For office use only	Team Control Number	For office use only
T1 _____	**666**	F1 _____
T2 _____		F2 _____
T3 _____	Problem Chosen	F3 _____
T4 _____	**A**	F4 _____

2016 Mathematical Contest in Modeling (MCM) Summary Sheet

Abstract

We have constructed a Stability time series model and a Markov model that to hold a promise for providing insight into not only predict the max ozone hole square in Antarctic in the next 50 years, but also foresee the ozone levels in different latitudes in the northern hemisphere in the next 50 years. This model considers a large number of parameters thought to be important to the ozone hole and ozone levels, including the CSCs concentration, the destruction CFCs to the ozone layer, light intensity, the atmospheric circulation, solar radiation and temperature.

The aforementioned Stability time series approach includes CFCs concentration data (1979-2016), max ozone hole square data in Antarctic (1979-2016) and the average solar radiation in Antarctic each year, in order to research the relationship between the max ozone hole square and the CFCs concentration and predict the max ozone hole square in the later 50 years by using the Holt-Winters Method.

The Markov model approach includes the ozone levels data of $15\,^{\circ}N$ to $55\,^{\circ}N$ in the northern hemisphere in 1986 to 2016. Ozone transition, impacting the ozone levels in different latitudes and the CFCs concentration. The different day length in the different latitudes determined the reaction time of CFCs and the ozone. The day length, CFCs concentration and ozone transition can be reflect in the historical changes. We get the probability transfer matrix from the historical data, which can predict the most probable ozone levels in the $15\,^{\circ}N$ to $55\,^{\circ}N$.

Specific attention is given to the sensitivity of our model to variations in its fundamental parameters, whose values are based largely on inadequate and varied statistical data. We attempt to use our model to identify the most important factors related to the ozone levels, and show simulation results related to in the Stability time series model.

Ultimately, we have concluded that given the complex nature of this scenario and the limited quantity and quality of detailed information concerning the change of max ozone hole square in Antarctic and the ozone levels in the $15\,^{\circ}N$ to $55\,^{\circ}N$ in the next 50 years, it is not possible at this time to quantitatively predict the effectiveness of the ozone levels recovery plan. Instead, the results presented here qualitatively show the relationship between ozone hole square and CFCs concentration .These qualitative results are then used to craft a tentative deployment strategy for the ozone levels recovery.

The Model of Ozone Level Prediction in 50 Years

Contents

1 Introduction

1.1 Context of The Problem

The ozone layer protects Earth from dangerous UV radiations which can cause mutations . In humans, higher rates of skin cancers, cataracts, and immune system problems can be the consequences of the damage of ozone layer. Furthermore, an increase in UV radiation could affect plants and marine ecosystem. thus gives the earth a constant influence.

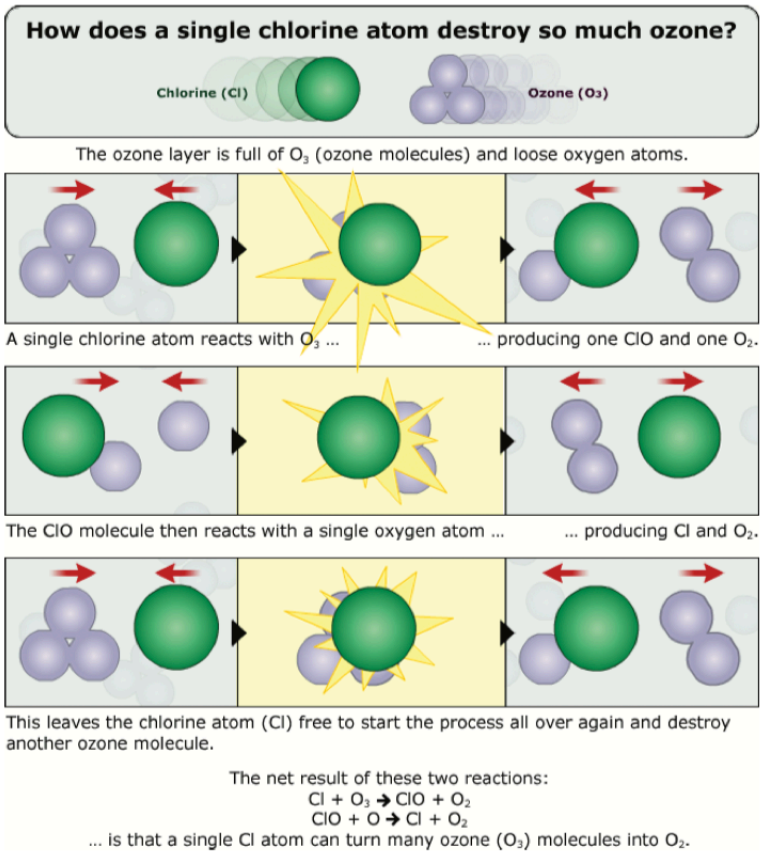

Figure 1: Formular

By the studies of F.Sherwood Rowland and Mario Molina, the ozone layer is full of O_3 (ozone molecules) and loose oxygen atoms, once a single atom reacts with O_3 it will producing one ClO and one O_2but the ClO molecule won't stay long, soon