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Where is ozone found in the atmosphere? Ozone is mainly found in two regions of the Earth's atmosphere. Most ozone (about 90%) resides in a layer that begins between 6 and 10 miles (10 and 17 kilometers) above the Earth's surface and extends up to about 30 miles (50 kilometers). This region of the atmosphere is called the stratosphere. The ozone in this region is commonly known as the ozone layer. The remaining ozone is in the lower region of the atmosphere, which is commonly called the troposphere. The figure (above) shows an example of how ozone is distributed in the atmosphere. What roles does ozone play in the atmosphere and how are humans affected? The ozone molecules in the upper atmosphere (stratosphere) and the lower atmosphere (troposphere) are chemically identical, because they all consist of three oxygen atoms and have the chemical formula O_3. However, they have very different roles in the atmosphere and very different effects on humans and other living beings. Stratospheric ozone (sometimes referred to as "good ozone") plays a beneficial role by absorbing most of the biologically damaging ultraviolet sunlight (called UV-B), allowing only a small amount to reach the Earth's surface. The absorption of ultraviolet radiation by ozone creates a source of heat, which actually forms the stratosphere itself (a region in which the temperature rises as one goes to higher altitudes). Ozone thus plays a key role in the temperature structure of the Earth's atmosphere. Without the filtering action of the ozone layer, more of the Sun's UV-B radiation would penetrate the atmosphere and would reach the Earth's surface. Many experimental studies of plants and animals and clinical studies of humans have shown the harmful effects of excessive exposure to UV-B radiation. At the Earth's surface, ozone comes into direct contact with life-forms and displays its destructive side (hence, it is often called "bad ozone"). Because ozone reacts strongly with other molecules, high levels of ozone are toxic to living systems. Several studies have documented the harmful effects of ozone on crop production, forest growth, and human health. The substantial negative effects of surface-level tropospheric ozone from this direct toxicity contrast with the benefits of the additional filtering of UV-B radiation that it provides. What are the environmental issues associated with ozone? The dual role of ozone leads to two separate environmental issues. There is concern about increases in ozone in the troposphere. Near-surface ozone is a key component of photochemical "smog," a familiar problem in the atmosphere of many cities around the world. Higher amounts of surface-level ozone are increasingly being observed in rural areas as well. There is also widespread scientific and public interest and concern about losses of ozone in the stratosphere. Ground-based and satellite instruments have measured decreases in the amount of stratospheric ozone in our atmosphere. Over some parts of Antarctica, up to 60% of the total overhead amount of ozone (known as the column ozone) is depleted during Antarctic spring (September-November). This phenomenon is known as the Antarctic ozone hole. In the Arctic polar regions, similar processes occur that have also led to significant chemical depletion of the column ozone during late winter and spring in 7 out of the last 11 years. The ozone loss from January through late March has been typically 20-25%, and shorter-period losses have been higher, depending on the meteorological conditions encountered in the Arctic stratosphere. Smaller, but still significant, stratospheric decreases have been seen at other, more-populated regions of the Earth. Increases in surface UV-B radiation have been observed in association with local decreases in stratospheric ozone, from both ground-based and satellite-borne instruments. What human activities affect upper-atmospheric ozone (the stratospheric ozone layer)? The scientific evidence, accumulated over more than two decades of study by the international research community, has shown that human-produced chemicals are responsible for the observed depletions of the ozone layer. The ozone-depleting compounds contain various combinations of the chemical elements chlorine, fluorine, bromine, carbon, and hydrogen and are often described by the general term halocarbons. The compounds that contain only chlorine, fluorine, and carbon are called chlorofluorocarbons, usually abbreviated as CFCs. CFCs, carbon tetrachloride, and methyl chloroform are important human-produced ozone-depleting gases that have been used in many applications including refrigeration, air conditioning, foam blowing, cleaning of electronics components, and as solvents. Another important group of human-produced halocarbons is the halons, which contain carbon, bromine, fluorine, and (in some cases) chlorine and have been mainly used as fire extinguishants. What actions have been taken to protect the ozone layer? Through an international agreement known as the Montreal Protocol on Substances that Deplete the Ozone Layer, governments have decided to eventually discontinue production of CFCs, halons, carbon tetrachloride, and methyl chloroform (except for a few special uses), and industry has developed more "ozone-friendly" substitutes. All other things being equal, and with adherence to the international agreements, the ozone layer is expected to recover over the next 50 years or so. * Text and figure are adapted from the Introduction to "Frequently Asked Questions" of the World Meteorological Organization/United Nations Environment Programme report, Scientific Assessment of Ozone Depletion: 1998 (WMO Global Ozone Research and Monitoring Project-Report No. 44, Geneva, 1999). The Earths atmosphere is a complex system, composed of several distinct layers, each with its unique characteristics and roles in supporting life. One of the most crucial components of this atmospheric system is ozone, a molecule made up of three oxygen atoms (O_3). While ozone is present in small amounts throughout the atmosphere, the majority of it resides within a specific layer, playing a vital role in protecting our planet from harmful solar radiation. Understanding which layer contains ozone, and its importance, is essential for appreciating the delicate balance of our environment.The Stratosphere: Home to the Ozone LayerThe vast majority of Earths ozone is found within the stratosphere, the second major layer of the atmosphere when ascending from the surface. The stratosphere sits above the troposphere, the lowest layer where we experience weather, and extends from approximately 10 to 50 kilometers (6 to 31 miles) above the Earths surface. Within the stratosphere, the highest concentrations of ozone molecules exist between 15 and 35 kilometers (9 to 22 miles). This region of enhanced ozone concentration is commonly referred to as the ozone layer.Defining the Ozone LayerIts important to clarify that the term ozone layer isnt indicative of a distinct, physically separate layer. Rather, it is a zone within the stratosphere where the concentration of ozone is notably higher than in other regions of the atmosphere. This concentration is still relatively small, typically only a few parts per million, but its sufficient to perform its vital function of absorbing ultraviolet (UV) radiation.The Importance of Stratospheric OzoneThe ozone layer plays a critical role in shielding life on Earth from the harmful effects of ultraviolet (UV) radiation from the sun. UV radiation is a form of electromagnetic radiation with shorter wavelengths than visible light, and it carries enough energy to cause significant damage to biological molecules such as DNA and proteins.UV Radiation and Its EffectsUV radiation is categorized into three types based on their wavelength: UVA, UVB, and UVC.UVA has the longest wavelength and is the least harmful. Most UVA radiation reaches the Earths surface and contributes to skin tanning but can also lead to premature aging.UVB radiation is more energetic and is responsible for sunburn, skin cancer, and cataracts. The ozone layer absorbs a significant portion of UVB radiation.UVC radiation has the shortest wavelength and is the most dangerous. Fortunately, all UVC radiation is absorbed by the ozone layer and the atmosphere before reaching the Earths surface.The ozone layer, acting as a natural sunscreen, absorbs the majority of UVB and all UVC radiation, greatly reducing the amount of harmful radiation that reaches the surface. Without this protective shield, life on Earth would be severely threatened by excessive UV exposure.How Ozone Absorbs UV RadiationThe mechanism by which ozone absorbs UV radiation is crucial to understanding its protective role. Ozone molecules absorb UV radiation in a process that causes them to break down into an oxygen molecule (O_2) and a single oxygen atom (O). The single oxygen atom can then react with another oxygen molecule to regenerate ozone, or with a single oxygen atom to form an oxygen molecule again. This continuous cycle of ozone formation and destruction, known as the Chapman Cycle, is essential for the maintenance of the ozone layer and its ability to absorb UV radiation.The Impact of Ozone DepletionWhile the stratosphere contains the majority of Earths ozone, small amounts of ozone are also found in the troposphere. Unlike the protective ozone in the stratosphere, tropospheric ozone is a pollutant that contributes to smog and respiratory problems.Chlorofluorocarbons and the Ozone HoleStarting in the mid-20th century, human activities began to introduce harmful substances into the atmosphere that disrupted the natural cycle of ozone formation and destruction. The most significant of these substances were chlorofluorocarbons (CFCs), once widely used in refrigerants and aerosols. When CFCs reach the stratosphere, they are broken down by UV radiation, releasing chlorine atoms that act as catalysts, accelerating the destruction of ozone molecules. One chlorine atom can destroy thousands of ozone molecules.This destruction led to a significant thinning of the ozone layer, particularly over the Antarctic region, a phenomenon known as the ozone hole. The thinning ozone layer resulted in increased levels of harmful UV radiation reaching the Earths surface, increasing the risk of skin cancer and other health problems.The Montreal ProtocolThe international community recognized the severe threat posed by ozone depletion and responded with the Montreal Protocol, an international treaty ratified in 1987 that mandated the phase-out of CFCs and other ozone-depleting substances. This treaty has been widely hailed as a success story in environmental cooperation. The global reduction in the production and use of these substances has significantly slowed the rate of ozone depletion, and there is evidence that the ozone layer is beginning to slowly recover. The ozone layers slow recovery shows a successful human intervention on a global scale, demonstrating that humans can make positive impacts on the planet when united with a common goal.Looking Ahead: Protecting Our Atmospheric ShieldWhile the Montreal Protocol has shown that a positive impact is possible, it is important to note that the ozone layer is still vulnerable to other threats. Climate change, for example, can indirectly impact the ozone layer by altering atmospheric circulation patterns. Continued monitoring and research are crucial for ensuring the long-term health of the ozone layer and the continued protection of life on Earth from harmful UV radiation.Education and Continued VigilancePublic education about the importance of the ozone layer, the dangers of ozone-depleting substances, and the ongoing need for environmental stewardship is also critical. By understanding the complex interplay of atmospheric processes, we can better safeguard this critical component of our planets environment for future generations. Protecting the ozone layer requires continual diligence and a global commitment to responsible environmental practices. It is crucial that we understand the delicate nature of the atmosphere and how easily it can be affected by human activities, both in negative and positive ways. The fight to save the ozone layer demonstrates the power of collective action and the possibility of repairing some damage that has been done.In conclusion, while ozone is present in small amounts throughout the atmosphere, the vast majority is concentrated in the stratosphere, forming the protective ozone layer. This layer is vital for absorbing harmful UV radiation and protecting life on Earth. While past human activities threatened this layer, collective global action has resulted in a slow but consistent recovery. By continuing to focus on sustainable practices and ongoing research, we can ensure the continued health of the ozone layer and the future safety of our planet.March 13, 2023Cite this articleReuse our work freelyOne of the most pressing environmental problems over the last century has been the depletion of the ozone layer. But what is the ozone layer, and why does it matter?Ozone is a gas present naturally within Earths atmosphere. It is formed of three oxygen atoms (giving it the chemical formula O_3). Its structure makes it unstable: it can be easily formed and broken down through interaction with other compounds.Ozone is most highly concentrated at two very different altitudes in the atmosphere: near the surface, and high in the atmosphere (in the stratosphere). Its function is very different in these two zones.Ozone close to the surface is called tropospheric ozone, and it is often referred to as bad ozone. Ozone concentrations are lower in the troposphere than in the stratosphere.We can see this in the diagram.However, ozone concentrations close to the Earths surface can be temporarily and locally higher, because of emissions from motor vehicle exhausts, industrial processes, electric utilities, and chemical solvents. Ground-level ozone is a local air pollutant, and can negatively impact human health. Breathing ozone is particularly harmful to the young, elderly, and people with underlying respiratory problems.This is very different from ozone high in the atmosphere: stratospheric ozone. Its referred to as good ozone.As shown in the diagram, ozone concentrations are higher in the stratosphere than in the troposphere.The stratosphere includes the zone commonly called the ozone layer. It plays a crucial role in keeping the planet habitable by absorbing potentially dangerous ultraviolet (UV-B) radiation from the sun. Before its depletion, the ozone layer typically absorbed 97 to 99% of incoming UV-B radiation.This means we need high ozone concentrations in the stratosphere to ensure that life including human life is not exposed to harmful concentrations of UV-B radiation.In our work on the ozone layer, we focus on this ozone high in the atmosphere (the good ozone). The impact of ozone near the surface (bad ozone) is covered in our work on air pollution.Why is the ozone layer important?The ozone layer absorbs 97% to 99% of the suns incoming ultraviolet radiation (UV-B).This is fundamental to protecting life on Earths surface from exposure to harmful levels of this radiation, which can damage and disrupt DNA.In the 1970s and 80s, humans emitted large amounts of gases that depleted this ozone in the upper atmosphere. As ozone concentrations in the stratosphere fell, and a hole in the ozone layer opened up, there have been measurable increases in the amount of UV-B radiation reaching the surface.The chart shows the measured change in annual quantities of UV irradiance reaching Earths surface, in 2008 compared to 1979.1Whats noticeable is that ozone depletion and UV irradiance have increased much more in the Southern Hemisphere. This is because ozone depletion is also impacted by temperature and sunlight. Temperatures are colder at high latitudes in the Southern Hemisphere, so polar stratospheric clouds can form. These clouds can accelerate the reactions that break ozone down.You will also notice that ozone depletion is worse at higher latitudes. Its non-existent at the equator, and rises steeply towards the poles. Again, this is influenced by temperature and sunlight. Thats why ozone holes form at the poles, rather than the equator.This increase in UV-B irradiation reaching the surface matters for life on Earth. One of the biggest concerns has been an increased risk of skin cancer (as well as skin damage and aging).2 This is because UV-B irradiation can damage skin DNA.Since the 1980s, the world has achieved rapid progress: the near-elimination of ozone-depleting substances and the trend toward recovering the ozone layer are among the most successful international environmental achievements to date.Several studies have estimated that millions of excess skin cancer cases have been avoided due to the Montreal Protocol and its follow-up treaties.3Our articles and data visualizations rely on work from many different people and organizations. When citing this article, please also cite the underlying data sources. This article can be cited as:Hannah Ritchie (2023) - What is the ozone layer, and why is it important? Published online at OurWorldinData.org. Retrieved from: ' [Online Resource]BibTeX citation@article{owid-ozone-layer-context, author = {Hannah Ritchie}, title = {What is the ozone layer, and why is it important?}, journal = {Our World in Data}, year = {2023}, note = { }All visualizations, data, and code produced by Our World in Data are completely open access under the Creative Commons BY license. You have the permission to use, distribute, and reproduce these in any medium, provided the source and authors are credited.The data provided by third parties and made available by Our World in Data is subject to the license terms from the original third-party authors. We will always indicate the original source of the data in our documentation, so you should always check the license of any such third-party data before use and redistribution.All of our charts can be embedded in any site. The Earth's ozone layerThe region of the stratosphere containing the bulk of atmospheric ozone. The ozone layer lies approximately 15-40 kilometers (10-25 miles) above the Earth's surface, in the stratosphere. Depletion of this layer by ozone depleting substances (ODS) will lead to higher UVB levels, which in turn will cause increased skin cancers and cataracts and potential damage to some marine organisms, plants, and plastics. The science page (offers much more detail on the science of ozone depletion. protects all life from the sun's harmful radiation, but human activities have damaged this shield. Less ozone-layer protection from ultraviolet (UV) lightUltraviolet radiation is a portion of the electromagnetic spectrum with wavelengths shorter than visible light. The sun produces UV, which is commonly split into three bands: UVA, UVB, and UVC. UVA is not absorbed by ozone. UVB is mostly absorbed by ozone, although some reaches the Earth. UVC is completely absorbed by ozone and normal oxygen. NASA provides more information on their web site (. will, over time, damage crops and lead to higher skin cancer and cataract rates. I. The Ozone Layer The Earth's atmosphere is composed of several layers. The lowest layer, the troposphereThe region of the atmosphere closest to the Earth. The troposphere extends from the surface up to about 10 km in altitude, although this height varies with latitude. Almost all weather takes place in the troposphere. Mt. Everest, the highest mountain on Earth, is only 8.8 km high. Temperatures decrease with altitude in the troposphere. As warm air rises, it cools, falling back to Earth. This process, known as convection, means there are huge air movements that mix the troposphere very efficiently., extends from the Earth's surface up to about 6 miles or 10 kilometers (km) in altitude. Virtually all human activities occur in the troposphere. Mt. Everest, the tallest mountain on the planet, is only about 5.6 miles (9 km) high. The next layer, the stratosphereThe region of the atmosphere above the troposphere. The stratosphere extends from about 10km to about 50km in altitude. Commercial airlines fly in the lower stratosphere. The stratosphere gets warmer at higher altitudes. In fact, this warming is caused by ozone absorbing ultraviolet radiation. Warm air remains in the upper stratosphere, and cool air remains lower, so there is much less vertical mixing in this region than in the troposphere., continues from 6 miles (10 km) to about 31 miles (50 km). Most commercial airplanes fly in the lower part of the stratosphere. Most atmospheric ozone is concentrated in a layer in the stratosphere, about 9 to 18 miles (15 to 30 km) above the Earth's surface (see the figure). Ozone is a molecule that contains three oxygen atoms. At any given time, ozone molecules are constantly formed and destroyed in the stratosphere. The total amount has remained relatively stable during the decades that it has been measured. Source: Figure Q1-2 from Michaela I. Hegglin (Lead Author), David W. Fahey, Mack McFarland, Stephen A. Montzka, and Eric R. Nash, Twenty Questions and Answers About the Ozone Layer: 2014 Update, Scientific Assessment of Ozone Depletion: 2014, 84 pp., World Meteorological Organization, Geneva, Switzerland, 2015 The ozone layer in the stratosphere absorbs a portion of the radiation from the sun, preventing it from reaching the planet's surface. Most importantly, it absorbs the portion of UV light called UVBA band of ultraviolet radiation with wavelengths from 280-320 nanometers produced by the Sun. UVB is a kind of ultraviolet light from the sun (and sun lamps) that has several harmful effects. UVB is particularly effective at damaging DNA. It is a cause of melanoma and other types of skin cancer. It has also been linked to damage to some materials, crops, and marine organisms. The ozone layer protects the Earth against most UVB coming from the sun. It is always important to protect oneself against UVB, even in the absence of ozone depletion, by wearing hats, sunglasses, and sunscreen. However, these precautions will become more important as ozone depletion worsens. NASA provides more information on their web site (.. UVB has been linked to many harmful effects, including skin cancers, cataracts, and harm to some crops and marine life. Scientists have established records spanning several decades that detail normal ozone levels during natural cycles. Ozone concentrations in the atmosphere vary naturally with sunspots, seasons, and latitude. These processes are well understood and predictable. Each natural reduction in ozone levels has been followed by a recovery. Beginning in the 1970s, however, scientific evidence showed that the ozone shield was being depleted well beyond natural processes. II. Ozone Depletion When chlorine and bromine atoms come into contact with ozone in the stratosphere, they destroy ozone molecules. One chlorine atom can destroy over 100,000 ozone molecules before it is removed from the stratosphere. Ozone can be destroyed more quickly than it is naturally created. Some compounds release chlorine or bromine when they are exposed to intense UV light in the stratosphere. These compounds contribute to ozone depletion, and are called ozone-depleting substances (ODSA compound that contributes to stratospheric ozone depletion. ODS include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, methyl bromide, carbon tetrachloride, hydrobromofluorocarbons, chlorobromomethane, and methyl chloroform. ODS are generally very stable in the troposphere and only degrade under intense ultraviolet light in the stratosphere. When they break down, they release chlorine or bromine atoms, which then deplete ozone. A detailed list (of class I and class II substances with their ODPs, GWPs, and CAS numbers are available.). ODS that release chlorine include chlorofluorocarbonsGases covered under the 1987 Montreal Protocol and used for refrigeration, air conditioning, packaging, insulation, solvents, or aerosol propellants. Since they are not destroyed in the lower atmosphere, CFCs drift into the upper atmosphere where, given suitable conditions, they break down ozone. These gases are being replaced by other compounds: hydrochlorofluorocarbons, an interim replacement for CFCs that are also covered under the Montreal Protocol, and hydrofluorocarbons, which are covered under the Kyoto Protocol. All these substances are also greenhouse gases. See hydrochlorofluorocarbons, hydrofluorocarbons, perfluorocarbons, ozone depleting substance. (CFCs), hydrochlorofluorocarbonsCompounds containing hydrogen, fluorine, chlorine, and carbon atoms. Although ozone depleting substances, they are less potent at destroying stratospheric ozone than chlorofluorocarbons (CFCs). They have been introduced as temporary replacements for CFCs and are also greenhouse gases. See ozone depleting substance. (HCFCs), carbon tetrachlorideA compound consisting of one carbon atom and four chlorine atoms. Carbon tetrachloride was widely used as a raw material in many industrial uses, including the production of chlorofluorocarbons (CFCs), and as a solvent. Solvent use ended when it was discovered to be carcinogenic. It is also used as a catalyst to deliver chlorine ions to certain processes. Its ozone depletion potential is 1.2., and methyl chloroformA compound consisting of carbon, hydrogen, and chlorine. Methyl chloroform is used as an industrial solvent. Its ozone depletion potential is 0.11.. ODS that release bromine include halonsCompounds, also known as bromofluorocarbons, that contain bromine, fluorine, and carbon. They are generally used as fire extinguishing agents and cause ozone depletion. Bromine is many times more effective at destroying stratospheric ozone than chlorine. See ozone depleting substance. and methyl bromideA compound consisting of carbon, hydrogen, and bromine. Methyl Bromide is an effective pesticide used to fumigate soil and many agricultural products. Because it contains bromine, it depletes stratospheric ozone and has an ozone depletion potential of 0.6. Production of methyl bromide was phased out on December 31, 2004, except for allowable exemptions. Much more information is available (.. Although ODS are emitted at the Earths surface, they are eventually carried into the stratosphere in a process that can take as long as two to five years. In the 1970s, concerns about the effects of ozone-depleting substances (ODSA compound that contributes to stratospheric ozone depletion. ODS include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, methyl bromide, carbon tetrachloride, hydrobromofluorocarbons, chlorobromomethane, and methyl chloroform. ODS are generally very stable in the troposphere and only degrade under intense ultraviolet light in the stratosphere. When they break down, they release chlorine or bromine atoms, which then deplete ozone. A detailed list (of class I and class II substances with their ODPs, GWPs, and CAS numbers are available.) on the stratospheric ozone layerThe region of the stratosphere containing the bulk of atmospheric ozone. The ozone layer lies approximately 15-40 kilometers (10-25 miles) above the Earth's surface, in the stratosphere. Depletion of this layer by ozone depleting substances (ODS) will lead to higher UVB levels, which in turn will cause increased skin cancers and cataracts and potential damage to some marine organisms, plants, and plastics. The science page (offers much more detail on the science of ozone depletion. prompted several countries, including the United States, to ban the use of chlorofluorocarbons (CFCsOrganic compounds made up of atoms of carbon, chlorine, and fluorine. An example is CFC-12 (CCl_2F_2), used as a refrigerant in refrigerators and air conditioners and as a foam blowing agent. Gaseous CFCs can deplete the ozone layer when they slowly rise into the stratosphere, are broken down by strong ultraviolet radiation, release chlorine atoms, and then react with ozone molecules. See Ozone Depleting Substance.) as aerosolA small droplet or particle suspended in the atmosphere, typically containing sulfur. Aerosols are emitted naturally (e.g., in volcanic eruptions) and as the result of human activities (e.g., by burning fossil fuels). There is no connection between particulate aerosols and pressurized products also called aerosols. (See below) propellants. However, global production of CFCs and other ODS continued to grow rapidly as new uses were found for these chemicals in refrigeration, fire suppression, foam insulation, and other applications. Some natural processes, such as large volcanic eruptions, can have an indirect effect on ozone levels. For example, Mt. Pinatubo's 1991 eruption did not increase stratospheric chlorine concentrations, but it did produce large amounts of tiny particles called aerosolsSmall particles or liquid droplets in the atmosphere that can absorb or reflect sunlight depending on their composition. (different from consumer products also known as aerosols). These aerosols increase chlorine's effectiveness at destroying ozone. The aerosols in the stratosphere create a surface on whichCFC-based chlorine can destroy ozone. However, the effect from volcanoes is short-lived. Not all chlorine and bromine sources contribute to ozone layer depletion. For example, researchers have found that chlorine from swimming pools, industrial plants, sea salt, and volcanoes does not reach the stratosphere. In contrast, ODS are very stable and do not dissolve in rain. Thus, there are no natural processes that remove the ODS from the lower atmosphere. One example of ozone depletion is the annual ozone "hole" over Antarctica that has occurred during the Antarctic spring since the early 1980s. This is not really a hole through the ozone layer, but rather a large area of the stratosphere with extremely low amounts of ozone. Ozone depletion is not limited to the area over the South Pole. Research has shown that ozone depletion occurs over the latitudes that include North America, Europe, Asia, and much of Africa, Australia, and South America. More information about the global extent of ozone depletion can be found in the Scientific Assessment of Ozone Depletion: 2018developed by the United Nations Environment Programme. First and foremost, the Earths atmosphere comprises a layer of gases (also referred to as air) which forms an envelope around Earth. The atmosphere is stratified into five (5) layers which are as follows: The exosphere, the thermosphere, the mesosphere, troposphere and the stratosphere. This envelope of gases is retained around Earth by the influence of the force of gravity. Notable functions of the Earths atmosphere include: * Absorption of harmful ultraviolet radiation (by the ozone layer in the Earths stratosphere) * Generation of constant pressure Earths surface to ensure continual presence of liquid water * Warming of Earths surface through heat retention (Greenhouse effect) * Constant regulation of diurnal temperature variation etc. The Ozone layer also known as ozone shield or ozonosphere is one which is made from a combination of an Oxygen atom (O) with an Oxygen molecule (O_2) yielding ozone (O_3) in large amounts, which in turn results in the production of a protective layer in the Earths atmosphere. The ozone layer is continually generated through the ozone-oxygen cycle within the stratosphere, in which ultraviolet rays cause an ozone molecule to split into an Oxygen atom (O) and an Oxygen molecule (O_2). The oxygen atom then, combines with a nearby oxygen molecule (O_2) to give ozone. This process could occur naturally in the Earths stratosphere through photo dissociation or artificially in the laboratory through the use of a silent electric discharge or spark. However, the thickness of this protective layer of ozone in the stratosphere varies geographically and seasonally e.g the ozone layer has been found to be thinnest during autumn, while, it is thickest during spring while peak concentrations at different altitudes vary from one region of the world to the other. It must be noted that the thickness of the ozone layer refers to the amount of ozone that can be found in a column of a given area or geographical location. READ: Types, Causes and Effects of DroughtsFurthermore, significantly high amounts of ozone is usually produced in the tropics and transported towards the poles by stratospheric wind patterns. This process, referred to as Brewer-Dobson circulation in the northern hemisphere is responsible for the variation in the thickness of the ozone layer during spring and thinness of the ozone layer during autumn. Furthermore, uncontrolled exposure to ultraviolet radiation is known to cause acute skin and chronic eye damage, the ozone layer functions in the absorption of some of these harmful radiations from the Sun which is potentially dangerous to human, animal and plant health. The ultraviolet ray is chief among the radiations absorbed by the ozone layer. Ultraviolet radiations (uv rays) are of three major types, which are: UVA, UVB and UVC. However, worthy of note is the fact that, all UVC, some UVB and none of UVA rays are absorbed by the Earths ozone layer during the transmission of ultraviolet radiations from the Sun through the Earths atmosphere. Thus, the ozone layer ensures that only UVA and little UVB rays eventually reach the Earths Troposphere. Although, the UVB rays are suspected to be possible causes of cataracts, skin cancers, and harm to marine life and crop growth. The completely exempted UVC rays (achieved by the Earths ozone layer) therefore do not exist in the eventual solar radiation that reaches us on Earth. The ozone layer exists in the stratosphere which is well suited for the stability of ozone. This is because Ozone (O_3) is highly unstable and short-lived in other layers of the Earths atmosphere. In the stratosphere the main function of this protective ozone layer is to absorb harmful ultraviolet radiations emitted by the Sun (at a relatively low concentration of about 12 parts per million when compared to the concentration of other gases in the atmosphere) and thereby control the exposure of life forms on Earth to ultraviolet radiations, which are potentially harmful radiations emitted by the Sun. READ: What are Various Types of Forests and The Importance of Forests?This layer is usually found in the lower portion of the stratosphere, approximately 15 to 35 kilometers (9.3 to 21.7 mi) above Earth. Furthermore, peak concentrations of ozone in the mid-latitudes occur at about 20km to 25km (about 12 to 16 miles), while in the tropics, peak concentrations occur at an altitude of about 26km to 28km (approximately 16 to 17 miles) and about 12km to 20km (approximately 7 to 12 miles) towards the poles. The following points illustrate the importance of the ozone layer as an essential component of the Earths atmosphere: The Ozone layer absorbs harmful radiations from the Sun, thereby reducing cancer and cataract risks, making life on Earth safe from hazardous cosmic rays.It exerts greenhouse effect, thereby enabling conservation of radiant energy from the Sun in the form of heat.The presence of Ozone in the Stratosphere is very essential to life on Earth. Without this protective layer, life on earth would not be feasible. The ozone layer as pointed out above is very important for the maintenance and protection of land and water life forms. However, since the late 1970s, the ozone layer in the Earths atmosphere has been found to decrease in proportions of about 4%. Also, a decrease in the spring thickness of the ozone layer in the Stratosphere called for major concern, as this development poses a major risk to land and water life forms. This depletion in the thickness of the stratospheric ozone layer during spring is referred to as ozone hole. In addition, tropospheric decreases in springtime polar ozone concentration exists, which further contributes to the depletion of the amount of springtime ozone concentration in addition to the initial stratospheric events. READ: Causes and Effects of HurricanesIn a bid to nip the potential adverse events that might occur as a result of the decreased integrity of the ozone layer in the bud, scientists conducted large numbers of researches aimed at investigating the possible causes of this depletion. This effort by the scientists led to the discovery of the root causes of ozone layer depletion. This includes: Manufacture of chemicals, especially the manufacture of refrigerants, propellants, solvents, halocarbon compounds and foam-blowing agents such as Chlorofluorocarbons (CFCs) and Hydro chlorofluorocarbons (HCFCs), altogether referred to as Ozone-depleting substances ODS. These ozone depleting substances are transported in to the stratospheric layer by wind currents after being emitted from the various manufacturing plants. Once these substances arrive the stratosphere, they release halogen atoms through a process of photo dissociation. The halogen atom released in this process catalyzes the breakdown of ozone (O_3) into Oxygen atom (O) and (O_2) molecule. Thus, the protective function of the ozone layer becomes greatly impaired and permits the passage of some harmful cosmic radiations. In short, the higher the halogen or halocarbon atoms present in the atmosphere, the greater the depletion of the Earths ozone layer. Thus, in 1987, a global agreement to protect the ozone layer by phasing out the production and use of ozone-depleting substances was reached in the United States of America. This was tagged the Montreal Protocol. This measure, as well as many other measures put in place by various countries of the world has led to an improvement in the condition of the ozone layer. Sources: The atmosphere of the earth is the layer of gases (commonly called air) that surrounds the earth and creates an inhabitable environment, maintains temperature, causes weather, and protects its inhabitants from solar radiation. Layers of the Atmosphere Scientists divide the atmosphere into 5 different layers based on factors like air pressure and density. The names of these layers, in order of lowest to highest, are: TroposphereStratosphereMesosphereThermosphereExosphere Temperature: 62F (17C) around the lowest point to -60F (-51C) near the top The troposphere is the lowest layer of the atmosphere, and it is where we live. It extends up to 5 to 10 miles (8 to 15 km) above the surface. It is the densest layer, containing more than half the volume of total air. Most of the atmospheric water vapor and dust are found here. This means that all the weather that we experience occurs at this level, as clouds are formed here. In the troposphere, the temperature falls as we get higher up, and is the lowest at the tropopause that acts as the boundary between this layer and the next. this is where Earths jet stream (a narrow, fast, winding air current) is found as well. Temperature: -60F (-51C) near the tropopause to 5F (-15C) near the next layer Lies just above the troposphere, extending up to 31 miles (50 km) high. It is the part of the atmosphere that contains the ozone layer, which is essential for our survival as it blocks the harmful UV rays of the Sun from reaching us. Unlike the troposphere, in this layer, the temperature increases as we go higher. Also, jet aircraft and weather balloons fly in this layer as there is less turbulence. The stratopause acts as the boundary between the stratosphere and the mesosphere. Temperature: Ranges from 5F (-15C) to -148F (-100C) as one ascends up the layer. The mesosphere extends from just above the stratosphere to 53-62 miles (85-100 km) high. It is the coldest layer of the atmosphere, with the temperature dropping to its lowest at the boundary between the mesosphere and thermosphere, called the mesopause. Nothing is known about this layer except that meteoroids burn up here, preventing them from reaching the Earths surface. Temperature: The temperatures in this layer depend on solar activity and can get as hot as 930F (500C) to 3,600F (2,000C) near the upper thermosphere. This layer extends from the mesopause to about 372 miles (600 km) high.It is the hottest layer of the atmosphere, but the air density is so low that the high temperature cannot be felt at all. Most of the thermosphere is actually considered part of outer space due to this low air density. This is where the Aurora Borealis and Aurora Australis occur. They are caused by collisions between charged particles from space and the air molecules in the thermosphere and can be seen as spectacular displays of light in the sky near the north and south poles respectively. Temperature: This layer has considerable cosmic radiation, which means the particles in the exosphere are full of kinetic energy. They can reach temperatures up to 1800F (980C); however, since this layer is practically a vacuum with few atoms and molecules, this stored kinetic energy rarely gets converted to thermal or heat energy. As a result, the temperature remains freezing, close to an absolute zero. The exosphere extends from the upper boundary of the thermosphere, between 310 and 620 miles (500 and 1,000 km). The exact altitude can vary based on solar activity. Its lower boundary is called exobase or exopause, and this is the altitude above which atmospheric temperature remains almost constant. The exosphere is the least dense layer of the atmosphere, comprised of mostly helium and hydrogen. Q1. What layer of the atmosphere do satellites orbit the earth? Ans. The thermosphere is where satellites and space stations, like the International Space Station, orbit the Earth. Q2. Airplanes fly in what layer of the atmosphere? Ans. Airplanes and other commercial aircraft fly in the troposphere. Q3. At what height does outer space start? Ans. The Krmn line, at 62 miles (100 km) above the surface, is often said to be the point at which outer space starts. Q4. What is the ionosphere and where does it lie in the atmosphere? Ans. The ionosphere is a layer of charged particles (ions) that stretches from 48 km above the surface to around 965 km. It stretches over the mesosphere, most of the thermosphere, and some parts of the stratosphere. It is important for radio communications and is responsible for auroras. Its size varies with daytime and nighttime. Article was last reviewed on Friday, October 6, 2023 Region of the stratosphereThe ozone layer visible from space at Earth's horizon as a blue band of afterglow within the bottom of the large bright blue band that is the stratosphere, with a silhouette of a cumulonimbus in the orange afterglow of the troposphere.The ozone layer or ozone shield is a region of Earth's stratosphere that absorbs most of the Sun's ultraviolet radiation. It contains a high concentration of ozone (O_3) in relation to other parts of the atmosphere, although still small in relation to other gases in the stratosphere. The ozone layer peaks at 8 to 15 parts per million of ozone,[1] while the average ozone concentration in Earth's atmosphere as a whole is about 0.3 parts per million. The ozone layer is mainly found in the lower portion of the stratosphere, from approximately 15 to 35 kilometers (9 to 22mi) above Earth, although its thickness varies seasonally and geographically.[2]The ozone layer was discovered in 1913 by French physicists Charles Fabry and Henri Buisson. Measurements of the sun showed that the radiation sent out from its surface and reaching the ground on Earth is usually consistent with the spectrum of a black body with a temperature in the range of 5,5006,000K (5,2305,730C), except that there was no radiation below a wavelength of about 310nm at the ultraviolet end of the spectrum. It was deduced that the missing radiation was being absorbed by something in the atmosphere. Eventually the spectrum of the missing radiation was matched to only one known chemical, ozone.[3] Its properties were explored in detail by the British meteorologist G. M. B. Dobson, who developed a simple spectrophotometer (the Dobsonmeter) that could be used to measure stratospheric ozone from the ground. Between 1928 and 1958, Dobson established a worldwide network of ozone monitoring stations, which continue to operate to this day. The "Dobson unit" (DU), a convenient measure of the amount of ozone overhead, is named in his honor.The ozone layer absorbs 97 to 99 percent of the Sun's medium-frequency ultraviolet light (from about 200nm to 315nm wavelength), which otherwise would potentially damage exposed life forms near the surface.[4]In 1985, atmospheric research revealed that the ozone layer was being depleted by chemicals released by industry, mainly chlorofluorocarbons (CFCs). Concerns that increased UV radiation due to ozone depletion threatened life on Earth, including increased skin cancer in humans and other ecological problems,[5] led to bans on the chemicals, and the latest evidence is that ozone depletion has slowed or stopped. The United Nations General Assembly has designated September 16 as the International Day for the Preservation of the Ozone Layer.Venus also has a thin ozone layer at an altitude of 100 kilometers above the planet's surface.[6]Main article: Ozoneoxygen cycleOzone-oxygen cycle in the ozone layerThe Earth's ozone layer formed about 500 million years ago, when the neoproterozoic oxygenation event brought the fraction of oxygen in the atmosphere to about 20%.[7]The photochemical mechanisms that give rise to the ozone layer were discovered by the British physicist Sydney Chapman in 1930. Ozone in the Earth's stratosphere is created by ultraviolet light striking ordinary oxygen molecules containing two oxygen atoms (O_2), splitting them into individual oxygen atoms (atomic oxygen); the atomic oxygen then combines with unbroken O_2 to create ozone, O_3. The ozone molecule is unstable (although, in the stratosphere, long-lived) and when ultraviolet light hits ozone it splits into a molecule of O_2 and an individual atom of oxygen, a continuing process called the ozoneoxygen cycle. Chemically, this can be described as: O 2 + h uv 2 O {\displaystyle {\ce {O2{}+{\mathit {h}}u _{uv}->2O}}} O + O 2 O 3 {\displaystyle {\ce {O + O2 O3}}} About 90% of the ozone in the atmosphere is contained in the stratosphere. Ozone concentrations are greatest between about 20 and 40 kilometres (66,000 and 131,000ft), where they range from about 2 to 8 parts per million. If all of the ozone were compressed to the pressure of the air at sea level, it would be only 3 millimetres (18 inch) thick.[8]UV-B energy levels at several altitudes. Blue line shows DNA sensitivity. Red line shows surface energy level with 10 percent decrease in ozoneLevels of ozone at various altitudes and blocking of different bands of ultraviolet radiation. Essentially all UV-C (100280nm) is blocked by dioxygen (from 100200nm) or else by ozone (200280nm) in the atmosphere. The shorter portion of the UV-C band and the more energetic UV above this band causes the formation of the ozone layer, when single oxygen atoms produced by UV photolysis of dioxygen (below 240nm) react with more dioxygen. The ozone layer also blocks most, but not quite all, of the sunburn-producing UV-B (280315nm) band, which lies in the wavelengths longer than UV-C. The band of UV closest to visible light, UV-A (315400nm), is hardly affected by ozone, and most of it reaches the ground. UV-A does not primarily cause skin reddening, but there is evidence that it causes long-term skin damage.Although the concentration of the ozone in the ozone layer is very small, it is vitally important to life because it absorbs biologically harmful ultraviolet (UV) radiation coming from the Sun. Extremely short or vacuum UV (10100nm) is screened out by nitrogen. UV radiation capable of penetrating nitrogen is divided into three categories, based on its wavelength; these are referred to as UV-A (400315nm), UV-B (315280nm), and UV-C (280100nm).UV-C, which is very harmful to all living things, is entirely screened out by a combination of dioxygen (< 200nm) and ozone (> about 200nm) by around 35 kilometres (115,000ft) altitude. UV-B radiation can be harmful to the skin and is the main cause of sunburn; excessive exposure can also cause cataracts, immune system suppression, and genetic damage, resulting in problems such as skin cancer. The ozone layer (which absorbs from about 200nm to 310nm with a maximal absorption at about 250nm)[9] is very effective at screening out UV-B; for radiation with a wavelength of 290nm, the intensity at the top of the atmosphere is 350 million times stronger than at the Earth's surface. Nevertheless, some UV-B, particularly at its longest wavelengths, reaches the surface, and is important for the skin's production of vitamin D in mammals.Ozone is transparent to most UV-A, so most of this longer-wavelength UV radiation reaches the surface, and it constitutes most of the UV reaching the Earth. This type of UV radiation is significantly less harmful to DNA, although it may still potentially cause physical damage, premature aging of the skin, indirect genetic damage, and skin cancer.[10]This section needs additional citations for verification. Please help improve this article by adding citations to reliable sources in this section. Unsourced material may be challenged and removed. (February 2013) (Learn how and when to remove this message)Ozone layer within Earth's atmosphere by altitudeThe thickness of the ozone layer varies worldwide and is generally thinner near the equator and thicker near the poles.[11] Thickness refers to how much ozone is in a column over a given area and varies from season to season. The reasons for these variations are due to atmospheric circulation patterns and solar intensity.[12]The ozone layer ends gradually, but in general its upper limit is where air becomes too thin for UV light to generate much ozone, and its lower limit is where generated ozone blocks enough UV light to stop most ozone production.In the homosphere, wind-driven movement is more important than relative gas weight. The majority of ozone is produced over the tropics and is transported toward the poles by stratospheric wind patterns. In the northern hemisphere these patterns, known as the BrewerDobson circulation, make the ozone layer thickest in the spring and thinnest in the fall.[11] When ozone is produced by solar UV radiation in the tropics, it is done so by circulation lifting ozone-poor air out of the troposphere and into the stratosphere where the sun photolyzes oxygen molecules and turns them into ozone. Then, the ozone-rich air is carried to higher latitudes and drops into lower layers of the atmosphere.[11]Research has found that the ozone levels in the United States are highest in the spring months of April and May and lowest in October. While the total amount of ozone increases moving from the tropics to higher latitudes, the concentrations are greater in high northern latitudes than in high southern latitudes, with spring ozone columns in high northern latitudes occasionally exceeding 600 DU and averaging 450 DU whereas 400 DU constituted a usual maximum in the Antarctic before anthropogenic ozone depletion. This difference occurred naturally because of the weaker polar vortex and stronger BrewerDobson circulation in the northern hemisphere owing to that hemisphere's large mountain ranges and greater contrasts between land and ocean temperatures.[13] The difference between high northern and southern latitudes has increased since the 1970s due to the ozone hole phenomenon.[11] The highest amounts of ozone are found over the Arctic during the spring months of March and April, but the Antarctic has the lowest amounts of ozone during the summer months of September and October,BrewerDobson circulation in the ozone layerMain article: Ozone depletionNASA projections of stratospheric ozone concentrations if chlorofluorocarbons had not been bannedThe ozone layer can be depleted by free radical catalysts, including nitric oxide (NO), nitrous oxide (N_2O), hydroxyl (OH), atomic chlorine (Cl), and atomic bromine (Br). While there are natural sources for all of these species, the concentrations of chlorine and bromine increased markedly in recent decades because of the release of large quantities of man-made organohalogen compounds, especially chlorofluorocarbons (CFCs) and bromofluorocarbons.[14] Atmospheric components are not sorted out by weight in the homosphere because of wind-driven mixing that extends to an altitude of about 90 km, well above the ozone layer. So despite being heavier than diatomic nitrogen and oxygen, these highly stable compounds rise into the stratosphere, where Cl and Br radicals are liberated by the action of ultraviolet light. Each radical is then free to initiate and catalyze a chain reaction capable of breaking down over 100,000 ozone molecules. By 2009, nitrous oxide was the largest ozone-depleting substance (ODS) emitted through human activities.[15]The breakdown of ozone in the stratosphere results in reduced absorption of ultraviolet radiation. Consequently, unabsorbed and dangerous ultraviolet radiation reaches the Earth's surface at a higher intensity. Ozone levels have dropped by a worldwide average of about 4 percent since the late 1970s. For approximately 5 percent of the Earth's surface, around the north and south poles, much larger seasonal declines have been seen, and are described as "ozone holes". "Ozone holes" are actually patches in the ozone layer in which the ozone is thinner. The thinnest parts of the ozone are at the polar points of Earth's axis.[16] The discovery of the annual depletion of ozone above the Antarctic was first announced by Joe Farman, Brian Gardiner, and Jonathan Shanklin, in a paper which appeared in Nature on May 16, 1985.Regulation attempts have included but not have been limited to the Clean Air Act implemented by the United States Environmental Protection Agency. The Clean Air Act introduced the requirement of National Ambient Air Quality Standards (NAAQS) with ozone pollutions being one of six criteria pollutants. This regulation has proven to be effective since counties, cities, and tribal regions must abide by these standards and the EPA also provides assistance for each region to regulate contaminants.[17] Effective presentation of information has also proven to be important in order to educate the general population of the existence and regulation of ozone depletion and contaminants. A scientific paper was written by Sheldon Ungar in which the author explores and studies how information about the depletion of the ozone, climate change, and various related topics. The ozone case was communicated to lay persons "with easy-to-understand bridging metaphors derived from the popular culture" and related to "immediate risks with everyday relevance".[18] The specific metaphors used in the discussion (ozone shield, ozone hole) proved quite useful and, compared to global climate change, the ozone case was much more seen as a "hot issue" and imminent risk. Lay people were cautious about a depletion of the ozone layer and the risks of skin cancer.Satellites burning up upon re-entry into Earth's atmosphere produce aluminum oxide (Al_2O_3) nanoparticles that endure in the atmosphere for decades.[19] Estimates for 2022 alone were ~17 metric tons (~30kg of nanoparticles per ~250kg satellite).[19] Increasing populations of satellite constellations can eventually lead to significant ozone depletion.[19]"Bad" ozone[clarification needed] can cause adverse health risks respiratory effects (difficulty breathing) and is proven to be an aggravator of respiratory illnesses such as asthma, COPD, and emphysema.[20] That is why many countries have set in place regulations to improve "good" ozone[clarification needed] and prevent the increase of "bad" ozone in urban or residential areas. In terms of ozone protection (the preservation of "good" ozone) the European Union has strict guidelines on what products are allowed to be bought, distributed, or used in specific areas.[21] With effective regulation, the ozone is expected to heal over time.[22]Levels of atmospheric ozone measured by satellite show clear seasonal variations and appear to verify their decline over time.Main article: Ozone depletion and climate changeIn 1978, the United States, Canada, and Norway enacted bans on CFC-containing aerosol sprays that damage the ozone layer but the European Community rejected a similar proposal. In the U.S., chlorofluorocarbons continued to be used in other applications, such as refrigeration and industrial cleaning, until after the discovery of the Antarctic ozone hole in 1985. After negotiation of an international treaty (the Montreal Protocol), CFC production was capped at 1986 levels with commitments to long-term reductions.[23] This allowed for a ten-year phase-in for developing countries[24] (identified in Article 5 of the protocol). Since then, the treaty was amended to ban CFC production after 1995 in developed countries, and later in developing countries.[25] All of the world's 197 countries have signed the treaty. Beginning January 1, 1996, only recycled or stockpiled CFCs were available for use in developed countries like the US. The production phaseout was possible because of efforts to ensure that there would be substitute chemicals and technologies for all ODS uses.[26]On August 2, 2003, scientists announced that the global depletion of the ozone layer might be slowing because of the international regulation of ozone-depleting substances. In a study organized by the American Geophysical Union, three satellites and three ground stations confirmed that the upper-atmosphere ozone-depletion rate slowed significantly over the previous decade. Some breakdown was expected to continue because of ODSs used by nations which have not banned them, and because of gases already in the stratosphere. Some ODSs, including CFCs, have very long atmospheric lifetimes ranging from 50 to over 100 years. It has been estimated that the ozone layer will recover to 1980 levels near the middle of the 21st century.[27] A gradual trend toward "healing" was reported in 2016.[28]Compounds containing CH bonds (such as hydrochlorofluorocarbons, or HCFCs) have been designed to replace CFCs in certain applications. These replacement compounds are more reactive and less likely to survive long enough in the atmosphere to reach the stratosphere where they could affect the ozone layer. While being less damaging than CFCs, HCFCs can have a negative impact on the ozone layer, so they are also being phased out.[29] These in turn are being replaced by hydrofluorocarbons (HFCs) and other compounds that do not destroy stratospheric ozone at all.The residual effects of CFCs accumulating within the atmosphere lead to a concentration gradient between the atmosphere and the ocean. This organohalogen compound dissolves into the ocean's surface waters and acts as a time-dependent tracer. This tracer helps scientists study ocean circulation by tracing biological, physical, and chemical pathways.[30]As ozone in the atmosphere prevents most energetic ultraviolet radiation reaching the surface of the Earth, astronomical data in these wavelengths have to be gathered from satellites orbiting above the atmosphere and ozone layer. Most of the light from young hot stars is in the ultraviolet and so study of these wavelengths is important for studying the origins of galaxies. The Galaxy Evolution Explorer, GALEX, is an orbiting ultraviolet space telescope launched on April 28, 2003, which operated until early 2012.[31]This GALEX image of the Cygnus Loop nebula could not have been taken from the surface of the Earth because the ozone layer blocks the ultra-violet radiation emitted by the nebula.Cambrian explosionNuclear winterOxygenShort-lived climate pollutantsUnited Nations Environment Programme^ NASA Ozone Watch: Ozone facts^ "Ozone Basics". NOAA. March 20, 2008. Archived from the original on November 21, 2017. Retrieved January 29, 2007.^ McElroy, C.T.; Fogal, P.F. (2008). "Ozone: From discovery to protection". Atmosphere-Ocean. 46 (1): 113. Bibcode:2008AtO....46....1M. doi:10.3137/ao.460101. S2CID128994884.^ "Ozone layer". Archived from the original on May 2, 2021. Retrieved September 23, 2007.^ An Interview with Lee Thomas, EPA's 6th Administrator. Video, Transcript (see p13). April 19, 2012.^ SPACE.com staff (October 11, 2011). 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ISBN978-1-84977-226-6.Ritchie, Hannah, "What We Learned from Acid Rain: By working together, the nations of the world can solve climate change", Scientific American, vol. 330, no. 1 (January 2024), pp.7576. "[C]ountries will act only if they know others are willing to do the same. With acid rain, they did act collectively.... We did something similar to restore Earth's protective ozone layer.... [T]he cost of technology really matters.... In the past decade the price of solar energy has fallen by more than 90 percent and that of wind energy by more than 70 percent. Battery costs have tumbled by 98 percent since 1990, bringing the price of electric cars down with them....[T]he stance of elected officials matters more than their party affiliation.... Change can happen but not on its own. We need to drive it." (p.76.)United Nations Environment Programme (2010). Environmental Effects of Ozone Depletion and its Interactions with Climate Change: 2010 Assessment. Nairobi: UNEP.Velders, G. J. 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The stratosphere is the mass of protective gases clinging to our planet.The stratosphere gets its name because it is stratified, or layered: as elevation increases, the stratosphere gets warmer. The stratosphere increases in warmth with elevation because ozone gases in the upper layers absorb intense ultraviolet radiation from the sun.Ozone is only a trace gas in the atmosphereonly about three molecules for every 10 million molecules of air. But it does a very important job. Like a sponge, the ozone layer absorbs bits of radiation hitting Earth from the sun. Even though we need some of the sun's radiation to live, too much of it can damage living things. The ozone layer acts as a shield for life on Earth.Ozone is good at trapping a type of radiation called ultraviolet radiation, or UV light, which can penetrate organisms protective layers, like skin. This then may damage DNA molecules in plants and animals. There are two major types of UV light: UVB and UVA.UVB is the cause of skin conditions like sunburns, and cancers like basal cell carcinoma and squamous cell carcinoma.People used to think that UVA light, the radiation used in tanning beds, is harmless because it doesnt cause burns. However, scientists now know that UVA light is even more harmful than UVB, penetrating more deeply and causing a deadly skin cancer, melanoma, and premature aging. The ozone layer, Earths sunscreen, absorbs about 98 percent of this devastating UV light.The ozone layer is getting thinner. Chemicals called chlorofluorocarbons (CFCs) are a reason we have a thinning ozone layer. A CFC is a molecule that contains the elements carbon, chlorine, and fluorine. CFCs are everywhere, mostly in refrigerants and plastic products. Businesses and consumers use them because they're inexpensive, they don't catch fire easily, and they don't usually poison living things. But the CFCs start eating away at the ozone layer once they get blown into the stratosphere.Ozone molecules, which are simply made of three joined oxygen atoms, are always being destroyed and reformed naturally. But CFCs in the air make it very difficult for ozone to reform once its broken apart. The ozone layer, which only makes up 0.00006 percent of Earths atmosphere, is getting thinner and thinner all the time.Ozone holes are popular names for areas of damage to the ozone layer. This is inaccurate. Ozone layer damage is more like a really thin patch than a hole. The ozone layer is thinnest near the poles.In the 1970s, people all over the world started realizing the ozone layer was getting thinner and that this was a bad thing. Many governments and businesses agreed that some chemicals, like aerosol cans, should be outlawed. There are fewer aerosol cans produced today. The ozone layer has slowly recovered as people, businesses, and governments work to control such pollution.

Which layer of the atmosphere contains a protective layer of ozone. Which layer of earth's atmosphere is home to the ozone layer. Which layer of earth atmosphere contains ozone. Which layer of the atmosphere is the ozone layer located. Which layer of atmosphere has ozone layer to prevent the earth from ultraviolet rays. Name the layer of atmosphere which has ozone layer that prevent ultraviolet rays coming to the earth. Which layer of earth's atmosphere contains the ozone layer. Which layer of atmosphere has ozone layer. Which layer of the atmosphere is the ozone layer found in.