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The Hypothetical Ozone Hole: A Consequence Of Instrumental And Measurement Principle Errors

The hypothetical ozone hole and ozone depletion is the result of errors in so-called instruments and their measurement principles: A unique review and perspective.

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❖ *Abstract:*

This unique study critically re-examines the widely accepted notion of the so-called “ozone hole,” a concept that has been a major global environmental concern for decades. Based on factual evidence, theoretical principles, and rigorous scientific reasoning, it is demonstrated that the concept of ozone depletion largely arises from the inherent limitations and inaccuracies of measurement instruments, methodologies, and interpretations. A careful analysis of the scientific processes governing the formation and destruction of stratospheric ozone reveals natural balance within the Chapman cycle, thereby challenging conventional conclusions.

Solar ultraviolet (UV) radiation up to 290 nm (290 nanometer = 2900 Å = 2.9×10^{-7} m) is effectively absorbed by stratospheric oxygen and ozone. Molecular oxygen (O_2) undergoes photolysis to yield atomic oxygen, which recombines with O_2 to form ozone (O_3). Ozone itself is continuously destroyed through photolysis and spontaneous reactions ($O + O_3 \rightarrow 2O_2$; $O_3 + O_3 \rightarrow 3O_2$). This continuous cycle is active only in the presence of the Sun’s UV radiation. And this megacycle benefits our Earth in many ways, both directly and indirectly. Instead, increased UV radiation at specific geographic regions (Antarctica, Arctic, Tibet, Greenland, Himalayas, Alaska, etc.) is attributed to extremely low temperatures and exceptionally clean atmospheric conditions, not to the destruction of the ozone layer. Thus, the term “ozone hole” should be interpreted as enhanced UV radiation, rather than actual ozone loss. UV radiation is classified on a health basis, not on the basis of ozone absorption or any instrument-specific measurement principle. Accordingly, it is divided into three categories: UV-A (315–400 nm), UV-B (280–315 nm), and UV-C (100–280 nm). Among these, UV-C is the most harmful, but it is completely blocked by the oxygen–ozone shield. UV-B partially reaches the Earth’s surface and plays a crucial role in vitamin-D synthesis, while UV-A, though less harmful, reaches the surface almost entirely, with its intensity modulated primarily by other atmospheric constituents. In the primary stage, the oxygen layer absorbs extremely short-wavelength solar UV radiation, leading, as a consequence, to the formation of ozone in the secondary stage. In this secondary stage, the ozone layer absorbs, interferes with, attenuates, blocks, scatters, reflects, and refracts UV radiation with wavelengths shorter than 290 nm. As a result, biologically destructive UV-C radiation is fully eliminated before reaching the surface.

Modern scientific understanding has now almost firmly established that UV radiation beyond 290 nm is controlled predominantly by other atmospheric components, such as aerosols, OH, H_2O, SO_2, NO_2, CO_2, and related species. In this wavelength region, the influence of the ozone or oxygen layers is negligible, and therefore it is scientifically untenable to infer ozone concentration by measuring variations in UV intensity beyond 290 nm using instrument-based measurement principles. In conclusion, the stratospheric oxygen–ozone system functions as a natural protective umbrella for life on Earth. The perceived “ozone hole” does not represent true depletion, but rather reflects natural variations in UV radiation and limitations of measurement interpretations. The objective of this research is not to weaken environmental protection policies, but to correct pseudo-scientific narratives and establish a rigorous, fact-based scientific foundation for atmospheric studies.

Index Terms – The Ozone Hole, Ozone layer depletion, The Oxygen Layer, Ozone Layer, UV Index (UVI), Atmospheric Components Freezing, polar vortex, Antarctica and Tropical Ozone Holes, Greenland, Alaska, Himalayas, Tibet and Arctic Mini Ozone Hole, Stratospheric Water Vapor (SWV) and Stratospheric Aerosol Injection (SAI), Polar Stratospheric Clouds (PSCs), Mega Cycles, Brewer–Dobson Circulation (BDC), Dobson Spectrophotometer, Ozone Sonde, Satellite Observations, Chapman Cycle, Stratospheric Dynamics, Surface Albedo Effects, Measurement Limitations, The so-called, imaginary, hypothetical, ozone hole.

•INTRODUCTION

In this article we focus on the basic facts about ozone, the ozone layer and the so-called ozone hole so that we can redefine it based on basic information and save humanity from decades of panic. Looking back, we find clear evidence that due to Antarctica’s extreme climate and challenging conditions, research stations were closed during winter, and scientific teams returned only in summer. Operations were entirely dependent on weather and seasonal conditions. When spring arrives in Antarctica, after months of continuous darkness, scientists return to the research station.

Around 1985, during late winter or early spring, scientists recorded a seasonal increase in solar ultraviolet (UV) radiation using the Dobson Spectrophotometer. This instrument measures the stratospheric ozone layer by estimating the difference in the intensity of solar ultraviolet radiation reaching the Earth’s surface, assuming that UV radiation directly reaches the instrument after passing through the stratospheric ozone layer. However, in reality, the oxygen and ozone layers absorb, influence, or block solar ultraviolet radiation up to their limit (about 290 nanometers), and the remaining UV radiation reaching the surface is further affected, interfered with, scattered, reflected, or absorbed by other atmospheric components. These other atmospheric constituents effectively influence the UV Index (UVI, 290–400 nm) and even the solar spectrum (hv), and are primarily responsible for the variations (Increase or decrease) in its intensity. Therefore, the Dobson Spectrophotometer can only explain the UV index at its minimum operational wavelength (around 305 nm). Measuring the ozone layer with this instrument is perhaps hypothetical, because oxygen and ozone have already absorbed as much UV radiation as possible, and the remaining UV—after being modified by other atmospheric components—eventually reaches the surface and is recorded by the instrument.

The measurement of atmospheric constituents, particularly ozone, has historically been conducted through three major approaches: ground-based instruments, balloon-borne sondes, and satellites. Among the ground-based methods, the Dobson Spectrophotometer, developed by G. M. B. Dobson in the 1920s, is the oldest and most widely used standard. This instrument measures the intensity of solar ultraviolet radiation at two different wavelengths within the so-called "ozone absorption band". It is well established that ozone exhibits maximum absorption at 255 nm, and its final absorption limit lies near 290 nm. Therefore, we cannot determine the actual ozone layer by measuring the change in the subsequent pair ratio of ultraviolet radiation beyond 290 nanometers. This is because it has been established that ultraviolet radiation in this range is more sensitive to aerosols, as well as sulfur dioxide, nitrogen dioxide, carbon dioxide, and primarily water vapor and its allotropes.

•THE ANTARCTIC OZONE HOLE: RE-EVALUATION IN HISTORICAL AND SCIENTIFIC CONTEXT

The concept of the “Antarctic Ozone Hole” as a sudden alarming phenomenon in the 1980s does not withstand historical and scientific scrutiny. Systematic ozone measurements over Antarctica had already recorded significant seasonal declines decades earlier. G. M. B. Dobson, in his seminal paper “Forty Years’ Research on Atmospheric Ozone at Oxford: A History” (Applied Optics, Vol. 7, No. 3, March 1968, pp. 387–405), documented that ozone levels at Halley Bay in 1956–57 were approximately 150 units lower than expected when compared with stations like Spitsbergen. Initially, these results were considered possible instrumental errors or observational mistakes. However, repeated measurements in subsequent years confirmed that these seasonal declines were real and intrinsic to Antarctica’s unique atmospheric dynamics (Dobson, 1968).

The concept of the "Antarctic Ozone Hole" was not an entirely new phenomenon even when it was recognized in the 1980s. During the International Geophysical Year (IGY) in 1957–58, the first systematic global studies of the Earth’s atmosphere were conducted, and data from these years already revealed similar ozone variations in Antarctica. The IGY marked a crucial period when scientists began collecting extensive geophysical data, including measurements of ozone levels across various global locations, including Antarctica. This period laid the foundation for understanding ozone behavior and variations on a global scale, revealing that lower ozone values in Antarctica were part of natural seasonal cycles and not an unexpected anomaly.

The enhanced ultraviolet (UV) radiation observed in Antarctica is a direct consequence of its exceptionally clean atmosphere, characterized by extremely low levels of aerosols, dust, and pollutant gases such as NO_2 and SO_2. In most other regions, these constituents absorb or scatter solar UV radiation, reducing the intensity at the surface. Their near absence in Antarctica allows more UV radiation to reach the ground naturally. This means that the increase in UV radiation is entirely expected in such pristine conditions, and it had already been documented by Dobson decades before the 1980s. Despite this, the scientific community popularized the term “Ozone Hole” in the mid-1980s, largely based on readings from ozone-measuring instruments without fully accounting for Antarctica’s unique environmental conditions.

Predictions for ozone recovery have shifted repeatedly—from 2017 to 2050, and now projections extend to 2070 or even 2100—while ignoring the fact that regions like Antarctica have been naturally free of pollutants for millennia. Therefore, the observed increase in UV radiation is a natural phenomenon, not evidence of irreversible ozone depletion. It is misleading to declare a “hole” based solely on instrument readings without considering the region’s pristine atmosphere and extraordinary environmental characteristics.

In summary, the historical record and atmospheric context show that what has been termed the “Ozone Hole” is not a new crisis, but rather a misinterpretation of natural variability and the effects of Antarctica’s clean atmosphere on UV measurements. Enhanced UV exposure in these regions is an expected outcome of natural conditions, rather than anthropogenic ozone loss.

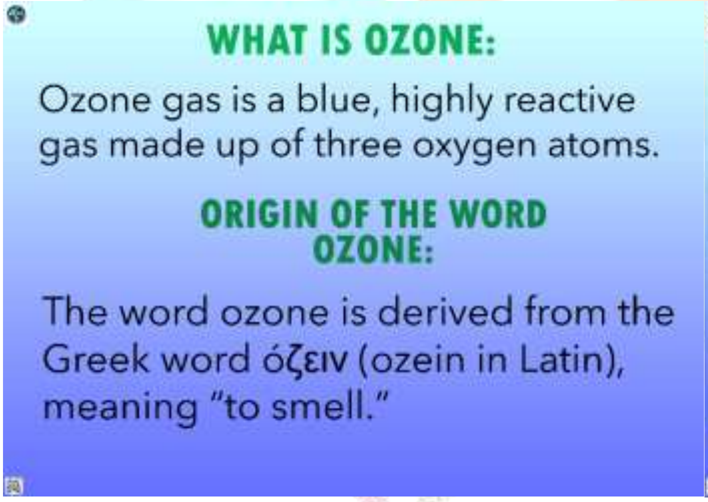
•BASIC FACTS AND CONCEPTS ON OZONE

Dobson and D. N. Harrison (1926) extended this measurement range beyond 290 nm to maintain the operational validity of the instrument, even though earlier findings by Charles Fabry and Henri Buisson (1913) had already demonstrated that ozone absorption ceases at 290 nm, beyond which no solar radiation exists in the spectrum. The great British scientist Sydney Chapman also recognized 290 nm as the cutoff limit for surface-reaching UV radiation.

In reality, ultraviolet radiation beyond 290 nm has no direct relation to the oxygen or ozone layer. Unfortunately, G. M. B. Dobson, influenced by laboratory-based absorption bands (which did not extend beyond 290 nm), attributed every increase or decrease in surface-reaching UV radiation solely to variations in the ozone layer. He assumed that diurnal, weekly, seasonal, and annual fluctuations in UV intensity were caused only by ozone concentration, neglecting the influence of other atmospheric constituents. With this assumption, Dobson applied laboratory absorption characteristics to the real atmosphere and developed the Dobson Spectrophotometer — a device that estimates ozone concentration in the stratosphere by comparing the intensity difference between two chosen UV wavelengths (305 nm and 325 nm). He further concluded that only ozone was responsible for variations in these wavelength pairs. To defend his instrument, he proposed that ozone concentration varies constantly — every moment, every day, and every season — and that stratospheric ozone has a long lifetime, is transported from the tropics to the poles, and undergoes destruction through catalytic reactions involving both natural and anthropogenic agents.

In doing so, Dobson effectively disregarded several well-established theoretical foundations, and on the basis of laboratory-measured ozone absorption bands, declared his instrument as the global standard for ozone measurement. This conceptual overreach ultimately led to the so-called "discovery" of the ozone hole itself — an outcome of the very instrument designed to measure it. From a theoretical standpoint, it is thus evident that 290 nm marks the ultimate boundary of ozone absorption, beyond which the role of ozone and oxygen becomes negligible. Therefore, attributing surface UV fluctuations entirely to the ozone layer — as done historically through the Dobson Spectrophotometer — represents a methodological misconception.

In reality, solar radiation beyond 290 nm is largely governed by multiple atmospheric constituents, including aerosols (black carbon BC, brown carbon BrC, sulfates, dust, sea salt) and gases such as H_2O, SO_2, NO_2, OH, NH_3, CO_2, CH_4, N_2O, and others, which continuously influence radiative transfer in the atmosphere. Hence, the assumption that a single instrument can provide a pure or isolated measurement of the ozone layer is scientifically untenable. All such measurements are inherently influenced by the dynamic behavior and phase-dependent radiative properties of multiple atmospheric components, particularly under extreme polar conditions. It is well established that ozone exhibits maximum absorption at 255 nm, and its final absorption limit terminates at 290 nm. However, beyond 290 nm, the absorption of solar ultraviolet radiation is primarily governed by other atmospheric constituents such as water vapor (H_2O), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), hydroxyl radical (OH), ammonia (NH_3), and various atmospheric aerosols (including black carbon, brown carbon, and sulfates), all of which possess multiple absorption bands active beyond 290 nm.

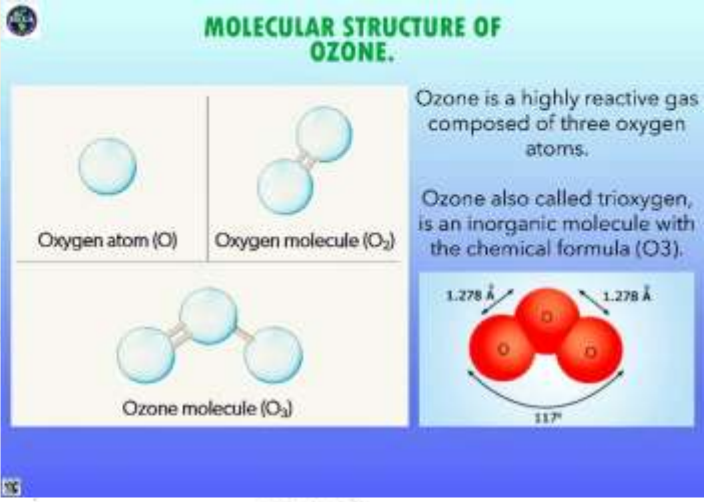


WHAT IS OZONE:

Ozone gas is a blue, highly reactive gas made up of three oxygen atoms.

ORIGIN OF THE WORD OZONE:

The word ozone is derived from the Greek word όζειν (ozein in Latin), meaning "to smell."



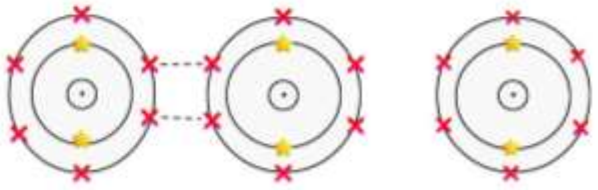
MOLECULAR STRUCTURE OF OZONE.

Ozone is a highly reactive gas composed of three oxygen atoms.

Ozone also called trioxygen, is an inorganic molecule with the chemical formula (O3).

- **Reactivity of Ozone**

  Ozone (O_3) is a highly reactive triatomic molecule with pronounced oxidizing potential, rendering it both chemically unstable and biologically hazardous. Its intrinsic instability arises from the weak bonding of the third oxygen atom, which can be readily detached upon interaction with free radicals or other reactive species. Consequently, ozone acts as a transient yet highly potent oxidizing agent in chemical and material systems.



©Electronic structure of molecular and excited atomic oxygen during ozone formation.

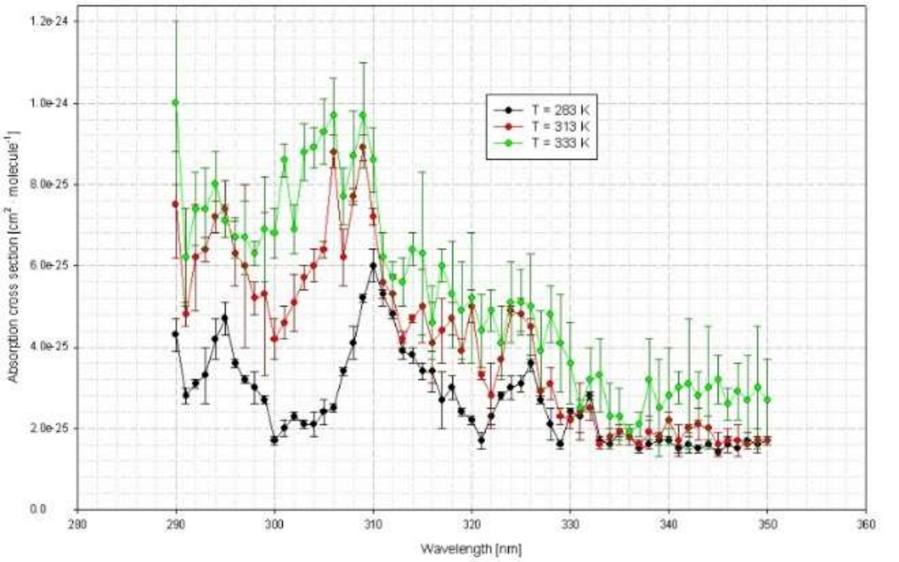
Fundamental Causes of Reactivity:

Structural Instability: Ozone possesses a resonance-stabilized but energetically strained configuration, making it inherently unstable. Dissociation releases an atomic oxygen species (O·), which readily initiates secondary reactions.

Oxidizing Potential: Ozone functions as a powerful oxidant, surpassing molecular oxygen in reactivity and comparable to strong industrial oxidizing agents such as sodium hypochlorite. This property enables it to attack diverse organic and inorganic substrates, often resulting in irreversible transformations.

• ABSORPTION BANDS OF OZONE (O_3)

Modern spectroscopic studies clearly establish that ozone exhibits its strongest and most effective ultraviolet absorption at approximately 254–255 nm, corresponding to the peak of the Hartley band, where ozone efficiently absorbs radiation and dissociates into nascent oxygen. Beyond this peak, the absorption strength progressively weakens and effectively terminates near 290 nm, which is widely recognized as the upper limit of meaningful atmospheric ozone absorption. Past this wavelength, ozone cannot be considered an absorbing species in the conventional spectroscopic sense. Although ozone molecules can undergo dissociation due to thermal energy, and such dissociation may occur when sufficient energy is supplied by ultraviolet, visible, or infrared radiation—extending in laboratory conditions up to wavelengths as long as 1180 nm, as discussed in Paul J. Crutzen Nobel Lecture—this process does not constitute spectral absorption. Molecular dissociation depends on intrinsic properties such as bond energy, molecular structure, stability, resonance, and fluorescence characteristics, and must be distinguished from selective radiative absorption. Consequently, the spectral region extending to 1180 nm cannot be defined as an ozone absorption band, nor can it be associated with atmospheric ozone layer measurements; it merely represents an energy range capable of inducing ozone dissociation under controlled laboratory conditions.

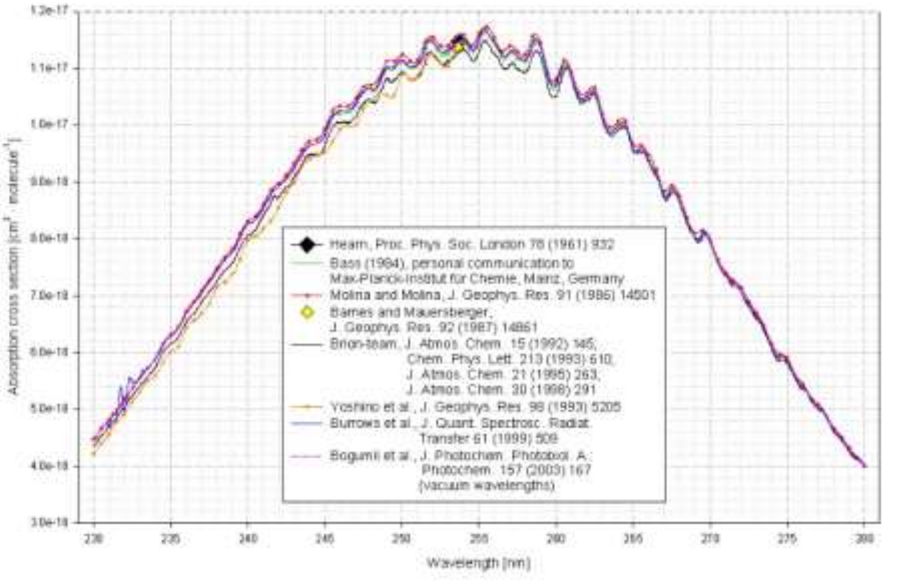


Temperature dependence of the absorption cross sections of water vapor H_2O,
Wang et al., J. Quant. Spectrosc. Radiat. Transfer 286 (2022) 108204

Furthermore, it is now well established that the 290–350 nm ultraviolet region is significantly more sensitive to water vapor and other atmospheric constituents than to ozone itself. Historically, measurements within this wavelength range were used to infer concentrations of these components. In Antarctica, extremely low temperatures lead to the formation of polar stratospheric clouds (PSCs) and, combined with atmospheric isolation by the polar vortex, result in a substantial reduction or absence of such constituents. This produces an apparent enhancement of ultraviolet radiation beyond 290 nm, which, under flawed measurement assumptions, was interpreted as ozone depletion. On this basis, the phenomenon was labeled as the so-called "ozone hole," which appears to arise from measurement and interpretation limitations rather than from actual large-scale destruction of stratospheric ozone.

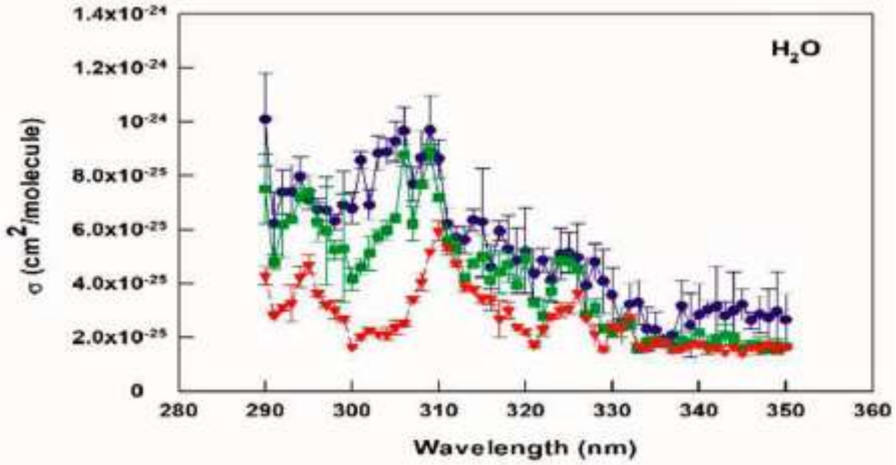
- **ABSORPTION OF SOLAR UV RADIATION (290–400 NM) BY ATMOSPHERIC WATER VAPOR**

Recent studies have established that atmospheric water vapor (H2O) exhibits measurable absorption across the entire 290–400 nm ultraviolet spectral range, which is directly relevant to surface ultraviolet radiation and the ultraviolet index (UVI).



Absorption cross sections of ozone O_3 around the maximum of the Hartley band at room temperature (230-280 nm)

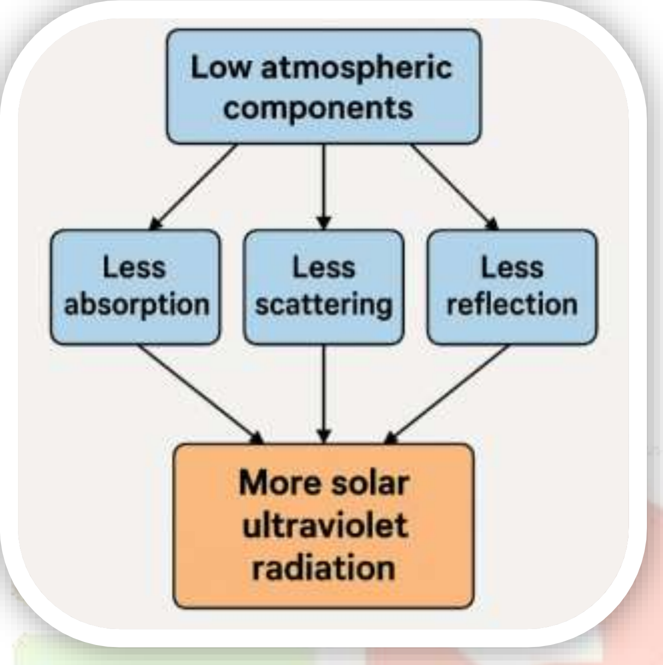
Laboratory spectroscopy and atmospheric field observations demonstrate that H_2O absorbs near-UV and UV radiation continuously within the 290–400 nm wavelength range. The measured absorption cross-sections in this region exhibit structured spectral features and wavelength-dependent variability, as confirmed by high-resolution laboratory measurements. These absorption characteristics, when integrated over realistic atmospheric water-vapor column densities, result in significant attenuation of ultraviolet radiation propagating through the troposphere. Importantly, this absorption is not only observed under controlled laboratory conditions but is also evident in field spectral measurements, confirming its relevance under real atmospheric conditions.



Inclusion of water vapor absorption within the 290–400 nm range in radiative-transfer calculations produces measurable changes in modeled surface UV irradiance, indicating that water vapor acts as an active ultraviolet absorber over the full UVI-relevant spectrum. Independent observational evidence from ultraviolet extinction analyses in the 290–400 nm wavelength range shows that variations in atmospheric water-vapor content correspond to systematic variations in surface ultraviolet intensity, demonstrating that water vapor absorption contributes materially to ultraviolet extinction in the lower atmosphere. Together, these studies establish that water vapor absorption across the 290–400 nm ultraviolet range is physically real, experimentally verified, and atmospherically significant, and constitutes a fundamental factor governing surface UV radiation and UVI variability (*Pei et al.,2019; Shukla A.P 2024; Bai, 2017*).

- **Influence of Atmospheric Constituents on UV Index (UVI)**

The Ultraviolet Index (UVI) quantifies the erythemally weighted intensity of solar ultraviolet radiation reaching the Earth's surface within the 280–400 nm spectral band, primarily emphasizing the UV-B range (280–315 nm) (WHO, 2002; EPA, 2023). Conventionally, changes in UVI have been attributed solely to stratospheric ozone variation; however, numerous atmospheric components—aerosols, clouds, water vapour (H_2O), and trace gases such as SO_2 and NO_2—strongly influence UV transmission, absorption, and scattering (EPA, 2022; Madronich et al., 2018).



The Dobson spectrophotometer, developed in the 1920s, operates on the same optical principle that defines the UV Index. It does not measure ozone molecules directly but instead computes "total column ozone" from the ratio of solar UV irradiances at two wavelengths—one strongly absorbed by ozone (~305 nm) and another weakly absorbed (~325 nm) (NOAA ESRL, 2020). Because this ratio essentially represents the attenuation of ultraviolet radiation, the Dobson system can logically be regarded as an indirect UVI-measuring instrument rather than a true ozone gas detector.

Historically, the "ozone hole" was defined as any region where the derived ozone column fell below 220 Dobson Units, based purely on these optical ratios (WMO, 2023). It is crucial to note that no physical hole or discontinuity in the ozone layer has ever been directly observed over Antarctica. Neither satellite imagery nor balloon-borne instruments have detected an actual gap in ozone molecules. What was recorded was merely an increase in UV radiation intensity, which, through Dobson's algorithm, appeared as a decrease in total ozone. In other words, the "ozone hole" originated as an optical and radiative anomaly, not a tangible depletion of atmospheric ozone. During the austral spring, extreme stratospheric cooling, the presence of polar stratospheric clouds (PSCs), reduced aerosol concentration, low water-vapour absorption, and enhanced surface albedo over ice collectively increase UV transmittance. These conditions cause instruments to register anomalously high UV ratios, yielding artificially low ozone values. Furthermore, the absence of sufficient water vapour—a major absorber and scattering modulator—changes the refractive and radiative properties of the Antarctic stratosphere, amplifying optical bias. Thus, under these conditions, both ground-based and satellite instruments are prone to systematic errors, leading to the appearance of an "ozone hole" even without actual chemical depletion. Consequently, the so-called Antarctic ozone hole is best understood as a UV radiation anomaly produced by combined optical, thermal, and atmospheric effects rather than as a literal cavity or chemical absence in the ozone layer. Therefore, any realistic assessment of UV variability or inferred ozone depletion must incorporate aerosol optical depth (AOD), cloud optical properties, water-vapour distribution, stratospheric temperature, and trace-gas composition alongside traditional Dobson-based optical measurements.

- **ANTARCTICA: A UNIQUE PLACE**

Antarctica represents the cleanest atmospheric region on Earth. At extremely low temperatures the surface temperature reaches around -78 °C / -108.4 °F / 195.15 K and the stratospheric temperature falls nearly to -97 °C / -142.6 °F / 176.15 K, certain atmospheric components can freeze, leading to an exceptionally transparent atmosphere. Under such conditions, it is natural and expected that solar UV radiation penetrates more intensely.

The so-called ozone hole created a wave of global panic, with warnings that it would soon spread over the entire planet and expose humanity to life-threatening levels of UV radiation. However, in reality, as long as oxygen and ozone molecules remain in Earth's atmosphere, it is virtually impossible for UV radiation below 290 nm to reach the surface.

- **DISCOVERY OF THE SO-CALLED OZONE HOLE**

In 1985, Joe Farman, Brian Gardiner, and Dr. Jonathan Shanklin of the British Antarctic Survey (BAS) reported a seasonal decline in ozone over Antarctica based on measurements made with a Dobson spectrophotometer (Farman et al., 1985, Nature, 315, pp. 207–210). They did not directly observe an "ozone hole"; rather, they interpreted increased levels of solar ultraviolet (UV) radiation, inferred through instrument readings, as evidence of ozone depletion and announced it as the "ozone hole." The Dobson spectrophotometer estimates total column ozone by measuring the difference in intensity between two selected wavelength pairs (Dobson, 1968, Applied Optics, 7, 387–405). If the recorded intensity at those wavelengths is higher than expected, the conclusion drawn is that ozone concentration must have decreased.

☞This image illustrates the unique conditions of Antarctica in spring.

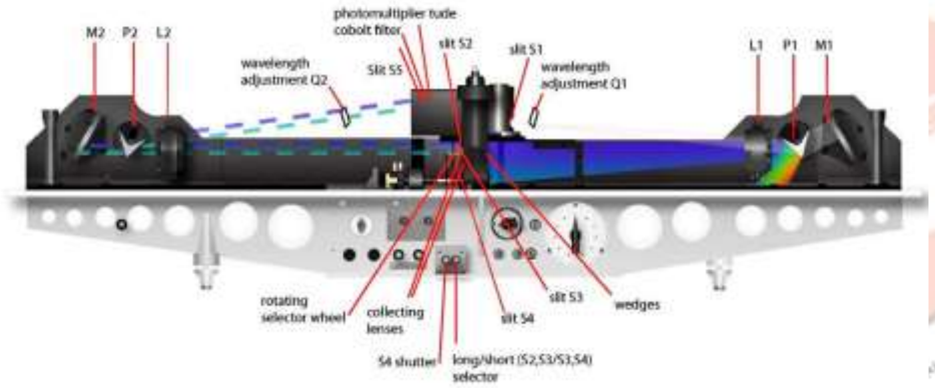
However, in reality, the prolonged absence of sunlight and extremely low temperatures in Antarctica (often below −80 °C) cause many atmospheric components such as H_2O, OH, NO_2, SO_2, and aerosols to freeze out or undergo phase changes, effectively removing them from the atmosphere. This makes Antarctica's atmosphere the cleanest on Earth, and under such conditions, an increase in solar UV radiation is a natural consequence. It was this natural enhancement of UV radiation that was mistakenly labeled as an "ozone hole," rather than an actual depletion of the ozone layer.

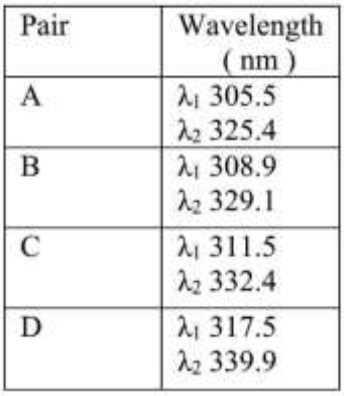
- **DOBSON SPECTROPHOTOMETER**

The Dobson Spectrophotometer, developed in the 1920s, is considered the oldest instrument used for measuring total ozone. However, in reality, this instrument is not capable of directly measuring the ozone layer. Its working principle is based on measuring the intensity ratio of two selected ultraviolet (UV) wavelengths, with the lowest measurable limit starting from about 305 nm.

In contrast, the actual and strongest absorption band of ozone lies between 230–290 nm, with a peak near 255 nm, which is outside the measurement capacity of the Dobson instrument.

This means that the Dobson Spectrophotometer does not directly detect ozone; instead, it measures variations in UV radiation intensity, which was later interpreted as ozone concentration. In practice, it essentially provides a UV index, and this UV index is influenced not only by ozone but also by other atmospheric components such as clouds, pollution, dust, smoke, aerosols, and trace gases.





Pair	Wavelength (nm)
A	λ_1 305.5 λ_2 325.4
B	λ_1 308.9 λ_2 329.1
C	λ_1 311.5 λ_2 332.4
D	λ_1 317.5 λ_2 339.9

Table. Presents the absorption coefficients that were officially adopted by the WMO (World Meteorological Organization) and the International Ozone Commission (IOC) in January 1992.

These values are known as the Bass–Paur coefficients, after the work of Bass and Paur, and are widely used in Dobson spectrophotometer ozone calculations [Komhyr et al., 1993]. In 1985, scientists of the British Antarctic Survey (BAS) recorded an increase in solar ultraviolet radiation over Antarctica using this so-called Dobson Spectrophotometer. Nobel Prize winner Sherwood Rowland is attributed with first using the term "ozone hole" after the British Antarctic Survey's May 1985 publication on ozone depletion over the Antarctic. They presented it as evidence of seasonal ozone loss, and this interpretation was further propagated by the media as the "ozone hole."

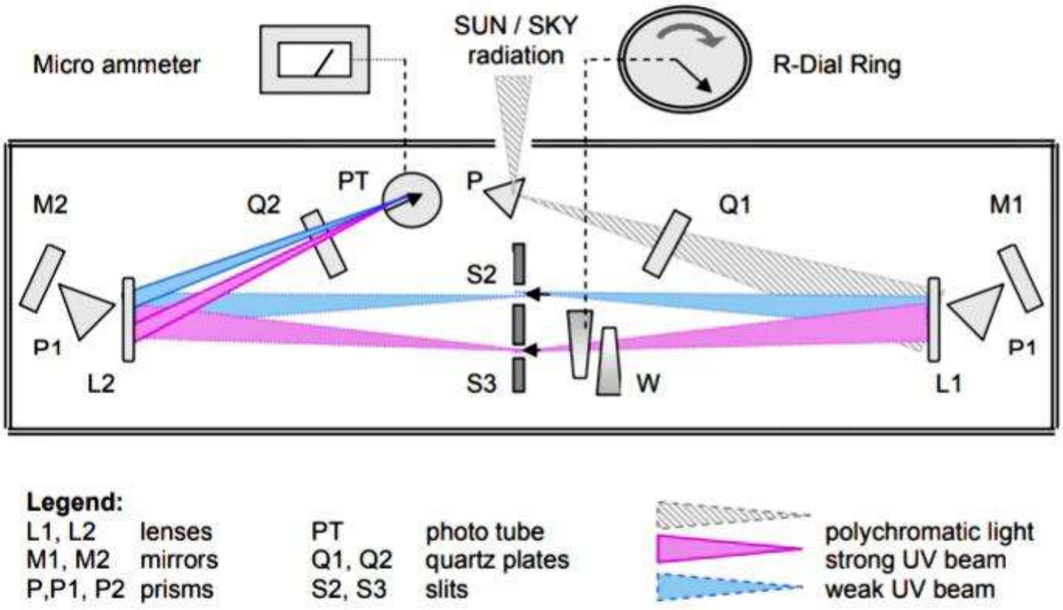


Figure 2. *Optical system of the Dobson spectrophotometer – a general design*

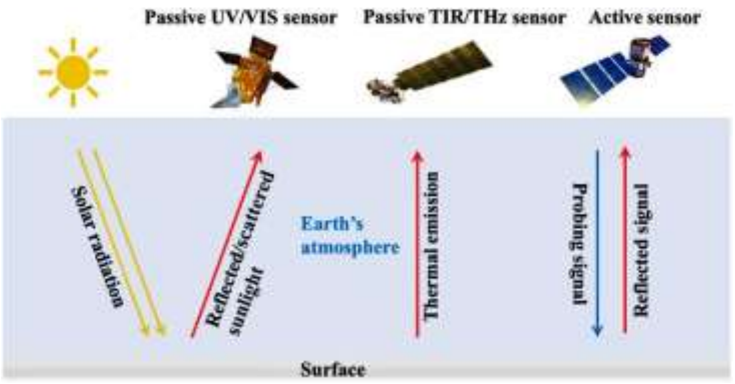
The Dobson spectrophotometer is an optical instrument that works as a double monochromator. Its purpose is to measure the relative intensity of solar ultraviolet radiation at carefully chosen wavelengths. By comparing radiation at these wavelengths, the instrument can estimate the amount of ozone and other atmospheric components above the observation site.

The optical system is designed with prisms and slits that isolate specific UV wavelengths. The double monochromator arrangement helps minimize stray light and improves accuracy. Essentially, the device alternates between pairs of wavelengths—one strongly absorbed by ozone and another weakly absorbed—to determine how much absorption has occurred. This ratio is then converted into a measure of the atmospheric ozone column. The design and function of the Dobson spectrophotometer have been described in detail in classic works by Dobson (1957a, 1957b, 1962), Komhyr (1980), Komhyr and Evans (1980), Komhyr et al. (1988), and Asbridge (2000). However, the fact remains that the Dobson Spectrophotometer only measures the ratio of UV radiation intensities and not the ozone layer itself. Therefore, the claim of an “ozone hole” based on this instrument’s data is a result of the inherent limitations of the device and misinterpretation of its measurements.

- **SO-CALLED OZONE MEASURING SATELLITE AND THEIR PRINCIPLES**

In 1985, the discovery of the so-called “ozone hole” was announced by the British Antarctic Survey (BAS), not by the National Aeronautics and Space Administration (NASA). The reason was that NASA’s satellite instruments, prior to that time, operated with detection algorithms focusing on shorter ultraviolet wavelengths below 290 nm, which are strongly absorbed by both ozone (O_3) and molecular oxygen (O_2) in the upper atmosphere. This caused an effective cutoff, making the extreme Antarctic depletion invisible to their standard retrieval scales. As a result, NASA failed to recognize the anomaly in time, which led to embarrassment when BAS reported the phenomenon first Subsequently, NASA adjusted the retrieval scale to include measurements above 290 nm, where atmospheric transmission is higher.

However, in this region the recorded radiances are not solely due to ozone absorption but are also significantly influenced by other atmospheric constituents (e.g., SO_2, NO_2, aerosols), thereby introducing systematic interference in the so-called ozone measurements. Satellite-based so-called ozone measuring instruments (e.g., TOMS, SBUV) fundamentally rely on backscattered solar ultraviolet radiation in the 290–340 nm range. During polar night in Antarctica, no sunlight is available; hence, no direct ozone measurement is possible.



©Satellite measurement of the intensity of solar radiation as affected by atmospheric components.

BUV (Backscatter Ultraviolet Spectrometer), Nimbus-4 (1970)
Principle: Measured backscattered solar UV radiation at selected wavelengths. By comparing the intensity of absorbed and unabsorbed wavelengths, total ozone content was inferred.
Irony: Although presented as an ozone instrument, its data were strongly affected by other atmospheric constituents. Hence, a so-called ozone measuring instrument.

TOMS (Total Ozone Mapping Spectrometer), Nimbus-7 (1978), Meteor-3 (1991), Earth Probe (1996)
Principle: At each scan position, Earth radiance was monitored at six wavelengths between 310 and 380 nm. By taking ratios, the instrument derived total ozone. The instrument completed a cross-scan in 8 seconds, covering a ~3000 km swath for global daily mapping.
Note: NASA itself states in the "TOMS-EP Mission Objectives" that the instrument also measured Sulphur dioxide (SO_2), volcanic plumes, and contributed to atmospheric chemistry.
Irony: By its name, TOMS appears to be solely an ozone instrument, but in reality, it also measured SO_2 and other species — making it only a so-called ozone instrument.

GOME (Global Ozone Monitoring Experiment), ERS-2 (1995)
Principle: Based on Differential Optical Absorption Spectroscopy (DOAS) in the UV-visible range. Retrieved ozone profiles as well as several trace gases by analyzing high-resolution spectra.
Note: Besides ozone, it detected NO_2, HCHO, BrO, and even OClO.
Irony: The name "Global Ozone Monitoring Experiment" suggests ozone-only, but in reality, it was a multi-gas spectrometer.

SCIAMACHY (Scanning Imaging Absorption Spectrometer), ENVISAT (2002)
Principle: Operated in UV, visible, and IR spectral regions using limb, nadir, and occultation geometries. It retrieved vertical profiles of many gases.
Note: Measured O_3 along with CH_4, CO, CO_2, N_2O, aerosols, and water vapor.
Irony: Despite its strong role in ozone science, it was not an ozone-specific sensor, but a comprehensive atmospheric chemistry instrument — a so-called ozone device.

OMI (Ozone Monitoring Instrument), Aura (2004)
Principle: Utilized hyperspectral UV–visible backscatter with a 2600 km swath, providing daily global coverage.
Note: Apart from ozone, it measured SO_2, NO_2, HCHO, aerosols, and UV irradiance.
Irony: The name "Ozone Monitoring Instrument" suggests exclusivity to ozone, but its actual application extended far beyond ozone.

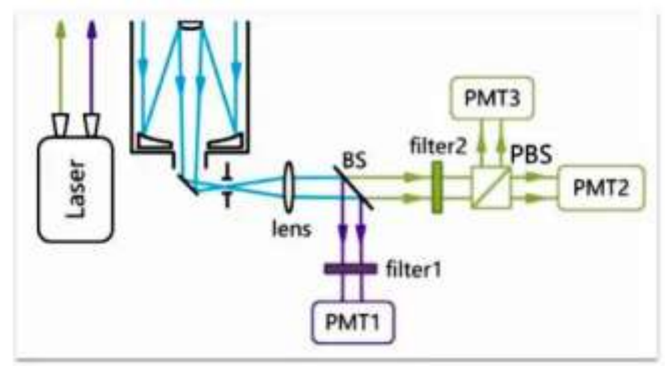
OMPS (Ozone Mapping Profiler Suite), Suomi-NPP (2011)
Principle: Based on UV backscatter profiling with nadir mapper and limb profiler. Designed for ozone layer continuity after TOMS and OMI.
Note: Sensitive to ozone but also retrieved NO_2, SO_2, and aerosol information.

Irony: The suite is branded as "Ozone Mapping", but it clearly measures more than ozone — another so-called ozone instrument.

TROPOMI (Tropospheric Monitoring Instrument), Sentinel-5P (2017)
Principle: High-resolution imaging spectrometer covering UV, visible, near-IR, and SWIR bands. Applied DOAS and absorption techniques for trace gases.
Note: Besides ozone, it measured SO_2, NO_2, CO, CH_4, HCHO, and aerosols with unprecedented accuracy.
Irony: Though often highlighted for ozone monitoring, TROPOMI is in fact a multi-gas sensor, making it only a so-called ozone instrument.

OZONE MEASUREMENT BY DIAL (SO-CALLED OZONE MEASURING INSTRUMENT)

The Differential Absorption Lidar (DIAL) technique is widely presented as a method to measure ozone distribution in the atmosphere. It works by transmitting two laser beams into the atmosphere: one wavelength is strongly absorbed by ozone (on-line), while the other is weakly absorbed (off-line). By comparing the return signals, the concentration of ozone at different heights is calculated, and a vertical ozone profile is constructed. However, in reality, this technique does not directly measure ozone molecules. It only interprets differences in absorption at two wavelengths, and assumes that the difference is solely due to ozone. This makes it a theoretical approximation rather than a direct measurement.



©*Measurement of radiation intensity affected by atmospheric components using Lidar method.*

Limitations (as per our interpretation)

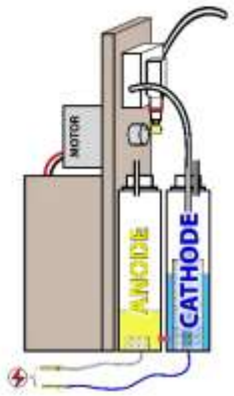
1. Clouds and Aerosols: Strongly influence the laser signal, yet are often treated as background noise.
2. Restricted Range: Effective only up to ~50–60 km, beyond which the return signal becomes too weak.
3. High Cost and Complexity: Requires powerful lasers, sensitive detectors, and advanced data processing.
4. Calibration Dependence: Must be validated with other indirect methods, which themselves have limitations.
5. Solar Interference: Daytime measurements can be strongly affected by sunlight, making accuracy questionable.
6. Assumption-based Method: It assumes that only ozone is responsible for differential absorption, ignoring contributions from other atmospheric gases and particles.

☞ Thus, while DIAL is considered an "advanced ozone measuring instrument," in our view it remains a so-called ozone measurement technique. It does not measure ozone directly but only provides an indirect estimation influenced by many atmospheric factors.

REVIEW OF OZONE SONDE

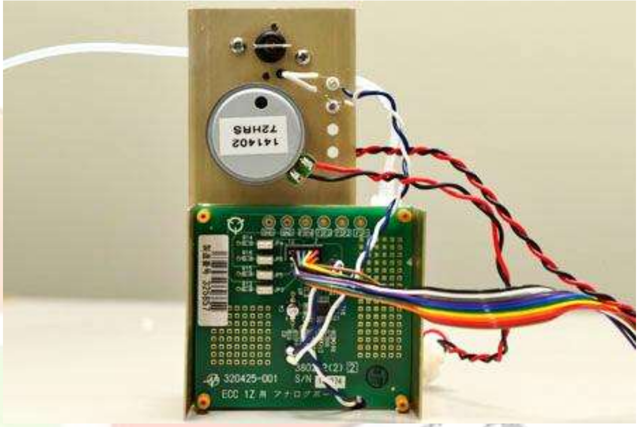
Misleading Nomenclature –

The very term “Ozone Sonde” creates a misconception, as it implies that the instrument directly measures ozone molecules or the ozone layer. In reality, the sonde does not directly quantify ozone. Its principle relies entirely on chemical reactions in a potassium iodide (KI) solution, where iodine (I_2) is released whenever oxidizing gases are present. The electrochemical cell then measures the signal of I_2, which is interpreted as “ozone concentration.”



© Ozone Sonde Credit by NOAA

$$O_3 \longrightarrow O_2 + O$$
$$2KI + H_2O + [O] \longrightarrow 2KOH + I_2$$
$$O_3 + 2KI + H_2O \longrightarrow 2KOH + O_2 + I_2$$



Key Chemical Reactions : -

Ozone reaction

$O_3 + 2KI + H_2O \rightarrow 2KOH + O_2 + I_2$

Nitrogen dioxide reaction

$NO_2 + 2KI + H_2O \rightarrow 2KOH + NO + I_2$

Sulfur dioxide reaction

$SO_2 + 4KI + 2H_2O \rightarrow 4KOH + S + 2I_2$

Reaction from atmospheric detergents

$2OH\cdot + 2KI \rightarrow 2KOH + I_2$

Theoretical Limitations : Lack of Selectivity –

The above reactions demonstrate that the sonde is not “ozone-specific.” What it actually measures is the amount of iodine (I_2), which may originate from O_3, SO_2, or NO_2.

Distorted Vertical Profile –

As the balloon ascends, pressure, temperature, and humidity change. These factors alter both the rate of chemical reactions and the electrochemical response. Thus, the so-called vertical ozone profile is actually the vertical distribution of chemical signals, not of ozone itself.

Dependence on Calibration –

Calibration is based on laboratory conditions. However, the stratosphere presents extreme conditions (low temperature, low pressure, complex polar chemistry) that differ from laboratory standards. The assumption that calibration remains valid under all circumstances is theoretically flawed.

Interpretation Bias –

The data from ozonesonde are often presented as direct ozone profiles. Theoretically, however, they are only indirect chemical signals interpreted as ozone. This creates a scientific bias and sustains a misleading belief that the Sonde measures ozone itself.

From a theoretical perspective, the Ozone Sonde does not measure ozone directly. Instead, it measures iodine produced in a potassium iodide solution, which may be generated by ozone as well as by SO_2 and NO_2. The nomenclature itself is misleading, and the method is indirect, non-specific, and uncertain. Any scientific conclusions based on its data should explicitly acknowledge these fundamental limitations.

- **THE REAL CAUSE OF INCREASED UV**

The recorded rise in solar UV radiation was indeed a factual observation. However, the conclusion that it was caused by the depletion of the ozone layer was scientifically misleading. In reality, such an increase in UV radiation was the result of the freezing—or reduced concentration—of other atmospheric components under the region's extremely low temperatures, not due to the destruction of stratospheric ozone.

Importantly, the Dobson Spectrometer, the oldest instrument of its kind developed in the 1920s, does not directly measure the ozone layer as is often claimed. Instead, it measures the intensity of UV radiation—with a minimum sensitivity around 305 nanometers. What it essentially provides is the UV index, which is influenced not only by ozone but also by other atmospheric components such as clouds, gases, pollution, dust, smoke, and aerosols. Put simply, the term "ozone hole" should be understood literally as an increase in solar UV radiation reaching the surface, rather than an actual depletion of the ozone layer itself. At certain locations on Earth, particularly where the atmosphere is exceptionally clean and temperatures are extremely low, such increases in UV radiation are natural and expected. Antarctica, being the cleanest environment on the planet, is the most prominent example of this phenomenon.

- **HIGHEST LEVEL OF UV RADIATION ON EARTH**

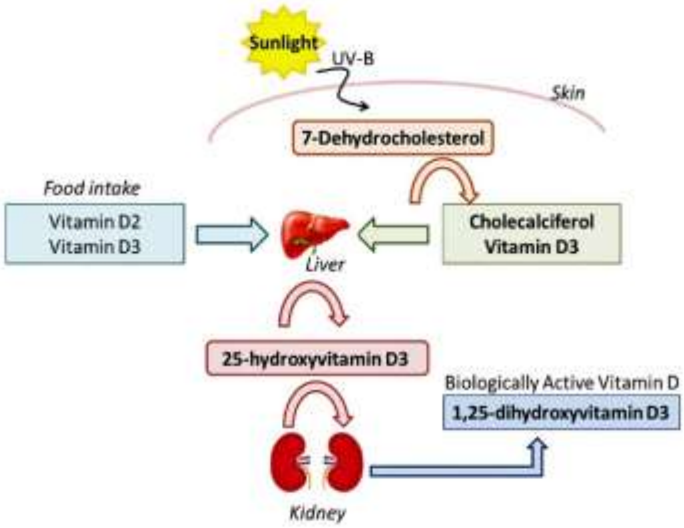
The present findings indicate that the exceptionally high values of surface UV radiation reported in different parts of the globe cannot be directly attributed to ozone layer depletion. The highest recorded UVI of 43.3 (Licancabur Volcano, Bolivia, 2003) and comparable measurements in equatorial and high-altitude regions have been explained by a combination of geographical and meteorological factors, such as proximity to the equator, reduced atmospheric column depth at higher elevations, persistent clear skies, and reflective ground surfaces (e.g., snow or sand).
In the case of Antarctica, similar observations of enhanced UV radiation must be interpreted within the framework of its unique environmental setting. Antarctica (90° S) represents the world's largest cold desert, characterized by:

1. Extremely dry snow surfaces with high reflectivity (albedo effect), which substantially amplify the incident UV radiation.
2. Extended clear-sky conditions during late winter and spring, when clouds and aerosols are minimal.
3. Low solar angles and long polar days, which allow continuous but oblique radiation that interacts differently with the atmosphere compared to mid-latitudes.
4. Local atmospheric composition variations (e.g., aerosols, trace gases) that may modulate scattering and absorption.

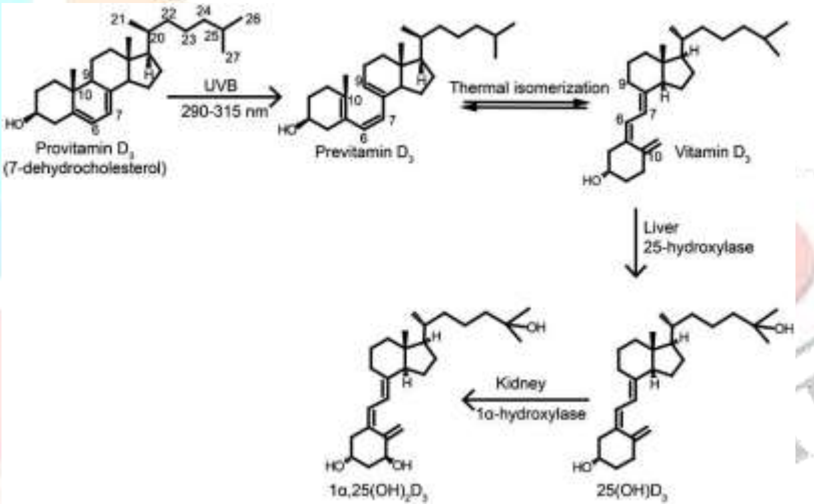
These factors collectively enhance the UV index over Antarctica. Therefore, the observed increase in UV radiation levels is more accurately explained by surface reflectivity, atmospheric dryness, and unique polar meteorology rather than by a permanent reduction or "hole" in the ozone layer.

- **VITAMIN D SYNTHESIS**

Vitamin D synthesis is initiated by ultraviolet B (UVB) radiation in the wavelength range of 290–315 nm, with peak production around 297 nm. In the epidermal layer of the skin, 7-dehydrocholesterol absorbs UVB photons and undergoes a photochemical reaction to form pre-vitamin D_3, which subsequently isomerizes through a heat-dependent process to vitamin D_3 (cholecalciferol).



This vitamin D_3 then enters the circulation bound to vitamin D–binding protein (DBP). In the liver, it is hydroxylated to 25-hydroxyvitamin D (calcidiol), and in the kidneys, it undergoes further hydroxylation to form 1,25-dihydroxyvitamin D (calcitriol), the biologically active form.



Only UVB radiation is effective for initiating this process, and its availability is influenced by environmental factors such as latitude, season, time of day, cloud cover, air pollution, and stratospheric ozone absorption. Notably, the same UVB wavelengths essential for vitamin D synthesis are also associated with an increased risk of skin cancer, highlighting the balance between adequate exposure and photo protection.

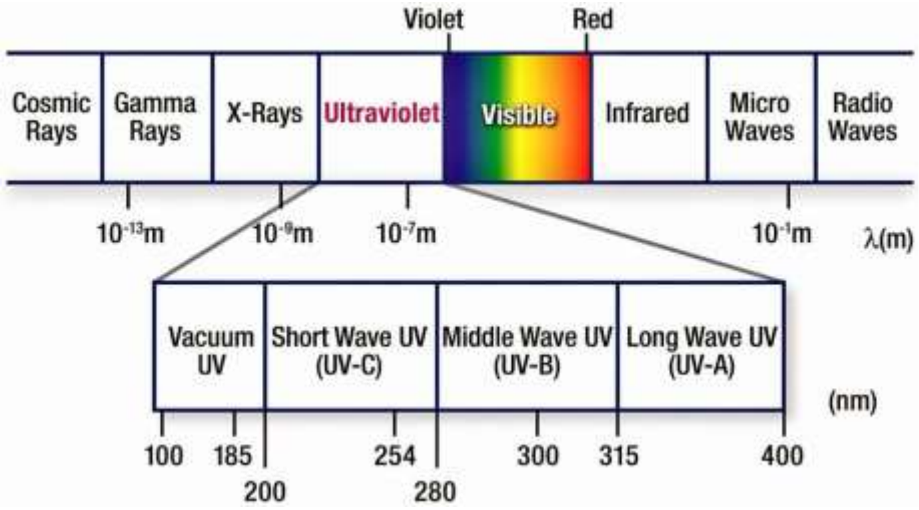
- **ULTRAVIOLET RADIATION (UV) CLASSIFICATION AND MISCONCEPTIONS**

Ultraviolet (UV) radiation is classified primarily based on health effects rather than measurement instruments or ozone absorption. UV is divided into three categories:

●● UV-C (100–280 nm): Highly harmful, but it cannot reach the Earth’s surface as long as the stratospheric oxygen and ozone layer is present.

□□UV-B (280–315 nm): Moderately harmful and the main natural source of Vitamin D. Humans require UV-B in limited, balanced amounts daily. Its intensity at the surface varies hourly, daily, and seasonally, depending on other atmospheric components for example water vapour. (Pei et al.,2019; Shukla A.P,2024;)

□□UV-A (315–400 nm): Least harmful, reaching the surface almost completely, with variations influenced by atmospheric components.



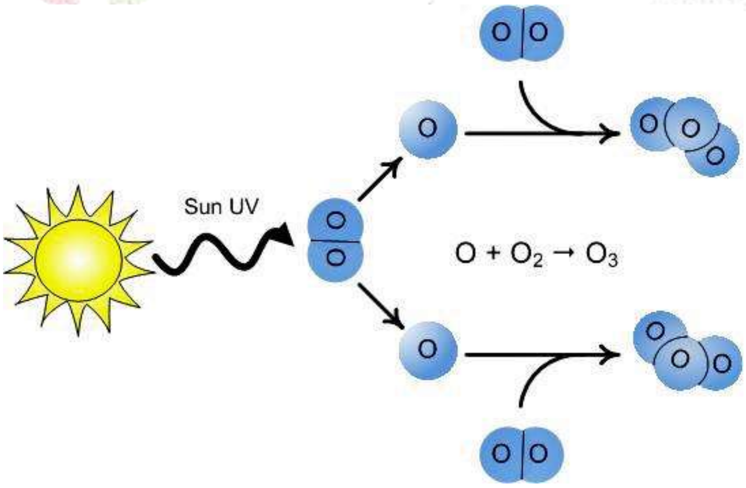
☞ UV radiation was split in this way to create UV lamps based on health to synthesize vitamin D and not due to absorption by the ozone layer.

Solar UV radiation up to 290 nm is effectively blocked by the stratospheric oxygen and ozone layers. Oxygen molecules (O_2) absorb this UV, dissociate into individual oxygen atoms (O), which then combine with O_2 to form ozone (O_3). This ozone is again converted into O_2 through photolysis and spontaneous reactions ($O + O_3 \rightarrow 2O_2$; $O_3 + O_3 \rightarrow 3O_2$), creating a continuous cycle in the presence of sunlight. Therefore, the oxygen or ozone layer is not responsible for seasonal or location-specific increases in UV radiation observed in regions like Antarctica, the Arctic, Tibet, Greenland, the Himalayas, and Alaska. These variations are determined by other atmospheric components and local environmental conditions.

- **CHEMISTRY OF THE OZONE LAYER**

There are natural processes that create and destroy ozone in the stratosphere. These processes regulate the balance of ozone and form what is known as the ozone layer.

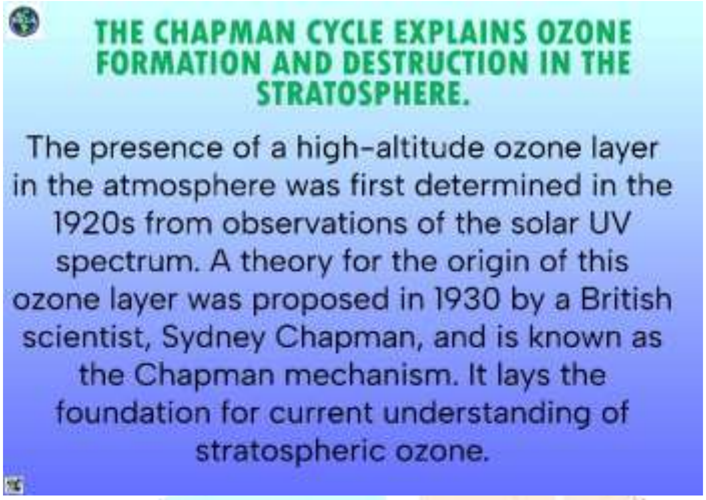
Ozone is created primarily by sunlight. When high-energy ultraviolet rays (UV-C) strike an oxygen molecule (O_2), they split the molecule into two single oxygen atoms, known as atomic oxygen. A freed oxygen atom then combines with another oxygen molecule to form a molecule of ozone (O_3).



© Natural formation of the ozone layer-Credit by ECCC.

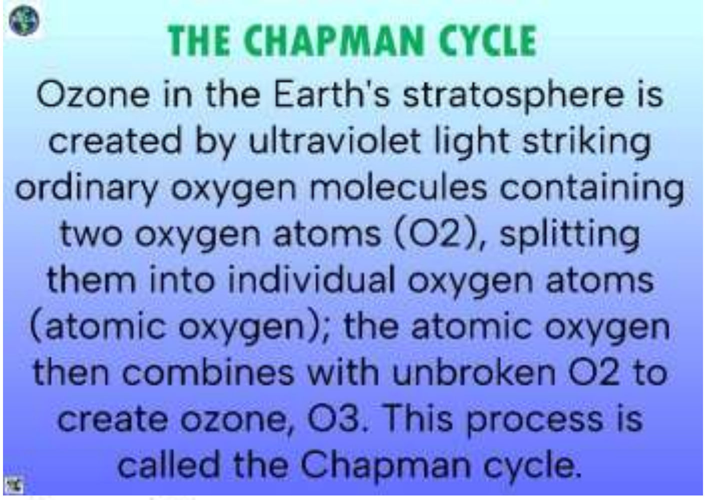
- **CHAPMAN MECHANISM (OZONE–OXYGEN CYCLE)**

In 1929, the British mathematician and geophysicist Sydney Chapman proposed a comprehensive theory describing the formation and destruction of ozone in the stratosphere. According to this mechanism, high-energy ultraviolet radiation (UV-C) from the Sun photodissociation molecular oxygen (O_2), producing two atomic oxygen (O) radicals. These highly reactive oxygen atoms subsequently combine with molecular oxygen to form ozone (O_3).



THE CHAPMAN CYCLE EXPLAINS OZONE FORMATION AND DESTRUCTION IN THE STRATOSPHERE.

The presence of a high-altitude ozone layer in the atmosphere was first determined in the 1920s from observations of the solar UV spectrum. A theory for the origin of this ozone layer was proposed in 1930 by a British scientist, Sydney Chapman, and is known as the Chapman mechanism. It lays the foundation for current understanding of stratospheric ozone.



THE CHAPMAN CYCLE

Ozone in the Earth's stratosphere is created by ultraviolet light striking ordinary oxygen molecules containing two oxygen atoms (O2), splitting them into individual oxygen atoms (atomic oxygen); the atomic oxygen then combines with unbroken O2 to create ozone, O3. This process is called the Chapman cycle.

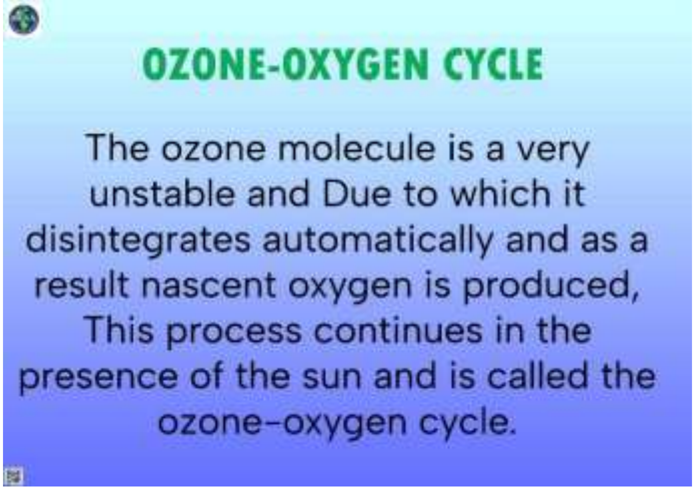
Ozone itself is photolyzed by ultraviolet radiation, decomposing back into molecular oxygen (O_2) and atomic oxygen (O). This continuous cycle of ozone formation and destruction maintains a dynamic equilibrium, often referred to as the ozone–oxygen cycle.

Functionally, this cycle acts as an “atmospheric umbrella.” When solar ultraviolet radiation is present, ozone absorbs much of this harmful radiation, thereby shielding the Earth’s surface. In the absence of solar UV radiation (e.g., during nighttime), the cycle ceases to operate actively, and the protective role is unnecessary. Overall, the Chapman mechanism demonstrates how natural photochemical processes regulate a balance of ozone in the stratosphere, effectively preventing high-energy UV-C radiation from reaching the Earth’s surface and ensuring the preservation of life.

- **STRATOSPHERIC NATURAL OXYGEN OZONE CYCLE**

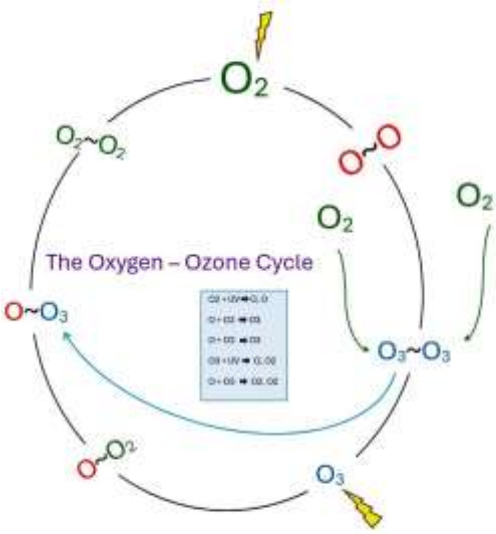
The theory of oxygen–ozone formation and destruction clearly considers the ozone–oxygen system as a protective umbrella in the presence of the Sun.

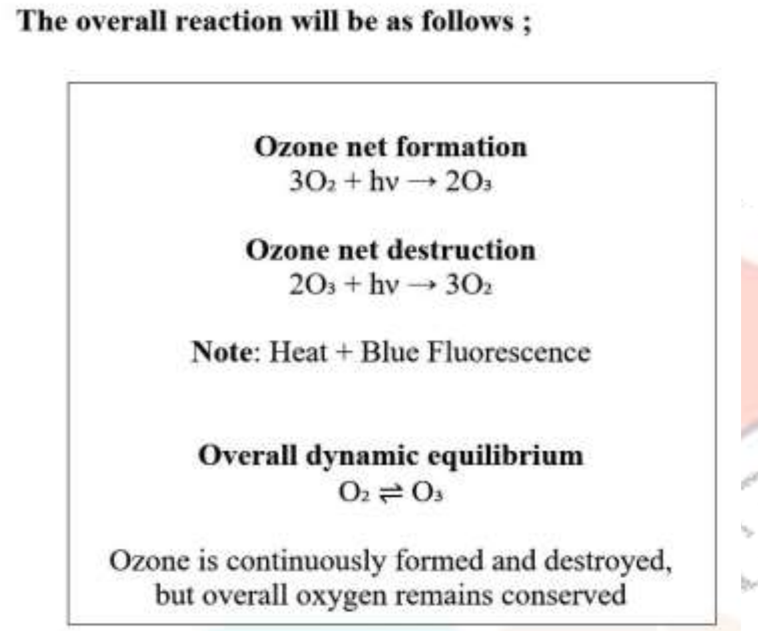
Wherever ultraviolet (UV) radiation reaches the atmosphere, the oxygen layer first encounters it and dissociates into two oxygen atoms. These atoms then combine with molecular oxygen to form ozone, creating the ozone layer. Subsequently, this ozone absorbs incoming UV radiation, breaks apart again, and converts back into molecular oxygen.



OZONE-OXYGEN CYCLE

The ozone molecule is a very unstable and Due to which it disintegrates automatically and as a result nascent oxygen is produced, This process continues in the presence of the sun and is called the ozone-oxygen cycle.





The overall reaction will be as follows ;

Ozone net formation
$3O_2 + h\nu \rightarrow 2O_3$

Ozone net destruction
$2O_3 + h\nu \rightarrow 3O_2$

Note: Heat + Blue Fluorescence

Overall dynamic equilibrium
$O_2 \rightleftharpoons O_3$

Ozone is continuously formed and destroyed, but overall oxygen remains conserved

- **Relationship Between Cold, Polar Vortex, and UV Radiation Increase**

During the long polar night in Antarctica, the Sun is absent, halting ozone formation ($O_2 \rightarrow O_3$ via UV-C) and causing extremely low stratospheric temperatures (around -78°C or 195 K). These low temperatures allow the formation of a strong polar vortex, which traps the cold air and stabilizes atmospheric circulation. At such temperatures, various atmospheric components (H_2O, HNO_3, SO_2, NO_2, CO_2, etc.) condense or freeze. Carbon dioxide, for example, directly sublimates from gas to solid at -78.5°C without becoming liquid. These phase changes can lead to the formation of Polar Stratospheric Clouds (PSCs), influenced by both the low temperature and the polar vortex.

PSCs are often visible just before sunrise or just after sunset, appearing as iridescent “mother-of-pearl” clouds. Key chemical processes,

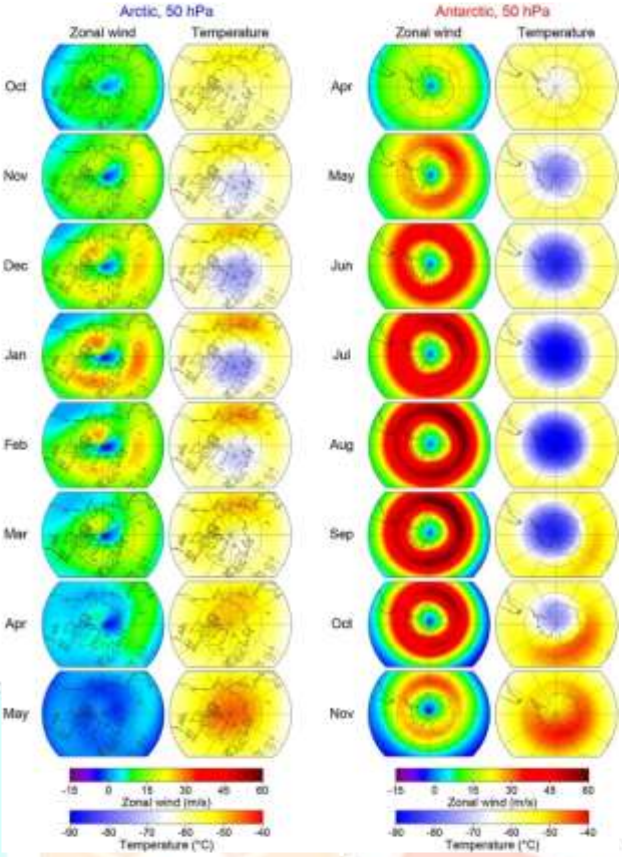
- $SO_2 + 2OH \rightarrow H_2SO_4$
- $NO_2 + OH \rightarrow HNO_3$

However, PSCs themselves do not directly increase surface UV radiation or the UV index. The actual reason for increased UV is that extreme cold causes several atmospheric components to become inactive or condensed, reducing their ability to absorb or scatter UV radiation. When the Sun returns in early Antarctic spring, more

UV-B reaches the surface. You can understand this with an example: if a Dobson Spectrometer is located in a polluted city or a cloudy region, direct solar radiation will be low, which does not indicate an increase in ozone; similarly, in Antarctica, frozen atmospheric components create optical effects that instruments can misinterpret as an "ozone hole."

Table. *Melting and boiling points of major atmospheric components and gases in normal atmosphere*

Sulfur trioxide (SO3)	44.8°C (113 °F)	16.9 °C (62.4 °F)
Sulfuric acid (H_2SO_4)	337 °C (639 °F)	10.31 °C (50.56 °F)
Water (H_2O)	100 °C (212 °F)	0 °C (32 °F)
Bromine (Br_2)	58.8 °C(137.8 °F)	-7. 2 °C (19.0 °F)
Nitrogen dioxide(NO_2)	21.2 °C (70.2 °F)	-11.2 °C (11.8 °F)
CFCs – 113	47.9 °C (117 °F)	-36 °C (-32°F)
Nitric acid (HNO_3)	83 °C (181 °F)	-42 °C (-44 °F)
Sulfur Dioxide (SO2)	-10 °C (14 °F)	-72.7°C (-98.9°F)
Ammonia (NH_3)	-33.3 °C(-28 °F)	-77.7°C (-107.9°F)
Carbon dioxide (CO_2)	Δ	-78.5°C (-109.3°F)
Hydrogen Sulfide(H_2S)	-60.2°C(-76.4 °F)	-85.5°C (-121.9°F)
Nitrous Oxide (N_2O)	-88.5 °C(-127 °F)	-90.9°C (-131.6°F)
CFCs – 114	3.8°C (38 °F)	-94°C (-137°F)
Chlorine (Cl_2)	-34.04°C (-29°F)	-101.5°C (-150.7°F)
CFCs – 11	23°C (74° F)	-111 °C (-168° F)
CFCs – 12	-29.8°C (-216°F)	-158°C (-252°F)
Ozone (O_3)	-112 °C (-170 °F)	-192.5°C (-314.5°F)



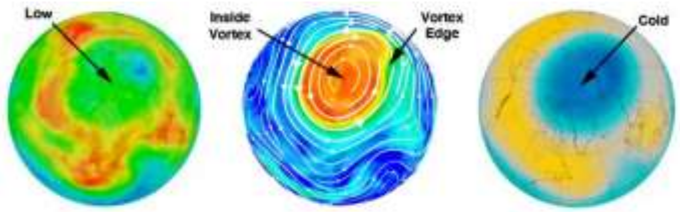
©Relationship Between Cold, Polar Vortex, and low concentration of Atmospheric Components.

The size of the Antarctic ozone hole in any given year Is strongly influenced by how cold the Southern Hemisphere winter was, and observed stratospheric cooling trends may further slow the apparent recovery of the ozone layer. The table lists the temperatures at which the main atmospheric components undergo phase changes, and you can also understand this more clearly by referring to the accompanying figure. PSCs are a consequence of extreme cold, not a main primary cause of UV increase. Surface UV increase occurs due to the temporary absence of active atmospheric components, and the so-called “ozone hole” is largely an instrument-measured artefact, not permanent ozone depletion.

- **MINI OZONE HOLE PHENOMENON**

The so-called “Mini Ozone Hole” observed in high-latitude regions is not a result of chemical destruction of ozone, but rather a manifestation of temporary variations in the concentrations of atmospheric constituents — particularly water vapor, aerosols, and trace gases. Observations from NASA and WMO satellites indicate that during such events, rapid changes in temperature and pressure, combined with strong polar vortex dynamics and stratospheric uplift, drive the redistribution of atmospheric gases. Consequently, the density of water vapor and other components in the lower stratosphere decreases temporarily, leading to a measurable reduction in total column absorption.

Figure. Satellite-observed variation in total column concentration over the polar region during a mini-hole event. The temporary reduction in atmospheric water vapor and related gases results in an apparent decline in UV absorption, often misinterpreted as ozone depletion.

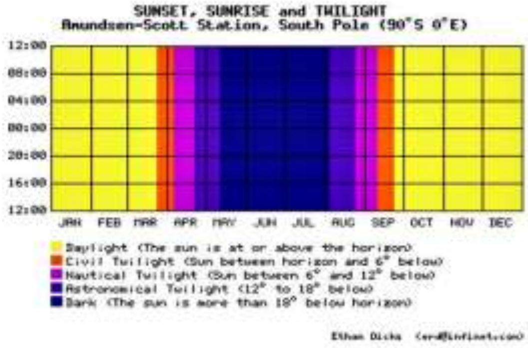


©The above false images clearly show that the concentrations of other atmospheric components gradually decrease with temperature and this position is determined by the polar vortex.

Please note that these false images are not able to explain the concentration of the ozone layer because the measurement principle after 290 nanometers only estimates the concentration of other atmospheric components. This apparent decrease is not an indication of actual ozone loss but a transient reorganization within the atmospheric structure, which returns to normal once the meteorological conditions stabilize. Therefore, the “Mini Ozone Hole” should be interpreted not as ozone depletion, but as a short-lived atmospheric response to thermodynamic and pressure imbalances causing temporary changes in gas concentrations.

- **EFFECT OF ABSENCE OF SUN FOR SEVERAL MONTHS ON THE OZONE LAYER**

At the poles of the Earth, the sun is absent for several months because the Earth’s axis is tilted by 23°5′. Ozone formation requires high-energy UV-C solar radiation, which splits oxygen molecules (O_2) into atomic oxygen, allowing the formation of ozone (O_3). During polar late winter and early spring, only UV-A and visible light are present due to the low sun angle, which is insufficient for ozone production. British scientist Sydney Chapman (1929) formulated the Chapman Mechanism, which states that natural formation and destruction of the ozone layer are possible only in the presence of sunlight. At the poles, for example, Antarctica (90° S), UV-C rays are absent for many months, making ozone formation impossible.



At the South Pole the sun goes below the horizon on the spring solstice (March 21/22) and does not reappear until the fall solstice (Sept 21/22) The same happens at the North Pole only reversed.

Seasons occur due to the tilt of Earth’s axis. As the Earth orbits the sun, different regions receive direct sunlight. In summer, Antarctica is tilted toward the sun and experiences continuous daylight, while in winter, it is tilted away, resulting in continuous darkness. Antarctica essentially has two seasons:

- Summer: six months of daylight
- Winter: six months of darkness

During polar winters, the absence of UV-C prevents oxygen molecules from splitting into atomic oxygen, halting ozone formation. Ozone can only form and undergo its reactive cycle when UV-C radiation is present. When sunlight returns, ozone production resumes.

- **BREWER–DOBSON CIRCULATION (BDC) ORIGINAL INTERPRETATION AND THE ROYAL AIR FORCE (RAF) CONNECTION**

In his monumental historical paper "Forty Years' Research on Atmospheric Ozone at Oxford" (Dobson, 1968), G. M. B. Dobson described how his work on ozone measurement became intimately connected with the study of upper-atmospheric humidity and temperature during the war years. Under the request of the Royal Air Force (RAF), Dobson and his colleagues were tasked with understanding the formation of condensation trails (contrails) behind high-altitude aircraft — a phenomenon that made reconnaissance planes easily visible to the enemy.

Dobson wrote:

"It might be thought that this work had nothing in common with the work on atmospheric ozone, but it became linked with the work on ozone in a very interesting way."

The RAF problem required accurate determination of temperature and humidity in the upper atmosphere, because these governed whether contrails would form. Dobson noted that existing hygrometers were too sluggish at low temperatures, so he and his collaborators, including A. W. Brewer and B. Cwilong, developed the frost-point method for measuring humidity at extremely low stratospheric temperatures. Through this RAF-linked research, Dobson observed that temperature, humidity, and air circulation were closely tied to ozone variability. Later, while analyzing data from the Halley Bay station during the International Geophysical Year (IGY, 1956–57), Dobson noticed unusually low ozone values during September and October.

He explained this not as a case of chemical destruction but as a meteorological effect, writing:

"The winter vortex over the South Pole was maintained late into the spring and this kept the ozone values low. When it suddenly broke up in November, both the ozone values and the stratosphere temperatures suddenly rose."

In the same work, Dobson summarized his overall understanding with clarity:

"The behaviour of atmospheric ozone should be regarded as part of the general circulation of the atmosphere rather than as a purely chemical phenomenon."

Thus, according to Dobson's own interpretation, the so-called ozone "deficiency" observed over Antarctica was not due to any chemical depletion, but rather to physical and dynamical processes — primarily the persistence of cold air masses, isolation of the polar vortex, and extremely low humidity. His wartime collaboration with the Royal Air Force directly led him to appreciate that optical and radiative variations in the stratosphere could easily alter ozone readings, without implying a real loss of ozone molecules. In summary, Dobson saw ozone as a tracer of temperature, circulation, and water vapor balance in the stratosphere, not as a chemically fragile gas. The later idea of a "chemical ozone hole" — popularized decades after his death — diverged sharply from Dobson's own meteorological and physical explanation rooted in his RAF-era discoveries.

FABRICATED CHLORINE CHEMISTRY: STRATOSPHERIC ANOMALIES

Nearly a decade before the so-called discovery of the ozone hole in 1985, the scientific community had already begun publishing speculative studies suggesting that ozone depletion could occur through various "auxiliary" or alternative chemical pathways, implicitly treating the ozone layer as a rigid, passive entity requiring external agents for its destruction—at times blaming supersonic aircraft, at times nuclear tests, and ultimately chlorofluoromethanes in 1974. In their seminal paper, Molina and Rowland (1974) clearly stated that chlorofluoromethanes are chemically inert in the troposphere, possess atmospheric lifetimes of several decades to over a century, and do not undergo photodissociation at wavelengths around 290 nm; they merely hypothesized that if such molecules were to reach the upper stratosphere (~30–40 km) via slow vertical diffusion, they might be dissociated by highly energetic far-UV radiation below ~200–220 nm, releasing chlorine atoms capable of participating in catalytic ozone loss cycles.

However, when the required sources, transport mechanisms, and realistic energetic conditions for this hypothesis could not be empirically demonstrated, the concept was later reinterpreted and forcibly linked to the 1985 Antarctic "ozone hole," with polar stratospheric clouds (PSCs) introduced as reactive surfaces—despite the fact that neither PSCs nor any polar ozone hole were mentioned in the original Molina–Rowland work. From a physical standpoint, the effective ascent of air-dense compounds such as CFCs into the stratosphere remains highly questionable, and at extremely low temperatures most ozone-depleting substances would undergo phase changes, further limiting their reactivity. The fundamental fact remains that ozone formation and destruction are naturally balanced processes governed by solar ultraviolet radiation itself, and do not require any auxiliary, catalytic, or artificially constructed chlorine chemistry to explain their equilibrium.

❖ CONCLUSION

This research paper clearly establishes that the so-called "ozone hole" has no direct physical or chemical connection with the actual stratospheric ozone layer. The identification of the ozone hole in 1985 was primarily based on observations made using the Dobson Spectrophotometer; however, this instrument fundamentally measures the intensity of incoming solar radiation rather than directly measuring the ozone layer itself. Solar radiation reaching the Earth's surface must pass through the entire atmosphere, during which it interacts with numerous atmospheric constituents; therefore, variations in recorded radiation cannot be attributed solely to changes in ozone concentration. In his Nobel Lecture, Mario J. Molina (1995) himself acknowledged that the stratosphere is extremely dry but that the concentration of water vapor is at the parts-per-million level, comparable in magnitude to that of ozone. Unique polar conditions, including the absence of sunlight for months at a time, lead to the formation of strong polar vortices and atmospheric isolation, particularly over Antarctica. When temperatures fall below about 195 K (−78 °C), Stratospheric Water Vapor (SWV) together with other atmospheric constituents condense onto pre-existing sulfuric acid aerosols, resulting in the formation of polar stratospheric clouds (PSCs). As a consequence, several absorbing and scattering constituents are temporarily sequestered, and during specific periods the polar stratosphere becomes exceptionally clean, allowing enhanced transmission of solar radiation, especially ultraviolet radiation.

This temporary enhancement in UV radiation was interpreted—through indirect, instrument-based, and legacy measurement principles—as large-scale ozone depletion, whereas in reality it results primarily from the freezing, phase transformation, and removal of other atmospheric components rather than from any actual destruction of stratospheric ozone. From a photochemical perspective, ozone absorption occurs mainly in the 230–290 nm wavelength range, with its strongest absorption band near 255 nm, as established by Chapman (1929); radiation at wavelengths longer than 290 nm is influenced predominantly by other atmospheric constituents rather than by ozone itself. Hence, the increased UV radiation recorded in 1985 was physically consistent and natural, but declaring it an "ozone hole" was scientifically inappropriate, and attributing this phenomenon to chlorofluorocarbons (CFCs) was equally unsupported by fundamental evidence. Moreover, ultraviolet-C radiation with wavelengths shorter than 290 nm is almost completely absorbed by the oxygen–ozone system and does not reach the Earth's surface.

Overall, it is concluded that the Earth's true stratospheric ozone layer is fully intact, stable, and governed by a naturally balanced mega-cycle of formation and destruction under solar ultraviolet radiation; Hence there is no ozone hole on our Earth. Therefore, the concept of an ozone hole appears more as an instrument-driven and interpretational misconception than as a physical atmospheric reality, and from a scientific standpoint it is more appropriate to express gratitude toward the oxygen layer, from which ozone is produced only as a secondary photochemical product.

Finally, we express our gratitude to the life-sustaining oxygen layer and the ozone layer, which act like a protective umbrella shielding Earth from harmful ultraviolet radiation below 290 nm, and like a photographic umbrella regulating light to make Earth visible, thereby enabling life on our planet.

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We clearly understand that science is always dynamic and never claims absolute completeness. Therefore, we must remain grateful to our great scientists of the past, who contributed their best using the most advanced knowledge and resources available in their time. It is neither appropriate nor scientifically justified to hold any individual personally responsible for the limitations or errors that may arise during the natural progression of scientific understanding. Let us move forward together; it is our collective moral responsibility to establish strong, solid, and evidence-based science, and to advance our great resolution—"Make Earth Great Again."

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Copernicus Atmosphere – Large 2023 Ozone Hole Closes: https://atmosphere.copernicus.eu/large-and-persistent-2023-ozone-hole-closes

Educational Resources

National Geographic – Ozone Layer Resource: https://education.nationalgeographic.org/resource/ozone-layer/
UCAR – Learning Zone: Ozone Layer: https://scied.ucar.edu/learning-zone/atmosphere/ozone-layer
Harvard – Introductory Atmospheric Chemistry (Book Chapter 10, PDF): https://projects.iq.harvard.edu/files/acmg/files/intro_atmo_chem_bookchap10.pdf
Antarctic Glaciers – Seasons of Antarctica: https://www.antarcticglaciers.org/antarctica-2/introductory-antarctic-resources/seasons-of-antarctica/
CCPO, Old Dominion University – Chapter on Ozone: http://www.ccpo.odu.edu/SEES/ozone/class/Chap_11/11_5.htm
JMA – Ozone Dobson Observation: https://www.jma-net.go.jp/kousou/obs_third_div/ozone/ozone_dob-e.html

Government & Public Awareness

UN – Observance of Ozone Day: https://www.un.org/en/observances/ozone-day
EEA – Current State of the Ozone Layer: https://www.eea.europa.eu/en/topics/in-depth/climate-change-mitigation-reducing-emissions/current-state-of-the-ozonelayer
Australian Government (DCCEEW) – Ozone Layer Factsheet: https://www.dcceew.gov.au/environment/protection/ozone/publications/ozone-layer-factsheet
EPA – Ozone Pollution and Your Health: https://www.epa.gov/ozone-pollution-and-your-patients-health/what-ozone
Ozone Cell India – Vienna Convention & Montreal Protocol: https://ozonecell.nic.in/home-page/vienna-convention-montreal-protocol/
UNEP – 20 Questions and Answers: https://ozone.unep.org/20-questions-and-answers
BBC Future – What happened to the world's ozone hole: https://www.bbc.com/future/article/20220321-what-happened-to-the-worlds-ozone-hole
NASA Space Place – Antarctica: https://spaceplace.nasa.gov/antarctica/en/
Understanding UV-C, Ozone production and New Far UV technology | UV Gear https://share.google/2aUg12SEjrvtpS1Up

Additional Glossary of Terms and Symbols :

AMS — The American Meteorological Society
BAS — British Antarctic Survey (United Kingdom).
CCMI — Chemistry–Climate Model Initiative.
CSIRO — Commonwealth Scientific and Industrial Research Organisation (Australia).
DOE — Department of Energy (United States).
EEA — European Environment Agency.
EPA — Environmental Protection Agency (United States).
ESA — European Space Agency.
GAW — Global Atmosphere Watch (WMO-coordinated programme).
GFDL — Geophysical Fluid Dynamics Laboratory (NOAA, USA).
IPCC — Intergovernmental Panel on Climate Change.
IMD — India Meteorological Department (MoES - INDIA)
JAXA — Japan Aerospace Exploration Agency.
JMA — Japan Meteorological Agency.
KMI — Royal Meteorological Institute of Belgium
METEOSAT — Meteorological Satellite Programme (EUMETSAT).
NARL — National Atmospheric Research Laboratory- ISRO (INDIA)
NCEP — National Centers for Environmental Prediction (USA).
NIES — National Institute for Environmental Studies (Japan).
NIWA — National Institute of Water and Atmospheric Research (New Zealand).
NPL — National Physical Laboratory (United Kingdom).

NSIDC — National Snow and Ice Data Center (USA).
NSF — National Science Foundation (USA).
PNNL — Pacific Northwest National Laboratory (USA).
UNFCCC — United Nations Framework Convention on Climate Change.
USGS — United States Geological Survey.
WCRP — World Climate Research Programme.
WHO — World Health Organization.
AFEAS — Alternative Fluorocarbons Environmental Acceptability Study.
Bank — The quantity, particularly of halons, remaining in equipment and not yet emitted into the atmosphere.
BEF — Bromine Efficiency Factor.
Bromine loading — The total concentration in the troposphere of compounds capable of transporting bromine into the stratosphere.
CFC — Chlorofluorocarbon; a compound consisting of carbon, chlorine, and fluorine only, historically used as refrigerants, foam-blowing agents, and aerosol propellants (e.g., CFC-11).
Chlorine loading — The total concentration in the troposphere of compounds capable of transporting chlorine into the stratosphere.
Chromophore — A molecule, or part of a molecule, that absorbs UV energy, possibly initiating structural or biological responses.
CNRS — Centre National de la Recherche Scientifique (France).
COSMAS — Core-Strategic Measurements for Atmospheric Science.
Cytokine — A class of natural chemicals that regulate immune function, released by a wide range of cells.
DETR — Department of the Environment, Transport and the Regions (UK).
DNA — Deoxyribonucleic acid.
DU — Dobson Units.
EASOE — European Arctic Stratospheric Ozone Experiment.
EESC — Equivalent Effective Stratospheric Chlorine.
EIA — Environmental Investigation Agency, a non-governmental organization.
EP — Earth Probe.
Erythemal UV — The incident UV spectrum weighted with the erythemal action spectrum and integrated across the full UV range (both UVB and UVA), indicating the effectiveness of radiation in producing erythema (sunburn).
EU — European Union.
FAO — Food and Agriculture Organization of the United Nations.
Firn — Unconsolidated snow.
GCM — General Circulation Model.
GHG — Greenhouse Gas.
GISS — Goddard Institute for Space Studies.
HALOE — Halogen Occultation Experiment.
Halon — A compound consisting of carbon, bromine, fluorine, and sometimes chlorine; identified as an ozone-depleting substance.
HBFC — Hydrobromofluorocarbon; a compound of carbon, bromine, fluorine, and hydrogen.
HCFC — Hydrochlorofluorocarbon; a compound of carbon, chlorine, fluorine, and hydrogen, used as a replacement for CFCs (e.g., HCFC-22).
HFC — Hydrofluorocarbon; a compound of carbon, fluorine, and hydrogen, used as a CFC and HCFC replacement (e.g., HFC-134a).
hPa — Hectopascal; a unit of pressure equivalent to a millibar (mbar).
IFMA — Instruments for Field Measurement in the Atmosphere.
K — Temperature in kelvin.
Kg — Kilogram.
Km — Kilometre.
LSAC — Laboratory Studies for Atmospheric Chemistry.
Mbar — Millibar; same as hectopascal.
mPa — Millipascal; unit of pressure.
MLF — Multilateral Fund; a fund under the Montreal Protocol supported by contributions from developed countries to assist developing nations in phasing out ozone-depleting substances.

Montreal Protocol — International treaty regulating the identification and control of ozone-depleting substances and their production and consumption.
NASA — National Aeronautics and Space Administration (USA).
NERC — Natural Environment Research Council (UK).
NH — Northern Hemisphere.
NRPB — National Radiological Protection Board (UK).
ODP — Ozone Depletion Potential; a relative measure of a compound's expected impact on ozone per unit mass emission compared with CFC-11.
ODP tonnes — Product of ODP and mass, providing an approximate measure of environmental impact.
ODS — Ozone-Depleting Substance; a compound identified under the Montreal Protocol as capable of depleting stratospheric ozone.
ONS — Office of National Statistics (UK).
PEM-West A & B — Pacific Exploratory Mission – West (Experiments A and B).
Ppbv — Parts per billion by volume.
Pptv — Parts per trillion by volume.
QBO — Quasi-Biennial Oscillation.
SAGE — Stratospheric Aerosol and Gas Experiment.
SBUV — Solar Backscatter Ultraviolet Radiometer.
SESAME — Second European Stratospheric Arctic and Mid-Latitude Experiment.
SH — Southern Hemisphere.
SOAZ — Système d'Analyses par Observations Zénithales.
SORG — Stratospheric Ozone Review Group.
SPARC — Stratospheric Processes and their Role in Climate.
SSU/MSU — Stratospheric Sounding Unit / Mesospheric Sounding Unit.
Stratosphere — Atmospheric layer between approximately 12 km and 50 km altitude.
STTA — Stratospheric Temperature Trends Assessment.
SZA — Solar Zenith Angle.
TEAP — Technology and Economic Assessment Panel (under the Montreal Protocol).
TOC — Technical Options Committee of TEAP.
TOMS — Total Ozone Mapping Spectrometer.
Troposphere — Atmospheric layer between the Earth's surface and about 12 km altitude.
UGAMP — Universities' Global Atmospheric Modelling Programme.
UKMO — United Kingdom Meteorological Office.
UMIRG — Ultraviolet Measurements and Impacts Review Group (UK).
UNEP — United Nations Environment Programme.
UTLS Ozone — Upper Troposphere–Lower Stratosphere Ozone Programme.
SWV — Stratospheric Water Vapor
SAI — Stratospheric Aerosol Injection
UV — Ultraviolet radiation.
UV-A — Ultraviolet radiation with wavelengths between 315 and 400 nm.
UV-B — Ultraviolet radiation with wavelengths between 280 and 315 nm.
UV-C — Ultraviolet radiation with wavelengths between 100 and 280 nm.
Nm — Nanometre; one billionth of a metre (10^{-9} m).
DU — Dobson Unit; a measure of total column ozone, where $1 \text{ DU} = 2.687 \times 10^{16}$ molecules cm^{-2}.
CO — Carbon Monoxide.
CO_2 — Carbon Dioxide.
H — Atomic Hydrogen.
H_2O — Water or Water Vapour.
HNO_3 — Nitric Acid.
H_2SO_4 — Sulphuric Acid.
N_2 — Molecular Nitrogen.
N_2O — Nitrous Oxide.
NO_x — Nitrogen Oxides (NO, NO_2, NO_3).
O — Atomic Oxygen.
O_2 — Molecular Oxygen.

O_3 — Ozone.

CH_4 — Methane.

OH — Hydroxyl Radical – The hydroxyl radical (•OH) is a highly reactive molecule (one oxygen, one hydrogen, with an unpaired electron) that acts as the atmosphere's main "detergent," cleansing pollutants and greenhouse gases like methane, while also causing damage in biological systems through oxidative stress.

Atmospheric Components — Major and trace constituents of the atmosphere, including aerosols, gases, water vapour, SO_2, NO_2, OH, NH_3, CO_2, CH_4, N_2O, SO_3, H_2O, HOCl, and others.

Freezing — The change of state from gas or liquid to solid; also refers to atmospheric condensation processes under special thermodynamic conditions.

Ozone Hole — The apparent seasonal reduction in total column ozone over Antarctica, first reported in 1985.

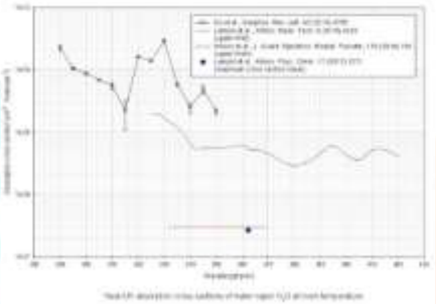
CFCs — Chlorofluorocarbons; compounds containing carbon, chlorine, and fluorine, historically used as refrigerants and aerosol propellants.

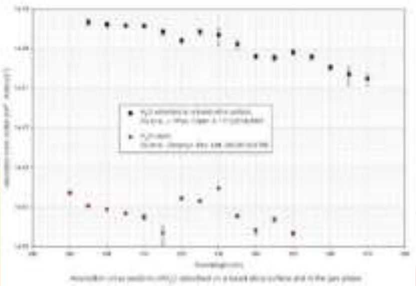
PSCs — Polar Stratospheric Clouds; clouds forming in the lower stratosphere at very low temperatures, composed of water, nitric acid, and sulphuric acid.

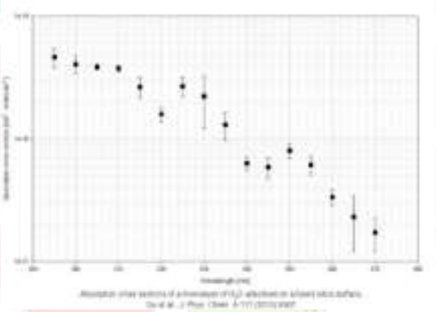
Δ (Delta) — Denotes a change or difference, particularly in temperature or pressure.

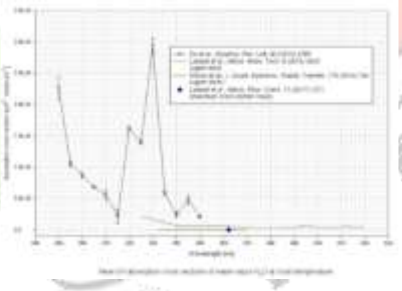
🔗 (Link symbol) — Indicates a connection to an external or online source of reference.

Other references :









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