



## Antarctic Ozone Hole

**For Prelims:** Antarctic [Ozone Hole](#), [Montreal Protocol](#), Ozone Depletion, Ultraviolet (UV) radiation, Chlorofluorocarbons (CFCs).

**For Mains:** Antarctic Ozone Hole, Environmental pollution and degradation.

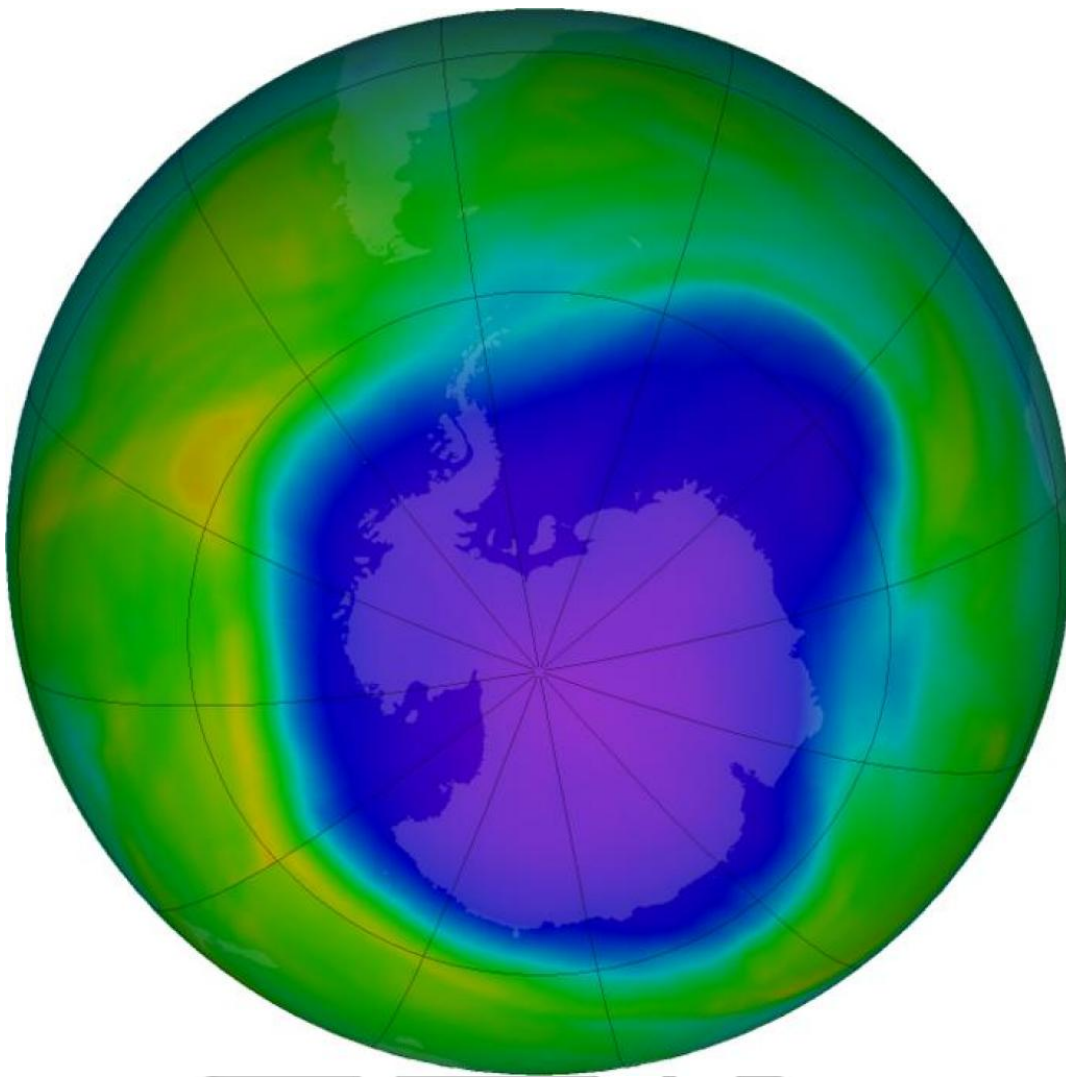
**Source:** [DTE](#)

### Why in News?

- According to a recent study, published in Nature Communications, stated that the **Antarctic Ozone Hole** has been massive in the last four years.

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## What are the Key Highlights of the Study?

- **Ozone Depletion:**
  - The Antarctic ozone hole has been **consistently large and has shown thinning over recent years**, contrary to the expected recovery trend observed since the 2000s.
  - The concentration of ozone at the **center of the hole has notably reduced**, indicating significant thinning of the ozone layer.
    - The concentration of ozone at the core of the ozone hole has **decreased by 26% from 2004 to 2022**, despite the efforts outlined in the [Montreal Protocol](#), which aimed to reduce human-generated chemicals that deplete the ozone layer.
- **Polar Vortex Influence:**
  - The Antarctic ozone hole exists within the polar vortex, a circular wind pattern in the stratosphere that forms during winter and is maintained until late spring.
  - Within this vortex, the Antarctic air from the mesosphere (the atmospheric layer above the stratosphere) falls into the stratosphere. This **intrusion of air brings natural chemicals (nitrogen dioxide, for example)** which impact ozone chemistry in October.
- **Factors Affecting Ozone Depletion:**
  - The role of meteorological conditions, such as temperature, wind patterns, aerosols from wildfires and volcanic eruptions, and changes in the solar cycle, influenced the size and behavior of the Antarctic ozone hole.
- **Recommendations:**
  - There's a need for **further research to understand the descent of air from the mesosphere** and its specific impacts on ozone chemistry.
  - Investigating these **mechanisms will likely shed light on the future behavior** of the Antarctic ozone hole.

## What is an Ozone Hole?

### ▪ About:

- An Ozone Hole refers to a **severe depletion of the ozone layer**—a region in the Earth's stratosphere containing a **higher concentration of ozone molecules**.
- Ozone molecules (O<sub>3</sub>) in this layer play a crucial role in **shielding the Earth from harmful Ultraviolet (UV) radiation from the sun**.
- The ozone layer depletion leads to the **formation of an area with significantly reduced ozone concentrations**, often observed over Antarctica.
- This phenomenon occurs primarily during the **Southern Hemisphere's spring months (August to October)**, though it can also be influenced by global factors.

### ▪ Reasons for Ozone Hole:

- The depletion is caused by human-generated chemicals known as **ozone-depleting substances (ODS)**, including **Chlorofluorocarbons (CFCs)**, halons, carbon tetrachloride, and methyl chloroform.
- These substances, once released into the atmosphere, rise to the stratosphere, where they break down due to the sun's ultraviolet radiation, releasing chlorine and bromine atoms that destroy ozone molecules.
  - The Antarctic ozone hole is the most famous and severe example of this phenomenon. It's characterized by a **drastic reduction in ozone levels, allowing increased amounts of harmful UV** radiation to reach the Earth's surface.

### ▪ Impact:

- The increased UV radiation poses health risks to humans, including higher rates of skin cancers, cataracts, and compromised immune systems.
- UV radiation can harm various organisms and ecosystems. Ozone depletion can indirectly influence climate change. Changes in the stratosphere due to ozone depletion can **impact atmospheric circulation patterns**, potentially affecting weather and climate in certain regions.

## What are the Global Initiatives to Curb Ozone Depletion?

- The **1985 Vienna Convention for the Protection of the Ozone Layer** was an international agreement in which United Nations members recognized the fundamental importance of preventing damage to the stratospheric ozone layer.
- The **1987 Montreal Protocol on Substances that Deplete the Ozone Layer** and its succeeding amendments were subsequently negotiated to control the consumption and production of anthropogenic (ODSs) and some hydrofluorocarbons (HFCs).
  - The Protocol **was signed by 197 parties in 1987 to control the use of ozone-depleting substances**, mainly chlorofluorocarbons (CFCs). Montreal Protocol deals with the development of replacement of substances, firstly hydrochlorofluorocarbons (HCFCs) and then HFCs, in a number of industrial sectors.
  - While HFCs have only a minor effect on stratospheric ozone, some HFCs are powerful greenhouse gases (GHGs).
- The adoption of the **2016 Kigali Amendment** to the Montreal Protocol will phase down the production and consumption of some HFCs and avoid much of the projected global increase and associated climate change.

## UPSC Civil Services Examination, Previous Year Questions (PYQs)

Q. Which one of the following is associated with the issue of control and phasing out of the use of ozone depleting substances? (2015)

- (a)** Bretton Woods Conference
- (b)** Montreal Protocol
- (c)** Kyoto Protocol
- (d)** Nagoya Protocol

**Ans: (b)**

**Exp:**

- The Bretton Woods Conference, officially known as the United Nations Monetary and Financial Conference was a gathering of delegates from 44 nations that met in 1944 in Bretton Woods (USA) to agree upon a series of new rules for the post-World War-II international monetary system.
- The two major accomplishments of the conference were the creation of the International Monetary Fund (IMF) and the International Bank for Reconstruction and Development (IBRD).
- The Montreal Protocol is an international environmental agreement to protect the earth's ozone layer by eliminating the use of ozone depleting substances. Adopted on 15th September 1987, the protocol is to date the only UN treaty that ever has been ratified by every country on Earth - all 197 UN member states.
- The Kyoto Protocol is an international agreement linked to the UNFCCC, which commits its Parties by setting internationally binding GHGs (Greenhouse Gases) emission reduction targets.
  - The Kyoto Protocol was adopted in Kyoto, Japan on 11<sup>th</sup> December 1997 and entered into force on 16<sup>th</sup> February 2005.
  - The detailed rules for the implementation of the protocol were adopted as CoP7 in Marrakesh, Morocco in 2001 and referred as the Marrakesh Accord.
  - India has ratified the second commitment period (2008-2012) of the Kyoto protocol, that commits countries to contain emissions of greenhouse gases, reaffirming its stand on climate action.
  - The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization provides a transparent legal framework for the effective implementation of one of the three objectives of the Convention on Biological Diversity: the fair and equitable sharing of benefits arising out of the utilization of genetic resources, to promote sustainable use of biological diversity. India signed the protocol in 2011.
- Therefore, option (b) is the correct answer.