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On the relationship between ozone and stratospheric circulation extremes

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Changes in stratospheric ozone have well-known influences on the circulation, and changes in the circulation can also affect ozone. This two-way influence between ozone and the circulation may be important for stratospheric circulation variability on a range of time scales. We investigate this possibility on the intraseasonal time scale and study the impact of Arctic stratospheric circulation extremes on the spatial distribution of ozone. More specifically, we apply composite analysis to reanalysis to document how stratospheric sudden warming events, final warming events, and vortex intensification events affect the 4-dimensional distribution of stratospheric ozone. We find that each circulation event is associated with specific anomalies in the spatial and temporal distribution of ozone. The anomalies establish well before the mature phase of the events, they persist for many weeks, and they change their spatial signature over the course of the events. The anomalies are consistent with the actions of planetary waves on the transport and mixing of ozone. Our results reveal a significant amount of temporal and spatial intraseasonal variability in ozone, which may be important for the simulation of the stratospheric circulation.