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A comparison of spatial patterns in mean and extreme values of total ozone at mid-latitudes and the relationship to atmospheric dynamics and chemistry

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We present a spatial analysis of patterns in mean (Frossard et al., 2011) and extreme (Rieder et al., 2011b) total ozone at mid-latitudes in relation to atmospheric dynamics and chemistry. Two different statistical models have been applied in this analysis: (i) a standard multiple regression model for mean values of column ozone and (ii) a r-largest order statistics model for the extremes. In both models important variables such as the 11-year solar cycle, QBO, ENSO, NAO, AAO, ODS, volcanic eruptions are included as covariates. This study was motivated by earlier local/regional case studies (Rieder et al., 2010a,b; 2011a) as the results showed that a lot of interesting information is captured in the tails of ozone time series, while it remains uncovered in the mean. Within the current study spatial patterns are analyzed for the mean and extreme values on large spatial scale to address similarities and differences in the influence of atmospheric dynamics and chemistry in the tails and the bulk of the ozone data. The NIWA assimilated total ozone data set (spatial resolution: 1°longitude x 1.5° latitude, temporal resolution: daily values) is used in this study. We address similarities and differences on hemispheric and regional scale and provide an overview about the spatial influence of the atmospheric covariates on the ozone means/extremes. Findings of particular interest concern the large scale spatial pattern of the ENSO in both hemispheres, the NAO in the northern hemisphere and the connection between the ENSO phase and the southern ozone "collar", confirming results of earlier local/regional studies mentioned above. Further it is shown that clear "fingerprints" of the eruption of Mt. Pinatubo can be found for ozone extremes in the southern hemisphere while such feature is almost invisible in the mean, providing clear evidence that the masking of the Mt. Pinatubo effect in mean column ozone is of dynamical origin.

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