Assignment 2: ozone depletion in the stratosphere essay

[Environment](), [Global Warming]()

Assignment 2: ozone depletion in the stratosphere 1. What is ozone? Ans: Ozone is a gas of three oxygen atoms(O3). Ozone can be formed when a mixture of oxides of Nitrogen and volatile organic compounds is exposed to the sunlight at ground level and action of ultraviolet light on oxygen in the stratosphere. 2. How is ozone produced in the stratosphere? Ans: Ozone is formed in the stratosphere by the action of sunlight on oxygen. The highenergy ultra violet light causes a molecule of oxygen to split into two atoms, one of thesetwo atoms then join an oxygen molecule to form ozone.

In this process, ozone absorbsmost of the ultra violet light preventing it from reaching the atmosphere of the earth. 3. Distinguish between " good ozone" and " bad ozone"? Ans: Good ozone is the ozone that is present high up in the stratosphere where it absorbs most of the ultra violet light and prevents it from reaching the earth. Hence the harmful effects of ultra violet on humans are prevented due to the presence of ozone high up.

This is the good ozone. It is present about 10 to 20 miles above the earth. Bad ozone is the ozone that is present at the ground level due to pollution. It is formed by the combination of oxides of Nitrogen (which are emitted in combustion processes and in vehicle exhaust) and volatile organic compounds in the presence of sunlight. It makes the eyes water and causes various problems for people with certain diseases. This is the bad ozone which is present at the ground level. 4.

What are the potential health effects due to depletion of stratospheric ozone? Ans: The depletion of stratospheric ozone increases the amount of UV radiation to which we are exposed. This has damaging effects on both humans and animals. It causes skin cancer (non melanoma skin cancer and malignant melanoma), cataracts and immunosuppression. Severe photo allergies (allergy to light), faster aging of the skin, sunburn, tanning and eye damage can occur.

5. What are CFCs? When were they invented and what have they been used for? Ans: CFC's, chloroflourocarbons are several of many organic compounds which aremade up of carbon, chlorine, fluorine and hydrogen as a name of Freon. They weredeveloped for the first time in the 1930s after the Second World War more than 70 yearsago.

Trichlorofluoromethane(CFC11) and dichlorodifluoromethane(CFC12) areimportant CFC's which have applications as refrigerants, aerosol spray propellants, solvents and foam blowing agents. 6. How long do CFCs last in the atmosphere? Ans: CFC's are very inert compounds and last in the atmosphere for a very long time, fordecades and even up to a hundred years and then they move into the upper part of theatmosphere where the high energy ultra violet radiation breaks it down. CFC11 lasts for40 to 80 years and CFC 12 for 75 to 150 years. 7.

What component of the CFC molecule destroys ozone? Ans: Free chlorine atoms are released from the CFC's in the presence of high energywavelengths of light and this reaction is called photolysis. The chlorine atoms releasedare the component of CFC's that destroy ozone. 8.

Why is sunlight necessary in order for stratospheric ozone destruction toproceed? Ans: Ozone destruction in the stratosphere occurs due to a reaction called photolysiswhich can take place only in the presence of sunlight. Due to this reaction which occurswith the help of high energy light wavelengths in the sunlight, free chlorine atoms arereleased which destroy ozone. 9. Explain why a single chorine atom can destroy many ozone molecules.(Hint: Catalytic process)Ans: Ozone reacts with a single chlorine atom and forms chlorine monoxide andmolecular oxygen. Natural atomic oxygen is also available from the ozone cycle and thisreacts with the chlorine monoxide formed to re form free chlorine atom and molecularoxygen. This chlorine atom/chlorine radical is now available to attack another ozonemolecule.

This is the process of catalysis and a single chlorine atom can thus destroymany ozone molecules. 10. What is the Antarctic " ozone hole"?(Why is it called a " hole"?)Ans: The ozone hole is a well defined area of large scale destruction of the ozone layerover Antarctica that occurs during the Antarctic spring. This is a layer of thinned outportion of ozone with a destruction of more than 70% of ozone that is otherwise normallyfound over the region of Antarctica. 11. How was the ozone hole discovered, and by what group? Ans: The ozone hole over Antarctica was discovered by a group of British scientistsJoseph Farman, Brian Gardiner and Jonathan Shanklin who all belonged to the BritishAntarctic Survey team. The way in which they had discovered it was by an observationthat there was deepening of the spring time ozone layer above Halley Bay in Antarctica.

Measurements from satellites and other Antarctic research stations like the south pole hadconfirmed this discovery. 12. How is the level of ozone monitored over Antarctica?(One is ground-based; the other is not.)Ans: The optical and chemical properties of ozone make the measurement ormonitoring possible. Direct measurements of ozone are done by sending the ozone gasinto an instrument and then using UV ray absorption of this ozone or by electrical currentto measure it. Ozonesondes are light weight balloons which ascend up into theatmosphere and can measure ozone in the stratosphere.

Research aircraft are also sent tomeasure and monitor the levels of ozone in the troposphere and lower stratosphere. Remote measurement of ozone can also be done by using its UV ray absorbing property. DIAL or Differential absorbing lidar systems have been used for measuring ozone from aircraft. LITE or the lidar in-space technology experimentwas deployed in 1994 and hence space based lidars are also used. The total column ozone at ground level can be measured using aninstrument called the Dobson spectrophotometer. A 16-station GMD Cooperative Dobson Network is a major contributor to ground based ozone level monitoring. Six of these Dobson instruments are automated and provide vertical profiles up to an altitude of 32 km. Satellite instruments are used to monitor ozone.

13. Is the ozone hole a constant feature? If not, when does it form andhow long does it last? Ans: The ozone hole is not a constant feature. The ozone hole appears in the month of August and reaches its maximum size by October disappearing by the end of the year. 14. How much ozone reduction occurs in the ozone hole? Ans: The ozone hole as measured in the year 2000

was at its largest area recorded in early September which was 28. 4 million square kilometers.

More than 40% reduction in ozone levels occurs over Antarctica compared to the total amounts present in the early 1980’s. This is a significant reduction and ozone measurements vary. 15. Is the Antarctic ozone hole always the same size? If not, describe how muchit varies from year to year. Ans: The Antarctic ozone hole is not the same size always. It varies from year to year. There are fluctuations which occur apart from a general trend in the size.

The largest average area ever recorded was 26. 5 million square kilometers, recorded in 2000 with the largest ever being 29 million square kilometers. 16. Why is ozone depletion so much greater over the Antarctic than elsewhere?(Hint: polar vortex, PSCs)Ans: Low temperatures below -78degrees in the Antarctic cause the formation of PSC’s type 1, Polar stratospheric clouds and chemical reactions occur which produce active chlorine and bromine atoms which cause ozone catalysis in sunlight and cause large losses of ozone.

When temperatures go below -85degress, then pure water ice clouds are formed, the type 2 PSC’s which produce more active chlorine atoms and even huge losses of ozone. The polar vertex is a low pressure system in which high velocity winds in the stratosphere circle the Antarctic. Exposure of this vortex air to sunlight causes ozone loss which are more in the Antarctic area due to the polar vortex, low temperatures and sunlight exposure of the vortex. 17.

What was the Montreal Protocol? Has it worked, i. e., are CFCs starting to diminish? Ans: The Montreal protocol on Substances that deplete the ozone layer was signed on 16 September, 1987 by 24 countries. It said that the production as well as the consumption of compounds which deplete ozone like the CFC's, halons, carbon tetra chloride and methyl chloroform(by 2005) are not to be phased out by the year 2000 with a total phase out by 2005.

It has worked to a certain extent. The levels of these substances have began to decline but not completely phased out yet. CFC's have been replaced by HCFC's now. 18.

Is the Antarctic ozone hole " going away"? Ans: The lifetimes of the CFC's, halons and HCFC's are long and they have not been eliminated from use yet. Hence the ozone hole is not going away for a long time to come. We can expect it to return to the 1979 level by about 2050.

19. Is stratospheric ozone depletion restricted to the Antarctic? If not, describe the extent of the destructionAns: It also occurs in the arctic region in the winter-spring period and is quite significant. There had been reports of an ozone decrease over the heavily populated northern mid-latitudes (30-60N) but this happens much more slowly of only a few percent per year. The decreases of ozone in the Arctic region have reached a maximum of 22% but this varies year to year and does not happen every year unlike the Antarctic. 20. What would be the impact of an Arctic ozone hole, if one were to develop? Why might such a hole form? (Hint: What has been happening to temperatures in the stratosphere.)Ans: An artic ozone hole could expose

almost more then 700 million people, plants and animals to dangerous UV ray levels which have bad health effects. Global warming in the upper atmosphere and changes in the temperatures of the upper atmosphere in the Northern hemisphere becoming similar to the Antarctic conditions will cause a further deterioration of the ozone layer and the possibility of an arctic hole cannot be ruled out.

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