The GMI-MERRA Chemistry Transport Model Quantifies the Roles of Dynamics and Chemistry in Arctic Spring Ozone

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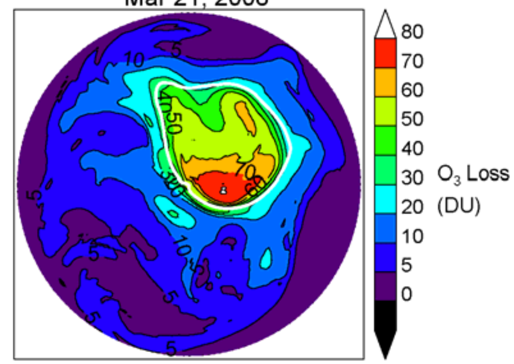
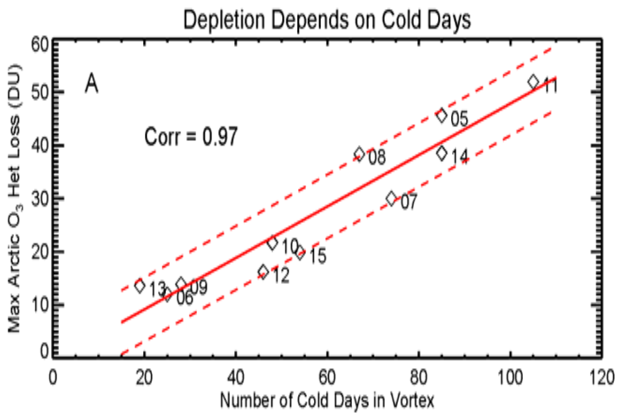
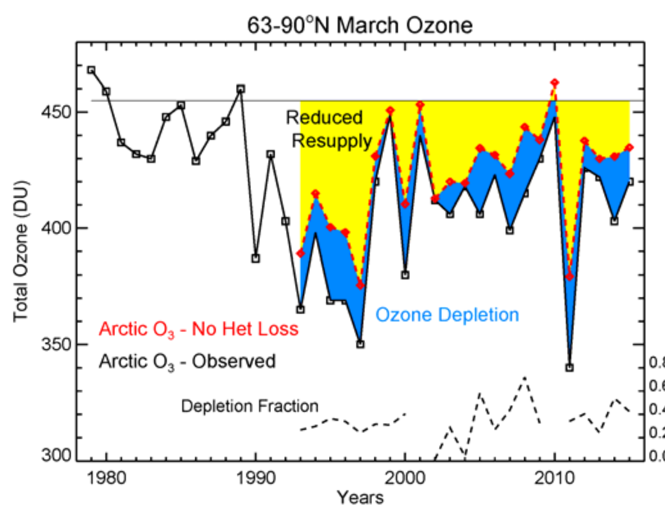
(**Right**) The GMI model was run with and without the chemical reactions that cause ozone (O_3) depletion to quantify Arctic depletion each year, 2005-2015. We calculated the maximum column O_3 depletion each season averaged over the polar cap (63°-90°N) and counted the number of days each season cold enough to form polar stratospheric clouds (PSCs). The figure shows large O_3 depletion in 2008.

Column O_3 Depletion
Mar 21, 2008





(**Left**) We found a linear relationship between the maximum O_3 depletion and the number of days cold enough to form PSCs. This simple, highly correlated relationship allowed us to estimate O_3 depletion using MERRA temperatures for the years prior to Aura when uncertainties in the MERRA transport circulation didn't permit accurate model calculations.



Significance: **We found that ~2/3 of the interannual variability was caused by variations in the O_3 transported to the polar region (yellow) while only ~1/3 was due to depletion (blue).** For every 3 Dobson Units (DU) that Arctic O_3 increases, 2 DU come from transport and 1 DU comes from a reduction in ozone loss (i.e., warmer temperatures).

Strahan, S. E., A.R. Douglass, S.D. Steenrod (2016), Chemical and Dynamical Impacts of Stratospheric Sudden Warmings on Arctic Ozone Variability, J. Geophys. Res., 121, 11,836–11,851, doi:10.1002/2016JD025128