

Ozone Holes: Where and Size, Bad and Good Laurie Wei, Ph.D. Student

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INTRODUCTION

By the mid-1980s, scientists had already discovered that there was an unusual thinning of the ozone layer over Antarctica. When ozone level is less than 220 Dobson Units that means there is a loss of ozone layer thickness and concentration. Ozone depletion substances (ODS) refer to chemicals that are <mark>accused</mark> for destroying ozone layer. <mark>Many are good</mark> refrigerants, such as, Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs), commonly used in Heating, Ventilation and Air Conditioning (HVAC) and refrigeration devices.

OBJECTIVES

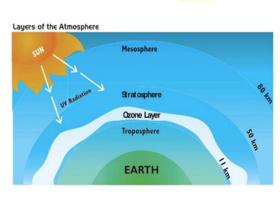
- Why ozone holes vary in size?
- Why it is appearing in locations where no population and refrigeration are used?
- Any bad and good impacts on the globe?
- What is the role of (CFCs) and other (ODS) on ozone

METHODS

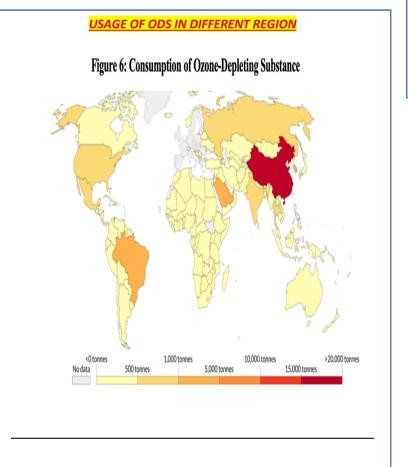
- Relation between UV distribution vs OD.
- ♦ CFCs distribution and chlorine accumulation in the stratosphere.
- ◆ How cold temperature and wind pattern carrying ODS to create OD over the Antarctic, North Pole, and Tibetan mountains
- ♦ Skin cancer and eyes problem distribution with comparison to UV-OD distribution.

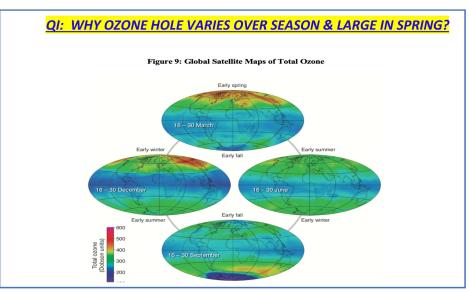
OZONE LAYER

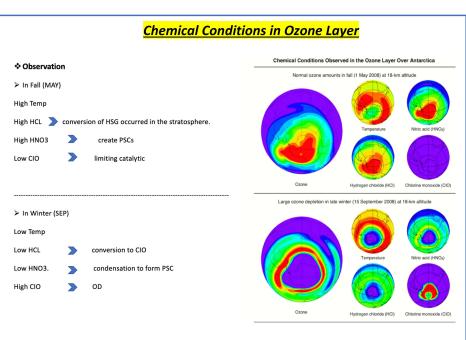
• Stratospheric O_{3} , a natural sunscreen that protects life from harmful ultraviolet (UV-C)



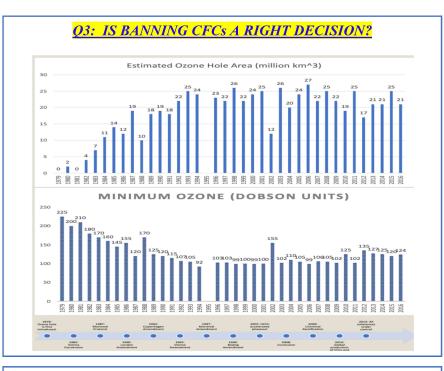
HOW ODS DESTROY OZONE LAYER? Figure 4: Halogen Source to Reactive Halogen gases Stratospheric Halogen Gases ualogen source gase. geactive halogen gase CFC-12 Very short-lived bromine gases Bromine nitrate (BrONO₂) Hydrogen chloride (HCl) | largest hlorine nitrate (CIONO₂) reservoirs ultraviolet (UV) Carbon radiation and chemical Chlorine monoxide (CIO) Bromine monoxide (BrO) reactions most CFC-11 Bromine atoms (Br) conversion Chlorine atoms (CI) Cycle 3 Cycle 2 $CIO + BrO \rightarrow CI + Br + O_2$ $CIO + CIO \rightarrow (CIO)_2$ $CIO + BrO \rightarrow BrCI + O_2$ BrCl + sunlight → Cl + Br $C(O)_2 + sunlight \rightarrow C(OO + C(O)_2)$ $CI + O_3 \rightarrow CIO + O_2$ $CIOO \rightarrow CI + O_2$ $2(CI + O_3 \rightarrow CIO + O_2)$ $Br + O_3 \rightarrow BrO + O_2$ Net: $2O_3 \rightarrow 3O_2$ Net: $2O_3 \rightarrow 3O_2$







Q2: IS OZONE DEPLETION RESPONSIBLE TO SKIN CANCERS? Figure 11: Average Daily Ultraviolet Radiation (UVR) level



FURTHER QUESTIONS?

- Q4: Why ozone holes appear to places where little population and effectively no HVAC and refrigeration are
- > Q5: Why UV radiation on Earth ground is higher near the equator, where ozone layer is not thin or dilute?
- Q6: Why a 3rd Hole Found in Tibet, Less Emitters and Near **Equator?**
- Q7: Can ozone holes do any good for Earth and human beings?
- Q8: Are ozone holes the entrance to Earth of bad radiation or an exit from Earth of harming substances?

REFERENCES

- 1. Twenty Questions and Answers About the Ozone Layer: Scientific Assessment of Ozone Depletion: 2010, Retrieved 2/05/2019 from https://www.esrl.noaa.gov/csd/assessments/ozone/2010/twenty questions/authors.html
- 2. Ritchie, H., Roser, M. (2018). Ozone Layer. Retrieved 2/20/2019, from https://ourworldindata.org/ozone-layer
- Atherton, M. (2018). Where in the world are you most likely to develop skin cancer. Retrieved 3/05/2019 from https://www.express.co.uk/life-style/health/994835/skin-cancersymptoms-signs-melanoma-uk-world
- 4. Student I.Alelm (Prof. Nieh, S.), "Ozone Hole" Research Paper for Class ENGR 534, CUA, December, 2018.
- Student Wei, L. (Prof. Nieh, S.) "Antarctic Ozone Hole: Ozone Hole and Ozone Depletion", Research Paper for Class ENGR 534, CUA, December, 2018.