seuil d'alerte	400 µg/m³ **(UE)**		moyenne horaire pendant 3 heures consécutives
PARTICULES (PM_{10})			
Valeur limite pour la protection de la santé	50 µg/m³ **(MA)**		centile 90.4 des moyennes journalières
Valeur limite pour la protection de la santé	50 µg/m³ **(UE)**		en moyenne journalière à ne pas dépasser plus de 35jours par an
	40 µg/m³ **(UE)**		en moyenne annuelle
Seuil d'information	150 µg/m³ **(MA)**		moyenne mesurée sur 24 heures
Seuil d'alerte	200 µg/m³ **(MA)**		moyenne mesurée sur 24 heures
PARTICULES ($PM_{2,5}$)			
Valeur limite pour la protection de la santé	25 µg/m³ **(UE)**		en moyenne annuelle
DIOXYDE de SOUFRE (SO_2)			
Valeur limite pour la protection de la santé	125 µg/m³ **(MA)**		centiles 99.2 des moyennes journalières
Valeur limite pour la protection des écosystèmes	20 µg/m³ **(MA)**		en moyenne annuelle
Valeur limite pour	350 µg/m³ **(UE)**		en moyenne horaire à ne pas dépasser plus de 24heures par an

la protection de la santé	125 µg/m³ **(UE)**		en moyenne journalière à ne pas dépasser plus de 3jours par an
Niveau critique pour la protection des écosystèmes	20 µg/m³ **(UE)**		en moyenne annuelle et en moyenne sur la période du 1er octobre au 31 mars
Seuil d'information	350 µg/m³ **(MA)**		en moyenne horaire
Seuil d'alerte	550 µg/m³ **(MA)**		en moyenne horaire pendant 3 heures consécutives
OZONE (O_3)			
Valeur limite pour la protection de la santé	110 µg/m³ **(MA)**		moyennesur une plage de 8 heures
Valeur limite pour la protection de la végétation	65 µg/m³ **(MA)**		moyenne journalière ne devant pas être dépassée plus de 3 jours consécutifs
Valeur cible pour la protection de la santé	120 µg/m³ **(UE)**		maximum journalier de la moyenne sur 8 heuresà ne pas dépasser plus de 25 jours par an (en moyenne sur 3 ans)
Seuil d'information	200 µg/m³ **(MA)**		en moyenne horaire
Seuil d'alerte	260 µg/m³ **(MA)**		en moyenne horaire
MONOXYDE de CARBONE (CO)			
Valeur limite pour la protection de la santé	10 mg/m³ soit 10 000 µg/m³ **(MA) (UE)**		pour le maximum journalier de la moyenne glissantesur 8 heures
BENZÈNE (C_6H_6)			
Valeur limite pour la protection de la santé	10 µg/m³ **(MA)**		en moyenne annuelle
Valeur limite pour la protection de la santé	5 µg/m³ **(UE)**		en moyenne annuelle
MÉTAUX LOURDS			
Valeur limite pour la protection de la santé	**Plomb (Pb)**	1 µg/m³ **(MA)**	en moyenne annuelle
		0,5 µg/m³ **(UE)**	
	Cadmium (Cd)	5 ng/m³ **(MA)**	
Valeur cible	**Arsenic (As)**	6 ng/m³ **(UE)**	en moyenne annuelle du contenu total de la fraction PM10
	Cadmium (Cd)	5 ng/m³ **(UE)**	
	Nickel (Ni)	20 ng/m³ **(UE)**	

- ***Definitions of Air Quality standards***

Target value*: a level of concentration of polluting substances in the atmosphere set with the aim of avoiding, preventing or reducing harmful effects on human health or the environment as a whole, to be achieved, as far as possible, within a given time frame;*

Limit value*: a level of concentration of polluting substances in the atmosphere set on the basis of scientific knowledge not to be exceeded with the aim of avoiding, preventing or reducing the harmful effects of those substances on human health or on the environment as a whole;*

Information threshold*: a level of concentration of polluting substances in the atmosphere above which short-term exposure poses a risk to human health in particularly sensitive groups of the population, requiring immediate and adequate information;*

Alert threshold*: a level of concentration of polluting substances in the atmosphere above which short-term exposure poses a risk to the health of the general population or environmental degradation justifying the intervention of emergency measures.*

2. *Air Quality Measurement Campaign: Baseline State*

The air quality in the site's environment complies with Moroccan regulations and European Union directives. Indeed, air quality measurements at two points P1 and P2 of the perimeter of the site using a mobile laboratory for 48 hours (24 hours for each site). These measurements were made in order to characterize the initial air quality in the study area.

The parameters measured and considered as indicators of air pollution are:

- *Ozone (O3);*
- *Carbon monoxide (CO);*
- *Sulphur dioxide (SO2);*
- *Nitrogen oxides (NO, NO2, NOx);*

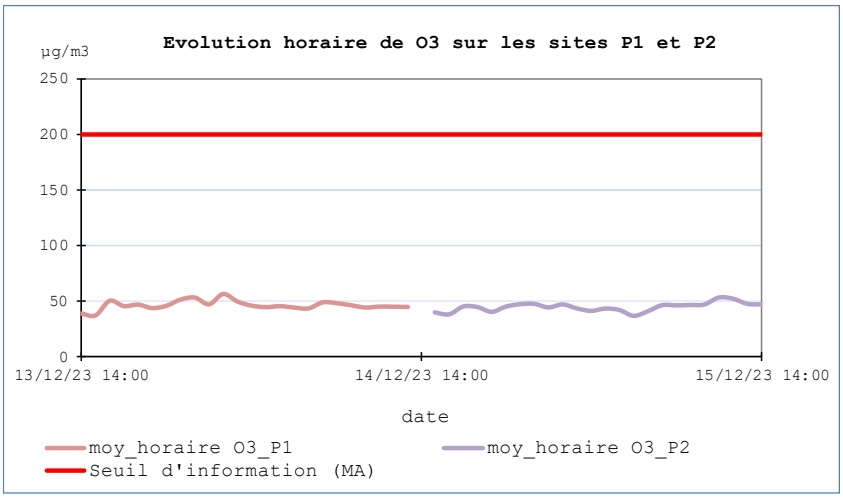
The measurement points that are the subject of the mobilization are characterized by the following coordinates:

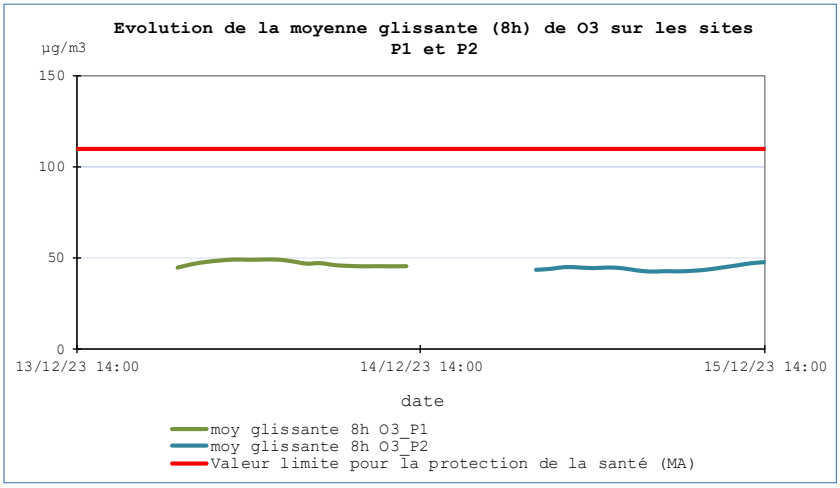
P1	***X : 34.301101, Y : - 6.397063***
P2	***X : 34.300654, Y : -6.394376***

The results obtained during the sampling campaign are as follows:

- ***Ozone O3:***

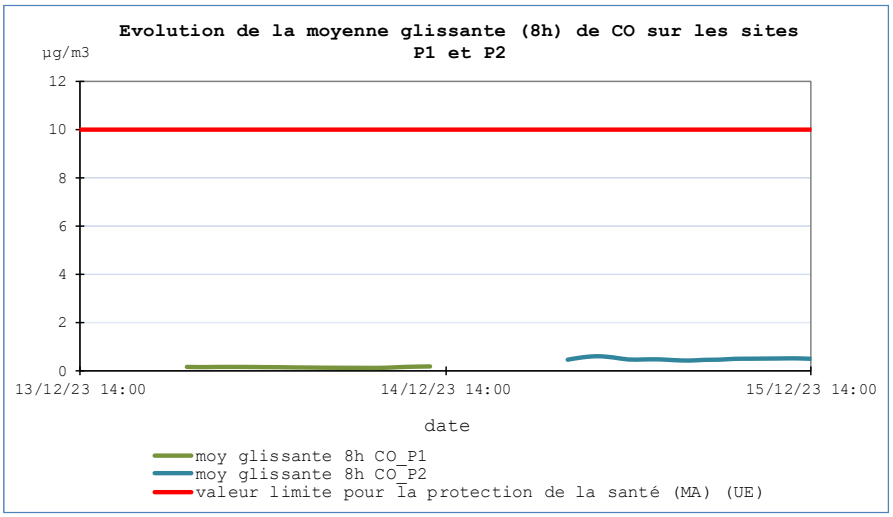
The results of the hourly ozone concentrations were compared with the limit value for health protection (110 µg/m3) and the information and alert thresholds (200 µg/m3 and 260 µg/m3) recommended by the Moroccan standard. The hourly averages of O3 at the two sites remain below the information threshold, these values are around 50 µg/m3. Similarly, the averages over an 8-hour period are below the limit value for health protection (110 µg/m3).





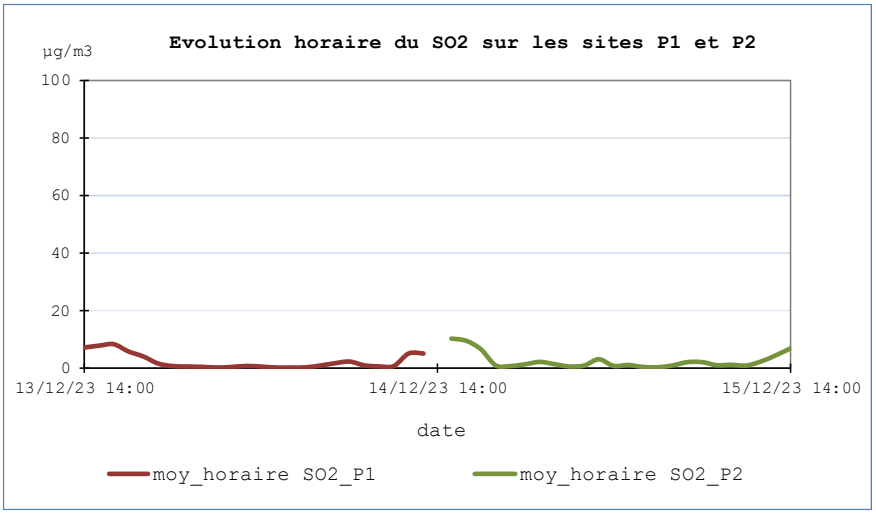
- ***Carbon monoxide CO:***

The rolling averages over an 8-hour range of carbon monoxide are very negligible compared to the limit value for health protection (10 mg/m³) at the two sites.



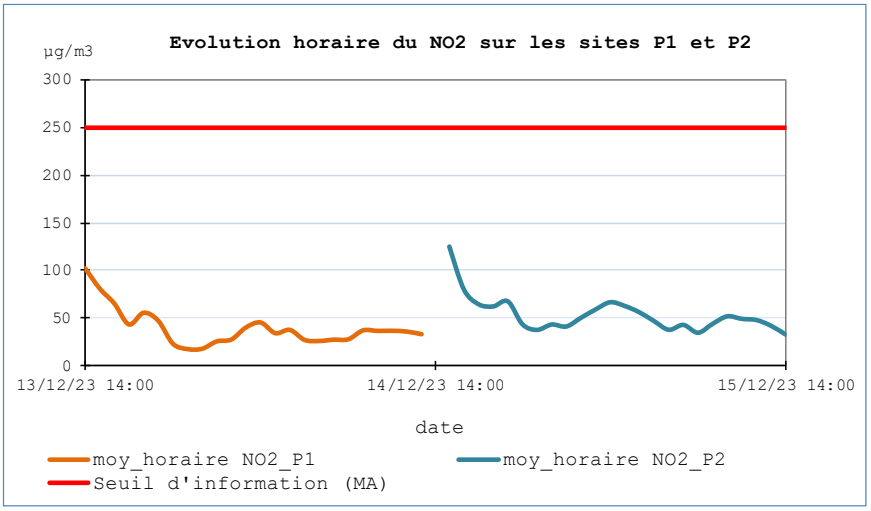
- ***Sulphur dioxide SO2:***

The hourly averages of sulphur dioxide are very negligible compared to the limit value for health protection (350µg/m³) recommended by the European Union directives and the information threshold (350µg/m³) recommended by the Moroccan standard.



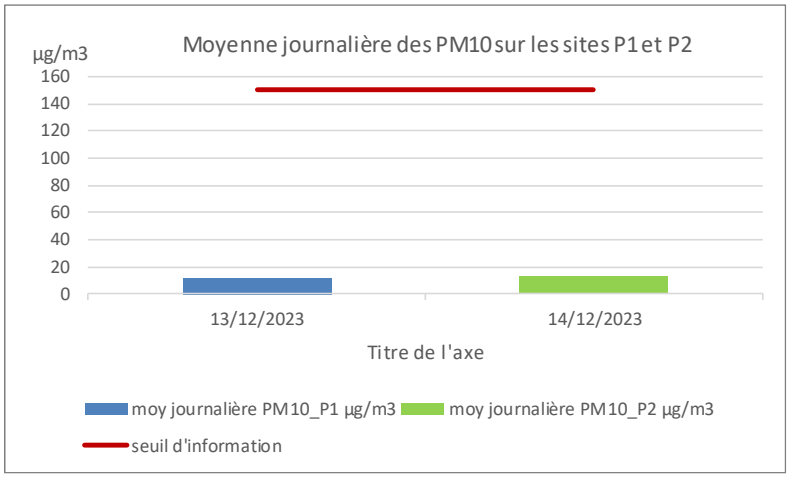
- ***Nitrogen dioxide NO2:***

The hourly averages of nitrogen dioxide are below the information threshold (250µg/m³) recommended by the Moroccan standard. The maximum does not exceed 126µg/m³.



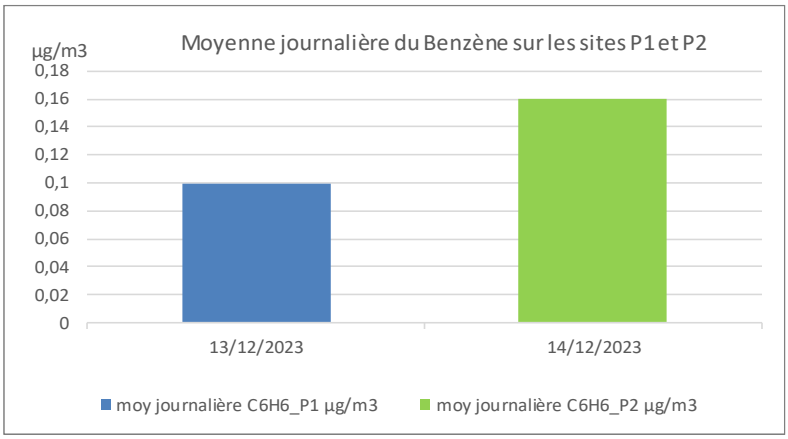
- ***PM10 particulate matter:***

The daily averages of PM10 at the P1 and P2 sites are very low compared to the information threshold (150µg/m³) recommended by the Moroccan standard. Values do not exceed 13µg/m³.



- ***Benzene C6H6:***

The daily averages of benzene at the P1 and P2 sites are very low when compared with the annual averages of the limit values for health protection of 10µg/m³ for Morocco and 5µg/m³ for the European Union.



- ***Heavy metals (Pb and Cd):***

The table below gives a summary of the results obtained for Pb and Cd concentrations:

POINT D'ECHANTILLONNAGE	*N° D'ESSAI*	*DATE ET HEURE DE DEBUT*	*DATE ET HEURE DE FIN*	*CONCENTRATION*	
				Pb µg/m3	*Cd ng/m3*
P1	*1*	*13/12/2023 à 13h00*	*14/12/2023 à 13h00*	***0,004***	***0,02***
P2	*1*	*13/12/2023 à 13h00*	*14/12/2023 à 13h00*	***0,3***	***0,85***
Valeur limite pour la protection de la santé en moyenne annuelle				***1 (MA) 0,5 (UE)***	***5 (MA) (UE)***

The measured concentrations of Pb and Cd are well below the limit values set by the regulations in force.

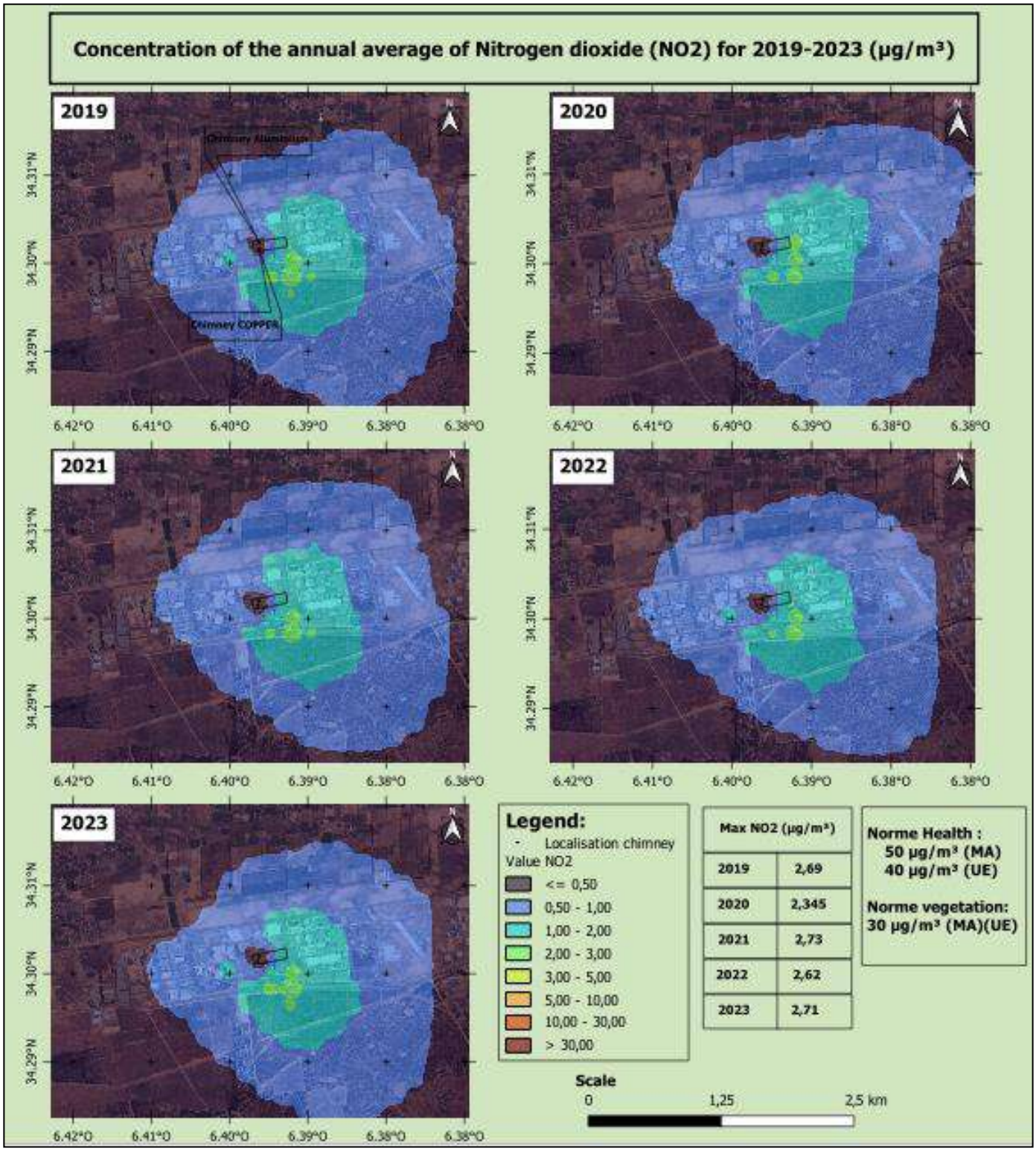
3. Results of Pollutant Dispersion Modelling

The outputs of the AERMOD model are in the form of surface concentration of hourly, daily and annual averages, percentiles are calculated on the basis of hourly or daily data according to the requirements of the standard under consideration. They are also determined in the form of maps or time series.

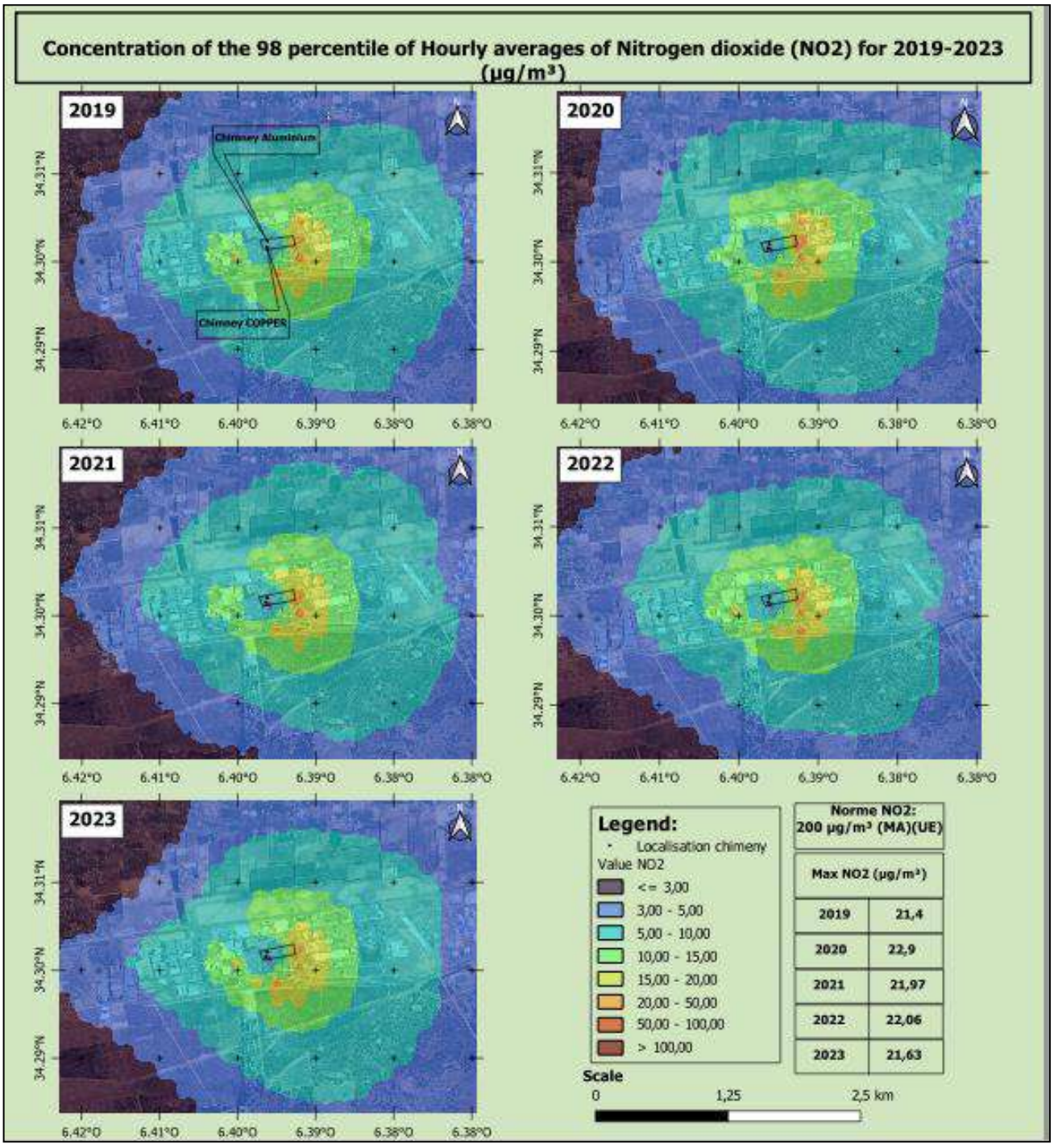
The latter are extracted for some pollutants, on the one hand at points where there are significant values to study their variations with the information and warning thresholds and, on the other hand, at sites where the air quality measurement campaign was carried out in order to compare the measured data with those of the model.

- ***Nitrogen dioxide (NO2) concentration:***

The annual average for the years 2019-2023 of nitrogen dioxide is very low compared to the limit value for the protection of vegetation (30µg/m3) and the limit value for the protection of health (50µg/m3 for MA) (40µg/m3 for EU).

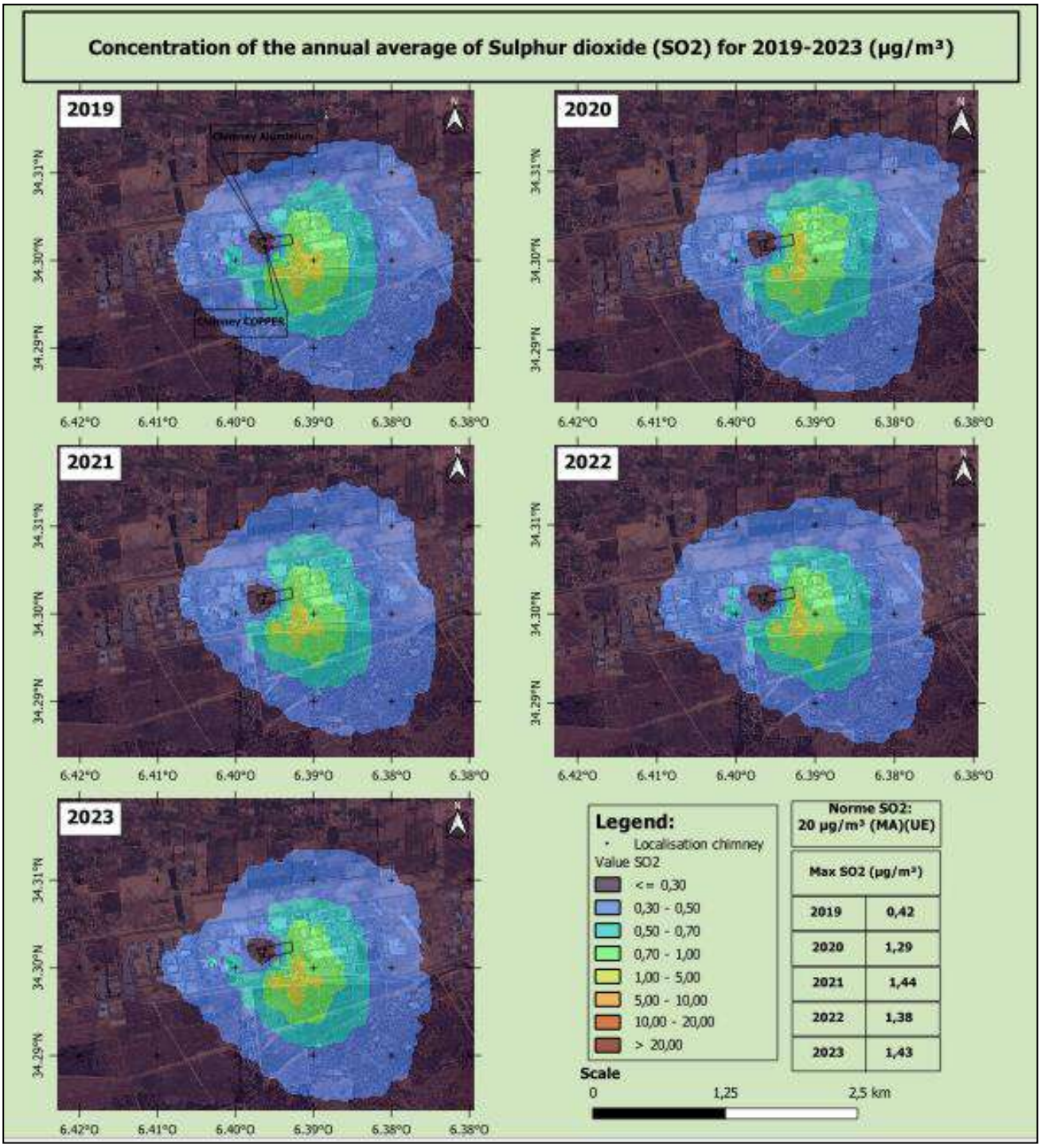


Similarly, the 98 percentiles of the hourly mean NO2 for the five years 2019-2023 comply with the limit value for health protection (200µg/m3 for MA). The maximum values do not exceed 23µg/m3.

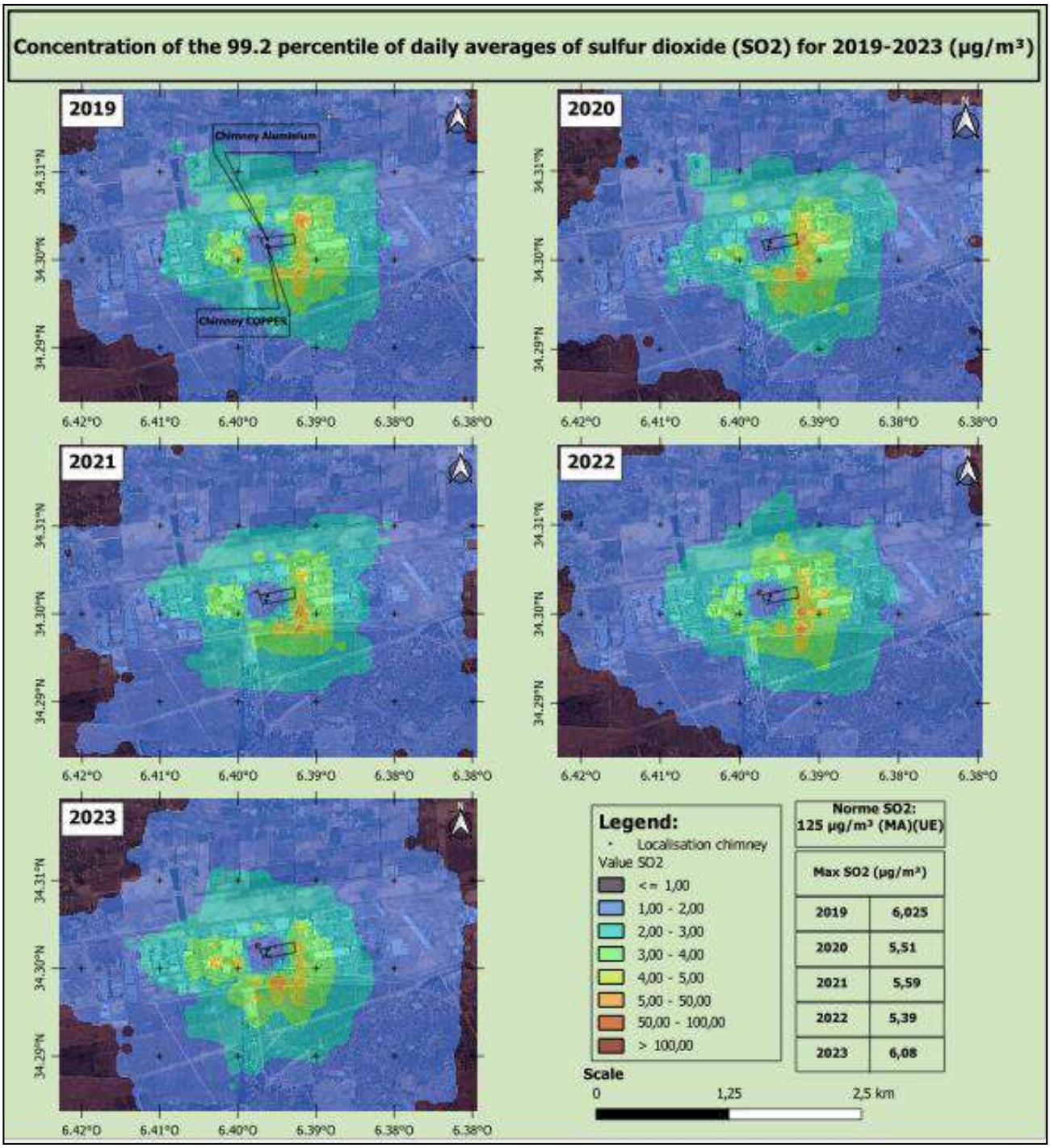


- ***Sulphur dioxide (SO2) concentration:***

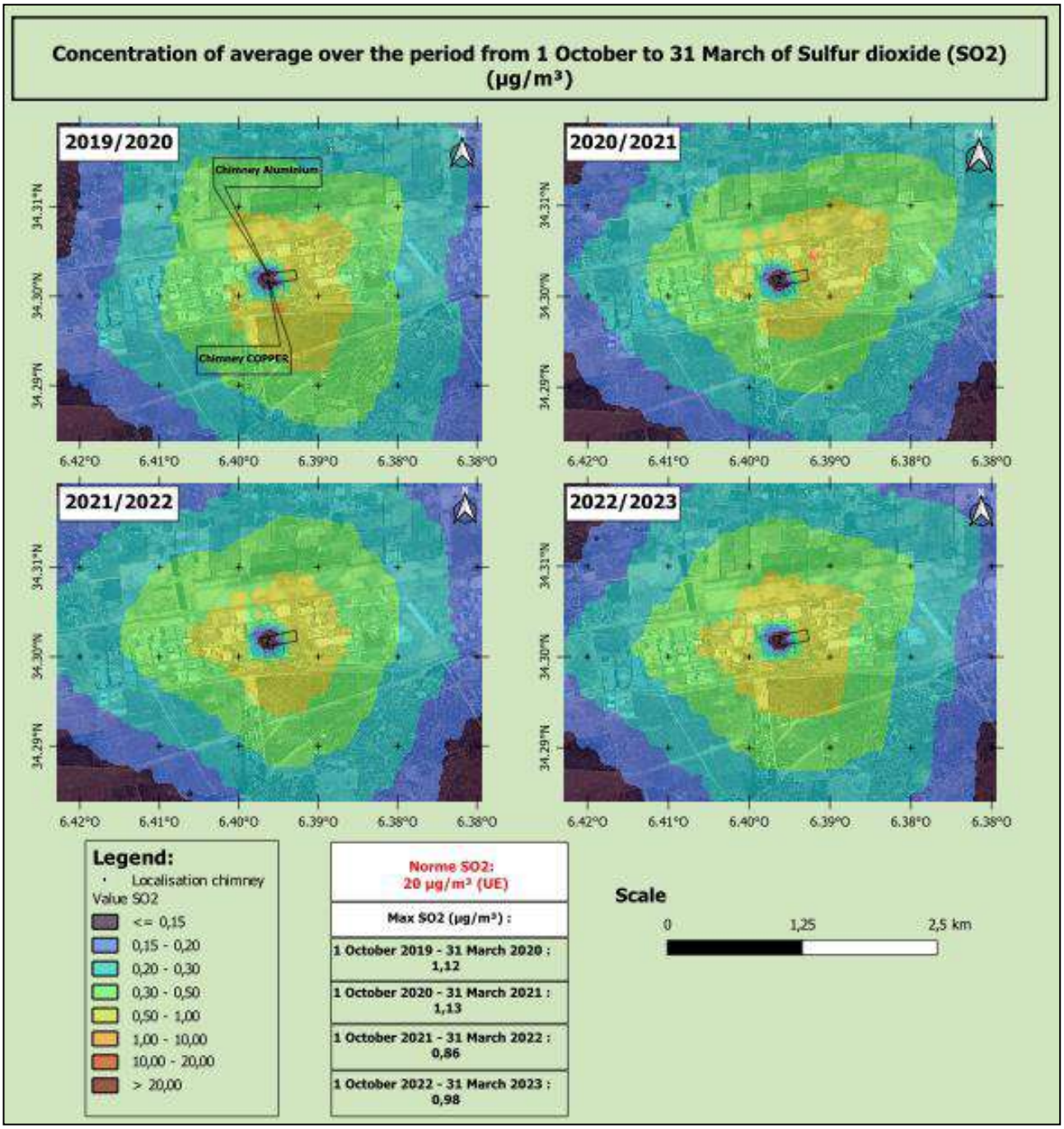
The annual average of sulphur dioxide during the period 2019-2023 is very low compared to the limit value for the protection of ecosystems (20µg/m3 for MA and EU). The maximum values do not exceed 2µg/m3.



The 99.2 percentiles of the daily SO2 averages during the five years 2019-2023 are negligible compared to the limit value for health protection (125µg/m3 for AD). The maximum values do not exceed 7µg/m3.

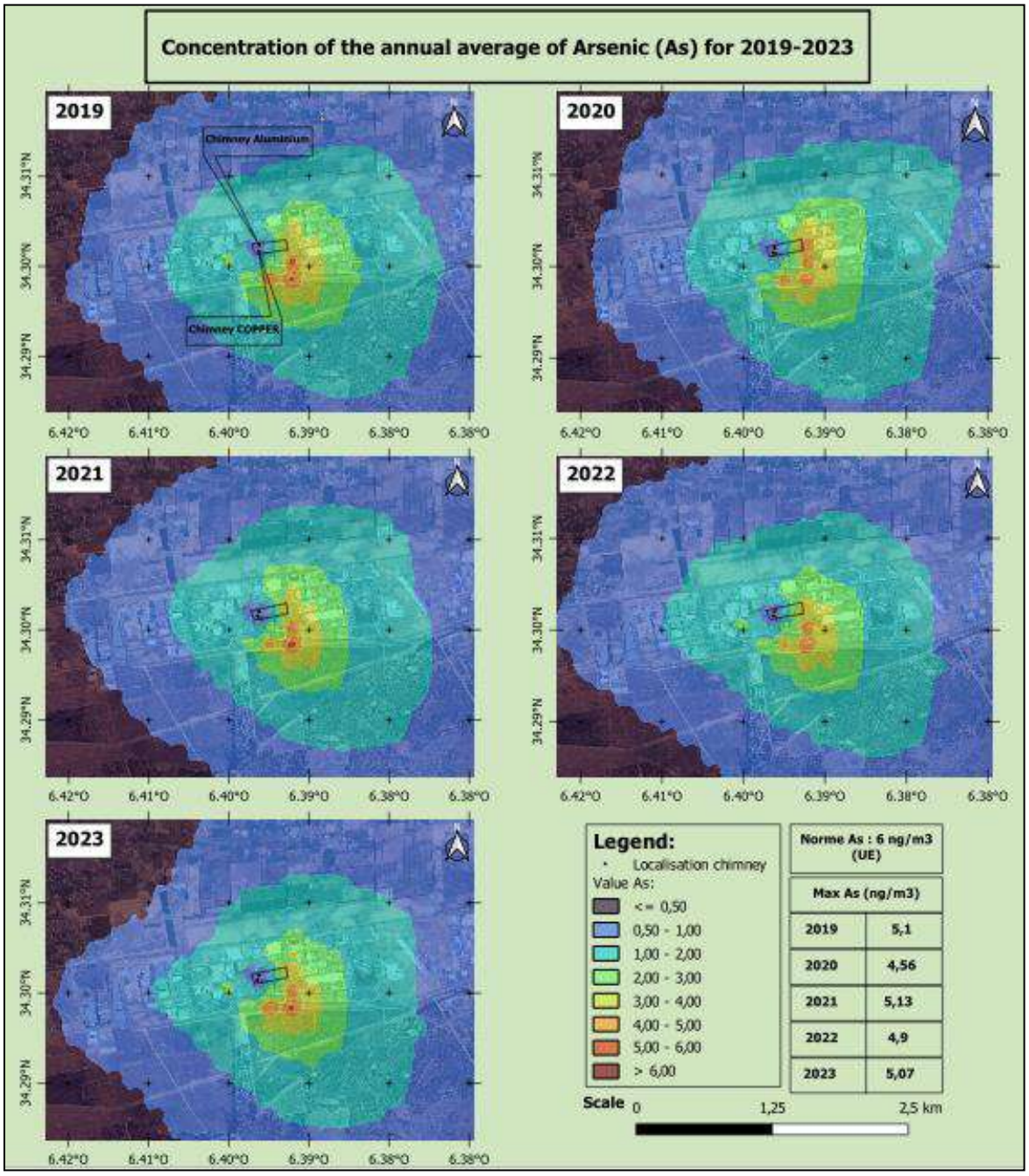


Similarly, the average SO2 concentrations for the period from October 1 to March 31 during the five years 2019-2023 are very negligible compared to the critical level for the protection of ecosystems recommended by the European Union (20µg/m3). The maximum values do not exceed 2µg/m3.



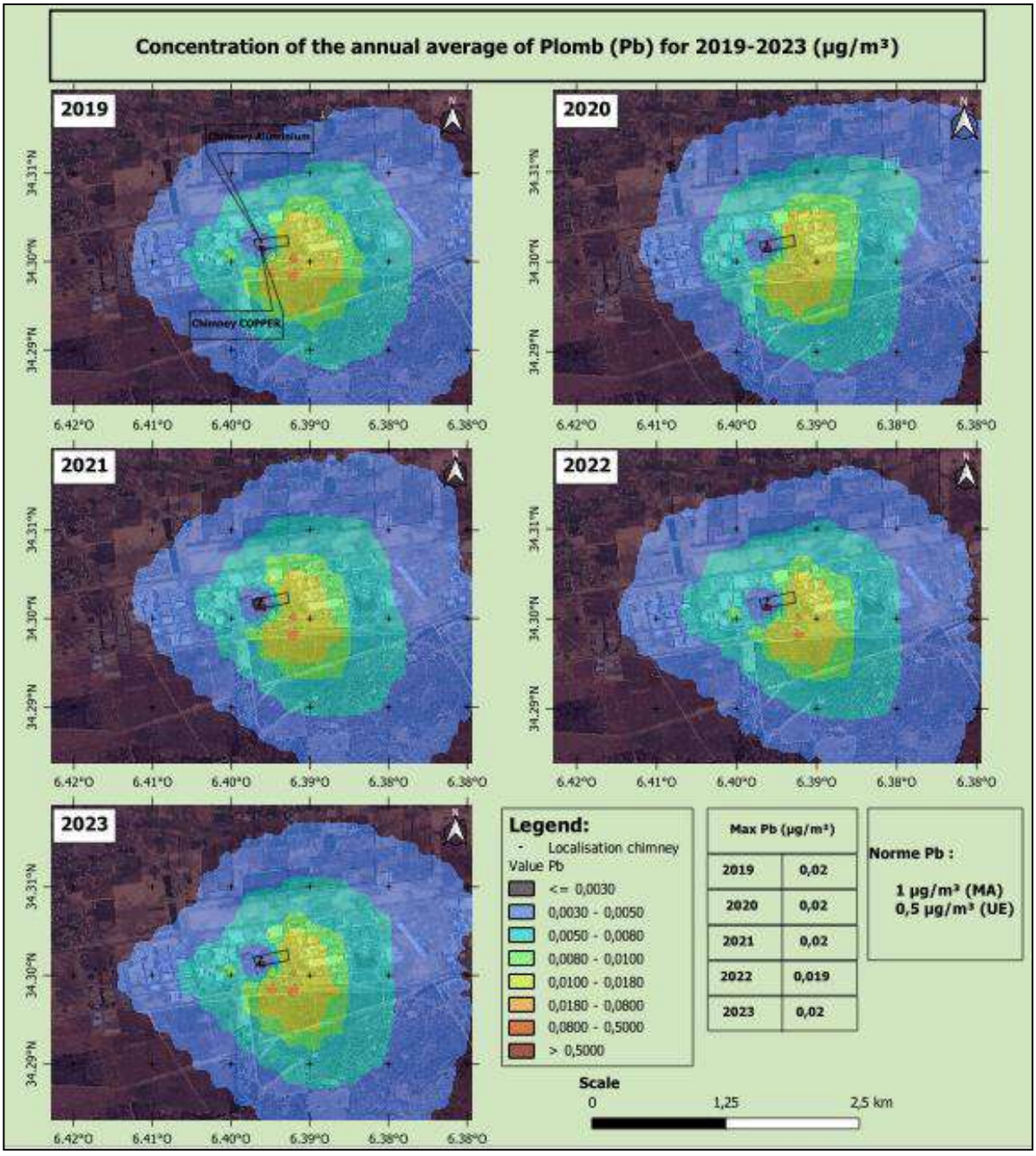
- ***Arsenic (As) concentration:***

The annual averages of Arsenic during the five years 2019-2023 remain very close to and below the target value required by the European Union directives (6ng/m3 EU); The maximum values are around 5ng/m3 and are recorded southeast of the industrial unit's installation site



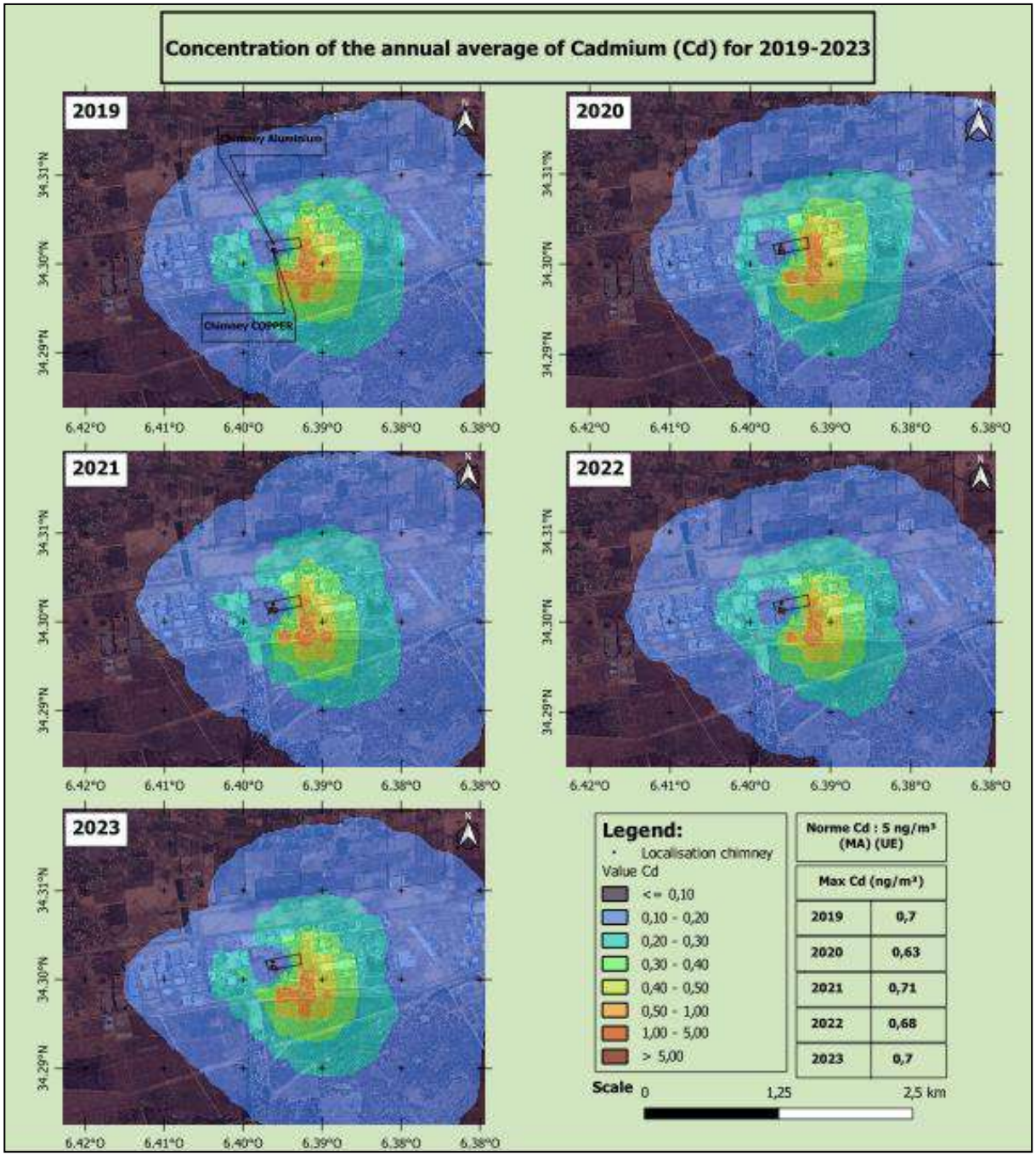
- ***Lead Concentration (Pb):***

The annual averages of Cadmium during the five years 2019-2023 remain very low compared to the limit value for health protection (1µg/m3 for MA and 0.5µg/m3 for EU); The maximum values do not exceed 0.02µg/m3 and are recorded southeast of the installation site of the industrial unit.



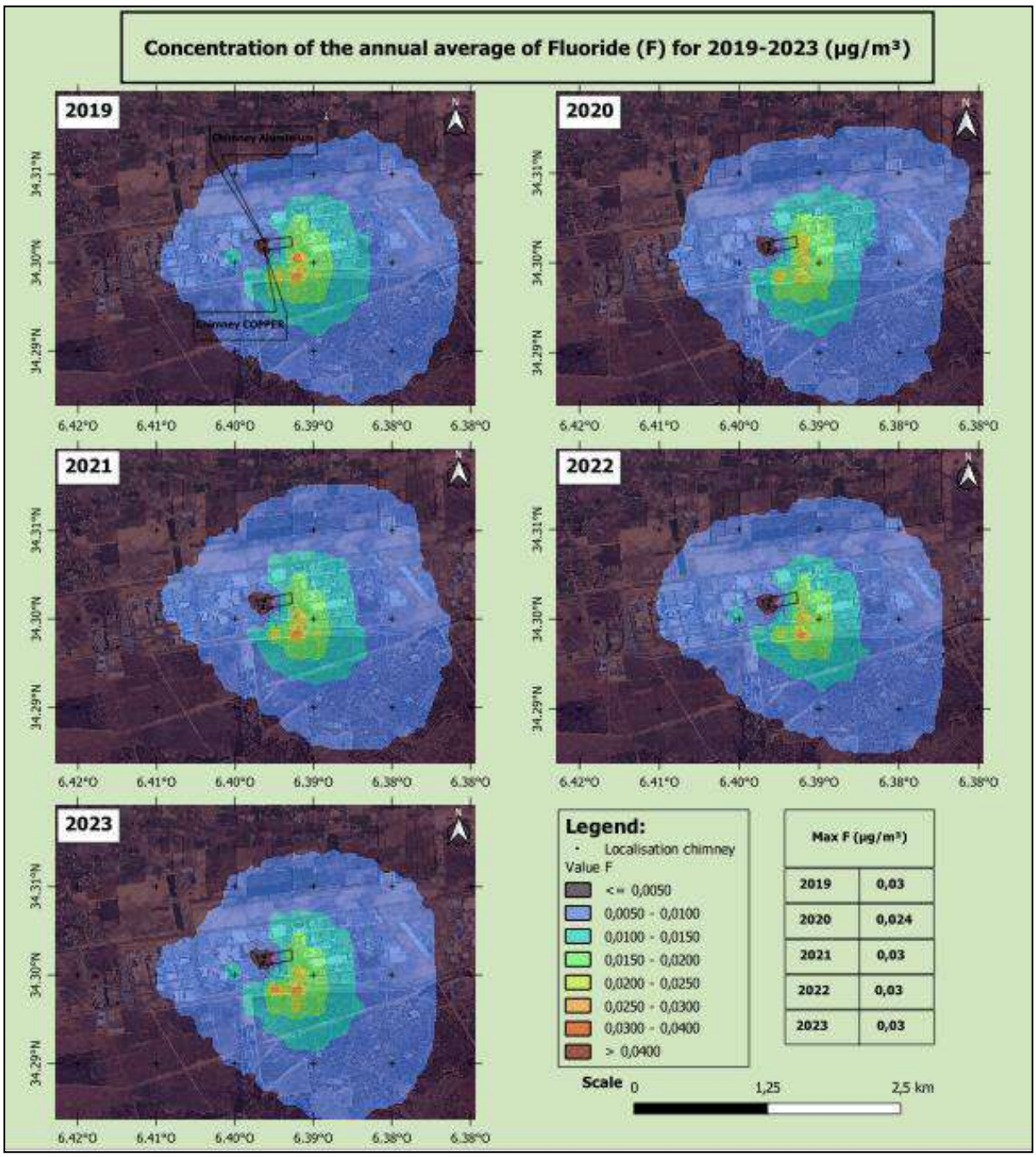
- ***Cadmium (Cd) concentration:***

The annual averages of Cadmium during the five years 2019-2023 remain below the limit value for health protection and the target value (5ng/m3 for MA and EU); The maximum values do not exceed 1ng/m3 and are recorded in the south-eastern sector of the industrial unit's installation site.



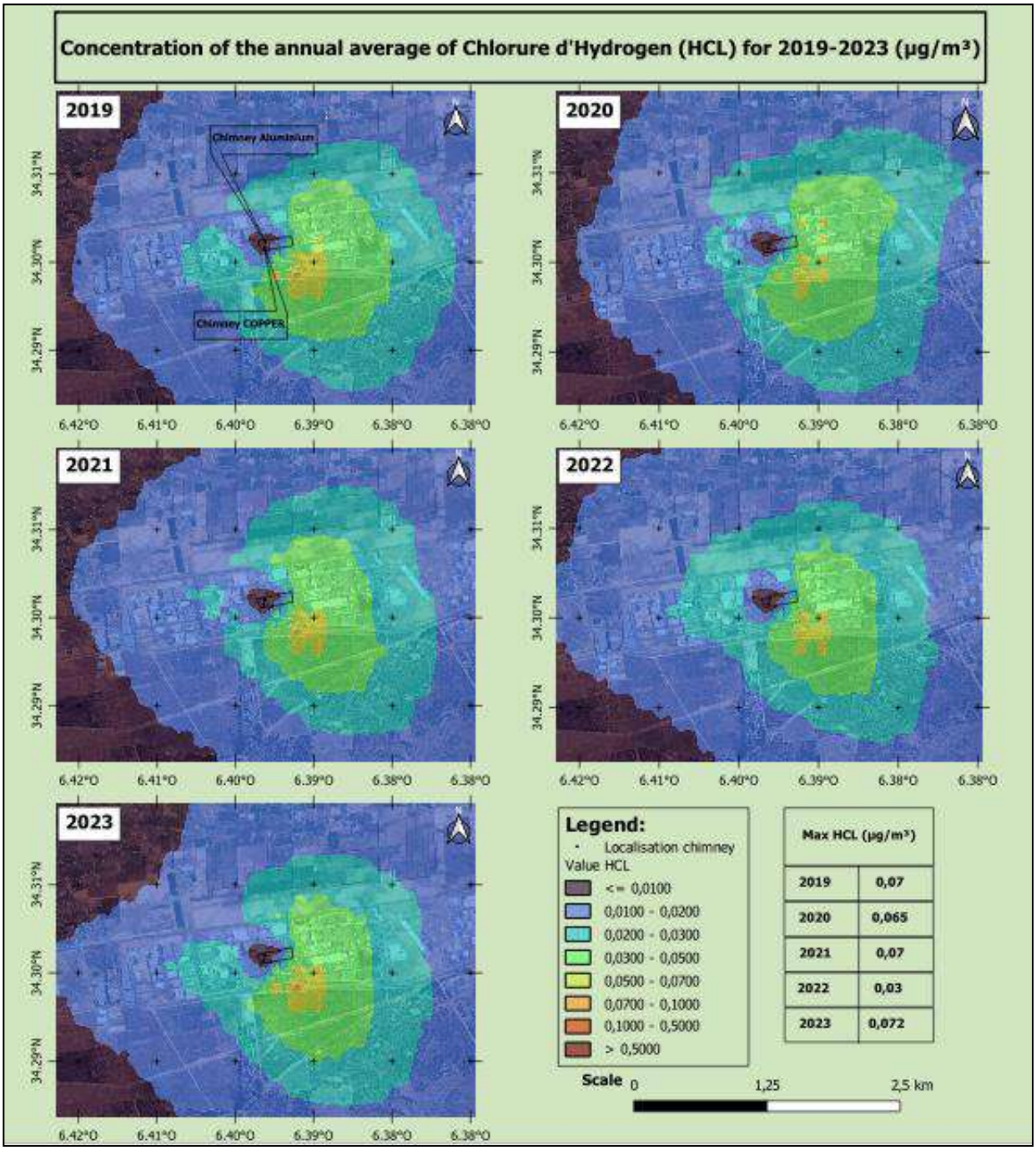
- ***Fluoride (F) concentration:***

The annual averages of fluoride remain almost stable during the five years, the maximum value is around 0.03µg/m3; The maximum values are recorded southeast of the installation site of the industrial unit.



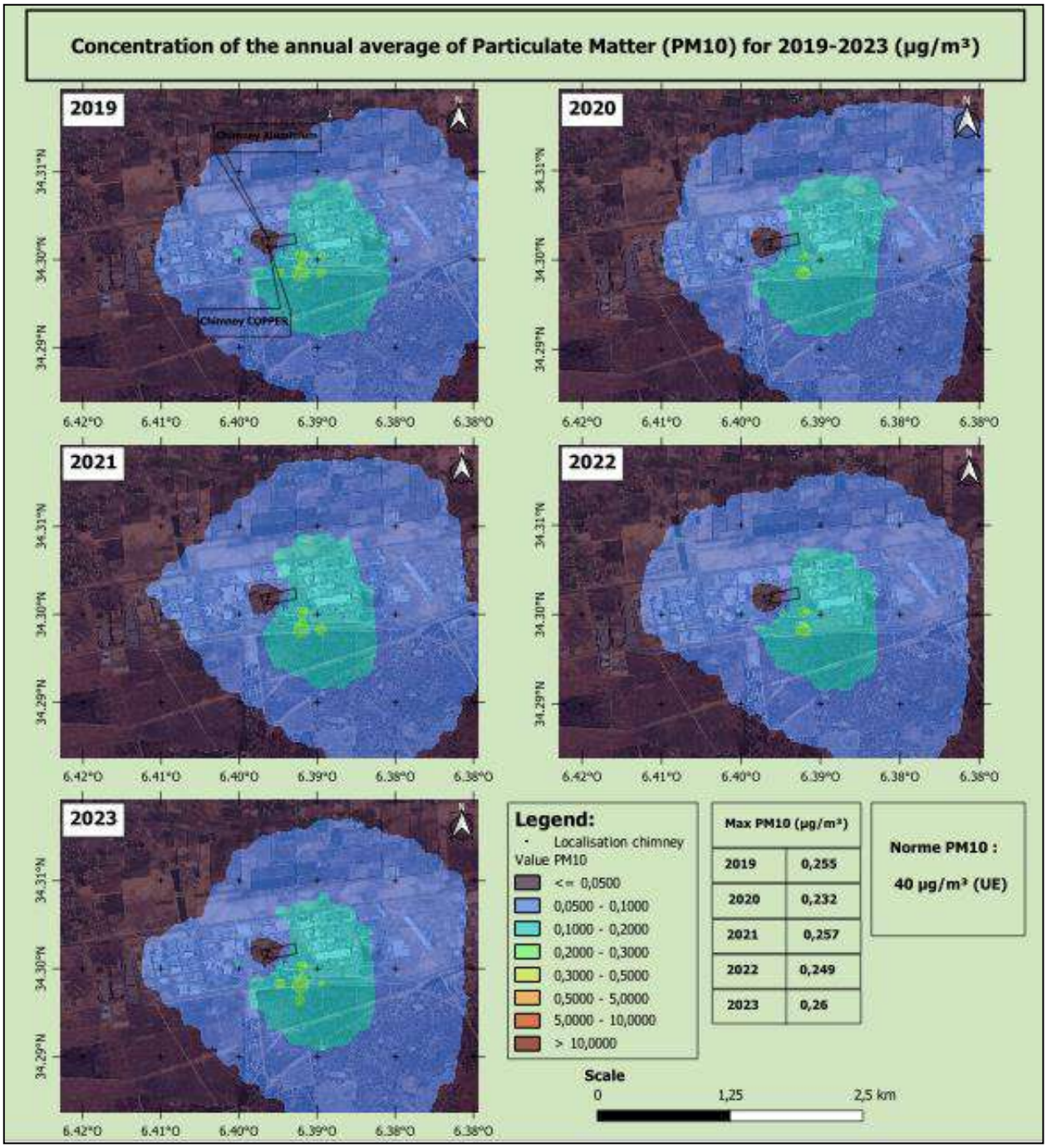
- ***Hydrogen Chloride (HCl) concentration:***

The annual averages for the years 2019-2023 of hydrogen chloride do not reach the value of 0.1µg/m3; The maximum values are recorded southeast of the installation site of the industrial unit.

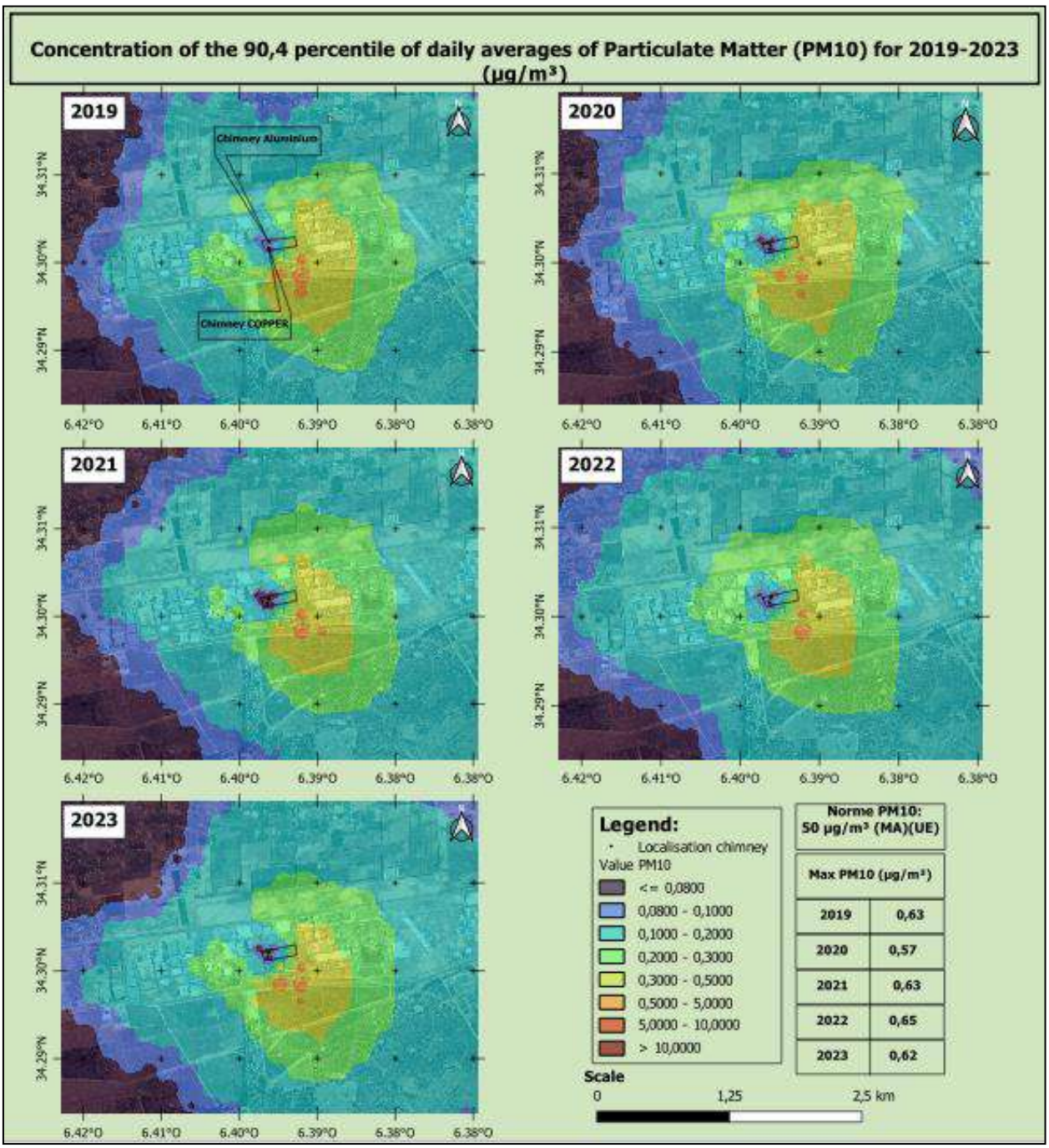


- ***Particulate matter concentration (PM10):***

The annual averages of PM10 during the period 2019-2023 are very negligible compared to the limit value for health protection recommended by the European Union (40µg/m3). The maximum values do not exceed 0.3µg/m3.

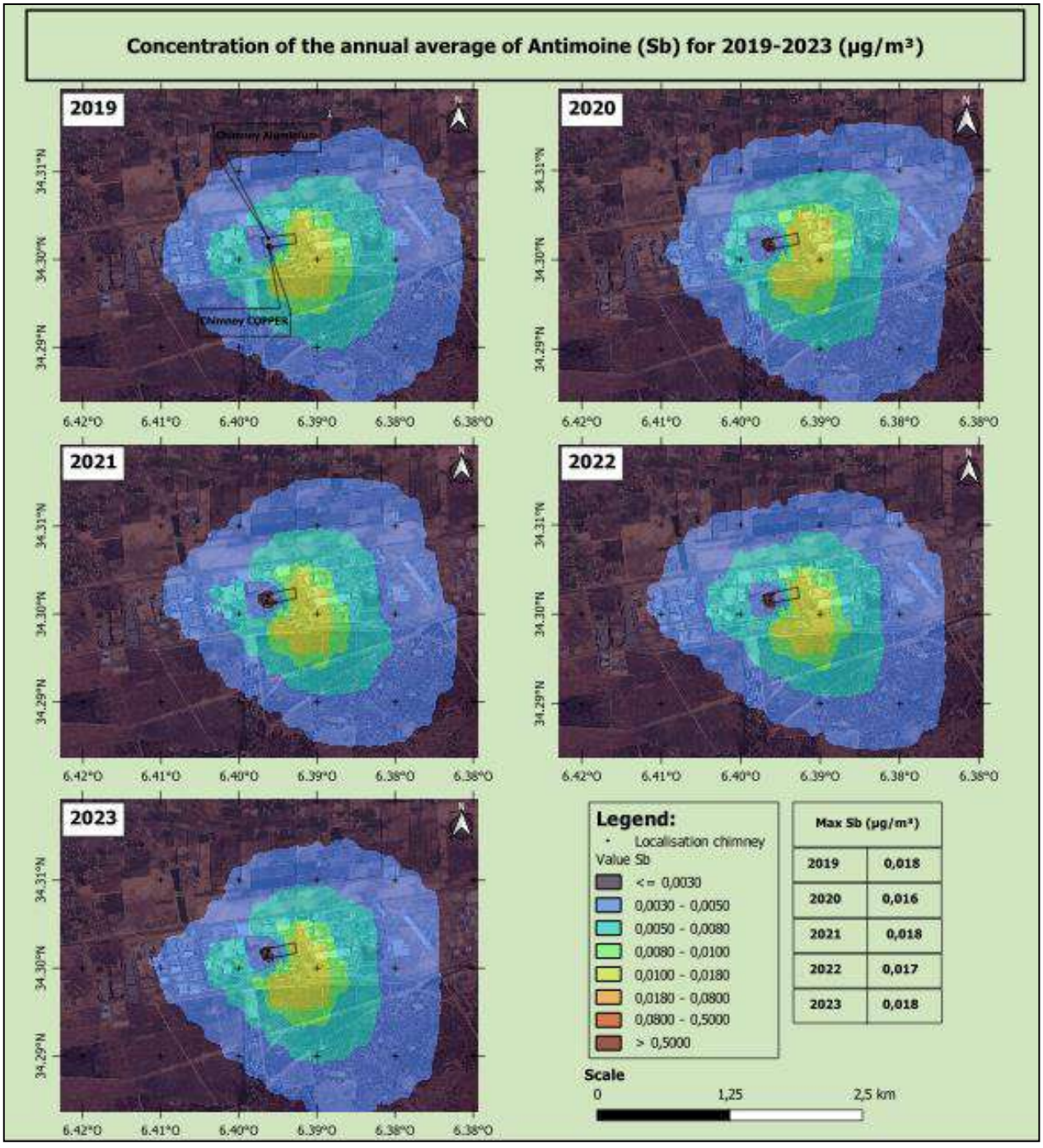


De même, les centiles 90,4 des moyennes journalières des PM10 durant la période 2019-2023 sont très négligeables devant la valeur limite pour la protection de la santé préconisée par la norme marocaine (50µg/m3). Les valeurs maximales ne dépassent pas 1µg/m3.



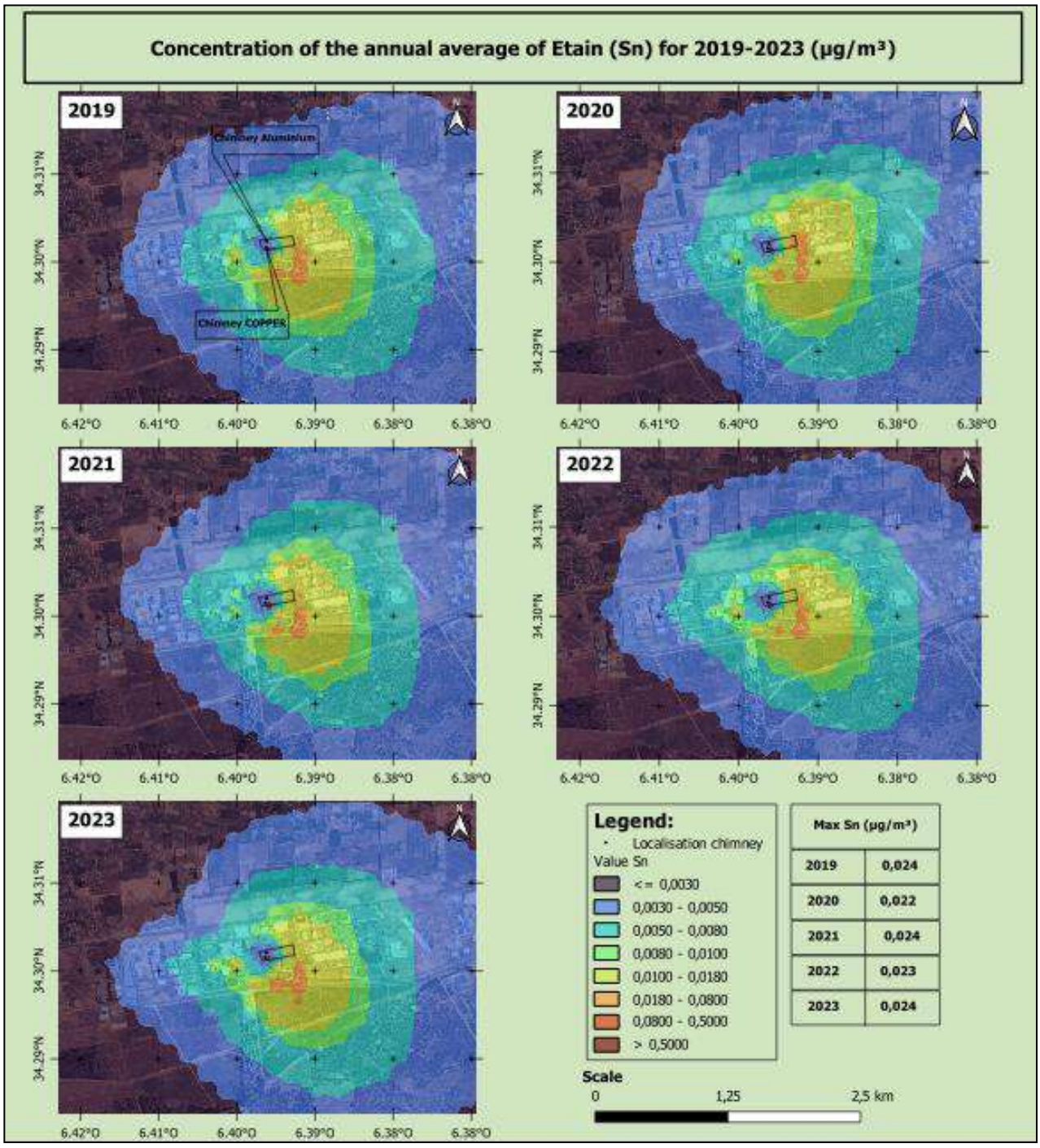
- ***Antimony concentration (Sb)***

The annual averages of Antimony remain almost stable during the five years 2019-2023, the maximum value is around 0.02µg/m3; The maximum values are recorded to the east of the industrial unit's installation site.



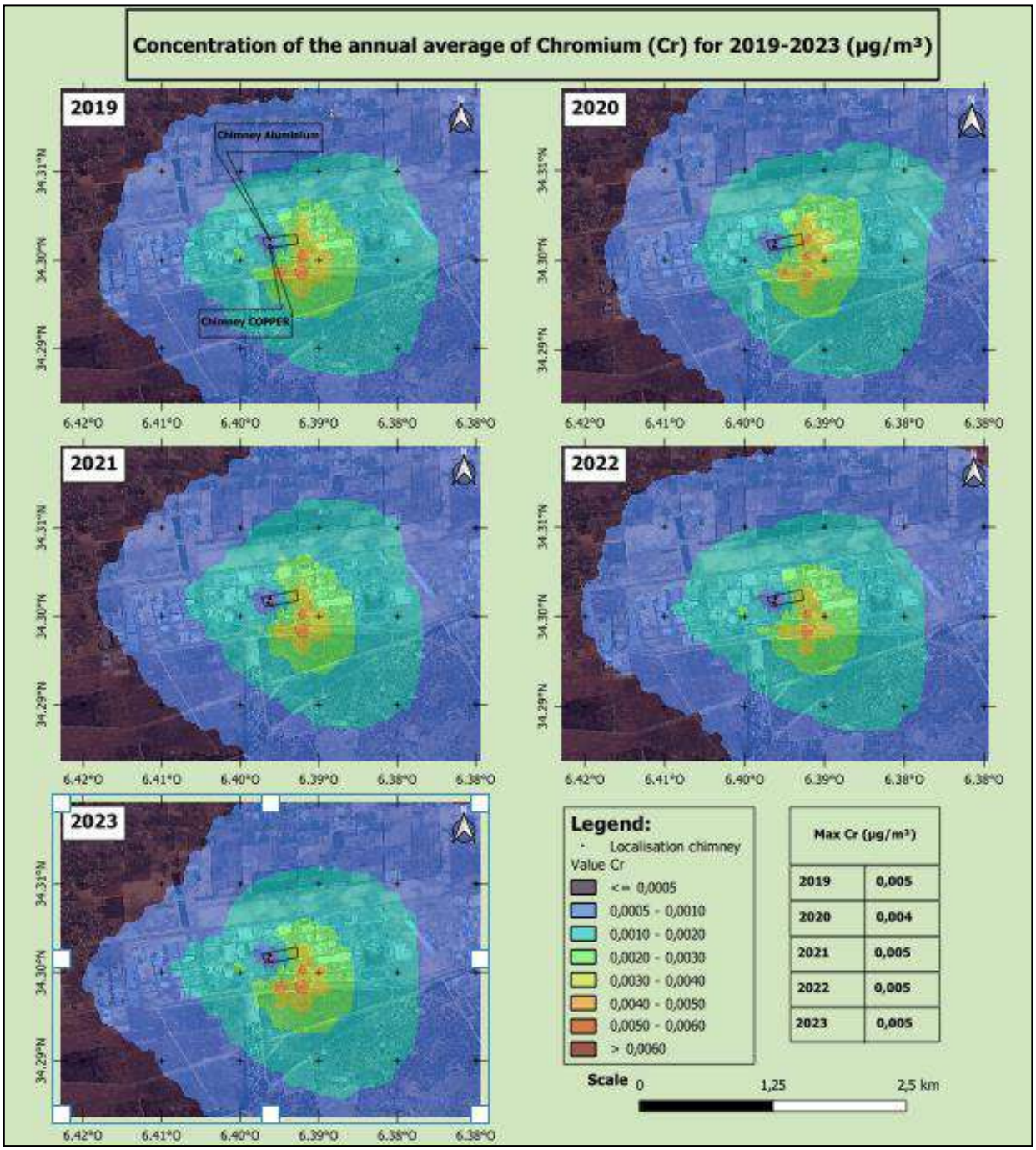
- ***Etain concentration (Sn):***

The annual averages of tin remain almost stable during the five years 2019-2023, the maximum value is around 0.025µg/m3; The maximum values are recorded southeast of the installation site of the industrial unit.



- ***Chromium (Cr) concentration:***

The annual averages of Chromium remain stable during the period 2019-2023 not exceeding the value 0.05µg/m3; The maximum values are recorded southeast of the installation site of the industrial unit.



4. Cumulative Impacts of Pollutants:

Background ambient concentrations were calculated using the air quality measurement campaign in the vicinity of the industrial unit installation site.

To estimate the cumulative effect of pollutants, the modelled concentrations (hourly and daily) over the entire study period (2019-2023) were summed to the maximum value (hourly or daily) of ambient background concentrations. The pollutants considered are SO2, NO2 and PM10.

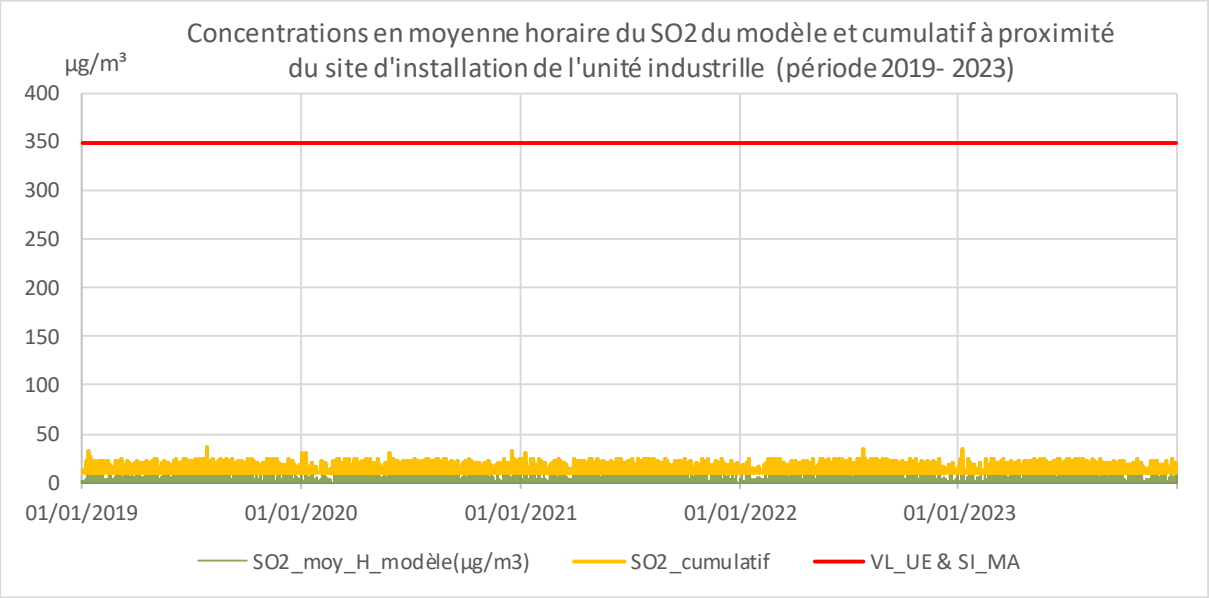
The table below shows the fund concentrations taken into account according to the corresponding limit values :

Pollutant	***Maximum hourly (µg/m3)***	***Maximum daily (µg/m3)***
SO2	**10,48**	**2,57**
NO2	**125,33**	**-**
PM10	**-**	**12,88**

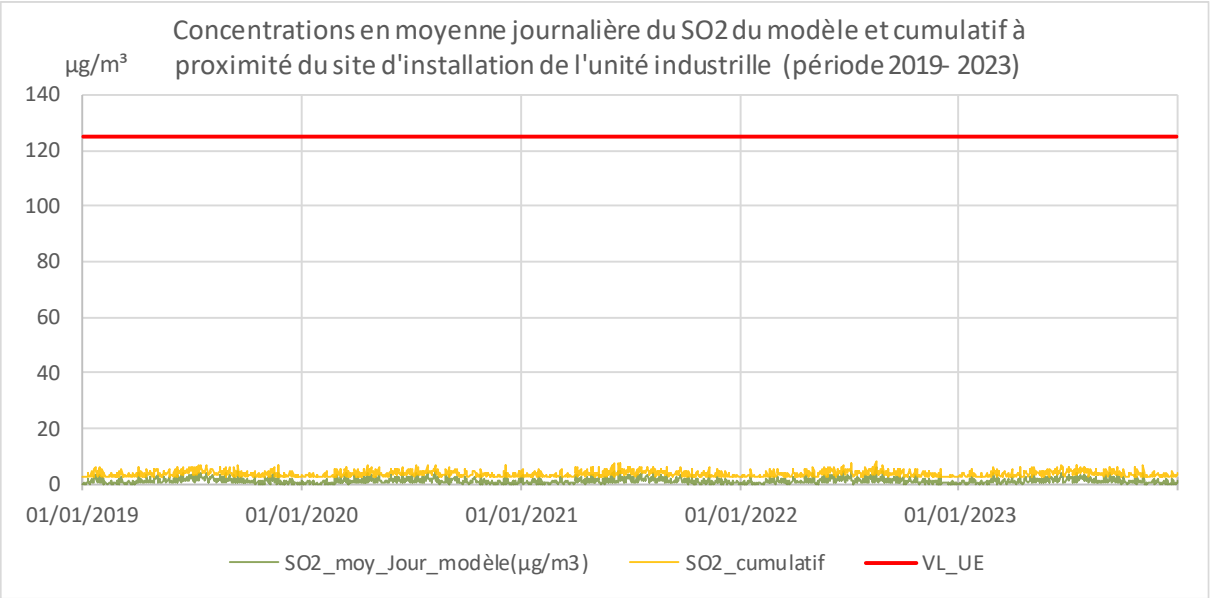
- ***Cumulative effect of sulphur dioxide (SO2):***

The choice of the site close to the location of the industrial unit to generate a time series of hourly or daily averages is based on the outputs of the AERMOD model, focusing on the point where there is the maximum concentration of the pollutant.

As the limit value for health protection (350µg/m3) as an hourly average recommended by the European Union directives, must not be exceeded more than 24 hours per year, the figure below shows that the hourly average concentrations of cumulative SO2 are very low compared to the limit value throughout the period 2019-2023.

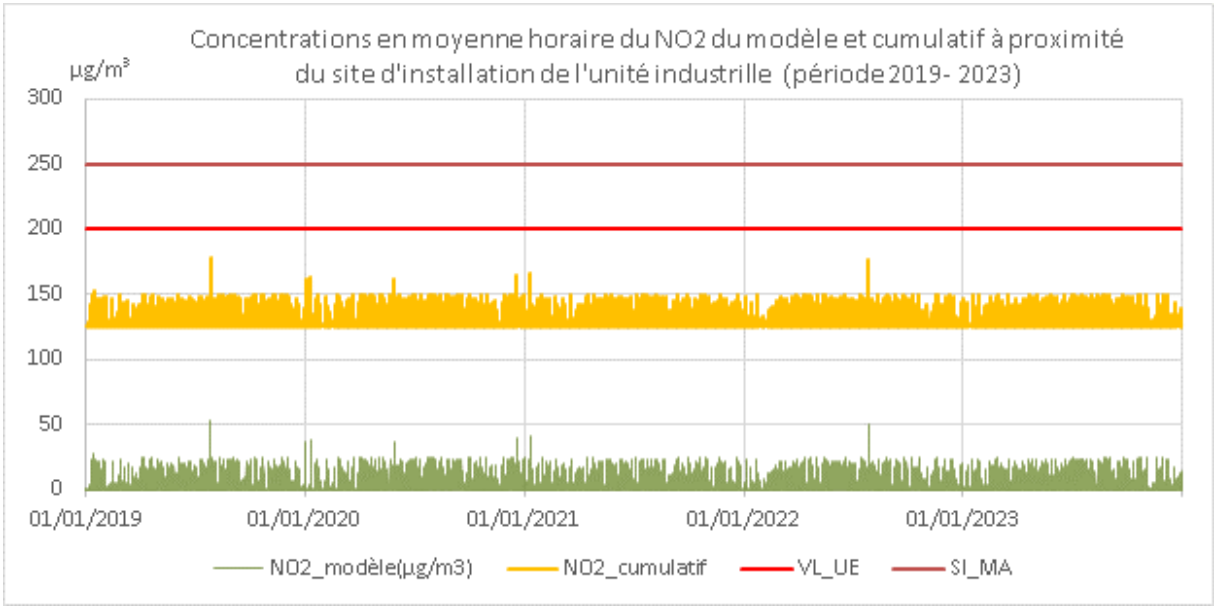


Similarly, the cumulative average daily concentrations of SO2 for the period 2019-2023 are negligible compared to the European Union's limit value for health protection (125 µg/m3) as a daily average not to exceed more than 3 days per year.



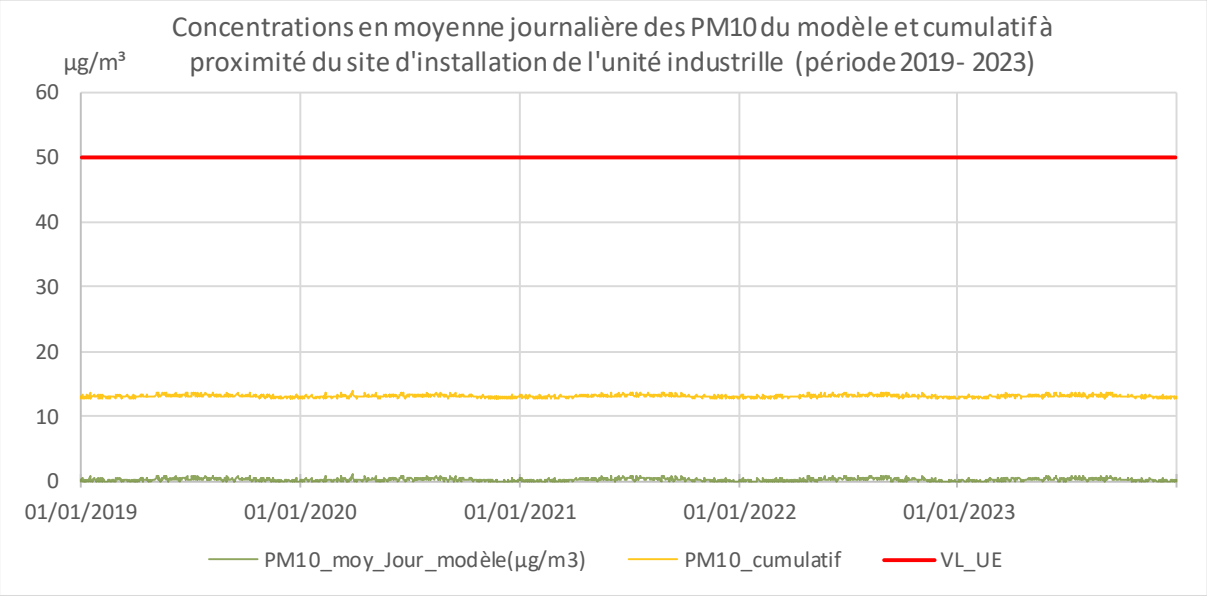
- ***Cumulative effect of nitrogen dioxide (NO2):***

The cumulative hourly average concentrations of NO2 for the period 2019-2023 are below the European Union limit value for health protection (200 µg/m3) on an hourly average of not more than 18 hours per year on the one hand, and the information threshold of the Moroccan standard (250 µg/m3) on the other hand.



- ***Cumulative effect of PM10:***

The cumulative average daily concentrations of PM10 for the period 2019-20123 are very low compared to the European Union's limit value for health protection (50µg/m3) as a daily average not to exceed 35 days per year.



IV. CONCLUSION

*As usual and on the basis of the analysis results provided by us, we can, unless there is a failure of the data provided by the customer in terms of emission sources and substances emitted (**change of positions or type of emission**. ..), decide on the quality of the simulated model using the **AERMOD** computer tools in the area where the **SAMTA METALS & ALLOYS** industrial unit is located, during a maximum production regime, continuous and simultaneous operation of the two plants (COPPER & ALUMI NIUM CHIMNIES), cumulatif impacts, in accordance with the standards and levels tolerated by local regulations, European and International ones.*

----------END

Visa
Office of environnemental studies

V. APPENDICES

1. Weather data from the WRF 'Weather Research and Forecasting' model:

extrait donnees_meteo_2019-2023_modèle WRF - Bloc-notes

Fichier Edition Format Affichage Aide

YEAR	MONTH	DAY	HOUR	dir(°)	speed(m/s)		T(°C)	CC(0-8)
2019	1	1	0	153,6	1,2	8,9	7	
2019	1	1	1	156,5	1,2	7,7	7	
2019	1	1	2	146,9	1,1	7,1	7	
2019	1	1	3	131,3	1,3	6,9	7	
2019	1	1	4	125,4	1,4	6,4	7	
2019	1	1	5	132,0	1,5	6,1	7	
2019	1	1	6	141,6	1,5	6,3	4	
2019	1	1	7	151,4	1,6	6,1	2	
2019	1	1	8	156,3	1,7	7,1	1	
2019	1	1	9	160,3	1,4	8,7	0	
2019	1	1	10	141,3	1,0	13,2	0	
2019	1	1	11	133,8	0,9	15,0	0	
2019	1	1	12	126,3	0,8	16,6	0	
2019	1	1	13	112,6	0,4	17,2	0	
2019	1	1	14	4,1	0,4	18,1	0	
2019	1	1	15	335,3	0,9	18,0	0	
2019	1	1	16	337,0	1,3	17,6	3	
2019	1	1	17	337,0	1,7	14,3	5	
2019	1	1	18	336,4	1,9	12,0	6	
2019	1	1	19	334,7	2,2	11,3	7	
2019	1	1	20	341,3	2,1	11,6	7	
2019	1	1	21	345,0	1,3	12,1	7	
2019	1	1	22	83,6	0,3	11,5	7	
2019	1	1	23	134,9	0,6	9,8	7	
2019	1	2	0	152,2	1,1	9,0	7	
2019	1	2	1	158,8	1,5	8,7	7	
2019	1	2	2	158,9	1,6	7,8	7	
2019	1	2	3	161,1	1,6	7,3	7	
2019	1	2	4	162,2	1,3	6,9	6	
2019	1	2	5	160,1	1,2	6,5	5	
2019	1	2	6	159,8	1,1	6,1	4	
2019	1	2	7	159,8	1,0	5,9	3	
2019	1	2	8	160,0	0,9	6,9	2	
2019	1	2	9	163,4	0,8	8,6	1	
2019	1	2	10	133,2	0,3	12,5	2	
2019	1	2	11	110,3	0,2	13,6	2	
2019	1	2	12	90,2	0,1	14,6	2	
2019	1	2	13	328,5	0,4	15,0	1	
2019	1	2	14	321,1	1,1	16,0	0	
2019	1	2	15	317,6	1,6	16,4	0	
2019	1	2	16	319,3	1,7	16,0	0	

2. The meteorological data generated by the AERMET module:

- ***Surface data:***

Extrait données meteo de surface generees par AERMET_2019-2023 - Bloc-notes

Fichier Edition Format Affichage Aide

```
   34.30N    06.39W             UA_ID: 00060252  SF_ID:   60252   OS_ID:0             VERSION: 12345
18 12 31 365 24  -94.2   .781   .000   .008   10. 1588.    426.5   .500   .75   .85    6.00  153.   10.0    1.0   10.0     1   1.00     50.  1013.      2
19  1  1   1  1  -77.5   .642   .000   .008   10. 1196.    288.2   .500   .75   .85    5.00  156.   10.0    1.0   10.0     1   1.00     50.  1013.      2
19  1  1   1  2 -143.8  1.193   .000   .008   10. 2958.    994.0   .500   .75   .85    9.00  146.   10.0    1.0   10.0     1   1.00     50.  1013.      1
19  1  1   1  3  -43.1   .357   .000   .008   10.  627.     89.2   .500   .75   .85    3.00  131.   10.0    1.0   10.0     1   1.00     50.  1013.      3
19  1  1   1  4  -60.5   .501   .000   .008   10.  813.    175.6   .500   .75   .85    4.00  125.   10.0    1.0   10.0     1   1.00     50.  1013.      5
19  1  1   1  5   -2.9   .024   .000   .008   10.   18.      .4   .500   .75   .85     .36    0.   10.0    1.0   10.0     1   1.00     50.  1013.      6
19  1  1   1  6  -94.2   .781   .000   .008   10. 1588.    426.5   .500   .75   .85    6.00  141.   10.0    1.0   10.0     1   1.00     50.  1013.      6
19  1  1   1  7  -60.5   .501   .000   .008   10.  839.    175.6   .500   .75   .85    4.00  151.   10.0    1.0   10.0     1   1.00     50.  1013.      7
19  1  1   1  8  -43.1   .357   .000   .008   10.  496.     89.2   .500   .75   .52    3.00  156.   10.0    1.0   10.0     1   1.00     50.  1013.      8
19  1  1   1  9   33.2   .424   .215   .008   10.  634.   -193.4   .500   .75   .39    3.00  160.   10.0    1.0   10.0     1   1.00     50.  1013.      5
19  1  1   1 10   61.7   .436   .702   .008  188.  663.   -113.4   .500   .75   .34    3.00  141.   10.0    1.0   10.0     1   1.00     50.  1013.      0
19  1  1   1 11  -64.3  1.066   .000   .008   10. 2514.   1581.3   .500   .75   .32    8.00  133.   10.0     .0   10.0     1   1.00     50.  1013.     11
19  1  1   1 12   18.8   .416   .177   .008   10.  707.   -322.8   .500   .75   .32    3.00  126.   10.0     .0   10.0     1   1.00     50.  1013.     10
19  1  1   1 13   85.4   .822   .795   .008  197. 1700.   -546.7   .500   .75   .32    6.00  112.   10.0     .0   10.0     1   1.00     50.  1013.      5
19  1  1   1 14   65.2   .185   .843   .008  308.  230.     -8.2   .500   .75   .34    1.00    4.   10.0     .0   10.0     1   1.00     50.  1013.      5
19  1  1   1 15  -22.8   .379   .000   .008  333.  535.    199.7   .500   .75   .39    3.00  335.   10.0     .0   10.0     1   1.00     50.  1013.     11
19  1  1   1 16   -2.9   .024   .000   .008   10.   12.      .4   .500   .75   .52     .36   31.   10.0    1.0   10.0     1   1.00     50.  1013.      3
19  1  1   1 17   -2.9   .024   .000   .008   10.    9.      .4   .500   .75   .85     .36  216.   10.0    1.0   10.0     1   1.00     50.  1013.      8
19  1  1   1 18  -31.3   .519   .000   .008   10.  860.    376.2   .500   .75   .85    4.00  336.   10.0    1.0   10.0     1   1.00     50.  1013.     11
19  1  1   1 19 -110.9   .919   .000   .008   10. 2012.    592.6   .500   .75   .85    7.00  334.   10.0    2.0   10.0     1   1.00     50.  1013.      2
19  1  1   1 20  -43.1   .357   .000   .008   10.  548.     89.6   .500   .75   .85    3.00  341.   10.0    2.0   10.0     1   1.00     50.  1013.      1
19  1  1   1 21   -2.9   .024   .000   .008   10.   14.      .4   .500   .75   .85     .36  321.   10.0    1.0   10.0     1   1.00     50.  1013.      3
19  1  1   1 22  -94.2   .781   .000   .008   10. 1588.    424.9   .500   .75   .85    6.00   83.   10.0     .0   10.0     1   1.00     50.  1013.      3
19  1  1   1 23 -143.8  1.193   .000   .008   10. 2955.    990.2   .500   .75   .85    9.00  134.   10.0     .0   10.0     1   1.00     50.  1013.      7
19  1  1   1 24  -25.3   .210   .000   .008   10.  370.     30.7   .500   .75   .85    2.00  152.   10.0    1.0   10.0     1   1.00     50.  1013.      1
19  1  2   2  1 -127.4  1.056   .000   .008   10. 2461.    779.5   .500   .75   .85    8.00  158.   10.0    1.0   10.0     1   1.00     50.  1013.      6
19  1  2   2  2 -143.8  1.193   .000   .008   10. 2972.    994.0   .500   .75   .85    9.00  158.   10.0    1.0   10.0     1   1.00     50.  1013.      7
19  1  2   2  3   -8.9   .074   .000   .008   10.  209.      3.8   .500   .75   .85    1.00  161.   10.0    1.0   10.0     1   1.00     50.  1013.      7
19  1  2   2  4  -25.3   .210   .000   .008   10.  220.     30.7   .500   .75   .85    2.00  162.   10.0    1.0   10.0     1   1.00     50.  1013.      3
19  1  2   2  5   -8.9   .074   .000   .008   10.   46.      3.8   .500   .75   .85    1.00  160.   10.0    1.0   10.0     1   1.00     50.  1013.      2
19  1  2   2  6 -127.4  1.056   .000   .008   10. 2497.    779.5   .500   .75   .85    8.00  159.   10.0    1.0   10.0     1   1.00     50.  1013.      1
19  1  2   2  7 -127.4  1.056   .000   .008   10. 2497.    779.5   .500   .75   .85    8.00  159.   10.0    1.0   10.0     1   1.00     50.  1013.      0
19  1  2   2  8   -1.5   .024   .000   .008   10.  127.      .8   .500   .75   .52     .36  348.   10.0     .0   10.0     1   1.00     50.  1013.     11
19  1  2   2  9    2.9   .539   .131   .008   26.  712.  -2000.0   .500   .75   .39    4.00  163.   10.0     .0   10.0     1   1.00     50.  1013.     10
19  1  2   2 10   67.2   .316   .689   .008  164.  411.    -39.6   .500   .75   .34    2.00  133.   10.0     .0   10.0     1   1.00     50.  1013.      3
19  1  2   2 11   88.0   .445   .914   .008  291.  682.    -84.2   .500   .75   .32    3.00  110.   10.0     .0   10.0     1   1.00     50.  1013.      2
19  1  2   2 12   93.5   .324  1.028   .008  390.  427.    -30.7   .500   .75   .32    2.00   90.   10.0     .0   10.0     1   1.00     50.  1013.      1
19  1  2   2 13   85.7   .694  1.061   .008  468. 1324.   -326.8   .500   .75   .32    5.00  328.   10.0     .0   10.0     1   1.00     50.  1013.      5
19  1  2   2 14   64.5   .185  1.002   .008  525.  209.     -8.3   .500   .75   .34    1.00  321.   10.0    1.0   10.0     1   1.00     50.  1013.      1
19  1  2   2 15   26.0   .812   .754   .008  556. 1679.  -1733.3   .500   .75   .39    6.00  317.   10.0    1.0   10.0     1   1.00     50.  1013.      7
19  1  2   2 16  -43.1   .357   .000   .008   10.  528.     89.2   .500   .75   .52    3.00  319.   10.0    1.0   10.0     1   1.00     50.  1013.      8
```

- ***Profile data:***

Extrait données_meteo de profil generees par AERMET_2019-2023 - Bloc-notes

Fichier Edition Format Affichage Aide

```
18 12 31 24   10.0 1  153.    6.00     1.0 -999.0 -999.00
19  1  1  1   10.0 1  156.    5.00     1.0 -999.0 -999.00
19  1  1  2   10.0 1  146.    9.00     1.0 -999.0 -999.00
19  1  1  3   10.0 1  131.    3.00     1.0 -999.0 -999.00
19  1  1  4   10.0 1  125.    4.00     1.0 -999.0 -999.00
19  1  1  5   10.0 1    0.     .36     1.0 -999.0 -999.00
19  1  1  6   10.0 1  141.    6.00     1.0 -999.0 -999.00
19  1  1  7   10.0 1  151.    4.00     1.0 -999.0 -999.00
19  1  1  8   10.0 1  156.    3.00     1.0 -999.0 -999.00
19  1  1  9   10.0 1  160.    3.00     1.0 -999.0 -999.00
19  1  1 10   10.0 1  141.    3.00     1.0 -999.0 -999.00
19  1  1 11   10.0 1  133.    8.00      .0 -999.0 -999.00
19  1  1 12   10.0 1  126.    3.00      .0 -999.0 -999.00
19  1  1 13   10.0 1  112.    6.00      .0 -999.0 -999.00
19  1  1 14   10.0 1    4.    1.00      .0 -999.0 -999.00
19  1  1 15   10.0 1  335.    3.00      .0 -999.0 -999.00
19  1  1 16   10.0 1   31.     .36     1.0 -999.0 -999.00
19  1  1 17   10.0 1  216.     .36     1.0 -999.0 -999.00
19  1  1 18   10.0 1  336.    4.00     1.0 -999.0 -999.00
19  1  1 19   10.0 1  334.    7.00     2.0 -999.0 -999.00
19  1  1 20   10.0 1  341.    3.00     2.0 -999.0 -999.00
19  1  1 21   10.0 1  321.     .36     1.0 -999.0 -999.00
19  1  1 22   10.0 1   83.    6.00      .0 -999.0 -999.00
19  1  1 23   10.0 1  134.    9.00      .0 -999.0 -999.00
19  1  1 24   10.0 1  152.    2.00     1.0 -999.0 -999.00
19  1  2  1   10.0 1  158.    8.00     1.0 -999.0 -999.00
19  1  2  2   10.0 1  158.    9.00     1.0 -999.0 -999.00
19  1  2  3   10.0 1  161.    1.00     1.0 -999.0 -999.00
19  1  2  4   10.0 1  162.    2.00     1.0 -999.0 -999.00
19  1  2  5   10.0 1  160.    1.00     1.0 -999.0 -999.00
19  1  2  6   10.0 1  159.    8.00     1.0 -999.0 -999.00
19  1  2  7   10.0 1  159.    8.00     1.0 -999.0 -999.00
19  1  2  8   10.0 1  348.     .36      .0 -999.0 -999.00
19  1  2  9   10.0 1  163.    4.00      .0 -999.0 -999.00
19  1  2 10   10.0 1  133.    2.00      .0 -999.0 -999.00
19  1  2 11   10.0 1  110.    3.00      .0 -999.0 -999.00
19  1  2 12   10.0 1   90.    2.00      .0 -999.0 -999.00
19  1  2 13   10.0 1  328.    5.00      .0 -999.0 -999.00
19  1  2 14   10.0 1  321.    1.00     1.0 -999.0 -999.00
19  1  2 15   10.0 1  317.    6.00     1.0 -999.0 -999.00
19  1  2 16   10.0 1  319.    3.00     1.0 -999.0 -999.00
19  1  2 17   10.0 1  320.    7.00     1.0 -999.0 -999.00
```