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Diurnally, Seasonally and Regionally Varying Background Ozone and Decadal Trends in the Planetary Boundary Layer Over Canada and the United States from 1997 to 2006

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PBL ozone temporal variations were investigated for diurnal, seasonal and decadal scales in various regions across Canada and the United States for the period 1997–2006. "Background" ozone is difficult to quantify and define through observations. Because of the importance of its estimates for achievable policy targets, evaluation of health impacts and relationship with climate, regional and continental backgrounds were estimated. Principal Component Analyses (PCA) were done for 97 non-urban ozone sites for four seasons separately to define the contiguous regions. Three independent analyses were done to quantify the regional and continental background ozone. Method 1, the new method, applies the regions derived by PCA; then uses backward air parcel trajectory to systematically select the “clean” background air cluster associated with the lowest May to September 95th percentile for each site. Method 2 uses the intercepts from the linear regression between ozone and NOz (NOy minus NOx) to estimate the ozone mixing ratio associated with photochemically-aged air. Method 3 uses trajectory residence time to extrapolate background ozone when the residence time is equal to zero within a given region.

On the diurnal scale, the amplitudes range from 19 to 45 ppb depending on season, altitude and region. On the seasonal scale, consistent results were found from the three methods in which the average ozone mixing ratios range from 17 to 49 ppb. On the decadal scale, the direction and magnitude of trends are different in all seasons across regions (-1.56 to +0.93 ppb/a). Increasing trends were observed in the Pacific coast for all seasons. This long-term changes are evidently masked by the much stronger regional signals in areas where the ozone precursors have significantly reduced since the mid-2000s. This paper emphasizes the importance of regional and local precursor reduction efforts regardless of the fact that the continental background is rising.