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Effects of Greenhouse Gases Like Carbon Dioxide Can Be Spotted Earlier in the Middle Atmosphere

What is this research about?

The observed increase of carbon dioxide (CO_2) in the Earth's atmosphere represents the single most significant anthropogenic change to the climate system. While the Earth's ecosystem is naturally effected by changes at the surface, changes at higher levels may also have an important impact on life. For example, the ozone layer is thickness at about 22 km, but it's presence has an important impact on UV radiation reaching the Earth's surface. In the middle atmosphere (between 15 and 90 km), the impact of changes in the chemical composition is enhanced. Over the past thirty years the temperature at the Earth's surface has increased by 0.2 to 0.4 °C due to trapping of heat by increased CO_2 levels. In contrast, the middle atmosphere has cooled by 2 to 5°C. (Unlike the troposphere which heats up, the middle atmosphere cools down as a response to increased CO_2 due to stronger emission of the remaining heat to space. This is an important difference in understanding the climate change issue).

What you need to know:

Understanding and dealing with climate change requires us to look at the atmosphere as a whole, not just the lowest portion near the surface. Analyzing the effects of greenhouse gases on the middle atmosphere helps to identify and understand the effects of climate change early on.

What did the researchers do?

Researchers used the Canadian Middle Atmosphere Model (CMAM) to look at how the middle atmosphere and troposphere react to a doubling of CO_2 - a scenario that is expected to occur near the end of the 21st century. Changes in temperature, ozone, and water vapor as a result of CO_2 doubling were analyzed.

What did the researchers find?

The researchers had a number of findings from CO_2 doubling in the atmosphere. Some of the findings include an overall temperature increase of 2.6 °C near the Earth's surface and of 2-4 °C throughout the troposphere. The middle atmosphere was actually found to cool by up to 10-12 °C as a result of CO_2 doubling.

In association with this cooling, the ozone concentration in the middle atmosphere was found to increase by up to 15-20%. The water content of the total atmosphere total was found to increase by approximately 22%.

How can you use this research?

This research may be useful to policymakers because it focuses on the middle part of the atmosphere where climate change is easier to detect and understand. Therefore, this research may allow policymakers to make more informed decisions in environmental, energy, and other policies. This research is also useful because it helps better understand the effects of increased CO2 levels in the whole atmosphere and not just the troposphere, which usually receives the most attention. Although the experiments in this research do not perfectly recreate the many factors at play in the active atmosphere, they provide a great way of testing out hypotheses about carbon dioxide increases in the atmosphere.

About the Researchers

Victor I. Fomichev is an Adjunct Professor and Research Associate with the Department of Earth & Space Science & Engineering at York University. A. I. Jonsson is a Post-Doctoral Fellow with the Department of Earth & Space Science & Engineering at York University. J. de Grandpré is a Post-Doctoral Fellow with the Department of Atmospheric and Oceanic Sciences at McGill University. S. R. Beagley is a Project Scientist with the Department of Earth & Space Science & Engineering at York University. C. McLandress is a Research Associate with the Department of Physics at the University of Toronto. Kirill Semeniuk is a Research Scientist with the Department of Earth & Space Science & Engineering at York University. T. G. Shepherd is a Professor with the Department of Physics at the University of Toronto.

victor@nimbus.yorku.ca

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kmbunit@yorku.ca

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