

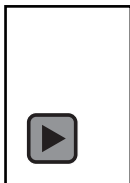
# Ozone: GBU

For People, Places and Environment – CTRP 0807

05/03/2022 Revision and Enhancement.

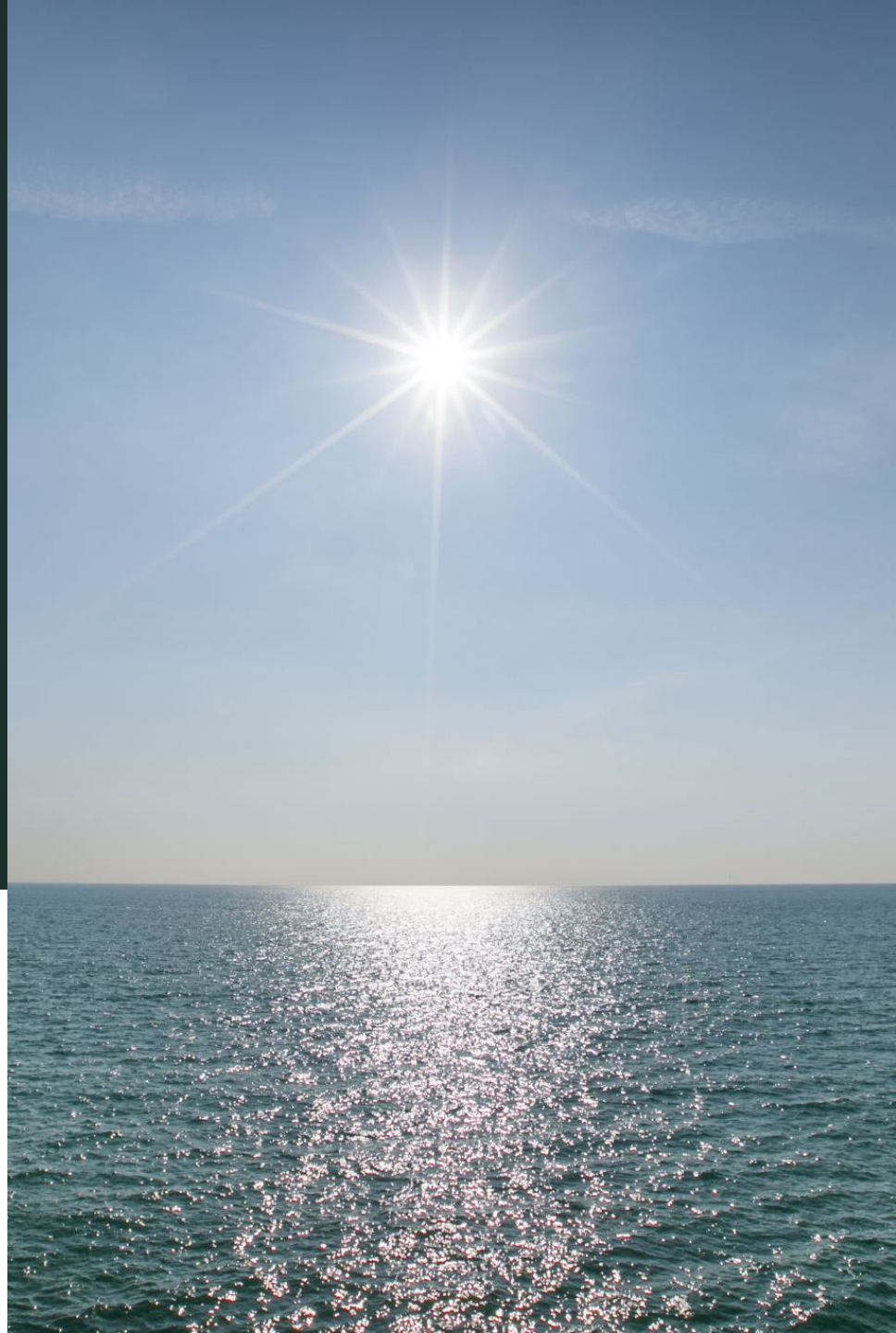
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# Ozone: The Good, The Bad, and The Ugly.



# What I need to know about Ozone.

The Basics: "Good" Ozone  
vs "Bad" Ozone

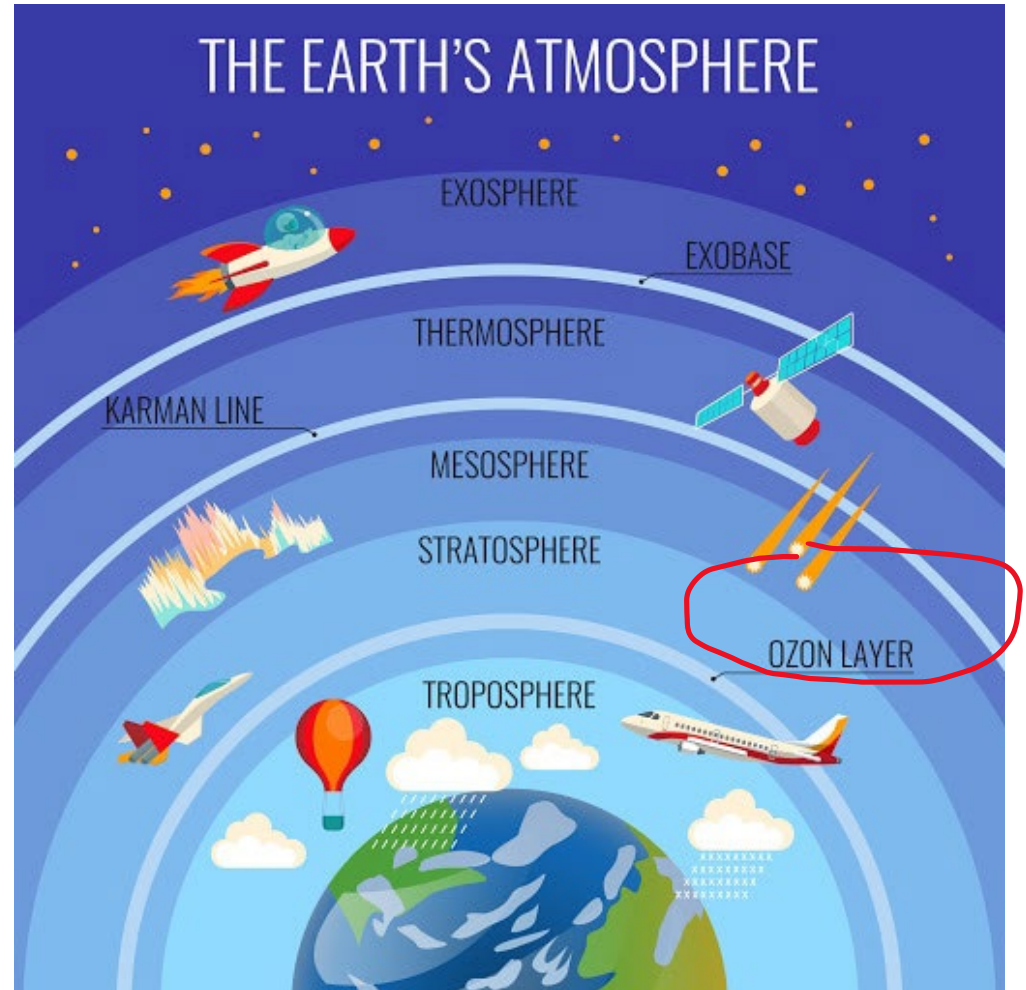


# Layers of the Atmosphere

Ozone is  $O_3$ ; Oxygen is usually found as a diatomic gas,  $O_2$ .

## The Good:

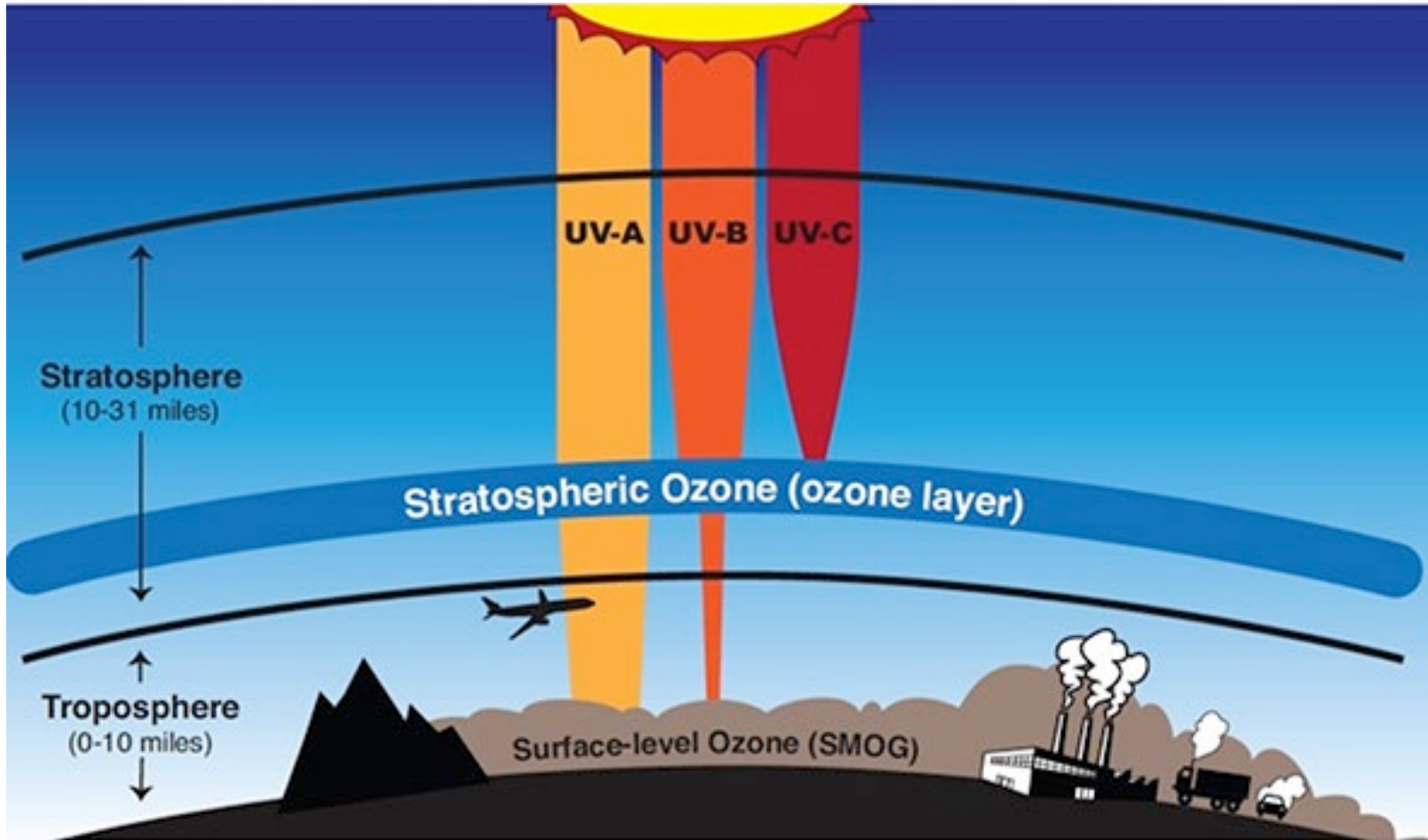
The Ozone Layer



If all the ozone in the stratosphere were compressed to the pressure of the air at sea level, it would be only 3 millimeters ( $1/8$  inch) thick.

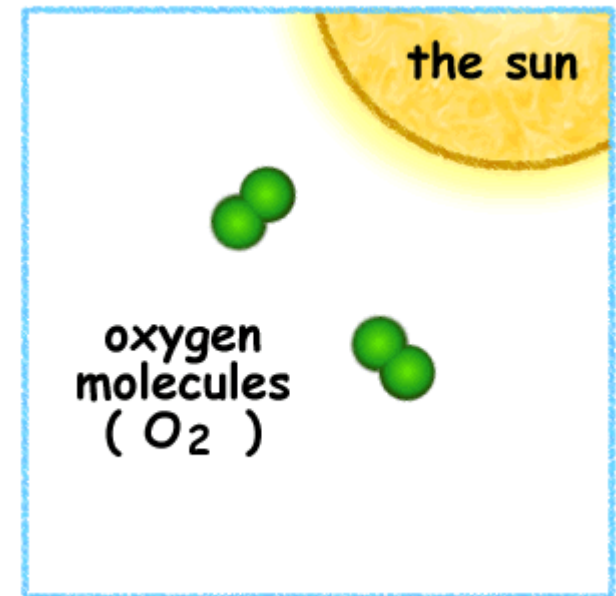
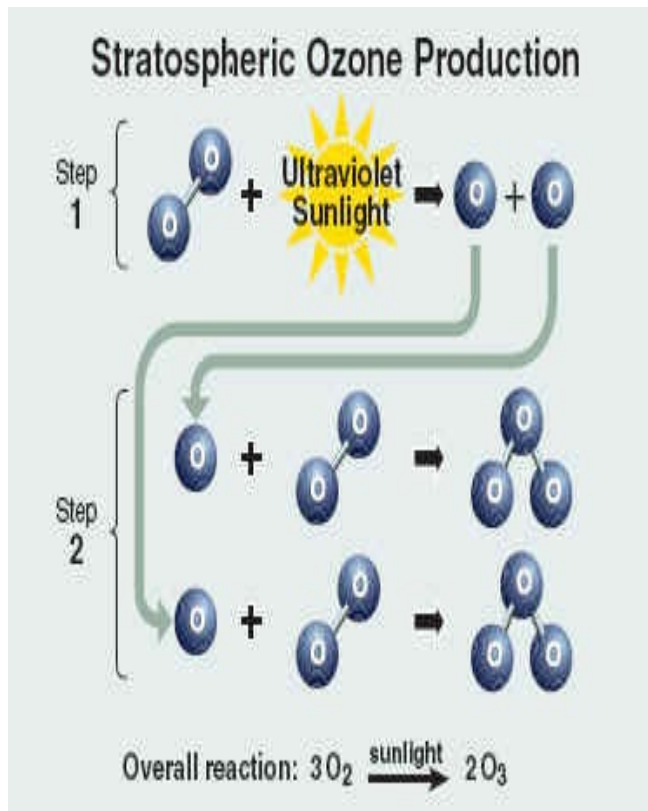
# What Does the Ozone Layer Do?

## It protects life from Dangerous Ultraviolet Radiation



# The Upper Atmosphere Ozone Cycle

## How Ozone Naturally Gets Born and Dies, and Then Reborn Again.



**So, What is the Problem With the Ozone Layer?**

**Scientist Discovered That The Ozone  
Layer Was Being Depleted.**

**Three Major Villains Identified  
(1973-1976).**

**What were they?**



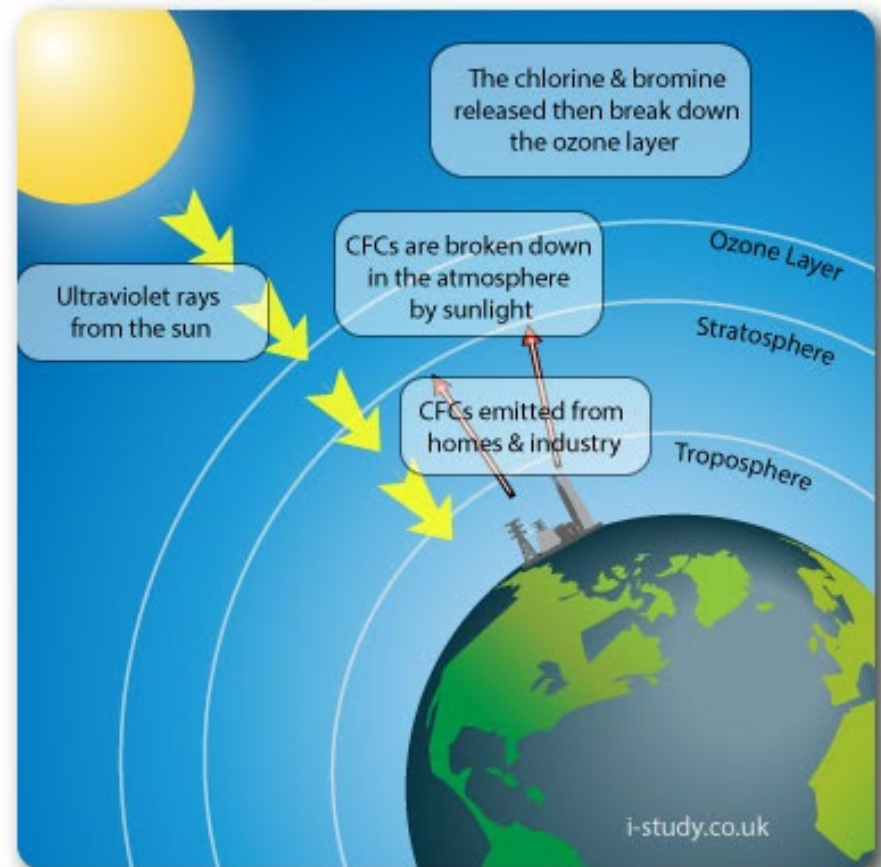
**Aerosol Sprays - Chlorofluorocarbons (CFCs) and  
Refrigerants - hydrochlorofluorocarbons (HCFCs)  
Fire-Retardants - bromofluorocarbons (BFCs)**





# How do CFCs, BFCs, & HCFCs Deplete Ozone?

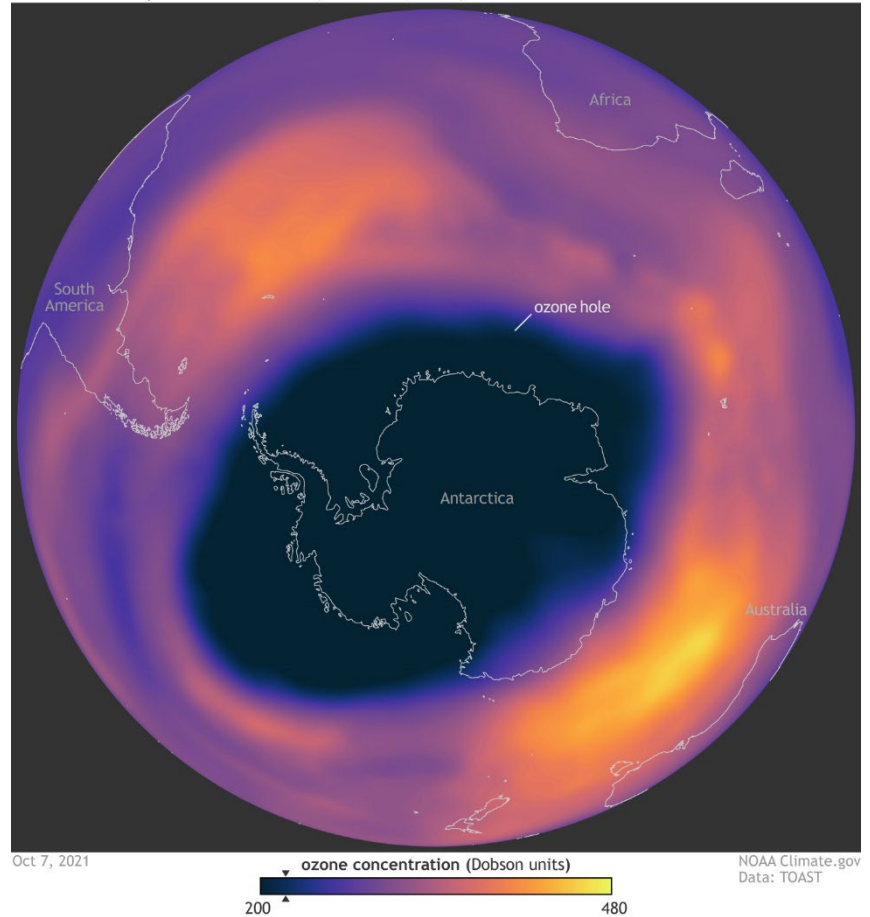
Free radical catalysts, including nitric oxide (NO), nitrous oxide (N<sub>2</sub>O), hydroxyl (OH), atomic chlorine (Cl), and atomic bromine (Br) interact with UV radiation and ozone (O<sub>3</sub>) combining with or breaking down O<sub>3</sub>.



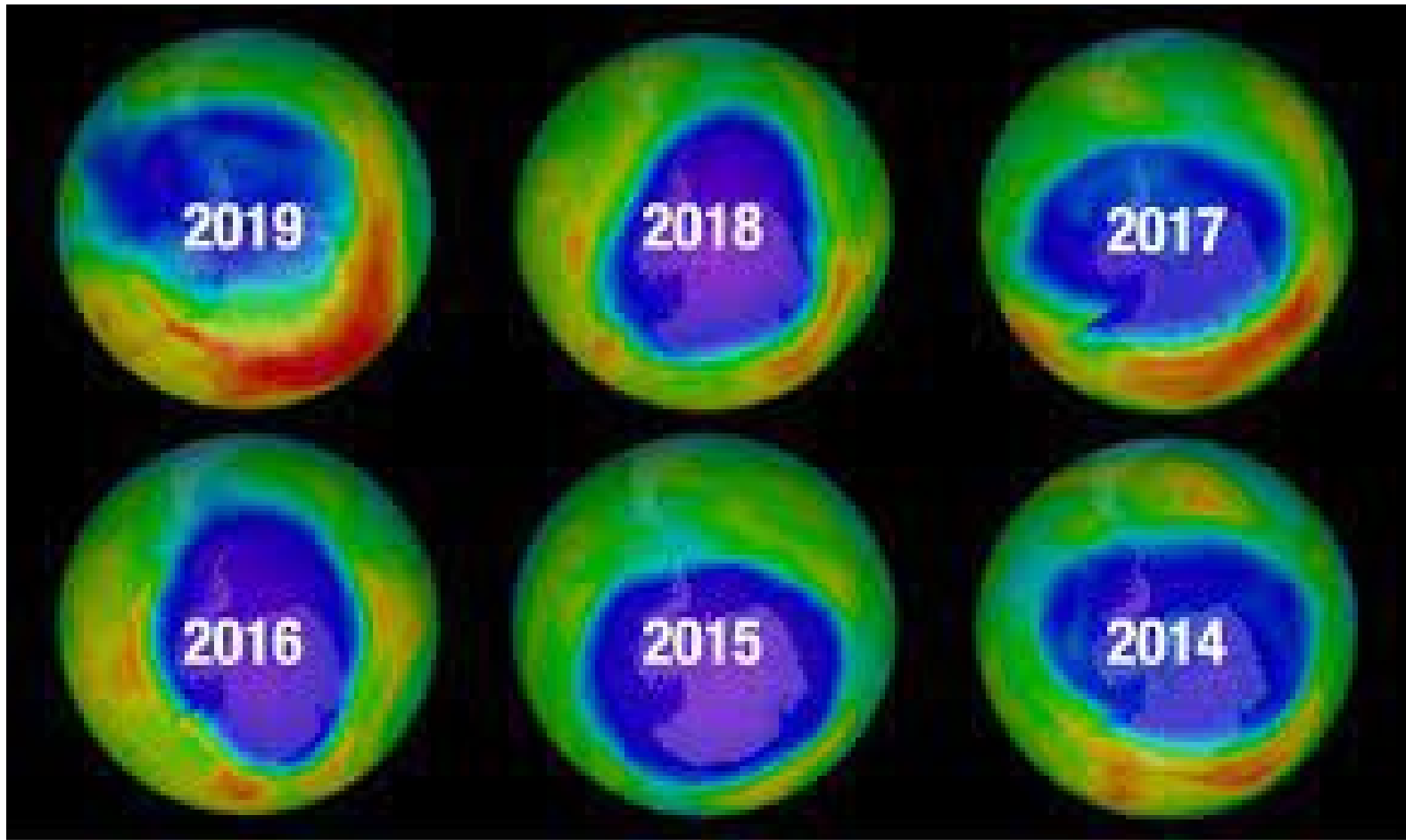
# What is the Ozone Hole?

The ozone hole is a thinning of the protective ozone layer in the stratosphere above Antarctica that begins every September. Human produced chlorine and bromine compounds are released and destroy the ozone layer as the sun rises in the Antarctic at the end of winter.

Southern Hemisphere ozone levels (October 7, 2021)



Starting in 1978, the both the use and production of CFCs and HCFCs has gradually been phased out – now banned in 197 countries (Montreal Protocol), allowing gradual healing of the ozone hole.

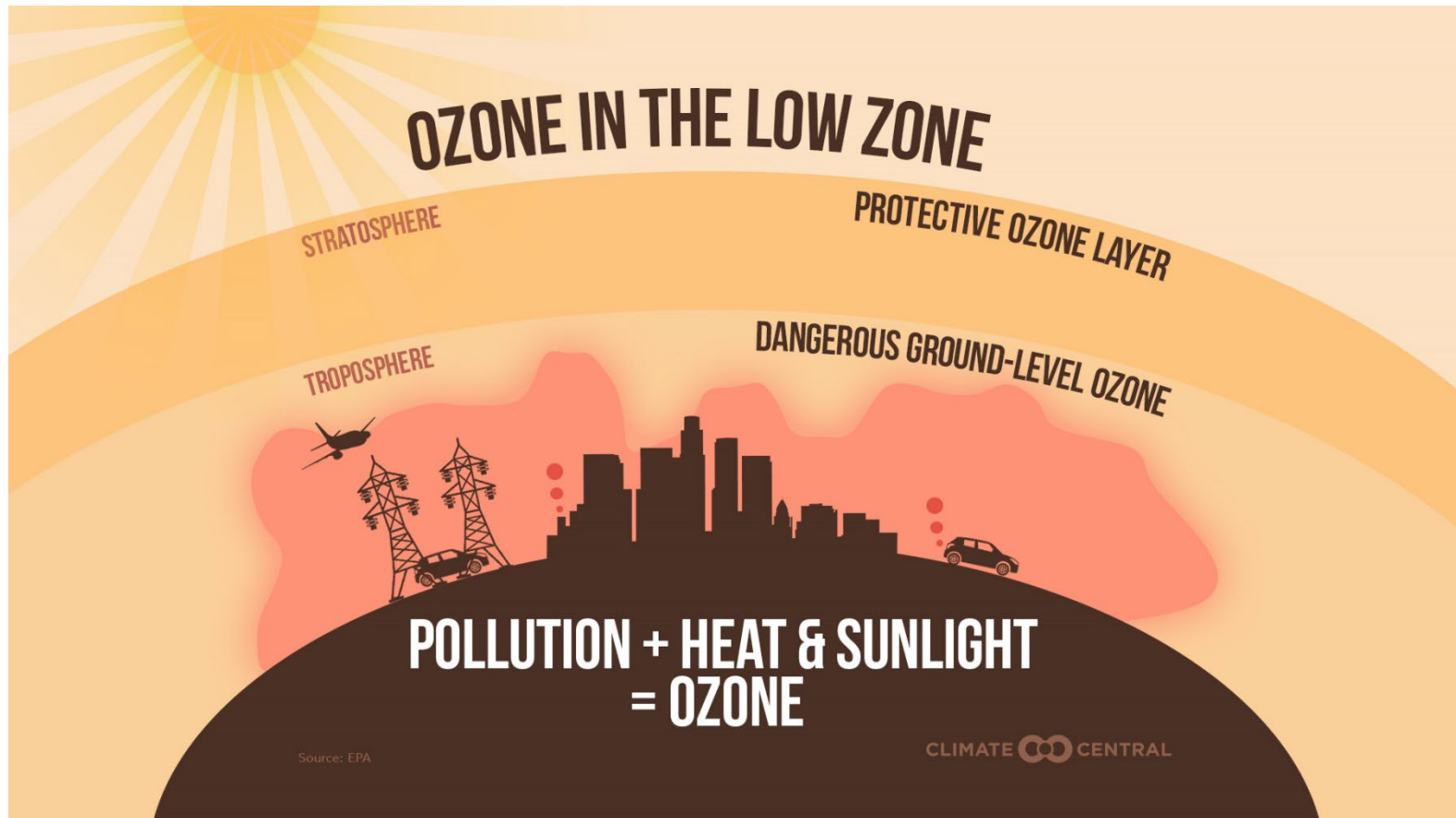


# The Montreal Protocol – A Success Story

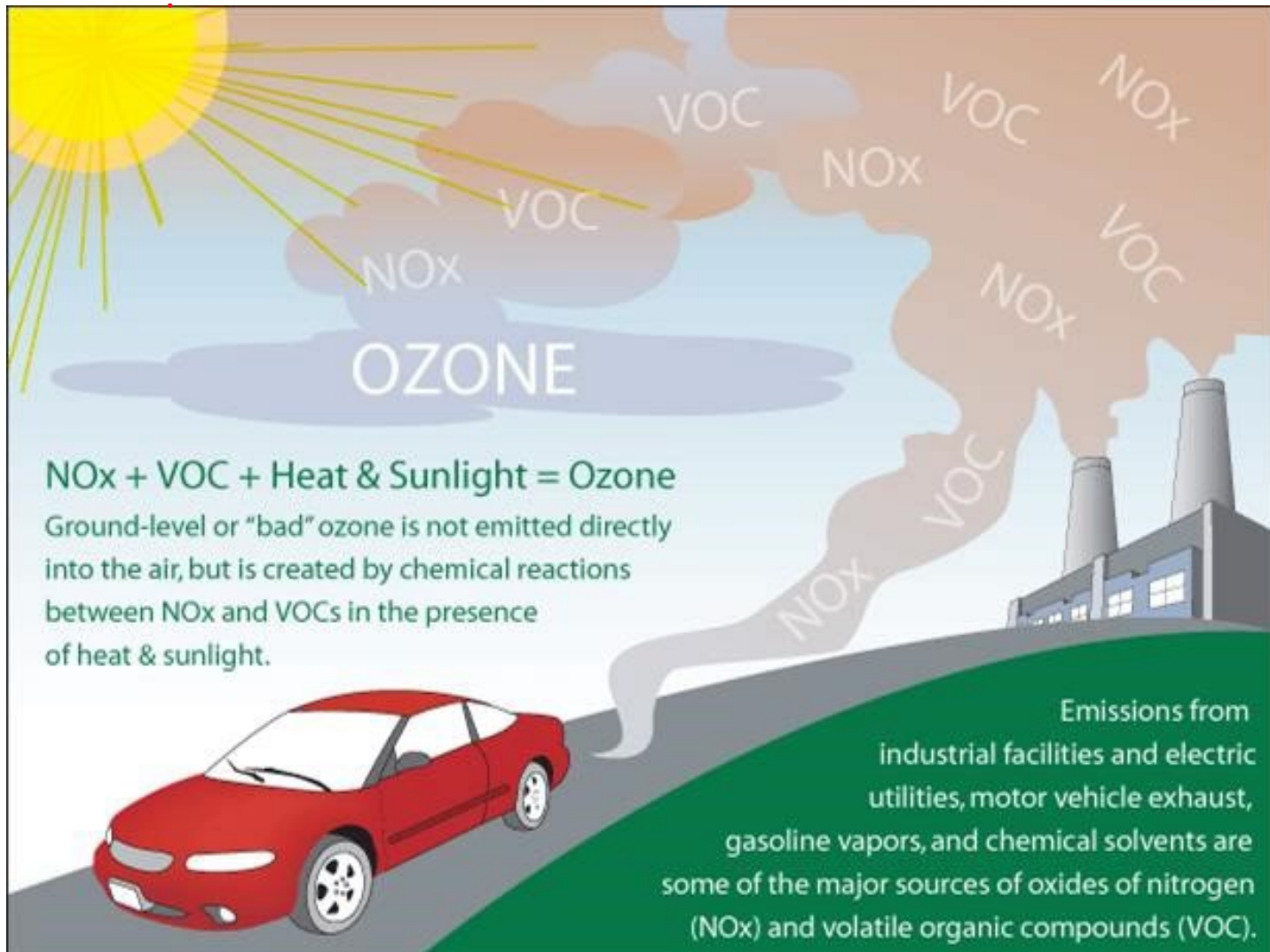
**A Success Compared to the  
Kyoto Protocol or the Paris  
Agreement.**

**There is Hope. We Can  
Cooperate. We Can Change Our  
Behavior!**

# Now for the “Bad” Ozone “Ground-Level Ozone”



# What is “Ground-Level Ozone” and What Causes It?





# Why is “Ground-Level Ozone “Bad”?

**WHAT ARE THE EFFECTS OF  
GROUND-LEVEL  
OZONE**

**BREATHING OZONE CAN TRIGGER  
A VARIETY OF HEALTH PROBLEMS**

Even at relatively low levels, ground-level ozone can be harmful to human health and the environment. It is especially a problem in urban and suburban communities; however winds can carry ozone precursor-emissions many miles from their original sources, affecting rural areas as well.

Children are at the greatest risk, because of their developing lungs and frequent outdoor activity. Anyone with a compromised respiratory system is especially vulnerable to ozone. Even healthy adults can be affected when working or playing outdoors.

**Coughing**  
**Difficulty breathing deeply and vigorously**

**Sore or scratchy throat**  
**Inflamed and damaged airways**

**Shortness of breathes and pain when taking a deep breath**

**Aggravation for lung diseases like asthma, emphysema, and chronic bronchitis**

**Increased frequency of asthma attacks**

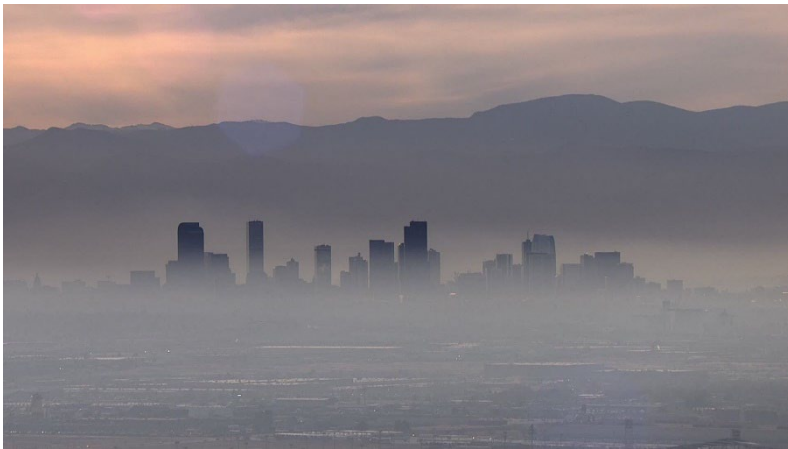
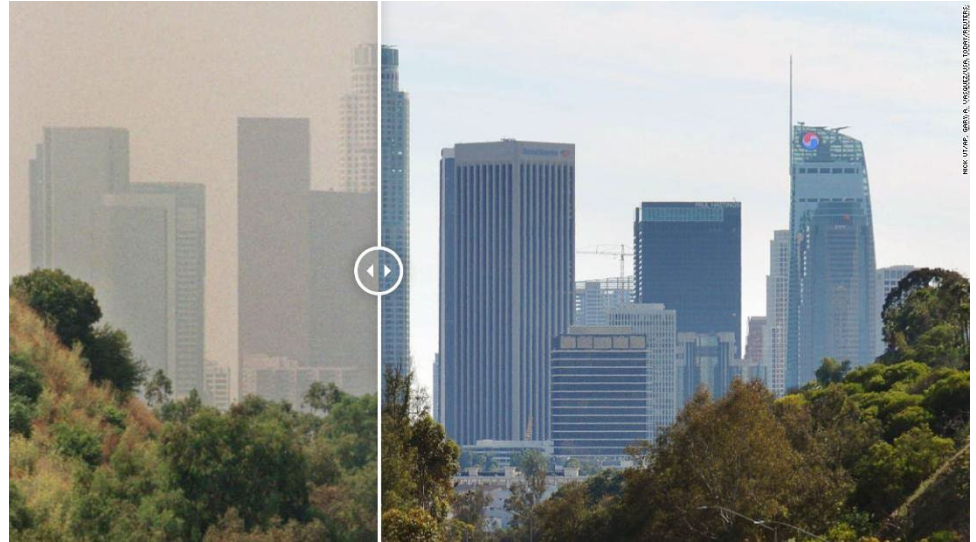
**Greater susceptibility to lung infection**

**Continued damage to the lungs even after symptoms have disappeared**

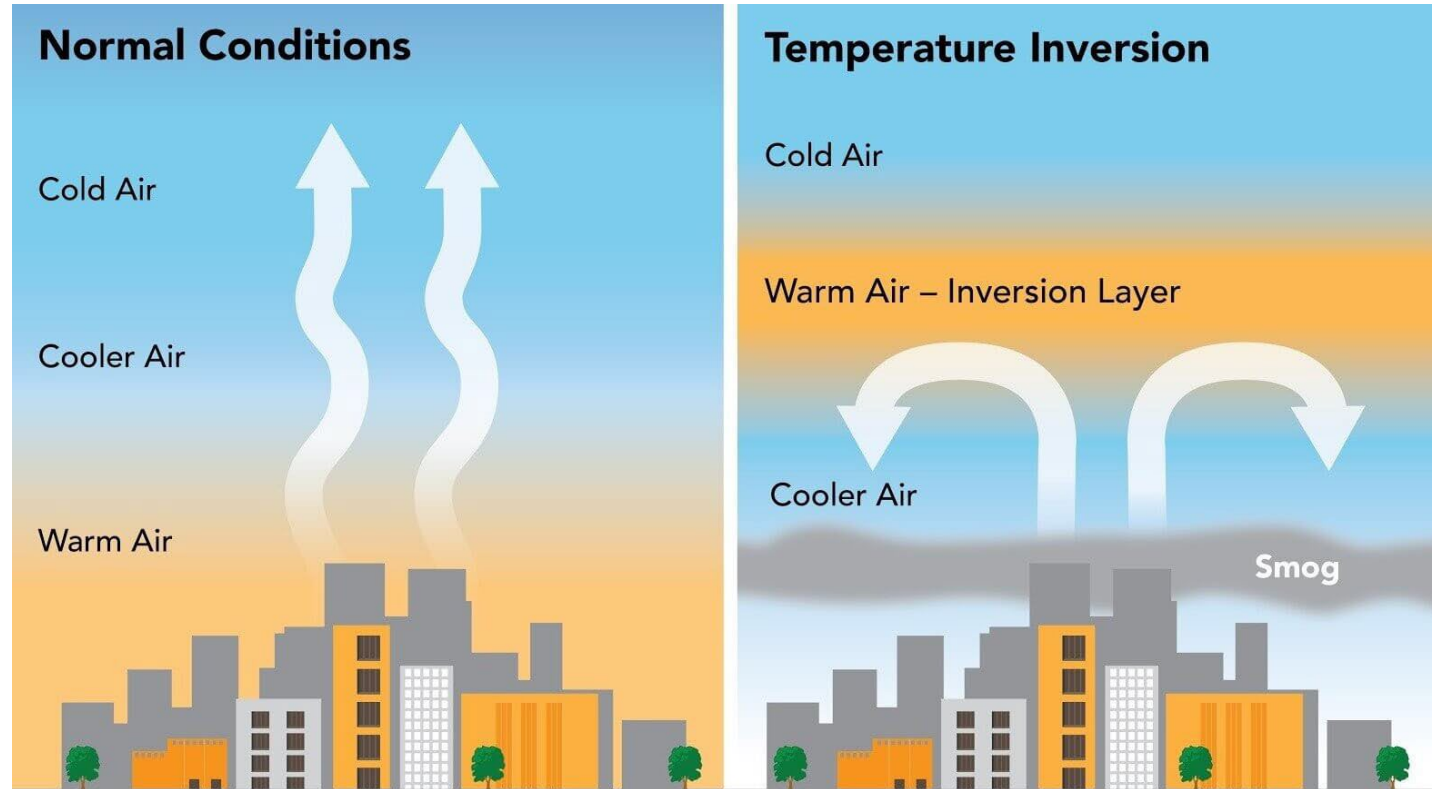


# The “Ugly” – Smog

Although Ozone is not a Cause of Smog, High levels of Ground-Level Ozone Can be Combined with Smog



# Atmospheric Inversion Traps Both Polluted Air and Ground-Level Ozone Acerbating Unhealthy Conditions



# The “Ugly” Smog in Philadelphia



# In Summary

**The Good:** Upper atmosphere ozone is good - protects life from harmful ultraviolet radiation.

**The Bad:** Ground-Level ozone is an acute condition which is harmful to our health.

**The Ugly:** Conventional air pollution and atmospheric inversion (smog), combined with ground-level ozone can make an even more irritating and unhealthy mix.

**Note:** Global Warming: The depletion the ozone layer or creation of ground-level ozone has little impact on Global Warming / Climate Change.

# *The Good, The Bad and The Ugly* Theme

## *The Good, The Bad and The Ugly* Theme Music

Music Performed by The Danish National Symphony Orchestra (Live / Posted Jan 26, 2018) 6:02 Minutes

<https://www.youtube.com/watch?v=enuOArEfqGo>

Composed by Ennio Morricone (Circa 1966)

- Various flutes: Hans Ulrik, Russell Itani
- Vocals: Tuva Semmingsen & Christine Nonbo Andersen
- Conducted by Sarah Hicks
- Orchestral arrangement/adaption from original recording: Martin Nygård Jørgensen
- Set design design: Nikolaj Trap; Light design: Mikael Sylvest
- Director of photography: Karsten Andersen