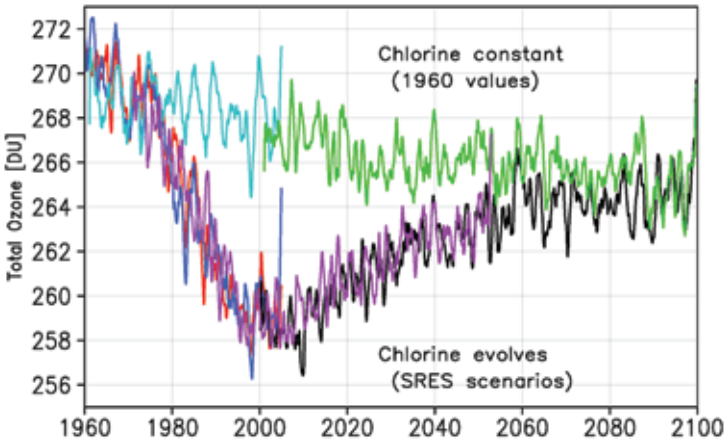
Modeling Interactions Between Ozone and Climate

Our research examines how changes in stratospheric ozone impact the climate and how changes in climate impact atmospheric chemistry. Climate is understood to be changing because of an increasing concentration of gases that trap heat in the lower atmosphere (greenhouse gases), which leads to warming near the surface and cooling in the higher atmosphere. Ozone has decreased between about 1970 and 2000 because of increased concentrations of chlorine and other halogens. Increases of both are known to be a consequence of increased emissions by human activity.

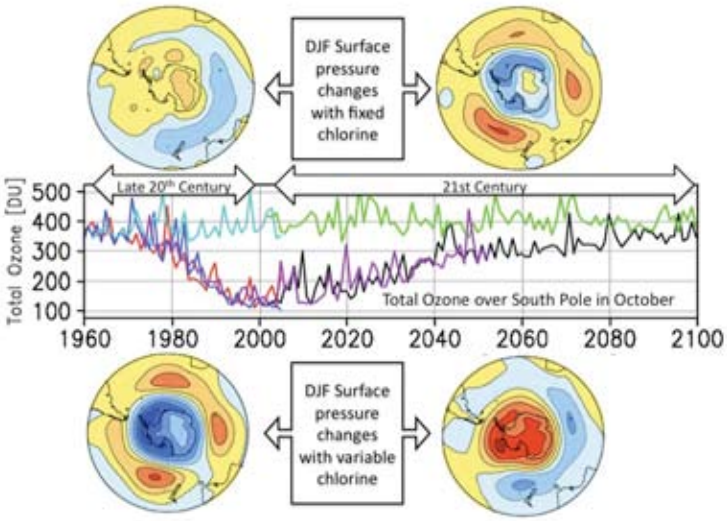
This work is closely related to NASA's mission to examine atmospheric composition. We make extensive use of the Agency's satellite observations to evaluate the realism of gases simulated in past years in our model. Our results support the case for NASA to maintain observing programs to monitor and understand atmospheric trace gas distributions.

Our models of the climate system used in these simulations are complex numerical solutions to mathematical equations that describe a physical system. The great computational challenge is to solve these equations in a way that takes advantage of today's computers, which often involves out-of-the-box thinking—an ongoing challenge is to figure out ways of representing the spherical atmosphere on a grid of processors, while at the same time, representing processes that differ in complexity (and hence the time needed for solution) over different parts of the globe. Generous allocations of NASA supercomputing resources have enabled us to run many decades of simulations needed to simulate atmospheric changes and to extract signals of forced variations in climate from "random" underlying signals of variability.

Our work helps scientists, politicians, and eventually the public appreciate the importance of regulating emissions—as yet, no international agreements are in place to regulate greenhouse-gas emissions.



Total tropical ozone column between 1960 and 2100, showing a long-term ozone decrease resulting from greenhouse gas increases. Fixing chlorine in two model runs (cyan/green) isolates impact of the increase and decay of chlorine on tropical ozone.



Total ozone over the South Pole in October in runs with and without ozone depletion and the impact of ozone on summertime (December-February: DJF) surface pressure changes. Pressure changes are computed for the late 20th and the 21st Centuries.

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