

Using the Relationship Between Mean 500-Millibar (Mb) Heights and Mean Surface Ozone Concentrations in Colorado to Decompose Ozone Time Series and Evaluate the Impacts of Changes in Precursor Emissions

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Since 1995, variations in summer weather have had more impact on year-to-year changes in ozone concentrations along Colorado’s Front Range than changes in emissions. Correcting the ozone record for the effects of weather provides us with a better tool for understanding local trends as they are affected by emissions. July monthly mean daily maximum 8-hour surface ozone concentrations are more strongly correlated with July mean 500-mb heights than a host of other logical choices for predictors of ozone, including mean surface temperatures, mean temperatures aloft, winds aloft, cloud cover, solar radiation, and number of days with temperatures above 90 degrees. While annual fourth maximum 8-hour ozone concentrations, benchmarks for attainment of health standards, can occur in any month in summer, it turns out that the mean July 500-mb height over Denver is also one of the single best predictors for this value. The R-squared values for the correlation between July mean ozone and heights ranges from about 0.60 to 0.86, suggesting that 60% to 86% of the year-to-year variation at these sites can be explained by changes in weather. This strong relationship is also evident at sites in Utah, Arizona, New Mexico, and Wyoming. Removing the effects of heights from the ozone time series may reveal the impacts of the recession in 2009, changes in tropospheric NO₂, and changes in various source categories, including power plants and the oil and gas industry in northern Colorado. While heights may be a surrogate for many factors that influence ground level ozone, the strong correspondence discussed here may also be related to the increased accumulation of ozone and its precursors in the troposphere under the influence of persistent upper level high-pressure systems.

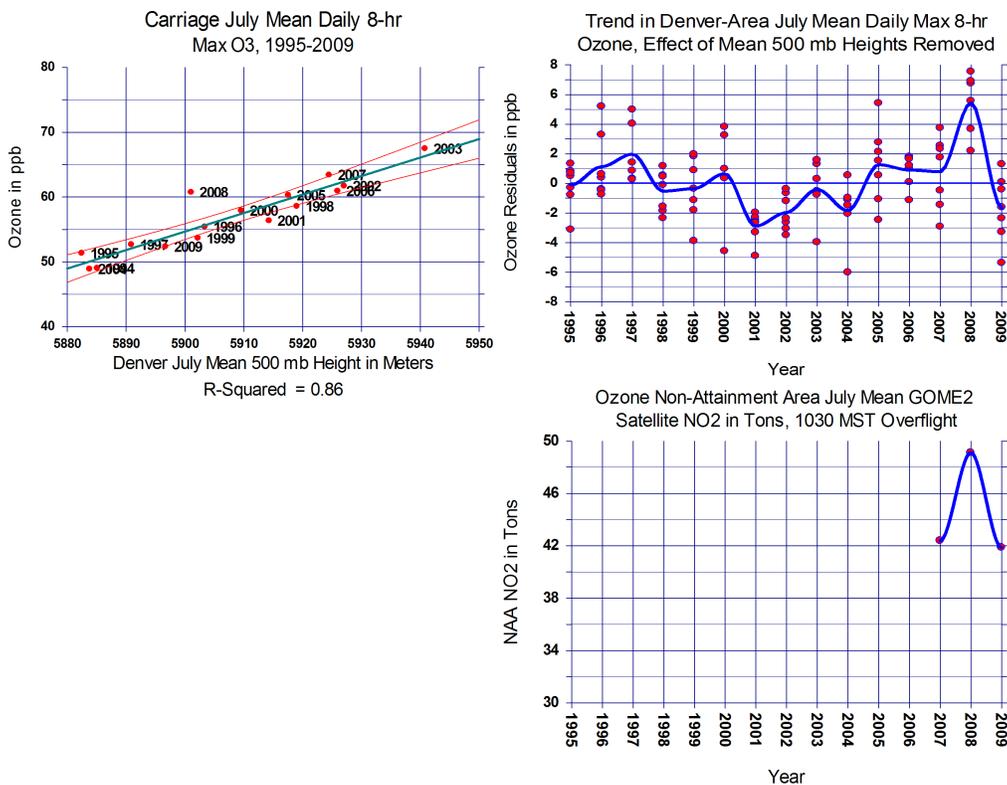


Figure 1. (Top Left): Denver monitor July mean daily max O₃ and heights, (Top Right): Denver area ozone time series after correcting for heights, and (Bottom) Global Ozone Monitoring Experiment 2, July mean NO₂ in tons for Denver Non-attainment area.