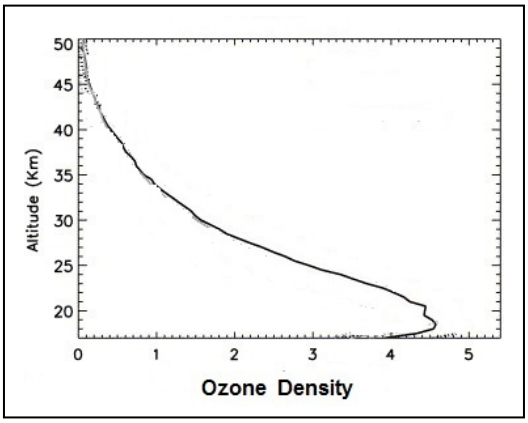

The Stratospheric Aerosol and Gas Experiment III (SAGE III), the sensor will be installed on the International Space Station (ISS) sometime in 2014. An earlier version of the SAGE-III instrument was flown in 2001 on the Russian Meteop-3M spacecraft. The new SAGE III will be using the sun and moon as light sources to measure how well the ozone layer is recovering and replenishing itself.

The ozone layer is located at an altitude of about 20 kilometers and blocks solar UV rays that would otherwise burn skin and cause cancer.

The data plot shows the density of ozone molecules at a range of altitudes as measured by the earlier SAGE-III instrument. The density of ozone molecules found in the stratosphere is presented in multiples of 1 trillion molecules per cubic centimeter.

Problem 1 – The ozone layer has the highest concentration of ozone molecules in the stratosphere. From the graph, over what altitude range does the concentration exceed 4 trillion molecules per cubic centimeter?

Problem 2 - If the density of the atmosphere in this region of the stratosphere is 400,000 trillion molecules, what fraction of the molecules are ozone if the ozone density is 4 trillion molecules/cm^3?

Problem 3 – For every million atmosphere molecules in the ozone layer, how many ozone molecules do you expect to find? (Scientists use the term parts-per-million to indicate this number.)

Data plot from
Lunar occultation with SCIAMACHY: First retrieval results
L.K. Amekudzi , A. Bracher, J. Meyer, A. Rozanov, H. Bovensmann, and J.P. Burrows
Advances in Space Research, Volume 36, Issue 5, 2005, Pages 906–914

Problem 1 – The ozone layer has the highest concentration of ozone molecules in the stratosphere. From the graph, over what altitude range does the concentration exceed 4 trillion molecules per cubic centimeter?

Answer: **Between 17 and 23 kilometers**.

Problem 2 - If the density of the atmosphere in this region of the stratosphere is 400,000 trillion molecules, what fraction of the molecules are ozone if the ozone density is 4 trillion molecules/cm^3?

Answer: 4 trillion ozone molecules/400,000 trillion atmosphere molecules = **1/100,000**

Problem 3 – For every million atmosphere molecules in the ozone layer, how many ozone molecules do you expect to find? (Scientists use the term parts-per-million to indicate this number.)

Answer: The ozone molecules are 1/100000 of the atmosphere molecules, so for every million atmosphere molecules, 1/100000 are ozone and so **10 ozone molecules** should be found for every 1 million atmosphere molecules.

This is written as 10 parts-per-million or 10 ppm.