



حاضنة الأعمال بجامعة الأغواط
Incubateur Universitaire de Laghouat

الجمهورية الجزائرية الديمقراطية الشعبية
REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE
وزارة التعليم العالي والبحث العلمي
MINISTÈRE DE L'ENSEIGNEMENT SUPERIEUR
ET DE LA RECHERCHE SCIENTIFIQUE
جامعة عمار تليدي بالأغواط
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Mémoire de Master

**Domaine : Sciences de la Matière
Et Technologie**

**Option : Physique des Matériaux
Et Maintenance industrielle**

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THEME

Study of the influence of natural plants on the purity of micro-climate

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Année Universitaire 2022/2023

Abstract:

This research study aims to discover the effect of natural vegetation on the purity of the local climate. Microclimate refers to the specific climatic conditions in a confined area, such as indoor environments, urban spaces, or agricultural settings. The presence of pollutants and changes in temperature, humidity and air circulation can greatly affect the purity of the local climate and its overall quality. In our study, we carried out measurements on more than 8 regions of the city of Laghouat. Each region differs from the other depending on its environment and the materials that affect it. These regions are as follows (Residential perimeter surrounded by vegetation - a nursery - the university garden - a district in the center - city congested with means of transport - the university library – the Sonelgaz - Electricity Production SPE- Hassi R'Mel)

Where the best place in terms of air quality was: both the nursery, the university garden and the garden Residential perimeter, where the percentage of carbon dioxide was 1, 10 and 10 ppm respectively, lower than the values international health standards estimated at less than 400 ppm Oxygen gas was less than twenty percent in all previous regions, with slight variation. And high values of carbon dioxide both in the city center congested with means of transport and in the Sonelgaz - Electricity Production SPE- Hassi R'Mel, and we recorded carbon dioxide levels at 10,000 in the center -city, and it varied between 1,000 and 10,000 to 100,000 ppm in Sonelgaz Electricity Production SPE- of Hassi R'Mel

Accordingly, reforestation should be widespread, watering and maintaining in a modern way to save the land from asphyxiation

Key word: purity of microclimate, effect of natural vegetation, air quality, percentage of O₂ and CO₂ in the air

Résumé :

Cette étude de recherche vise à découvrir l'effet de la végétation naturelle sur la pureté du climat local. Le microclimat fait référence aux conditions climatiques spécifiques dans une zone confinée, comme les environnements intérieurs, les espaces urbains ou les milieux agricoles. La présence de polluants et les changements de température, d'humidité et de circulation de l'air peuvent grandement affecter la pureté du climat local et sa qualité globale. Dans notre étude, nous avons effectué des mesures sur plus de 8 régions de la ville de Laghouat. Chaque région diffère de l'autre en fonction de son environnement et des matières qui l'affectent. Ces régions sont les suivantes (Périmètre résidentiel entouré de végétation - une pépinière - le jardin universitaire - un quartier du centre - ville encombré de moyens de transport - la bibliothèque universitaire - Sonelgaz - Production de l'Electricité SPE de Hassi R'Mel

Où le meilleur endroit en termes de qualité de l'air était le suivant: à la fois la pépinière, le jardin universitaire et le jardin Périmètre résidentiel, où le pourcentage de gaz carbonique était respectivement de 1, 10 et 10 ppm, inférieur aux valeurs internationales normes sanitaires estimées à moins de 400 ppm L'oxygène gazeux était à moins de vingt pour cent dans toutes les régions précédentes, avec une légère variation. Et des valeurs élevées de dioxyde de carbone à la fois dans le centre-ville encombré de moyens de transport et dans Sonelgaz - Production de l'Electricité SPE de Hassi R'Mel , et nous avons enregistré des niveaux de dioxyde de carbone à 10 000 dans le centre-ville, et il variait entre 1 000 et 10 000 à 100 000 ppm dans Sonelgaz - Production de l'Electricité SPE de Hassi R'Mel

En conséquence, le reboisement doit être généralisé, arroser et entretenir de manière moderne pour sauver la terre d'asphyxie

Mot clé : la pureté du microclimat, l'effet de la végétation naturelle, la qualité de l'air, pourcentage de O₂ et CO₂ dans l'air

ملخص:

تهدف هذه الدراسة البحثية إلى معرفة تأثير النباتات الطبيعية على نقاء المناخ المحلي. يشير المناخ المحلي إلى الظروف المناخية المحددة داخل منطقة محصورة ، مثل البيئات الداخلية أو المساحات الحضرية أو الأماكن الزراعية. يمكن أن يؤثر وجود الملوثات والتغيرات في درجة الحرارة والرطوبة وحركة الهواء بشكل كبير على نقاء المناخ المحلي وجودته الإجمالية حيث قمنا في دراستنا بقياسات على أكثر من 8 مناطق في مدينة الاغواط تختلف كل منطقة عن الأخرى من حيث محيطها والأمور المؤثرة فيها وهذه المناطق هي كتالي (مربع سكني محاط بشريط نباتي - مشتلة - حديقة الجامعة - حي وسط مدينة مكتظ بوسائل النقل - المكتبة الجامعية – سونلغاز - محطة إنتاج الكهرباء حاسي الرمل)

حيث كان احسن مكان من حيث جودة الهواء كالتالي : كلا من المشتلة و حديقة الجامعة وحديقة المنزل حيث كان نسبة غاز ثنائي اكسيد الكربون 1 و 10 و 10 جزء من المليون على التوالي أقل من قيم المعايير الصحية العالمية المقدره ب أقل 400 جزء من المليون أما بنسبة لغاز اكسجين كان في حدود العشرون بمائة في كل المناطق السابقة مع تغيير طفيف . وقيم عالية من أكسيد الكربون في كلا من وسط المدينة مكتظ بوسائل النقل ومحطة الذخ لشركة سونطراك رقم 5 وسجلنا نسب ثاني أكسيد الكربون ب 10.000 وسط المدينة و تتروح بين 1000 و 10.000 الى 100.000 في محطة إنتاج الكهرباء حاسي الرمل

وعليه يجب تعميم التشجير وسقيها وصيانتها بطريق حديثة لإنقاذ الارض من الاختناق

الكلمات المفتاحية: نقاء المناخ المحلي ، وتأثير الغطاء النباتي الطبيعي ، ونوعية الهواء ، ونسبة الأوكسجين وثاني أكسيد الكربون في الهواء

Acknowledgments

الحمد لله الذي منحنا القدرة على اتمام هذه المذكرة

كما نتقدم بالشكر الجزيل لاستاذنا المشرف بن غية علي وشفتان علي الذان منحان الثقة الكافية لاتمام هذا البح في احسن صور ولم يبخلا بنصائحهم القيمة جزاهما الله كل خير ولهما منا كل التقدير الاحترام .

وكما نتقد بشكر الوفير باللجنة لتقديم هذا العمل لهم منا كل الشكر والتقدير

Dedication

اللهم صل وسلم على سيدنا محمد صلاة تحل بها عقدي، وتفرج بها كربتي، وتمحو بها خطيئتي، وتقضي بها حاجتي. اللَّهُمَّ صَلِّ عَلَيَّ مُحَمَّدٍ وَأَنْزِلْهُ الْمَنْزِلَ الْمُقَرَّبَ مِنْكَ يَوْمَ الْقِيَامَةِ. اللهم صلّ صلاة كاملة وسلم سلاماً تاماً على سيدنا محمد النبي الأمي الذي تنحل به العقد، وتفرج به الكرب، وتُقضى به الحوائج، وتنال به الرغائب وحسن الخواتم، ويستسقى الغمام، وعلى آله وصحبه عدد كل معلوم لله وبعد

نهدي تخرجنا لأهلنا حفظهم الله وادامهم نخر وتاج على راسي، فقد انتظروا سنين ليروا أبناهم بما يحلموا أن يروه فيهم نهدي تخرجي لكل صديق ورفيق درب في مختلف مراحلنا الدراسية نهدي تخرجنا لأساتذتنا من الابتدائية إلى الإعدادية، إلى الثانوية إلى اساتذتنا ودكاترتنا في الجامعة الذين تعلمنا منهم الكثير جداً، ليس فقط بالعلم بل بالأخلاق والمحبة والتسامح والتفاني والجد ورأينا من خلالهم الحياة بمنظور آخر حقاً هم شمعة إضاءة لنا الكثير من الطرق لحياتنا

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General Introduction

The influence of natural plants on the purity of the microclimate is an area of growing interest and importance in the field of environmental science and sustainability. The microclimate refers to the localized climate conditions within a specific area, which can vary significantly from the broader regional or global climate. Factors such as temperature, humidity, air movement, and air quality play a crucial role in determining the quality of the microclimate [1].

In recent years, there has been a greater emphasis on understanding and improving the microclimate, particularly in indoor environments, urban spaces, and agricultural settings. The presence of pollutants, temperature fluctuations, and inadequate ventilation can have adverse effects on human health, productivity, and overall well-being. Thus, finding effective and sustainable methods to enhance the purity of the microclimate has become a priority [2-4].

Global warming refers to the long-term increase in Earth's average temperature primarily caused by the release of greenhouse gases (GHGs) into the atmosphere. The primary contributor to global warming is human activities, particularly the burning of fossil fuels such as coal, oil, and natural gas [5]. When these fuels are burned, carbon dioxide (CO₂) and other GHGs are released, trapping heat in the Earth's atmosphere and leading to a phenomenon known as the greenhouse effect [6, 7].

The consequences of global warming include rising temperatures, melting ice caps and glaciers, sea-level rise, more frequent and intense extreme weather events (such as hurricanes, droughts, and heatwaves), shifts in ecosystems and wildlife habitats, and disruptions in agriculture and food production. These effects pose significant challenges to human societies, ecosystems, and economies worldwide.]

To mitigate global warming, international efforts have been made to reduce GHG [8]emissions. The Paris Agreement, adopted in 2015, aims to limit global warming to well below 2 degrees Celsius above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5 degrees Celsius. Countries are encouraged to transition to renewable energy sources, improve energy efficiency, and implement policies to red Air pollution refers to the presence of harmful substances in the Earth's atmosphere, which can have detrimental effects on human health, ecosystems, and the environment. Sources of air pollution include industrial emissions, vehicular exhaust, burning of fossil fuels, agricultural activities, and household activities[8].

In Chapter 1 we referred to common particulate air pollutants (PM),, nitrogen oxides (NO_x), sulfur dioxide (SO₂), carbon monoxide (CO), and volatile organic compounds (VOCs). These pollutants can lead to respiratory and cardiovascular problems, contribute to the formation of smog, and harm plant and animal life. In addition to human health impacts, air pollution can also damage buildings, reduce visibility, and have adverse effects on climate and ecosystems[9].

Efforts to combat air pollution involve implementing stricter emission standards for industries and vehicles, promoting cleaner technologies, encouraging the use of renewable energy sources, and adopting sustainable agricultural practices. Improving air quality requires cooperation at local, national, and international levels to develop and enforce effective policies[8].

It is important to address both global warming and air pollution as they are interconnected issues with overlapping causes and consequences. By reducing GHG emissions and air pollutants, we can mitigate climate change, improve air quality, and create a healthier and more sustainable future.uce emissions.

Natural plants have long been recognized for their ability to influence the surrounding environment. They possess unique mechanisms for purifying air, regulating humidity, and moderating temperature. Through processes such as photosynthesis and transpiration, plants can filter harmful substances from the air, release oxygen, and add moisture to the surrounding atmosphere. Additionally, the complex microorganisms associated with plants' root systems can contribute to the overall microbial balance and improve soil health[10].

In Chapter 2 In our studies, we use two types of collectors and gas sensors with different working principles The first type is an electrochemical sensor, while the second is an infrared sensor. In our study, we will measure the percentage of CO₂ emissions and the percentage of O₂ gas in the air in the various regions of the state of Laghouat in order to survey and study the effect of plants on polluting gas emissions and their role in purifying the air in different regions Where we used sensors for jeulin company, and BW M5IR Offers we borrowed them from Sadiq Talbi High School and Krabsy Laboratory and we carried out a calibration process for the sensors in the laboratories of Material Sciences.

In Chapter 3 We discussed the results obtained from the measurement of oxygen and carbon dioxide in several areas of the city of Laghouat In conclusion, studying the influence of natural plants on the purity of the microclimate is a critical area of research with significant implications for environmental sustainability and human well-being. By understanding the mechanisms through which plants can improve air quality,

regulate temperature and humidity, and enhance overall microclimate purity, we can develop strategies to create healthier and more sustainable environments for present and future generations

I Chapter Etude bibliographique

I.1 The atmosphere

The atmosphere of Earth is the layer of gases, known collectively as air, retained by Earth's gravity that surrounds the planet and forms its planetary atmosphere. The atmosphere of Earth creates pressure, absorbs most meteoroids and ultraviolet solar radiation, warms the surface through heat retention (greenhouse effect), allowing life and liquid water to exist on the Earth's surface, and reduces temperature extremes between day and night (the diurnal temperature variation).

As of 2023, by mole fraction (i.e., by number of molecules), dry air contains 78.08% nitrogen, 20.95% oxygen, 0.93% argon, 0.04% carbon dioxide, and small amounts of other gases. Air also contains a variable amount of water vapor, on average around 1% at sea level, and 0.4% over the entire atmosphere. Air composition, temperature, and atmospheric pressure vary with altitude. Within the atmosphere, air suitable for use in photosynthesis by terrestrial plants and breathing of terrestrial animals is found only in Earth's troposphere.[1]¹

Earth's early atmosphere consisted of gases in the solar nebula, primarily hydrogen. The atmosphere changed significantly over time, affected by many factors such as volcanism, life, and weathering. Recently, human activity has also contributed to atmospheric changes, such as global warming, ozone depletion and acid deposition[6].

The atmosphere has a mass of about 5.15×10^{18} kg, three quarters of which is within about 11 km (6.8 mi; 36,000 ft) of the surface. The atmosphere becomes thinner with increasing altitude, with no definite boundary between the atmosphere and outer space. The Kármán line, at 100 km (62 mi) or 1.57% of Earth's radius, is often used as the border between the atmosphere and outer space. Atmospheric effects become noticeable during atmospheric reentry of spacecraft at an altitude of around 120 km (75 mi). Several layers can be distinguished in the atmosphere, based on characteristics such as temperature and composition[1].

The study of Earth's atmosphere and its processes is called atmospheric science (aerology), and includes multiple subfields, such as climatology and atmospheric physics. Early pioneers in the field include Léon Teisserenc de Bort and Richard Assmann. The study of historic atmosphere is called paleoclimatology[11, 12].

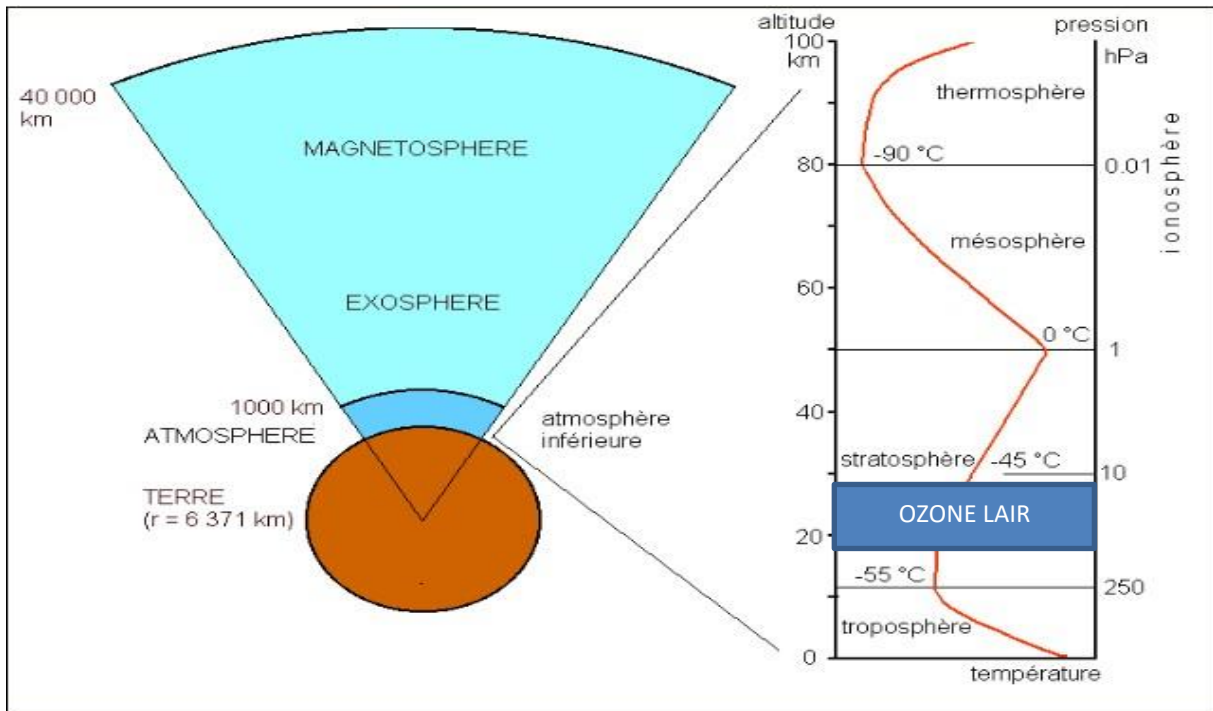


Figure 0.1 The atmosphere of Earth Composition

0.2 Composition of Earth's atmosphere

Composition of Earth's atmosphere by molecular count, excluding water vapor. Lower pie represents trace gases that together compose about 0.0434% of the atmosphere (0.0442% at August 2021 concentrations). Numbers are mainly from 2000, with CO₂ and methane from 2019, and do not represent any single source[13, 14].

The three major constituents of Earth's atmosphere are nitrogen, oxygen, and argon. Water vapor accounts for roughly 0.25% of the atmosphere by mass. The concentration of water vapor (a greenhouse gas) varies significantly from around 10 ppm by mole fraction in the coldest portions of the atmosphere to as much as 5% by mole fraction in hot, humid air masses, and concentrations of other atmospheric gases are typically quoted in terms of dry air (without water vapor).^{[11]:8} The remaining gases are often referred to as trace gases,^[12] among which are other greenhouse gases, principally carbon dioxide, methane, nitrous oxide, and ozone. Besides argon, already mentioned, other noble gases, neon, helium, krypton, and xenon are also present. Filtered air includes trace amounts of many other chemical compounds. Many substances of natural origin may be present in locally and seasonally variable small amounts as aerosols in an unfiltered air sample, including dust of mineral and organic composition, pollen and spores, sea spray, and volcanic ash. Various industrial pollutants also may be present as gases or aerosols, such as chlorine (elemental or in compounds), fluorine compounds and elemental mercury vapor. Sulfur compounds such as hydrogen sulfide and sulfur dioxide (SO₂) may be derived from natural sources or from industrial air pollution[13, 14].

Tableau 1: Major constituents of dry air major constituents of dry air, by mole fraction

Gas			Mole fraction(A)	
	Name	Formula	in ppm(B)	in %
Nitrogen		N ₂	780840	78.084
Oxygen		O ₂	209460	20.946
Argon		Ar	9340	0.9340
Carbon dioxide (April 2022)(C)		CO ₂	417	0.0417
Neon		Ne	18.18	0.001818
Helium		He	5.24	0.000524
Methane		CH ₄	1.87	0.000187
Krypton		Kr	1.14	0.000114
Not included in above dry atmosphere:				
Water vapor(D)		H ₂ O	0–30,000(D)	0–3%(E)

notes:

(A) Mole fraction is sometimes referred to as volume fraction; these are identical for an ideal gas only.

(B) ppm: parts per million by molecular count

The total ppm above adds up to more than 1 million (currently 83.43 above it) due to experimental error.

(C) The concentration of CO₂ has been increasing in recent decades

(D) Water vapor is about 0.25% by mass over full atmosphere

(E) Water vapor varies significantly locally

0.2.1 Stratification

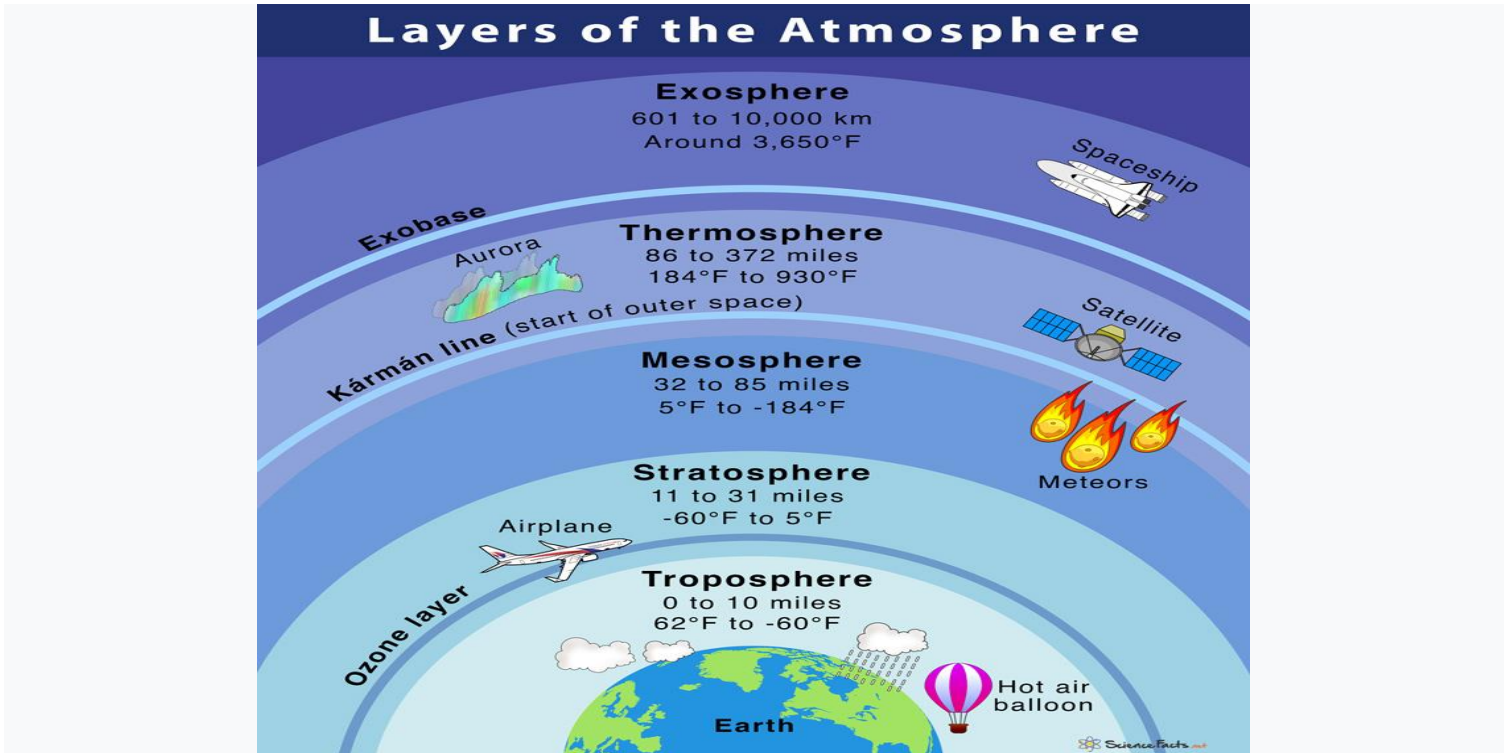


FIGURE 0.2 EARTH'S ATMOSPHERE

Earth's atmosphere. Lower four layers of the atmosphere in three dimensions as seen diagonally from above the exobase. Layers drawn to scale, objects within the layers are not to scale. Aurorae shown here at the bottom of the thermosphere can actually form at any altitude in this atmospheric layer.

In general, air pressure and density decrease with altitude in the atmosphere. However, the temperature has a more complicated profile with altitude, and may remain relatively constant or even increase with altitude in some regions (see the temperature section, below). Because the general pattern of the temperature/altitude profile, or lapse rate, is constant and measurable by means of instrumented balloon soundings, the temperature behavior provides a useful metric to distinguish atmospheric layers. In this way, Earth's atmosphere can be divided (called atmospheric stratification) into five main layers: troposphere, stratosphere, mesosphere, thermosphere, and exosphere[15-17]. The altitudes of the five layers are as follows:

- Exosphere: 700 to 10,000 km (440 to 6,200 miles)
- Thermosphere: 80 to 700 km (50 to 440 miles)
- Mesosphere: 50 to 80 km (31 to 50 miles)
- Stratosphere: 12 to 50 km (7 to 31 miles)
- Troposphere: 0 to 12 km (0 to 7 miles)

0.2.2 Exosphere

The exosphere is the outermost layer of Earth's atmosphere (though it is so tenuous that some scientists consider it to be part of interplanetary space rather than part of the atmosphere). It extends from the thermopause (also known as the "exobase") at the top of the thermosphere to a poorly defined boundary with the solar wind and interplanetary medium. The altitude of the exobase varies from about 500 kilometres (310 mi; 1,600,000 ft) to about 1,000 kilometres (620 mi) in times of higher incoming solar radiation. The upper limit varies depending on the definition. Various authorities consider it to end at about 10,000 kilometres (6,200 mi) or about 190,000 kilometres (120,000 mi)—about halfway to the moon, where the influence of Earth's gravity is about the same as radiation pressure from sunlight.^[22] The geocorona visible in the far ultraviolet (caused by neutral hydrogen) extends to at least 100,000 kilometres (62,000 mi).

This layer is mainly composed of extremely low densities of hydrogen, helium and several heavier molecules including nitrogen, oxygen, and carbon dioxide closer to the exobase. The atoms and molecules are so far apart that they can travel hundreds of kilometers without colliding with one another. Thus, the exosphere no longer behaves like a gas, and the particles constantly escape into space. These free-moving particles follow ballistic trajectories and may migrate in and out of the magnetosphere or the solar wind. Every second, the Earth loses about 3 kg of hydrogen, 50 g of helium, and much smaller amounts of other constituents.

The exosphere is too far above Earth for meteorological phenomena to be possible. However, Earth's auroras—the aurora borealis (northern lights) and aurora australis (southern lights)—sometimes occur in the lower part of the exosphere, where they overlap into the thermosphere. The exosphere contains many of the artificial satellites that orbit Earth[15-[17].

1.2.3 Thermosphere

The thermosphere is the second-highest layer of Earth's atmosphere. It extends from the mesopause (which separates it from the mesosphere) at an altitude of about 80 km (50 mi; 260,000 ft) up to the thermopause at an altitude range of 500–1000 km (310–620 mi; 1,600,000–3,300,000 ft). The height of the thermopause varies considerably due to changes in solar activity. Because the thermopause lies at the lower boundary of the exosphere, it is also referred to as the exobase. The lower part of the thermosphere, from 80 to 550 kilometres (50 to 342 mi) above Earth's surface, contains the ionosphere.

The temperature of the thermosphere gradually increases with height and can rise as high as 1500 °C (2700 °F), though the gas molecules are so far apart that its temperature in the usual sense is not very meaningful. The air is so rarefied that an individual molecule (of oxygen, for example) travels an average of 1 kilometre (0.62 mi; 3300 ft) between collisions with other molecules.^[25] Although the thermosphere has a

high proportion of molecules with high energy, it would not feel hot to a human in direct contact, because its density is too low to conduct a significant amount of energy to or from the skin[17].

This layer is completely cloudless and free of water vapor. However, non-hydrometeorological phenomena such as the aurora borealis and aurora australis are occasionally seen in the thermosphere. The International Space Station orbits in this layer, between 350 and 420 km (220 and 260 mi). It is this layer where many of the satellites orbiting the earth are present[17].

0.3 Global warming

Global warming is a term often used interchangeably with climate change, as it is one of the most important measures of global changes. Global warming refers to the rise in average global temperatures, which is linked to significant impacts on humans, wildlife, and ecosystems around the world. Because there are more factors and impacts than only rising surface temperatures, the term climate change is used to include these additional impacts. There is strong consensus among scientists, representing 97% of actively publishing climate scientists, that human influence has been the dominant cause of observed warming trends since the 20th century[18-20].

The concentration of carbon dioxide in the atmosphere has risen from hovering around 280 parts per million (ppm) in pre-Industrial time, to 413 ppm as of early 2020. This concentration of carbon dioxide is unprecedented in recorded history. Scientists have reported that we need to return to a ‘safe’ concentration of 350 ppm by 2100 in order to stabilize global warming[18-20].

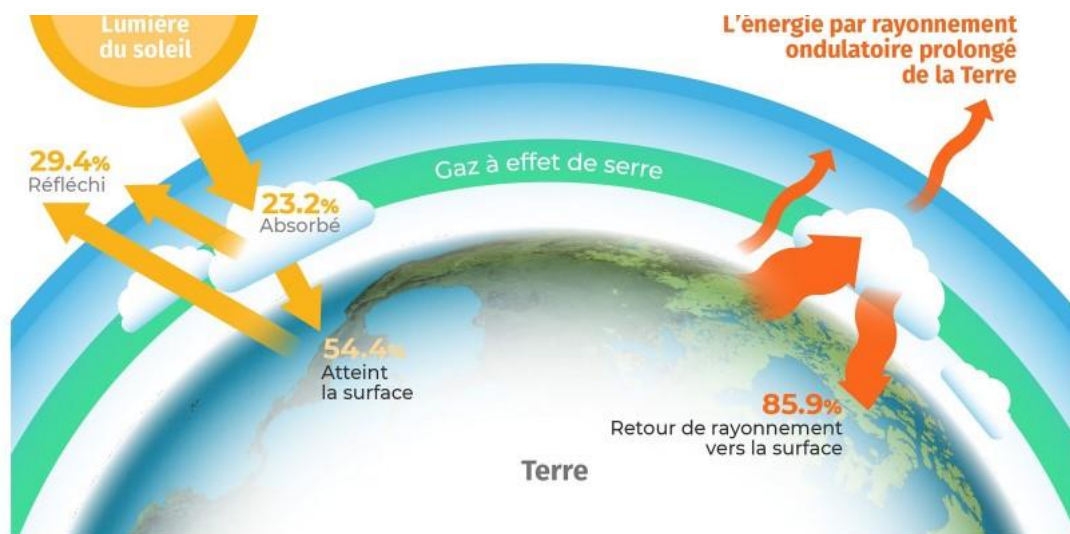


FIGURE 0 .3 GLOBAL WARMING

0.3.1 Causes of global warming

Global warming, also known as climate change, is primarily caused by human activities that release large amounts of greenhouse gases into the atmosphere. The most significant greenhouse gas is carbon dioxide (CO₂), which is released when we burn fossil fuels such as coal, oil, and gas for energy. Other greenhouse gases include methane, nitrous oxide, and fluorinated gases, which are also released through human activities such as agriculture, transportation, and industrial processes[21-23] [23].

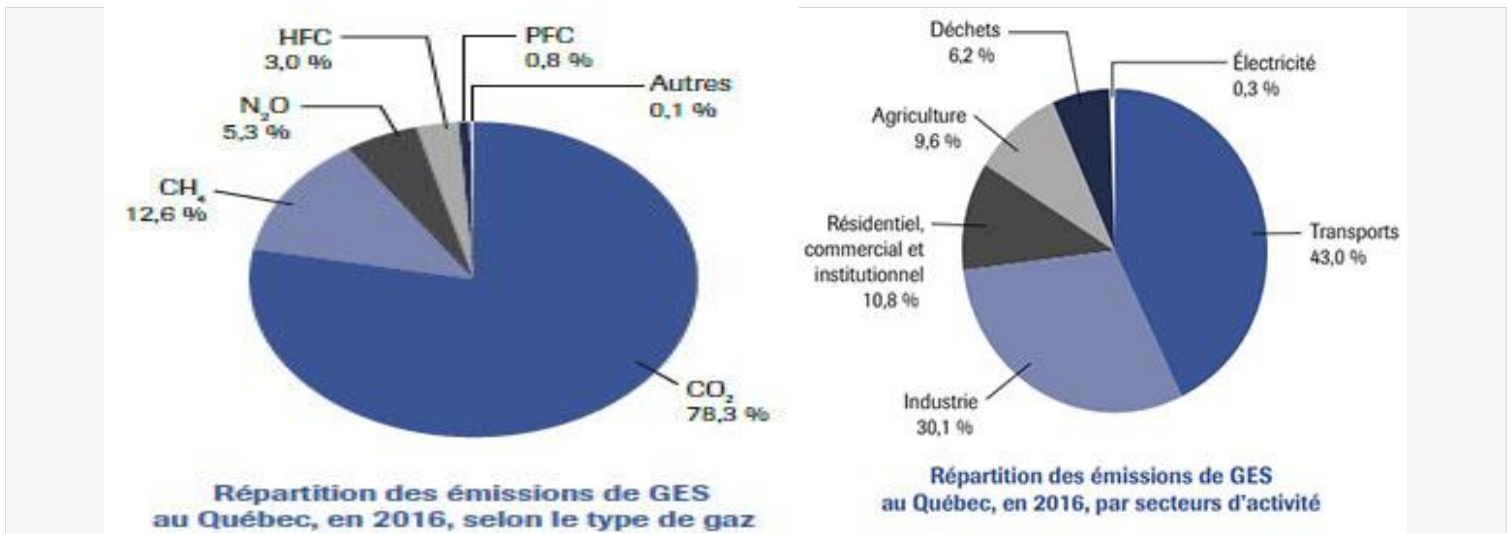




FIGURE 0.4: A- THE MOST SIGNIFICANT GREENHOUSE B- CAUSES OF GLOBAL WARMING.

0.3.2 The following are some of the main causes of global warming

-  **Burning fossil fuels:** The burning of fossil fuels for energy and transportation is the primary cause of the increasing levels of carbon dioxide in the atmosphere.
-  **Deforestation:** Trees absorb carbon dioxide from the atmosphere through photosynthesis. When forests are cleared, this carbon is released into the atmosphere, contributing to global warming.



➤ **Agriculture(9.6%):** : The production of meat and dairy products results in significant greenhouse gas emissions, mainly methane, from livestock. Additionally, agricultural practices such as the use of fertilizers also contribute to nitrous oxide emissions.

➤ **Industrial processes(30.1%):** Industrial processes such as cement production and the manufacturing of chemicals and plastics result in significant greenhouse gas emissions.

➤ **Land-use changes:** Land-use changes, such as the conversion of natural ecosystems into agricultural or urban areas, can result in significant greenhouse gas emissions.



➤ **Transportation(43%):** The use of cars, trucks, and airplanes for transportation results in significant greenhouse gas emissions, mainly from the burning of fossil fuels.



➤ **Waste: (6.8%)** : We put large amounts of organic matter in our garbage cans and when they decompose, they produce methane (CH₄) ,a powerful GHG. In addition GES

Overall, the release of greenhouse gases from human activities is causing the Earth's climate to warm, leading to a range of negative impacts, including sea-level rise, more frequent and severe weather events, and impacts on ecosystems and human health.

Effects of climate change Warmer temperatures over time are changing weather patterns and disrupting the usual balance of nature, posing many risks to human beings and all other forms of life on Earth[21-23] [23].

NEARLY ALL LAND AREAS ARE SEEING MORE HOT DAYS AND HEAT WAVES[24-26]; 2021 was one of the hottest years on record. Higher temperatures increase heat-related illnesses and can make it more difficult to work and move around. Wildfires start more easily and spread more rapidly when conditions are hotter.

Temperature rise is only the beginning of the story. Because the Earth is a system, where everything is connected, changes in one area often influence changes in all others. The consequences of climate change now include:

- intense droughts
- water scarcity
- severe fires
- rising sea levels
- flooding

- melting polar ice
- catastrophic storms
- declining biodiversity



FIGURE 0. 05.A-SEVERE FIRES B- WATER SCARCITY C- DECLINING BIODIVERSITY D- CATASTROPHIC STORMS

0.4 Air Quality Index

AQI stands for Air Quality Index. It is a numerical scale used to measure and report the level of air pollution in a specific area. The AQI provides information about the quality of the air people are breathing and helps to raise awareness about potential health risks associated with poor air quality.

The concept of AQI is based on the measurement of various air pollutants, including particulate matter (PM_{2.5} and PM₁₀), ozone (O₃), carbon monoxide (CO), sulfur dioxide (SO₂), and nitrogen dioxide (NO₂). These pollutants are known to have adverse effects on human health and the environment.

The AQI is typically reported on a scale from 0 to 500, where higher values indicate poorer air quality. The scale is divided into different categories or levels, such as good, moderate, unhealthy, very unhealthy, and hazardous, each corresponding to a specific range of values. These categories provide a simplified way to understand and compare air quality across different locations and time periods.

Government agencies and environmental organizations often monitor air quality and calculate the AQI using data from various monitoring stations located throughout a region. The data collected from these stations is analyzed, and the corresponding AQI values are determined based on the pollutant concentrations measured.

The AQI serves as a useful tool for public health officials, policymakers, and individuals to make informed decisions regarding outdoor activities, exposure to pollutants, and the need for protective measures such as wearing masks or limiting physical exertion during times of poor air quality. It also helps to raise awareness about the sources of air pollution and the importance of taking measures to reduce emissions and improve air quality [27-30].

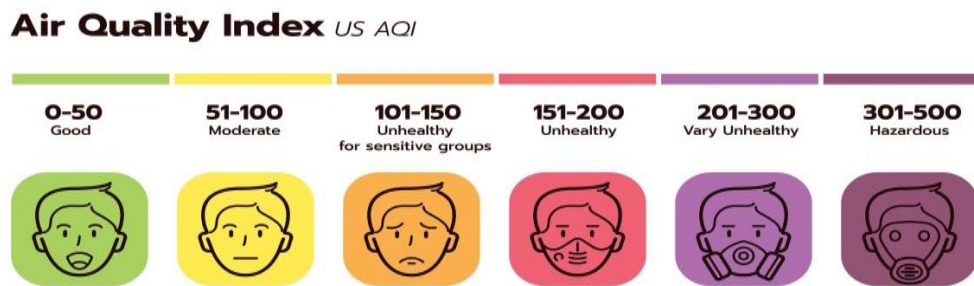


FIGURE 0.6 AIR QUALITY INDEX

	US AQI Level	PM2.5 (µg/m³)	Health Recommendation (for 24 hour exposure)
	Good 0-50	0-12.0	Air quality is satisfactory and poses little or no risk.
	Moderate 51-100	12.1-35.4	Sensitive individuals should avoid outdoor activity as they may experience respiratory symptoms.
	Unhealthy for Sensitive Groups 101-150	35.5-55.4	General public and sensitive individuals in particular are at risk to experience irritation and respiratory problems.
	Unhealthy 151-200	55.5-150.4	Increased likelihood of adverse effects and aggravation to the heart and lungs among general public.
	Very Unhealthy 201-300	150.5-250.4	General public will be noticeably affected. Sensitive groups should restrict outdoor activities.
	Hazardous 301+	250.5+	General public at high risk of experiencing strong irritations and adverse health effects. Should avoid outdoor activities.

FIGURE 0.7AQI INDEX

1.China: China has consistently been the largest emitter of CO2 for several years due to its rapid industrialization, extensive use of coal for energy, and large population.

2.India: With its large population and growing economy, India's greenhouse gas emissions have been increasing steadily. The country heavily depends on coal for electricity generation, contributing to its carbon footprint.

3.Russia: As a country rich in natural resources, Russia's economy is heavily reliant on fossil fuels, particularly oil and gas. This reliance has led to significant greenhouse gas emissions, particularly in the energy and industrial sectors.

4.European Union (EU) and the United Kingdom: The EU as a whole is a substantial emitter of greenhouse gases. However, it's important to note that individual countries within the EU have varying levels of emissions. Some countries, like Germany, France, and the United Kingdom, have higher emissions due to their industrial activities and energy consumption[27-30].

Please keep in mind that these examples are not an exhaustive list, and there are many other countries that contribute to global greenhouse gas emissions in different capacities. Additionally, efforts are being made worldwide to reduce emissions and transition to more sustainable energy sources to mitigate climate change[27-30].

What about algeria

Algeria, as a country with significant oil and gas reserves, has a notable role in greenhouse gas emissions. The extraction, production, and export of fossil fuels contribute to Algeria's carbon footprint. Additionally, Algeria heavily relies on fossil fuels for domestic energy consumption and electricity generation.

0.4.1 Air quality in the ozone layer:

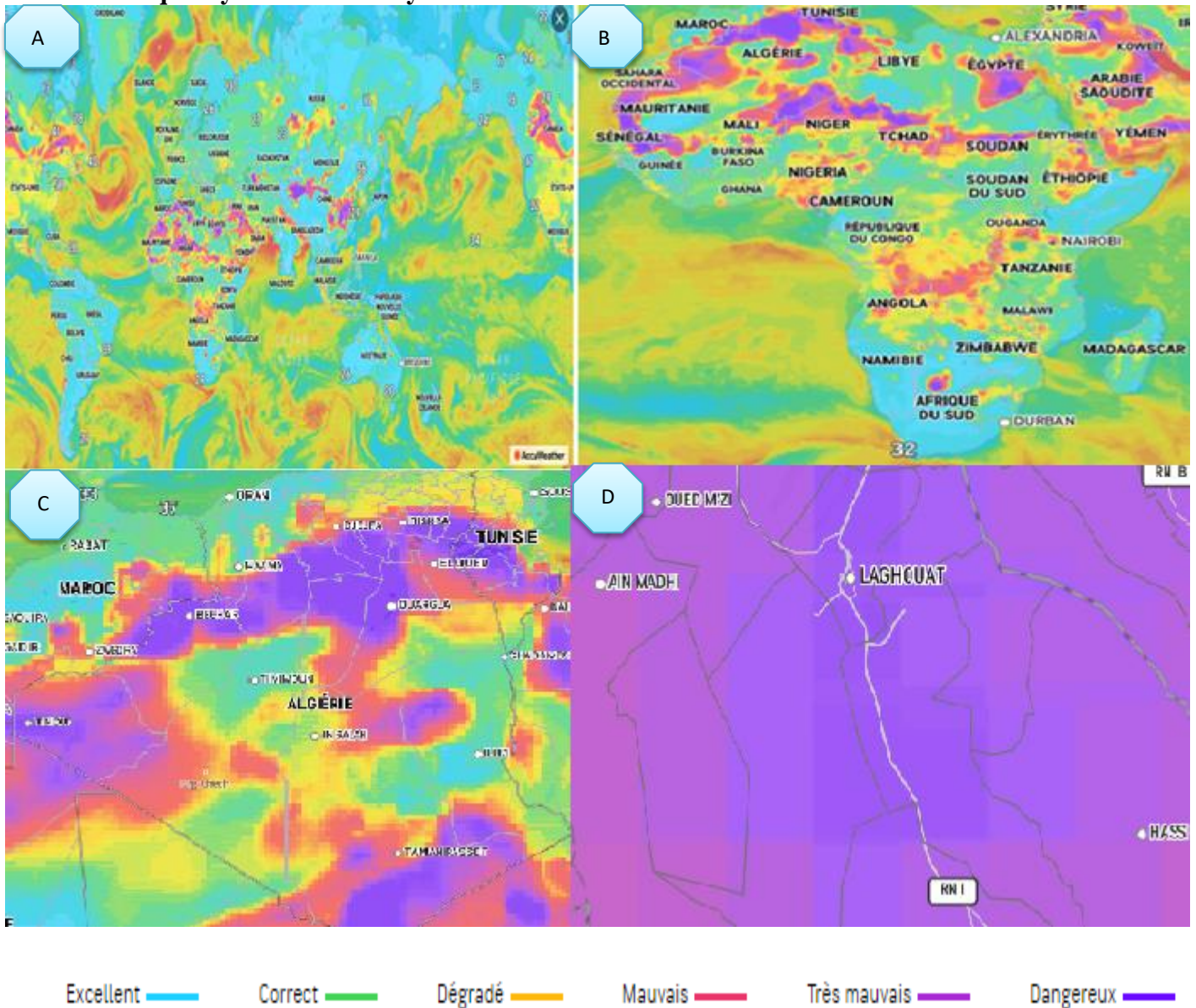


FIGURE 0.8: SATELLITE IMAGERY OF AIR QUALITY

A-THE WORLD

B-AFRICA

C-ALGERIA

D-LAGHOUAT

0.4.2 the last study about co2 and o2 in the air

As of my knowledge cutoff date of 2021-09, I can provide you with some information on the latest studies about CO₂ and O₂ levels in the air.

One recent study published in the journal Nature Climate Change in 2021 found that atmospheric CO₂ levels reached a new high of 414.8 parts per million (ppm) in May 2020, despite the global lockdowns

due to the COVID-19 pandemic. The study found that while CO2 emissions declined in 2020 due to the pandemic, they were not significant enough to lower atmospheric CO2 concentrations[31-33].

Another study published in the journal Environmental Science & Technology in 2020 found that atmospheric oxygen levels have been declining globally over the past few decades. The study attributed this decline to human activities such as deforestation and fossil fuel burning, which can contribute to increased CO2 concentrations and decreased O2 levels in the atmosphere[31-33].

Overall, these studies highlight the ongoing challenges of reducing greenhouse gas emissions and addressing climate change. Continued efforts are needed to reduce CO2 emissions and mitigate the negative impacts of climate change on the environment and human health.

However, based on the analysis of ice core records, it is estimated that the pre-industrial level of CO2 in the atmosphere was around 280 parts per million (ppm) and the level of O2 was around 21 percent by volume. This was a relatively stable condition that existed for thousands of years before the beginning of the Industrial Revolution in the mid-18th century, when human activities began to significantly alter the composition of the atmosphere.

Today, the level of CO2 in the atmosphere has exceeded 410 ppm, which is higher than it has been for at least the past 800,000 years, and the level of O2 remains around 21 percent by volume. These changes in the composition of the atmosphere have significant implications for the environment, including climate change, which is a major global challenge that requires urgent action to mitigate its impacts[31-33].

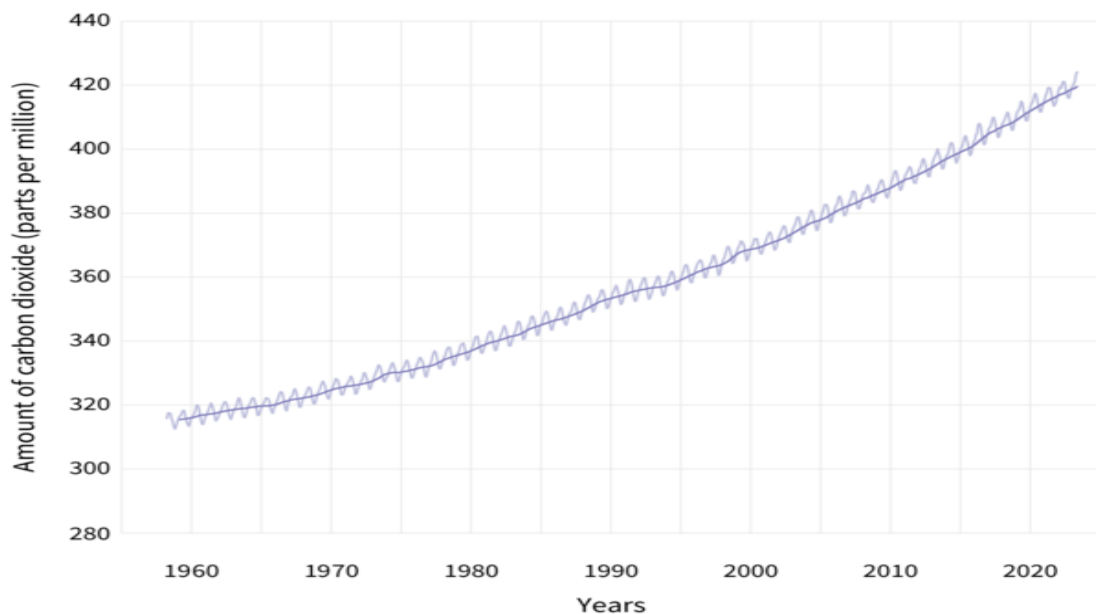


FIGURE 0.9:CARBON DIOXIDE LEVELS IN THE ATMOSPHERE OVER THE YEARS

II Chapter: Material and method

II.1 Sensor of gas

A sensor is a device or component that detects and responds to a physical stimulus or environmental condition, such as light, sound, pressure, temperature, or motion, and converts it into an electrical signal or other form of output that can be interpreted or used by an electronic system or human observer. Sensors are widely used in a variety of applications, including industrial automation, medical devices, environmental monitoring, consumer electronics, and scientific research. They play a critical role in enabling the collection and analysis of data for a wide range of purposes, from controlling processes to detecting anomalies and predicting future events[34-36].

Infrared Source: The sensor consists of an infrared light source that emits light in the infrared spectrum, typically at wavelengths of around 4.26 micrometers, which corresponds to the absorption band of CO₂[34-36].

Gas Chamber: The gas chamber is designed to allow the gas sample containing CO₂ to pass through. The chamber is typically sealed to prevent interference from external gases[34-36].

Detector: A detector is placed on the other side of the gas chamber to measure the intensity of the infrared light that passes through the chamber. The detector is sensitive to the specific wavelength absorbed by CO₂.

Reference Channel: To compensate for variations in the light source and detector, a reference channel is often included. The reference channel measures the intensity of the infrared light that bypasses the gas chamber.

Signal Processing: The sensor's signal processing circuitry compares the light intensity measured by the detector in the gas chamber with the reference channel. The difference in intensities is proportional to the concentration of CO₂ in the gas sample.

Calibration: Before deployment, CO₂ gas sensors usually undergo calibration to establish a relationship between the measured light intensity difference and the actual concentration of CO₂. This calibration ensures accurate CO₂ measurements.

When the gas sample containing CO₂ flows through the gas chamber, the CO₂ molecules absorb some of the infrared light emitted by the source. The amount of light absorbed depends on the concentration

of CO2 in the gas sample. The detector measures the remaining light intensity, and the signal processing circuitry calculates the CO2 concentration based on the difference between the gas chamber and reference channel measurements [34-36].

CO2 gas sensors are commonly used in applications such as indoor air quality monitoring, industrial emissions control, and climate research to measure and monitor CO2 levels in the atmosphere[34-37].

II.2 Equipment borrowing documents:

II.2.1-BW M5IR Offers

Nom et prénom du directeur de laboratoire ou Directeur du Centre de recherche ou chef de département ou du Responsable de l'incubateur *

Heffabachtir

E-mail du directeur de laboratoire ou Directeur du Centre de recherche ou Chef de département ou du Responsable de l'incubateur *

heffa@yahoo.fr

Nom et prénom du directeur de thèse ou directeur de PFE innovant ou master innovant *

Étude de l'influence des plantes naturelles sur la pureté du micro-climat

E-mail du directeur de thèse ou directeur de PFE innovant ou master innovant *

a.benghia@agh-univ.dz

Avis du Responsable de l'incubateur de votre institution universitaire pour les sujet innovant ou master innovant dans le cadre de la loi 1275 *

Benghia

Descriptif des analyses demandés *

Fiche d'analyse microscope optique

Fiche d'analyse polarimètre

Choix du Lieu de l'analyse (centre ou PTAPC de ...) *

Laghouat

Avez-vous besoin d'un hébergement* Oui Non

Combien de jours d'hébergement *

15

Joindre attestation justificative (certificat de scolarité d'étudiant PFE innovant ou Master innovant ou Doctorant innovant selon la loi 1275) *

- Copie de la carte nationale de tous les étudiants
- Certificat de scolarité de tous les étudiants
- Demande de prestation de service
- Fiches d'analyses bien renseignées

Signature du demandeur

Signature du directeur de thèse innovante ou de PFE /master innovant

Signature du directeur de laboratoire ou du chef de département

Signature du Responsable de l'incubateur

NB: - Le demandeur peut juste déposer ses équipements déjà préparés (selon les préparés sur place et prévoir un coté de protection)

FIGURE II. 1 BW M5IR OFFERS

II.2 2-foxy material

الجمهورية الجزائرية الديمقراطية الشعبية
وزارة التربية الوطنية
مديرية التربية لولاية الأغواط
شعبة الصادق طائفي-الأغواط


السنة الدراسية 2022-2023


شهادة أخذ على عاتق

أنا المصطفى أسفله السيد: **بن بعلال عباس** الوظيفة: **أستاذ جامعي (دكتور)**
أشهد أنني استلمت من السيد: **بشير بوعبيد** الوظيفة: **مدرس**
الأثاث المدون في الجدول التالي:

الرقم	تعيين الأثاث	العدد	رقم الجرد	الملاحظة
01	لاقط CO2 + بصير	01	7572	جمع لواصقها
02	لاقط O2 + بصير	01	7573	
03	واجهة interface	01	7574	جمع لواصقها
				تتميز بالمتانة

الأغواط في: 2023-03-05

امضاء المستلم: 

التصديق: 


العديد: 

FIGURE II. 2 FOXSY MATERIAL

II.3 Liste of material:

TABLEAU 2: LISTE OF MATERIAL:

Sensor CO2mètre
Sonde CO2
Sensor O2mètre

Sonde O2

Foxy interface

BW M5IR Offers

II.3.1 BW M5IR Offers :

Using a non-dispersive infrared sensor to monitor carbon dioxide levels while simultaneously monitoring and displaying up to four additional atmospheric hazards including O2, LEL and a range of toxic gases. Compact and lightweight, this detector comes housed in a highly concussion-proof enclosure. Audible, visual and vibrator alarms activate in the event of a Low, High, TWA or STEL alarm condition. Two months of continuous data at five second intervals via 32 MB Flash MMC card (64 MB and 128 MB cards also available); when full, the wrap-around feature replaces oldest data with most recent data.

Supported Gases*:

H2S - Hydrogen Sulfide

O3 – Ozone

CO - Carbon Monoxide

LEL Combustibles

O2 - Oxygen

NH3 - Ammonia

SO2 - Sulfur Dioxide

CO2 - Carbon Dioxide (through IR)



figureII. 3 BW M5IR Offers

*Dependent on the configuration ordered.

Features:

- Smaller and over 50% lighter than competitive instruments
- Water-resistant design in an integral concussion-proof enclosure
- Continuous LCD shows simultaneous gas concentrations for five gases
- 0 to 1000 ppm measurement of VOCs (Volatile Organic Compounds)
- Integral motorized pump option for remote sampling
- Two power options: AA alkaline or rechargeable hot-swappable battery pack
- Provides 95 dB alarm tone and two bright wide-angled alarm bars

- Equipped with internal vibrating alarm for high noise areas
- Multi-language support in English, French, German, Spanish, and Portuguese
- Three backlight options: standard- activates in low light (auto), in alarm (auto) and reactivates on-demand; alarm only- activates in alarm conditions and reactivates on-demand; stealth mode
- Four alarm levels: instantaneous Low and High Alarm for all gases; TWA (time-weighted average) and STEL (short-term exposure limit) for VOCs and toxic gases
- Simple automatic calibration procedure; compatible with BW MicroDock II automatic test and calibration station
- Records TWA, STEL, and maximum exposures to gas and displays readings on command
 - o User selectable field options include: PID correction factor, language selection, confidence beep, span level, set TWA/STEL calculation choice, set calibration due date, pass code protection, latching alarm, 'SAFE' display function, stealth mode, and selectable ppm resolution for some gases (e.g. SO₂ 0.1 ppm)
- Full function self-test of: sensor, battery and circuit integrity; and audible/visual alarms

Applications:

- Confined space entry
- Wineries and breweries
- Agriculture
- Marine fuel transport/shipping and shipyards
- Oil well fracturing
- Wastewater treatment
- Food industry/cold storage
- Industrial and chemical manufacturing

sensor definition

A gas sensor is a type of sensor specifically designed to detect and measure the presence or concentration of gases in the environment. It is commonly used in various applications to ensure safety, monitor air quality, control industrial processes, and detect potential hazards.

Gas sensors utilize different principles and technologies depending on the specific gas being detected. Some common types of gas sensors include:

Electrochemical Gas Sensors: These sensors use a chemical reaction that occurs at an electrode when it comes into contact with a target gas. The resulting current or voltage change is measured and correlated to the gas concentration.

Semiconductor Gas Sensors: These sensors utilize the change in electrical conductivity of a semiconductor material when it interacts with specific gases. The resistance or voltage change is measured to determine the gas concentration.

Catalytic Gas Sensors: These sensors are typically used for detecting combustible gases. They contain a catalytic material that promotes a chemical reaction when exposed to the target gas, leading to a change in temperature or electrical properties that can be measured.

Optical Gas Sensors: These sensors rely on the absorption or emission of light by gases. They use specific wavelengths of light to detect and measure the concentration of the target gas. Optical gas sensors can be based on techniques such as infrared absorption, ultraviolet spectroscopy, or laser-based sensing.

Gas sensors are widely used in various industries, including environmental monitoring, industrial safety, automotive applications, household safety devices, and gas leakage detection systems. They provide valuable information about the presence and concentration of gases, enabling prompt action to be taken to ensure safety, maintain air quality, or control industrial processes

Landfills



FIGURE II. 6 : CAPTEUR CO2

II.4.1 The operating principle of a CO2 sensor

The operating principle of a CO2 sensor involves detecting and measuring the concentration of carbon dioxide (CO2) gas in the surrounding environment. There are different types of CO2 sensors, but one common approach is based on non-dispersive infrared (NDIR) technology, which is widely used for CO2 sensing.

Here's a simplified explanation of the operating principle of an NDIR CO2 sensor:

Light Source: The sensor consists of an infrared light source that emits a specific wavelength of infrared light, typically around 4.26 micrometers, which is absorbed by CO2 molecules.

Chamber: The sensor has a chamber or optical path that allows the gas sample to pass through. The chamber contains an infrared detector positioned opposite the light source[38].

Gas Sample Interaction: The gas sample, which includes ambient air containing CO2, enters the chamber. The infrared light emitted by the source passes through the chamber and interacts with the CO2 molecules present in the sample[38]

CO2 Absorption: The CO2 molecules in the gas sample absorb some of the infrared light at the specific wavelength emitted by the light source. The amount of light absorbed is proportional to the concentration of CO2 in the sample[38].

Detector Measurement: The infrared detector on the opposite side of the chamber detects the intensity of the transmitted light. The detector measures the amount of light that has passed through the gas sample, considering the absorbed light due to CO₂.

Signal Processing: The detector converts the measured light intensity into an electrical signal, which is processed and analyzed by the sensor's electronics.

Calibration: To ensure accuracy, CO₂ sensors are typically calibrated using reference gases with known CO₂ concentrations. Calibration helps establish a linear relationship between the measured electrical signal and the actual CO₂ concentration[38].

Output: The sensor provides an output, usually in the form of an analog voltage or digital signal, that corresponds to the CO₂ concentration detected in the environment. This output can be displayed or further processed for control or monitoring purposes.

It's worth noting that there are other CO₂ sensing technologies as well, such as chemical sensors based on solid-state or electrochemical principles. These operate differently but serve the same purpose of detecting and measuring CO₂ concentration[38]

II.4.2 Interface Foxy :

- Disconnect the probes from the sensor o Place the probe in a beaker containing distilled water
- For a period longer than one week:
- Empty the electrolyte to avoid oxidation of the probe or evaporation of the electrolyte
- Rinse the electrodes and the probe head with distilled water
- Carefully wipe the electrodes
- Once a year:
- It is strongly recommended to change the probe head once a year
- If black spots appear on the silver electrode, gently clean the oxidized parts using a soft cloth soaked in a 0.1 M ammonia solution. Rinse thoroughly with water distilled.

II.4.3 Measurement ExAO

The Foxy inaugurates a new type of sensor: sensors with displays. Once inserted into the Foxy, they allow you to directly obtain the measured value, we speak of “measurement” mode. Thanks to the buttons of the sensor, you have access to the different calibers, different modes and the calibration function.

Once connected to the computer, the Foxy switches to “ExAO” mode: the displays are deactivated and the software is launched automatically without any driver or installation. The operating systems commonly used allow **the use of the Atelier Scientifique software:**

- Windows XP, Vista, 7 (32 and 64 bit)
- Linux Ubuntu
- Mac

TABLEAU 3: SCIENTIFIC WORKSHOP

Vert	Console connectée avec logiciel lancé
Rouge	Console allumée non connecté
Orange	Console connectée avec logiciel en cours d'ouverture
Orange clignotant	Console en cours de mise à jour

The Foxy has a USB input on the right side to connect a webcam or the Jeulin fast camera

II.4.6 Console Identification

The new installation system of the Foxy without driver or installation allows you to connect it to any computer of the establishment. In order to locate your console, an identification system is available:

- Power your console
- Connect your console to a computer
- Wait for the launcher to appear on the screen
- At the top right, two icons are present.
- Click on
- Click on "Identify the Foxy"
- Enter the information relating to the console (Room, material, etc.)
- Click on "Ok" to validate

II.4.7 Console update:

The Foxy incorporates a new software update system. As soon as a new version is available, you are immediately notified via an icon located on the launcher:

- Power your console
- Connect your console to a computer
- Wait for the launcher to appear on the screen
- At the top right, two icons are present.
- If the icon is present, an update is available

- Click on the icon in question
- The internet browser opens on a page
- Click on the link to download the update
- Click "Save" in the download window
- Once the update has been downloaded, double-click on the corresponding icon
- A window appears during the update
- Do not remove the power supply or disconnect the console from the computer
- Once the update is complete, click "Finish"
- To use your console, disconnect then reconnect the Foxy

II.5 Documentary resources

Resources are available on several supports In the workstation, by right-clicking on the "Foxy software" icon and selecting "Resources for Foxy", a web page appears where you will find a series of protocols and tutorials.

This same page can be found on the exao.fr site in the Foxy section

On the Jeulin site, protocols for Foxy are available in the section Download/Practical work/TP for Foxy

II.5.1 Oximeter sensor

II.5.1.1 General

The Air/Water Oximeter sensor associated with the O₂ probe is used to measure the variation in the O₂ level in the air or in the water. Two sizes are available, 0 to 25% in air and 0 to 20 mg/L in water.

The O₂ sensor must be connected to the adapter using the connector[38].

Connecteur

Sensor Oxymetre



2 Use

The Oximeter sensor can be used:

- In autonomous mode, by viewing the data on the sensor display.
- In mode connected to the Foxy console by viewing the data on a computer.

II.5.1.2 Connecting to the console

- Present the case in alignment with the chosen measurement channel.
- Engage it on the console guide.
- Engage thoroughly

II.5.1.3 Probe connection:

To connect the O₂ sensor, push the connector firmly into the socket then screw. Be careful not to bend the connection pins.

II.5.2 Calibration

- The calibration of the probe is done in 1 point.
- Calibration in air is easier with an already known O₂ level (20.9% in air).
- However, for users who would like to increase the accuracy of measurements, it is possible to calibrate the probe specifically for measurements in water.
- In this case, this calibration must take into account the water temperature*. Indeed, the concentration of dissolved oxygen in water depends on the temperature. Abacuses exist, which provide the rate of O₂ in the water, at saturation, according to its temperature.
- It is worth insisting on this last point, since to keep this level of precision, it is necessary to make the measurements, during the practical work, with water at saturation, a condition which is almost never fulfilled in practical work...
- Strictly speaking, this calibration adjustment is only truly accurate for pure water[38].
- Moreover, in addition to temperature, the concentration of dissolved oxygen also depends on salinity and atmospheric pressure.

- Calibration in stand-alone mode:

By default, the medium selected is air. An arrow is present in front of the “Air” and “25% O₂” indications of the sensor[38] [38].



FIGURE II. 9 CAPTEUR OXYMETRE

-Measurement in the air:

If you are measuring in air, you should set the value to 20.9% O₂. If the displayed value is too far from 20.9%, press the calibration button (small purple button) for 2 seconds. A flashing arrow appears under the “Abacus” indication.

Set the value to 20.9% with the central potentiometer. Once the value has been set, press the small purple button again, the arrow is found below the indication “Probe OK”. The probe is ready for use in air.



figureII.10
CapteurOxy
metre

Noticed :

If during calibration, the arrow remains below the “Caution” segment, the probe has a malfunction. Change or check the presence of electrolyte, check the probe head (refer to the probe manual)

-Measurement in water:

To take a measurement in water, change the caliber by pressing the orange button. The arrows are found in front of the indications “Water” and “20 mg/l” O₂. The procedure for adjusting the displayed value is identical to the adjustment in the air

- Calibration in online mode:

The oximeter is automatically recognized in the embedded software[38].

An "Adjustment" tab is available to adjust the O₂ rate. Indicate only the O₂ level in % or in mg/L that you wish.



FIGURE II 11 EXO

Noticed:

If you have already calibrated the probe in stand-alone mode, you do not need to redo the calibration in the software.

-The sensor display is inactive when used in connected mode[38].

II.5.3 Technical data :

Operating temperature range: +5/+45°C

• Air Mode:

- Measuring range: 0 to 25% O₂

- Accuracy: ± 1% of the maximum value in full scale

- Number of decimals displayed in stand-alone mode: 1

• Water Mode:

- Measurement range: 0 to 20 mg/L O₂

- Accuracy: $\pm 1\%$ of the maximum value in full scale
- Number of decimals displayed in stand-alone mode: 1

1 Introduction

The probe consists of a pH-type electrode, specially designed for measuring CO₂, immersed in a specific electrolyte whose pH is a function of the concentration of CO₂ in the medium in which it is placed. The electrolyte is separated from the medium to be analyzed by a Teflon membrane specifically permeable to CO₂[38].

The electrolyte and the membrane are specifically dedicated to the measurement of CO₂. The probe can be used in aqueous or gaseous media.

The probe is connected to the CO₂ sensor by the BNC socket[38].



FIGUREII 12 SONDE CO2

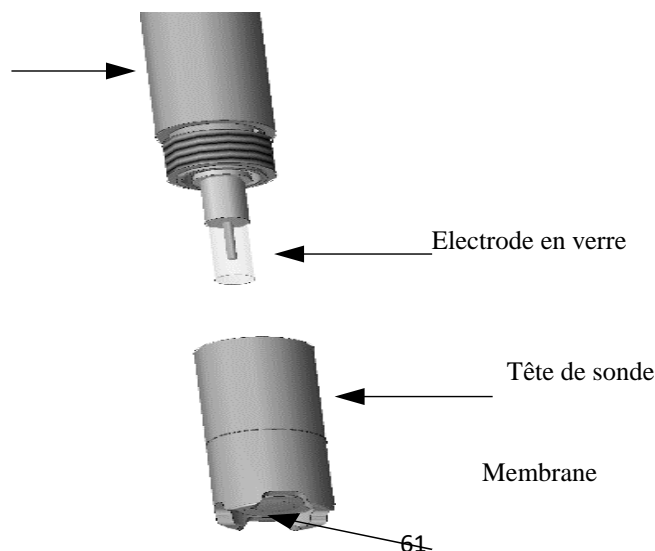
- human, animal and plant respiration,
- photosynthesis,
- fermentation.

ATTENTION :

The pH type electrode is made of special thin glass, so it is fragile

2 Principle of operation

2.1 Description



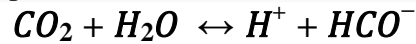
FIGUREII. 13 SONDE CO2

2.2 Electro-chemical principle of operation

The reaction in the electrolyte of the CO₂ probe is as follows:

2.2 Electro-chemical principle of operation

The reaction in the electrolyte of the CO₂ probe is as follows:



II.6 The dissociation constant of the reaction is

$$K = \frac{[H^+][HCO^{-3}]}{[CO_2]}$$

As the concentration of HCO₃⁻ is high in the electrolyte, it varies little, so we obtain $[H^+] = K' [CO_2] = K'' pCO_2$ (with pCO₂ corresponding to the partial pressure of CO₂) [38].

The concentration of CO₂ is therefore measured by measuring the pH of the electrolyte.

The CO₂ sensor is not temperature compensated. It would therefore theoretically be necessary to calibrate the probe at each temperature change. In practice, the precaution will be taken to use the CO₂ probe at an almost constant ambient temperature.

Consequence: when the probe is removed from the calibration solution after adjusting the "slope", it takes approximately 5 to 10 minutes for it to display a rate of less than 0.2%.

For a possible new zero adjustment: wait 15 min. before settling.

II.6.1 Commissioning:

II.6.1.1 Setup

The probe is delivered assembled but without electrolyte.

II.6.1.2 Filling the probe head

Unscrew the head then fill the probe head with electrolyte

- Tap the head on the bench to remove air bubbles.
- Make sure that there is a slight overflow of electrolyte when you finish screwing the probe head back on. The presence of a large bubble can be detected by observing the value returned by the probe positioned successively head up then head down: the value fluctuates if there is a bubble. In this case, unscrew the head and top up the electrolyte solution.
- When screwing the probe head back on, the excess electrolyte overflows
- Rinse the probe head with a wash bottle of distilled water.

II.6.1.3 Polarization:

Polarizing the probe consists of filling the head with electrolyte (see previous paragraph) and leaving it, upside down, for a time given in the table below. Polarization of the probe is required in the following situations:

TABLEAU 4 POLARIZATIO

Situation	Temps de polarisation
À la première mise en service	10 heures soit environ une nuit
Après un changement d'électrolyte	3 heures
Après un changement de tête de sonde	3 heures

Noticed :

Polarization does not require a power supply, the operation can be carried out without connecting the probe to its adapter or to the Ex.A.O.

In the case of this probe, by polarization is meant the achievement of a chemical equilibrium on either side of the glass electrode. After polarization, the probe must be calibrated.

The probe must be calibrated in the following situations:

- At first commissioning
- After an electrolyte change
- After changing the probe head
- Whenever precise measurement is required Notes:

Calibration should ideally be carried out at a temperature close to that of the experiment

Envisaged in a moderately humid atmosphere (50 to 70% RH). In practice, the ambient conditions of a laboratory or a classroom allow a satisfactory calibration.

It should be noted that the CO₂ level in a classroom with around twenty students can increase by 0.3% at the end of the session. Prefer calibration in a ventilated room.

Refer to the CO₂ probe calibration protocol for the procedure.

4 Storage and maintenance

The probe is stored in the open air

Store the probe upside down, protecting it from shocks.

5 Technical data:

Operating temperature: 5 to 45°C Length: 120 mm

Diameter: 12mm

Probe body material: POM

II.6.2 Calibration of probes:

II.6.2.1 O₂ PROBE CALIBRATION

The purpose of this manipulation is to commission and calibrate the oxygen sensor using the Foxy acquisition interface.

Necessary material :

-Oxygen sensor

-Oximeter sensor

- Foxy interface



FIGURE II.14 OXYGEN SENSOR

O₂ SENSOR CALIBRATION Head filling Fill the sensor head with electrolyte:

- Unscrew the probe head and fill it to the brim with the electrolyte provided.
- Screw the head back onto the body of the probe: an overflow must occur in order to avoid the presence of air bubbles.
- Rinse with distilled water, avoiding touching the membrane [38] [38].

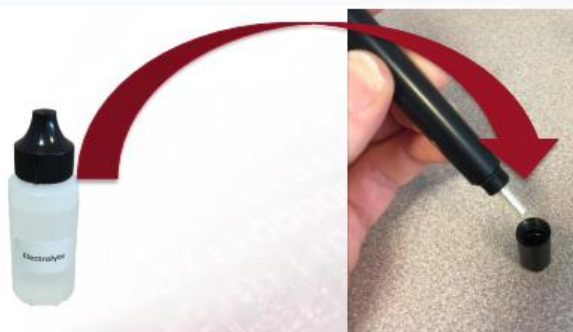
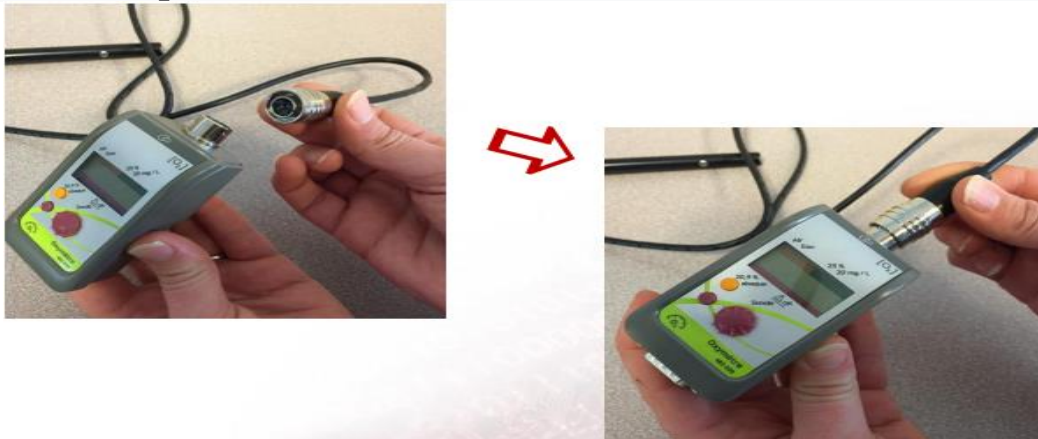


FIGURE II 15 STEP 1

II.6.2.2 Connect the O2 probe to the Oximeter sensor



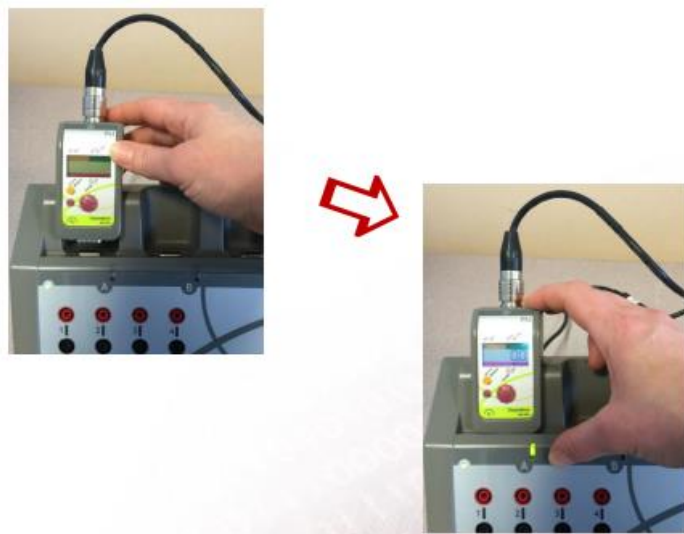
FIGUREII. 16 STEP 2

II.6.2.3 Connect the Foxy interface to the mains.



FIGUREII. 17 STEP3

II.6.2.4 Connect the Oximeter sensor to the interface



FIGUREII 18 STEP4

5 Allow the system to stabilize for approximately 10 minutes in air.

6 O2 PROBE CALIBRATION Connect the Foxy interface to the computer

7 The Scientific Workshop launches automatically Choose the Scientific Workshop Life and Earth Sciences

Select the Generalist module



FIGURE II. 19 STEP5

8 Drag and drop the Oximeter sensor on the y-axis

9 Click Air

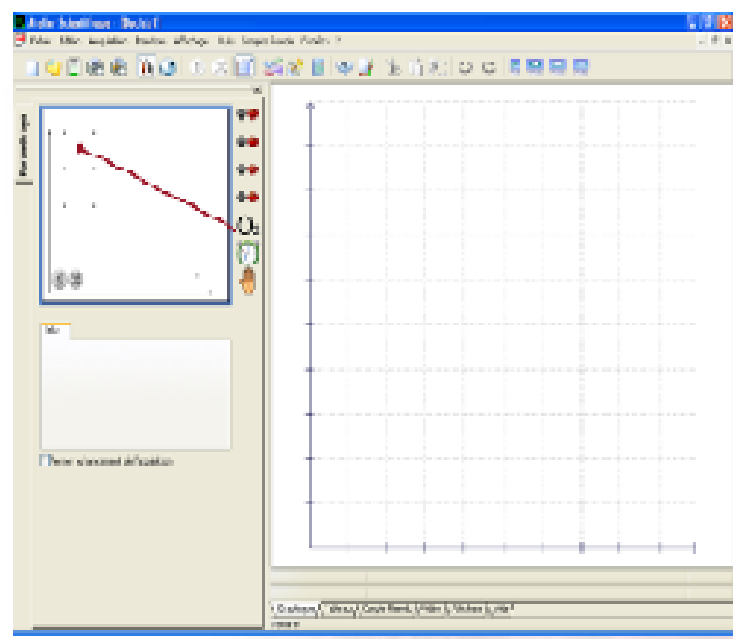


FIGURE II 20 STEP5

10 O2 PROBE CALIBRATION Click on the Settings tab

11 Then click on Start

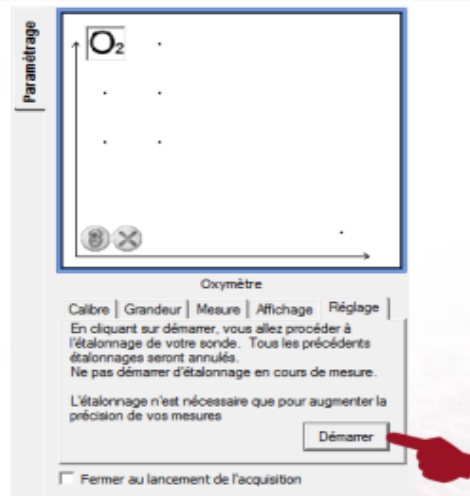


FIGURE II. 21 STEP6

12 Enter the O2 rate: 20.9%

Wait for the rectangle to turn green then click on set

The pictogram  must disappear

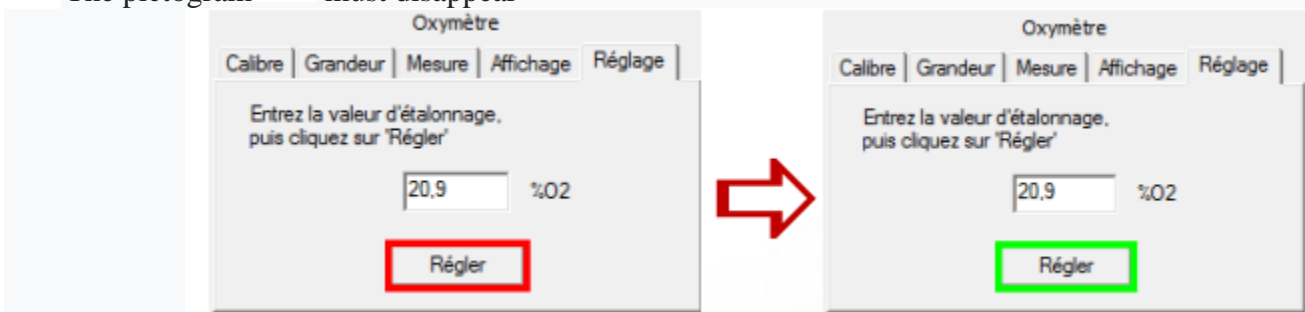


FIGURE II 22 STEP7

The probe is ready for use in air or water

13 Optional: To check the calibration of the probe, click on the Measurement tab

14 Optional: Immerse the probe in the bottle of zero solution. (Add 30 mL of distilled water to the powder contained in the vial)

15 The value read on the display must be close to 0% (0.153% O2 in our case)

16 Remove the probe from the bottle, rinse it with distilled water, dry it and then place it in the open air

17 Let the measurement stabilize for a few moments The value read on the display should be close to 20.9%

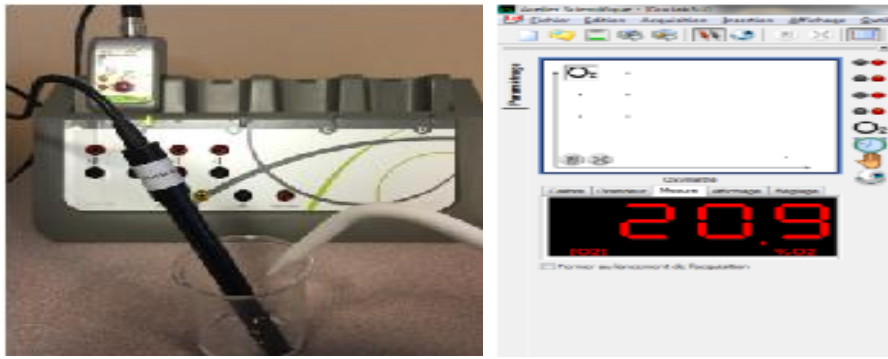


FIGURE II. 23 STEP 8

18 The probe head membrane is very fragile, so handle the probe with care. In the bioreactor, place the probe to one side and not in the center to avoid contact with the magnetic stirrer. At the end of the experiment, rinse the probe head well with distilled water in order to remove the small particles likely to obstruct the pores of the membrane.

19 For a period longer than one week

- : - Empty the electrolyte to avoid oxidation of the probe or evaporation of the electrolyte.
- Rinse the electrodes and the probe head with distilled water.
- Carefully wipe the electrodes
- . - Keep the probe body dry.

It is strongly recommended to change the probe head once a year

II.6.2.5 CO2 PROBE CALIBRATION

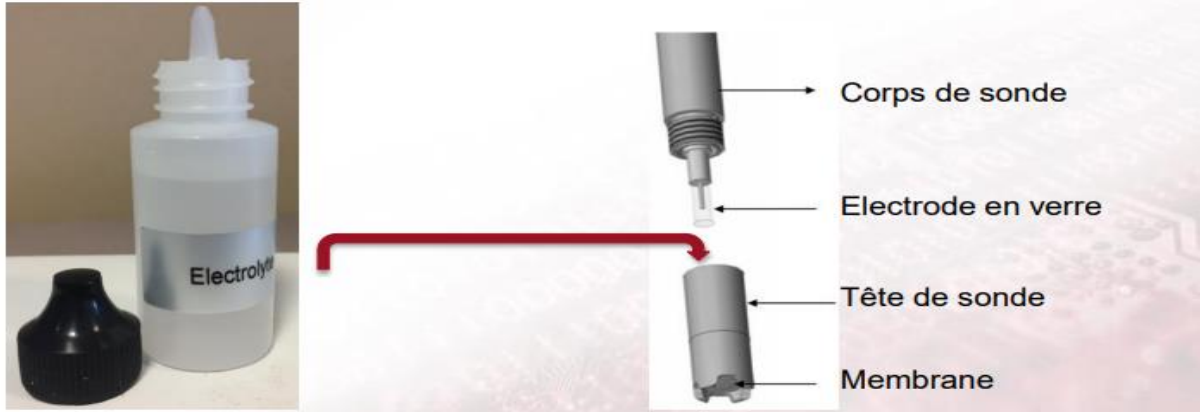
Necessary material :

- CO2 probe 1 CO2 meter sensor
- Electrolyte for CO2 sensor
- Reactive solution for CO2 probe calibration
- Basic calibration solution for CO2 probe
- Foxy interface

Head filling

To fill the probe head with electrolyte:

- Unscrew the probe head and fill it to the brim with the electrolyte provided.
- Screw the head back onto the body of the probe: an overflow must occur in order to avoid the presence of air bubbles.
- Rinse with distilled water, avoiding touching the membrane.



FIGUREII. 24 STEP 1

Respect the polarization time:

10 hours for a first commissioning or

- 3 hours in the event of a change of electrolyte or probe head.

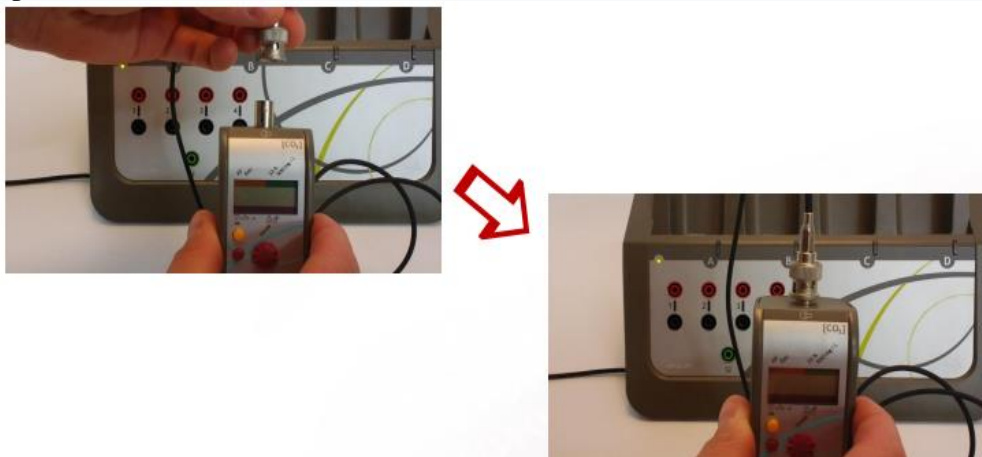
- Note: if you have not changed the electrolyte, there is no polarization time to respect. Head filling Note 2:

Generally, the CO2 sensor is calibrated once a year, at the start of the school year.

Steps:

1 Connect the Foxy interface to the mains.

2 Connect the CO2 probe to the CO2meter sensor[38].



FIGUREII. 25 STEP 3

4 Connect the CO2meter sensor to the interface.

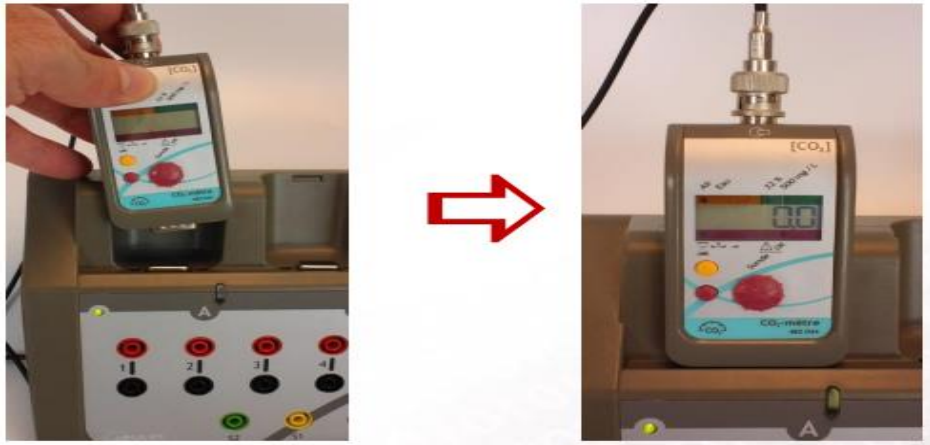


FIGURE II. 26 STEP 4

4.1 Connecting the Foxy interface to the computer

5 The Scientific Workshop launches automatically Choose the Scientific Workshop Life and Earth Sciences

Select the Generalist module

6 If there is an Attention panel in the left part of the window, wait for it to disappear[38].

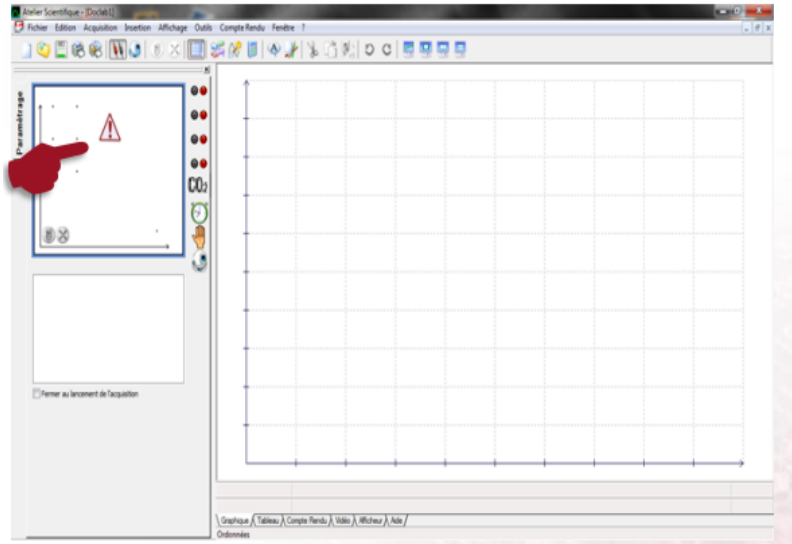
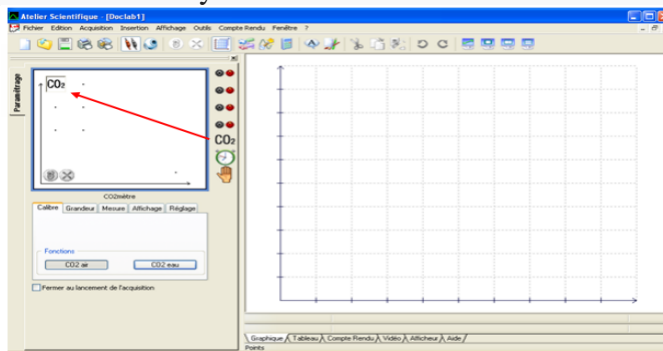


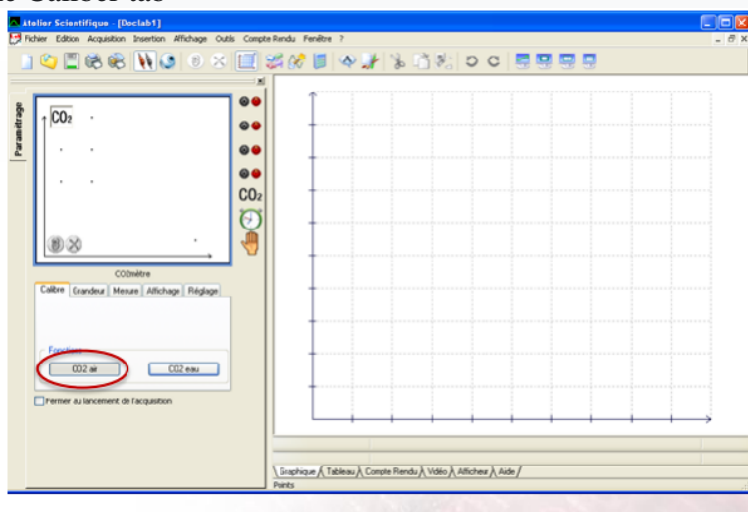
FIGURE II. 27 STEP 6

7 Drag and drop the CO2meter sensor onto the y-axis



FIGUREII. 28 STEP 7

8 Click on CO2 air in the Caliber tab



FIGUREII. 29 STEP 8

9 Preparation of the calibration solution: pour 25 ml of base solution into a bottle.

10 Add 3 ml of reagent solution.



FIGUREII. 30 STEP 10

1 Click on the Settings tab then click on Start

12 Leave the probe in the air. Enter the value 0.04% CO₂.

When the Set button turns green, click on it

13--Put the probe in the calibration solution.



FIGURE II. 31 STEP 13

Attention: la durée de vie de cette solution est de 10 à 15 min. En cas de dépassement, refaire une nouvelle solution.

14 Enter the value 5.8% CO₂. When the Set button turns green, click on it

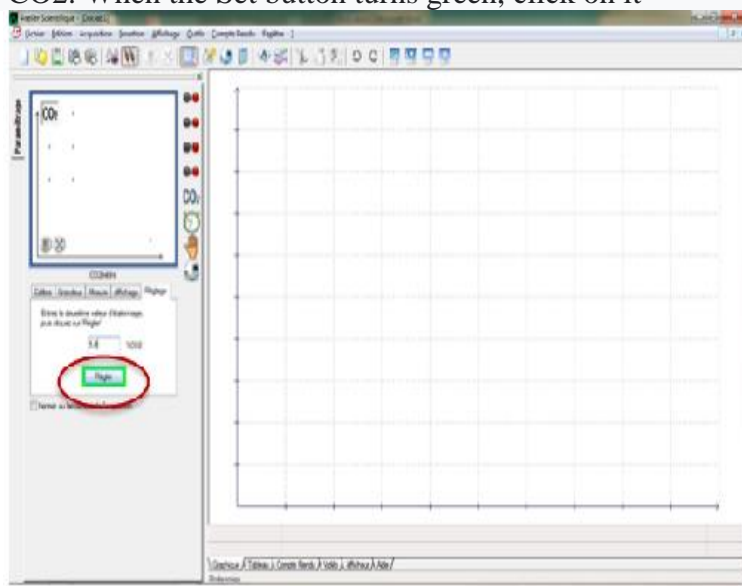


FIGURE II. 32 STEP 14

15 Rinse the probe with distilled water, then leave it in the air.

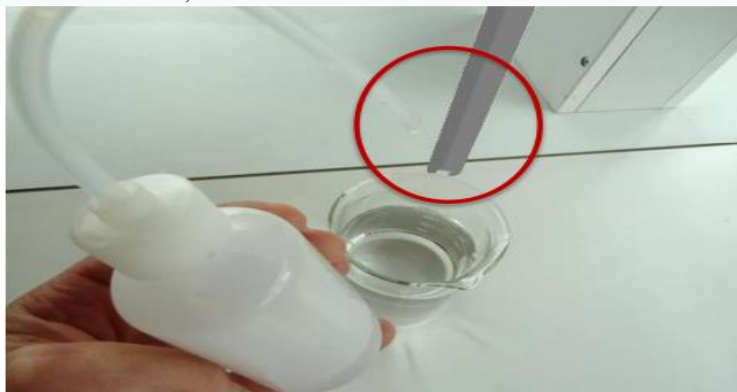


FIGURE II. 33 STEP 15

16 ALWAYS store the CO₂ probe with electrolyte inside the probe head.

The probe is stored in the open air, upside down, without a cap or with a non-airtight cap to avoid overpressure. It is not necessary to re-calibrate the probe before each TP. Ideally, the probe head should be changed once a year under normal conditions of use.

17 Once a year:

- Unscrew the probe head
- , - Empty the electrolyte from the probe head,
- Rinse the probe head with distilled water or change it if necessary[38]
- , - Fill the probe head with electrolyte,
- Screw the probe head back onto the body of the probe,
- Store the probes vertically in a dry beaker.

18 Possible malfunctions:

If you get an unstable reading, check that there are no air bubbles in the glass electrode. In this case, hunt - by shaking the electrode like a medical thermometer. If the problem persists, change the electrolyte and possibly the probe head. If the probe persists at 10% blockage, disassemble the probe head and rinse the electrode thoroughly with distilled water until a response is obtained[38].

III Chapter: Résultats and discussions

III.1 Introduction

The study aims to delve into the potential benefits of natural plants in maintaining a cleaner and more sustainable micro-climate. By examining the interactions between vegetation and micro-climate, we can gain insights into the effectiveness of plants in mitigating air pollution and regulating temperature. The findings will contribute to our understanding of nature-based solutions and their role in enhancing the quality of our living spaces.

We measured the value of oxygen gas O₂ and carbon dioxide gas CO₂ in several regions in the state of Laghouat in a different time range according to the need

III.2 test1: library

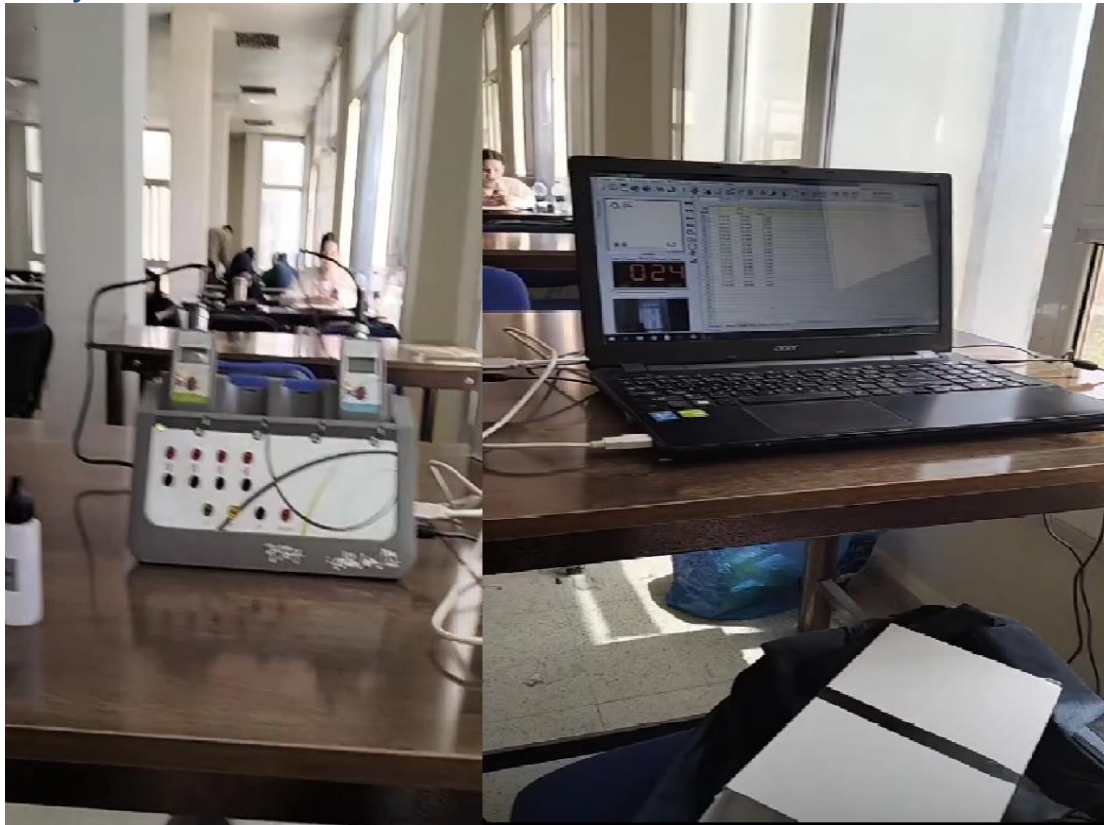


FIGURE III 1 LIBRARY OF LAGHOAUT UNIVERSTY

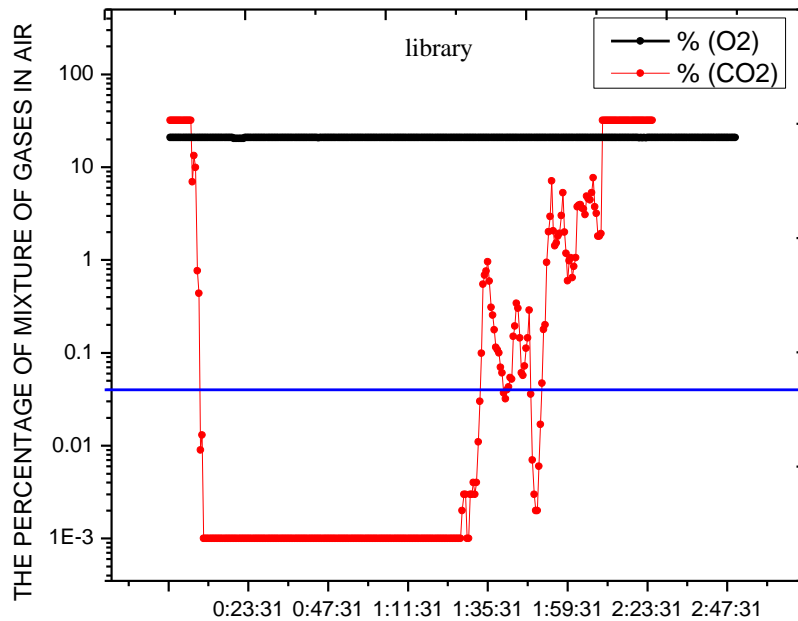


FIGURE III 2 GRAPH OF THE CONCENTRATION OF O₂ AND CO₂ THROUGH THE EXO PROGRAM

Discussion:

- The curve represents the concentration of CO₂ and O₂ in terms of time in the university library.
- During the first 22 minutes, we notice stability in the value of O₂ and the end of the CO₂ equilibrium stage
- the value of oxygen remains at a value of 20.86% and the value of carbon dioxide in the field of health standards under 400PPM(The number of people in a library was less than 10)
- After the hour, we notice a rise in the levels of carbon dioxide to 1%, with the number of people increasing to 80 people, then its decrease coincided with the decrease in the number of people inside the library and the stability of the oxygen level
- Instability of carbon dioxide levels resulting from the instability of the number of people inside as a source of carbon dioxide production and the absence of any type of plant to absorb carbon dioxide inside the library

III.3 Test2 Orif nursery



Figure III 3 nursery of ORIF sayeh

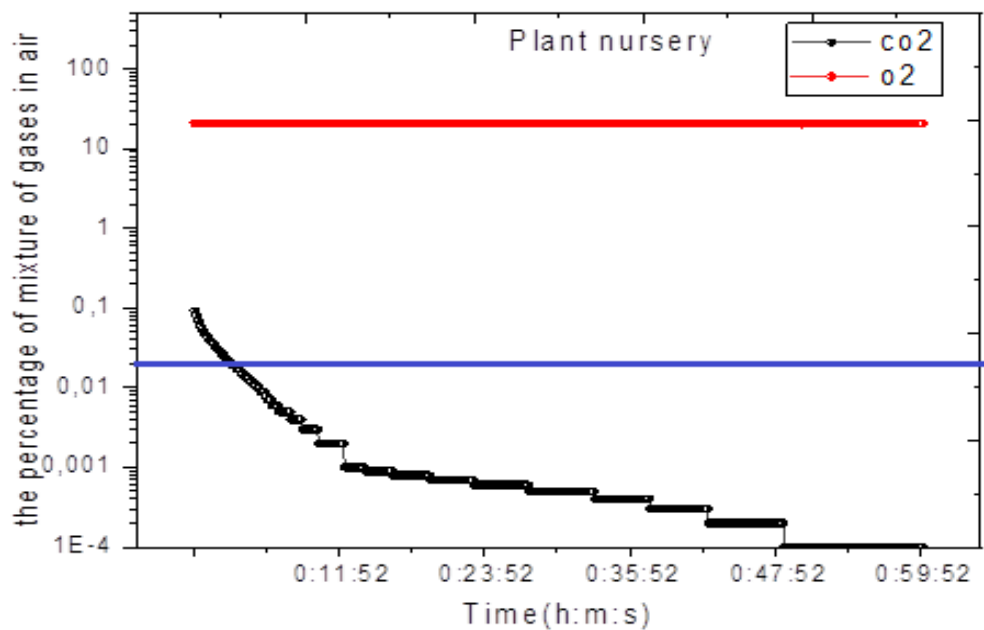


FIGURE III 4 GRAPH OF THE CONCENTRATION OF O₂ AND CO₂ THROUGH THE EXO PROGRAM

Discussion:

- At the nursery level, we notice the stability of carbon dioxide values in the healthy levels of air quality, which is estimated at 400 parts per million, with a much lower value estimated at 1 ppm. This is due to the diversity of plants inside the nursery and its clear effect on carbon dioxide absorption.
- The stability of the oxygen level in the high values, whose level is estimated at 20.9%, is due to the high oxygen productivity of seedling plants.

III.4 Test3 :plant University



FIGURE III 5 PLANT UNIVERSITY

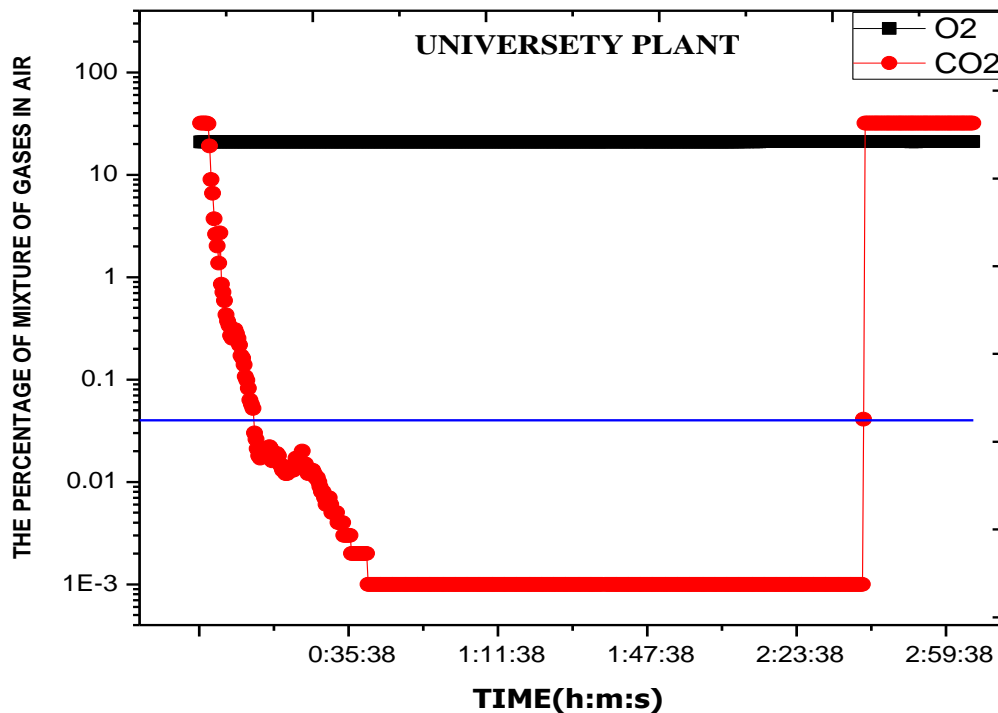


FIGURE III 5 GRAPH OF THE CONCENTRATION OF O₂ AND CO₂ THROUGH THE EXO PROGRAM

Discussion:

- The curve represents the concentration of carbon dioxide and oxygen in terms of time in a plant University
- During the first 20 minutes, we notice stability in the value of O₂ and the end of the CO₂ equilibrium stage
- After the equilibrium stage in the devices, we note the stability of oxygen at a value of 20.8 and 20.3% and the stability of carbon dioxide under health standards under 400 ppm
- We notice that due to the presence of many plants in the middle there is almost no carbon dioxide gas. This is due to the plants absorbing carbon dioxide gas
- Unlike the university library, due to the presence of plants that have an effect on absorbing carbon dioxide in the atmosphere
- Unlike the university library(figure III 6), due to the presence of plants that have an effect on absorbing carbon dioxide in the atmosphere
- Despite this, the values of carbon dioxide in the university garden 10ppm remain higher than its value in the nursery 1ppm (Figure III 7) due to a difference in the existing plants and trees.

III.5 Test4 : Downtown Laghouat



FIGURE III 7 DOWNTOWN LAGHOUAT

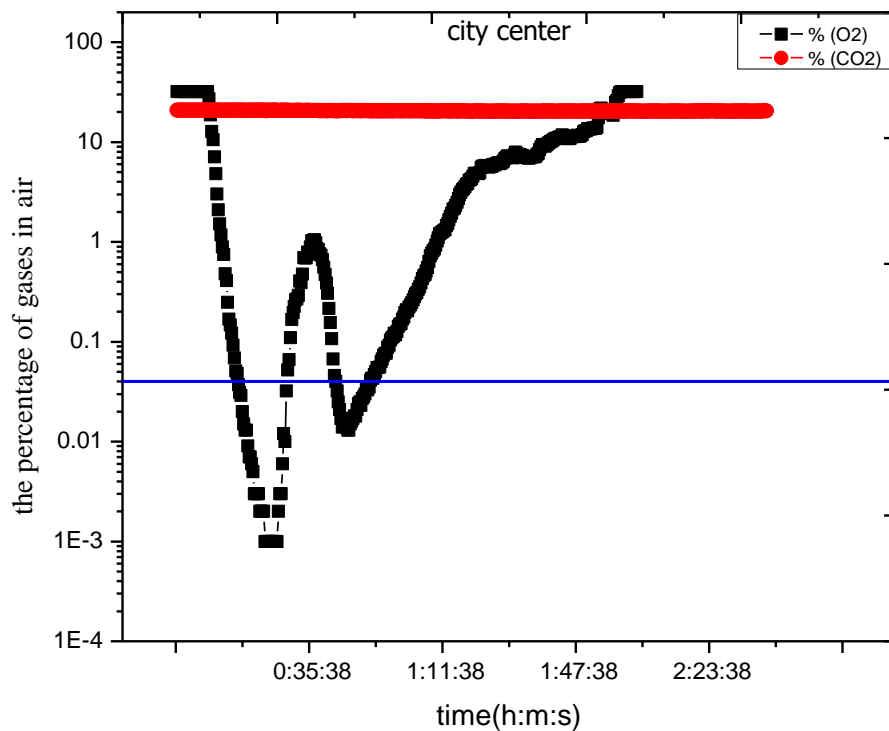


FIGURE III 8 GRAPH OF THE CONCENTRATION OF O₂ AND CO₂ THROUGH THE EXO PROGRAM

Discussion:

- The curve represents the concentration of carbon dioxide and oxygen in terms of time in a plant Contre ville
- During the first 32 minutes, we notice stability in the value of O₂ and the end of the CO₂ equilibrium stage
- After 32 minutes, we notice a rise in carbon dioxide levels up to 1 percent due to the high means of transportation in the area and the stability of oxygen at values of 20%-20.6%
- And by mentioning the previous results, especially the results of the library and the results of the university garden, we note that despite the presence of trees at the level of the road in the city center, the levels of carbon dioxide emissions are higher than the healthy level of air quality, which is estimated at 400 ppm, and exceeds it by more than 9600 ppm, down to 1 percent.

III.6 Test5 :home

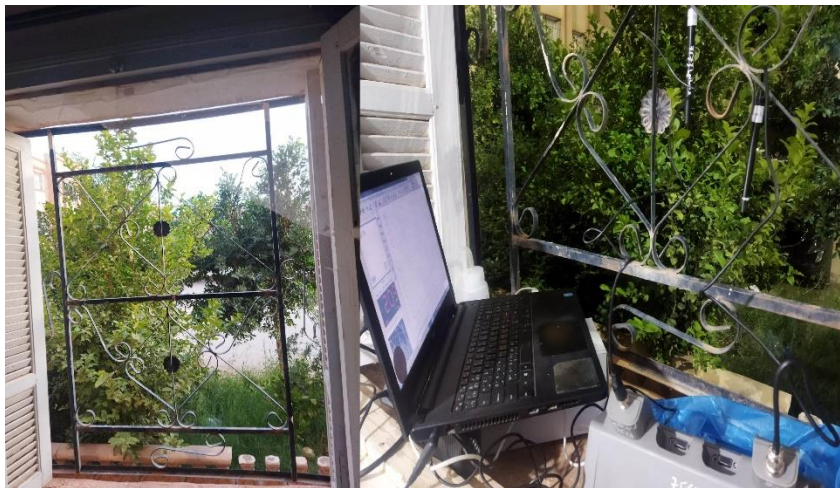


FIGURE III 9 RESIDENTIAL COMPLEX 80 DWELLINGS

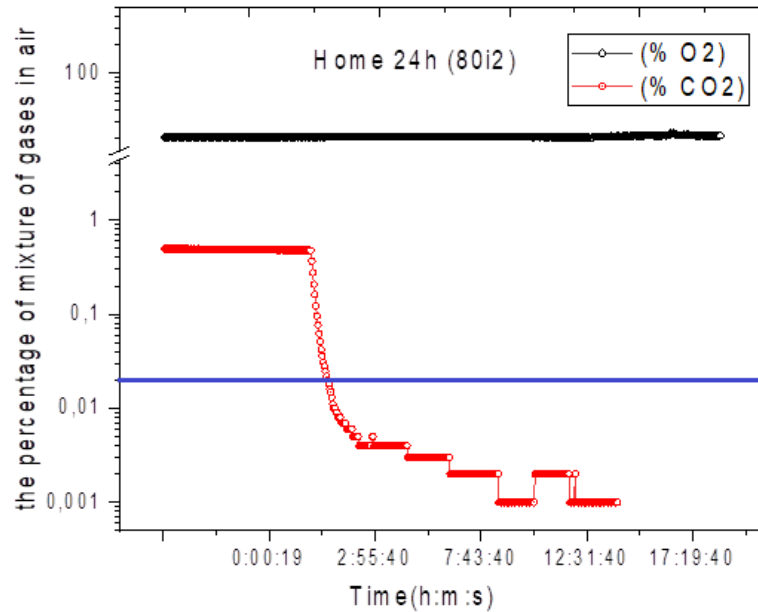


FIGURE III 10 GRAPH OF THE CONCENTRATION OF O₂ AND CO₂ THROUGH THE EXO PROGRAM

Discussion:

- After a period of equilibrium, we notice that the percentage of oxygen is constant between a value of approximately 20.9 and 20.1 for the percentage of carbon dioxide, we note that it is a value in the field of heal health for. As thy air quality standards, as it is estimated at 10 parts per million, less than the health limit, which is estimated at 400 parts per million, and this is the result of the plants that surround the residential square

III.7 Test6: Sonelgaz - Electricity Production SPE- Hassi R'Mel

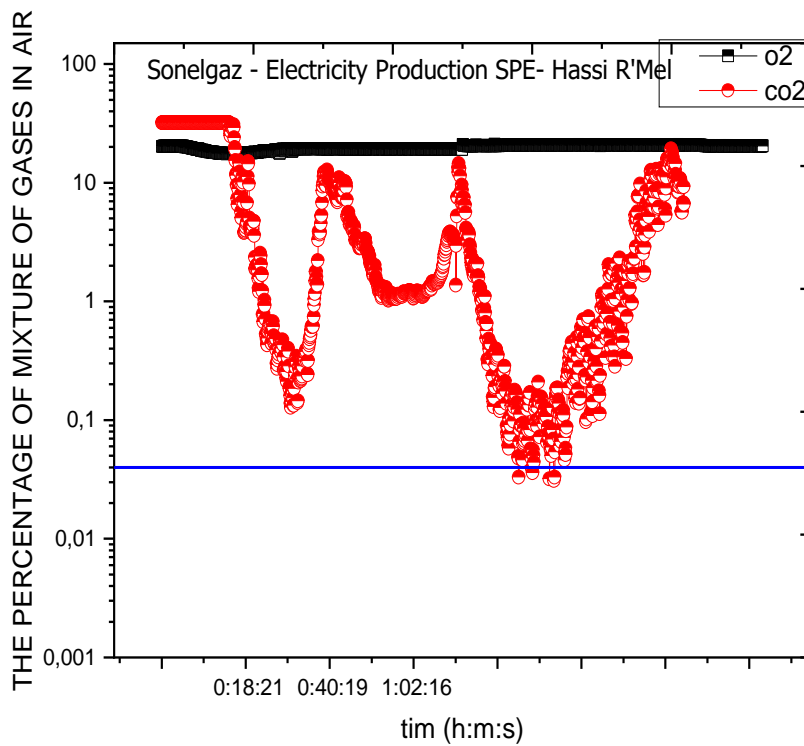


FIGURE III 11 SONELGAZ - ELECTRICITY PRODUCTION SPE- HASSI R'MEL

FIGURE III 12 GRAPH OF THE CONCENTRATION OF O₂ AND CO₂ THROUGH THE EXO PROGRAM

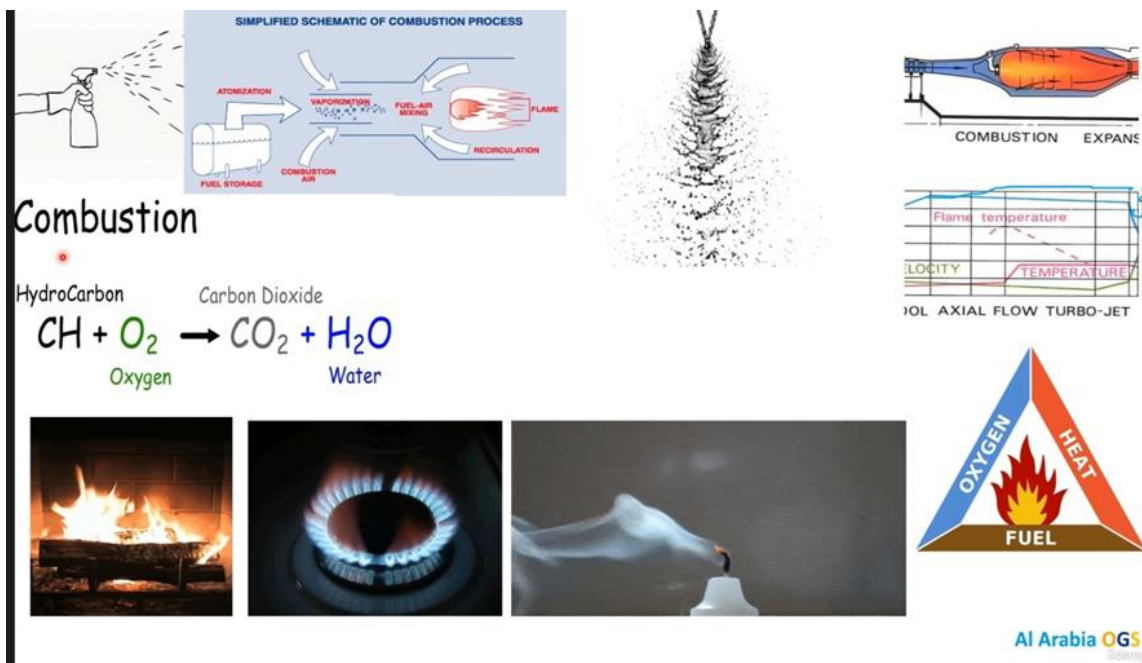


FIGURE III 9 PRINCIPLE OF GAS TURBINES

Note: We know that the working principle of gas turbines is 4 strokes and this raises our interest in emissions of gases burned

Discussion: The graph represents the percentage of oxygen and carbon dioxide over time, as we notice a significant decrease in the percentage of oxygen and a significant increase in the percentage of carbon dioxide due to the large gas emissions in the industrial area ,

Conclusion:

The study of the influence of natural plants on the purity of the microclimate has shed light on the significant role that plants play in improving air quality, regulating temperature and humidity, and creating healthier and more sustainable environments. Through systematic research and data analysis, we have gained valuable insights into the effectiveness of various plant species in purifying the microclimate.

The findings of this study have demonstrated that natural plants have the capacity to filter pollutants (Pépinière ORIF sayeh)....., release oxygen, and add moisture to the surrounding atmosphere, thereby enhancing air quality and creating a more pleasant and conducive microclimate. The presence of plants in indoor spaces(Residential complex 80 dwellings), urban areas (plant University ,)and agricultural settings can contribute to a healthier living environment, reducing the risk of respiratory illnesses, improving cognitive function, and increasing overall well-being.

In conclusion, the study of the influence of natural plants on the purity of the microclimate has provided compelling evidence of their significant impact on air quality, temperature regulation, and humidity control. This research highlights the importance of incorporating plants into our living and working spaces to create healthier,

more sustainable environments. By harnessing the power of natural plants, we can pave the way for a greener, cleaner, and more livable future.

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