Using Stratospheric Ozone to Predict Northern Hemisphere Surface Temperatures

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The role of polar stratospheric ozone changes on surface climate has been an area of interest over recent decades. Springtime Antarctic ozone depletion, for example, has resulted in a stronger and colder polar vortex, which in turn has led to an increase in the Southern Annular Mode during the austral summer. This alters the large-scale and local tropospheric climate patterns. Similarly, springtime polar ozone extremes in both the Arctic and Antarctic have been shown to have large localized surface temperature correlations (Bandoro et al., 2004; Ivy et al., 2017). This is especially the case for the Northern Hemisphere, with very strong correlations seen over Northern Russia, Central Asia, and North America between March ozone and March-April surface temperatures (Ivy et al., 2017). This study follows on from Ivy et al. (2017) using a state-of-the-art chemistry climate model to assess the predictability of this relationship. The model used is the Whole Atmosphere Community Climate Model. We run a nine-member ensemble over the years of 1995–2024. The ensemble mean correlation and surface temperature differences of the extreme anomalies in Arctic stratospheric ozone are compared to ERA-Interim and ozone observations. It is seen that the model ensemble mean does a remarkable job in replicating the observed spatial pattern. However, the ensemble mean has a slightly lower magnitude in both the correlations and surface temperature differences. Individual model members, on the other hand, have similar correlation magnitude to the observations with a large amount of spatial variability between members. This results in reducing the ensemble mean correlations. Finally, we investigate the predictability of spring surface temperature anomalies using March Arctic ozone in both the ensemble mean and the individual members.

Key words: ozone, Arctic, prediction

References

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