SCIENCE

Tropospheric Processes

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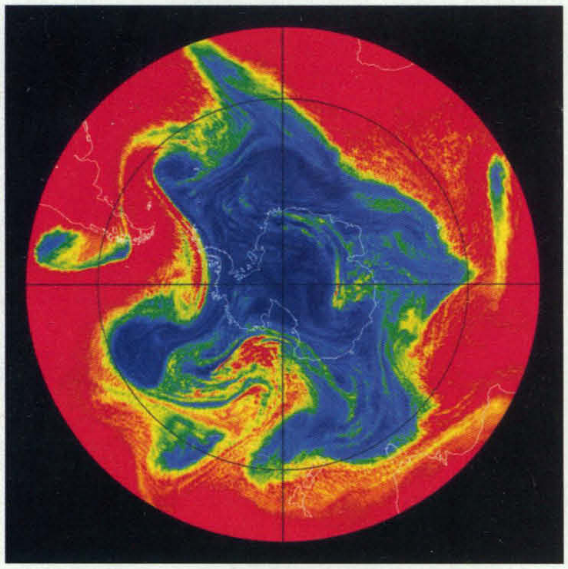
Most of what we commonly think of as Earth's atmosphere is made up of two layers, the troposphere, which extends from the Earth's surface up to between 10 and 17 kilometers, and the stratosphere, which extends from the top of the troposphere up to about 50 kilometers. They are separated by a boundary, the tropopause, across which flow is relatively limited. Following the discovery of the ozone hole in the polar stratosphere, research has focused on understanding the processes leading to its formation, and we may now understand more about the processes in the more distant stratosphere than about those in the troposphere. The troposphere contains a much wider variety of species and particles, and the higher atmospheric density and other factors such as the presence of much liquid water in the troposphere enhance the interactions and reactions among these species. Chemicals and particles enter the troposphere from many diverse sources, and some persist for only a few hours before they are removed or altered. Mixing is spatially and temporally variable at all levels, and the chemicals and particles interact in complex ways with large-scale processes such as cloud formation and convection. This special issue on Tropospheric Processes provides an overview of the current understanding of these complex processes, a detailed appreciation of which is vital for addressing societal issues such as air pollution and climate change.



In a brief overview article, Kley highlights some of the key issues related to the coupling of chemistry and transport in the troposphere. Three of the detailed articles focus on related aspects of tropospheric chemistry, which today is concerned increasingly with processes involving condensed species in the atmosphere. Finlayson-Pitts and Pitts Jr. focus on air pollution, Ravishankara examines reactions on and in tropospheric particles, and Andreae and Crutzen discuss the biogeochemical sources of aerosols and their effect on tropospheric chemisty, as exemplified by reactions associated with the marine boundary layer. As emphasized in all of these articles, and highlighted in an article by Roscoe and Clemitshaw, improving our understanding of tropospheric processes requires better measurements of chemicals and particles globally. Baker describes how the microphysics of aerosols, ice particles, and water droplets affect the large-scale properties of clouds. Mahlman discusses transport processes in the upper troposphere and across the tropopause, which affect the chemistry of key species such as ozone, in both the troposphere and stratosphere. In a news story, Kerr examines the attempts to link these and other small- and large-scale processes in climate models. Finally, in a Policy Forum, Zillman highlights some of the recent problems and successes in linking basic atmospheric science and international public policy, and the need for international coordination.

–Julia Uppenbrink and Brooks Hanson