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Tropospheric ozone over Southern Africa changing: A new look at evidence from profiles and surface data

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There is considerable interest in determining trends in tropospheric ozone, an important greenhouse gas, but a scarcity of relevant observations. Surface data do not necessarily represent the free troposphere (FT) where the radiative forcing effects of ozone are concentrated. A case study of ozone measurements collected from the Johannesburg-Pretoria (Gauteng) region of South Africa from 1990 through 2007 is presented. Free tropospheric ozone (4-12 km) derived from Irene SHADOZ sondes (25S, 28E) shows no statistically significant increase during this time even when classified by a 3-tier ozone level scheme. We show that ozone profile trends have been misinterpreted due to drifting launch times. Surface data from several regional sites are examined a We look for evidence of an ENSO signal in FT ozone; extends the latitude range of this important teleconnection, previously quantified only to 15S. Somewhat surprisingly the ENSO signal is very strong in surface ozone data from Elandfontein, 125 km east of Irene. Precipitation amount and cloud modulated photochemistry are presumed to be the drivers for variability (high ozone during El Niño, low ozone during La Nina). MOZAIC/IAGOS aircraft profiles, more numerous than the ozonesondes, appear consisten with the Irene results. Particular attention is given to sampling strategies for determining ozone trends. To clearly establish trends over Gauteng, a concerted strategy of soundings and surface observations are required, along with an assessment of NOx and hydrocarbon sources over the southern African highveld region.