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Synoptic controls on summertime surface ozone in the northeastern United States

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Abstract

The relationship between synoptic-scale circulation patterns and surface ozone (O_3) across the northeastern United States was investigated for summers 2000–2004. Observational data consisted of 1200 UT sea level pressure fields obtained from the National Centers for Environmental Prediction Global Final Analysis and O_3 measurements from 474 Environmental Protection Agency and five AIRMAP monitoring sites. The five most common circulation patterns, or map types (I–V), were identified with a correlation-based synoptic categorization technique, which persisted on 65% of the days during the study period. Map type I, characterized by stagnant warm conditions throughout the northeast, occurred most frequently (21%) with associated episodes of high O_3. Interannual variability in O_3 varied regionally from a seasonally averaged daily maximum value of 64 ppbv in 2002 to a minimum of 52 ppbv in 2004. By considering both the sea level pressure system intensity and frequency of each map type, 46% of the interannual variability in summertime O_3 was reproduced with intensity being the dominant factor. The remaining interannual variability was possibly due to nonlinear relationships between climate and biogenic emissions and/or recent reductions of power plant emissions of nitrogen oxides (NO_x) over the eastern United States. The storm track of cyclones in the eastern United States was a key determinate of the intensity of circulation patterns.