Contrasting Behavior of Inert and Photochemically Reactive Gases during the August 21, 2017, Solar Eclipse at the Boulder Reservoir

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The total solar eclipse on August 21, 2017 provided a rare opportunity to observe and test our understanding of atmospheric dynamics and photochemical dependency on solar irradiance. Here, we utilize observations from the continuous monitoring of both inert and photoreactive trace gases near Boulder, Colorado, for contrasting the unique dynamic and photochemical forcings on the eclipse day. The monitoring station saw a 93% solar obstruction during the peak of the eclipse. Eclipse day data are contrasted with the full month's record from this site. The loss of irradiance caused cooling of the surface air by ~3°C, and weakened convective and turbulent mixing. This resulted in a buildup of non-reactive gases (methane, volatile organic compounds) as well as nitrogen oxides (NO, NO_2) in the surface layer. In contrast, ozone (O_3) declined by ~15 ppb during the first part of the eclipse compared to median August diurnal mixing ratios. Similar O_3 signatures were observed at a series of network stations along the Northern Colorado Front Range. With the loss of irradiance, the initial ratio of NO/(NO+NO_2) of ~0.2 dropped steadily, bottoming out at <0.01, but rebounded to ~50% above average levels towards the end of the eclipse. Above average O_3 enhancements were seen in the afternoon hours following the eclipse. The contrasting behavior of reactive and non-reactive gases, and comparison with other published eclipse data, allow characterizing these responses as urban/polluted behavior.

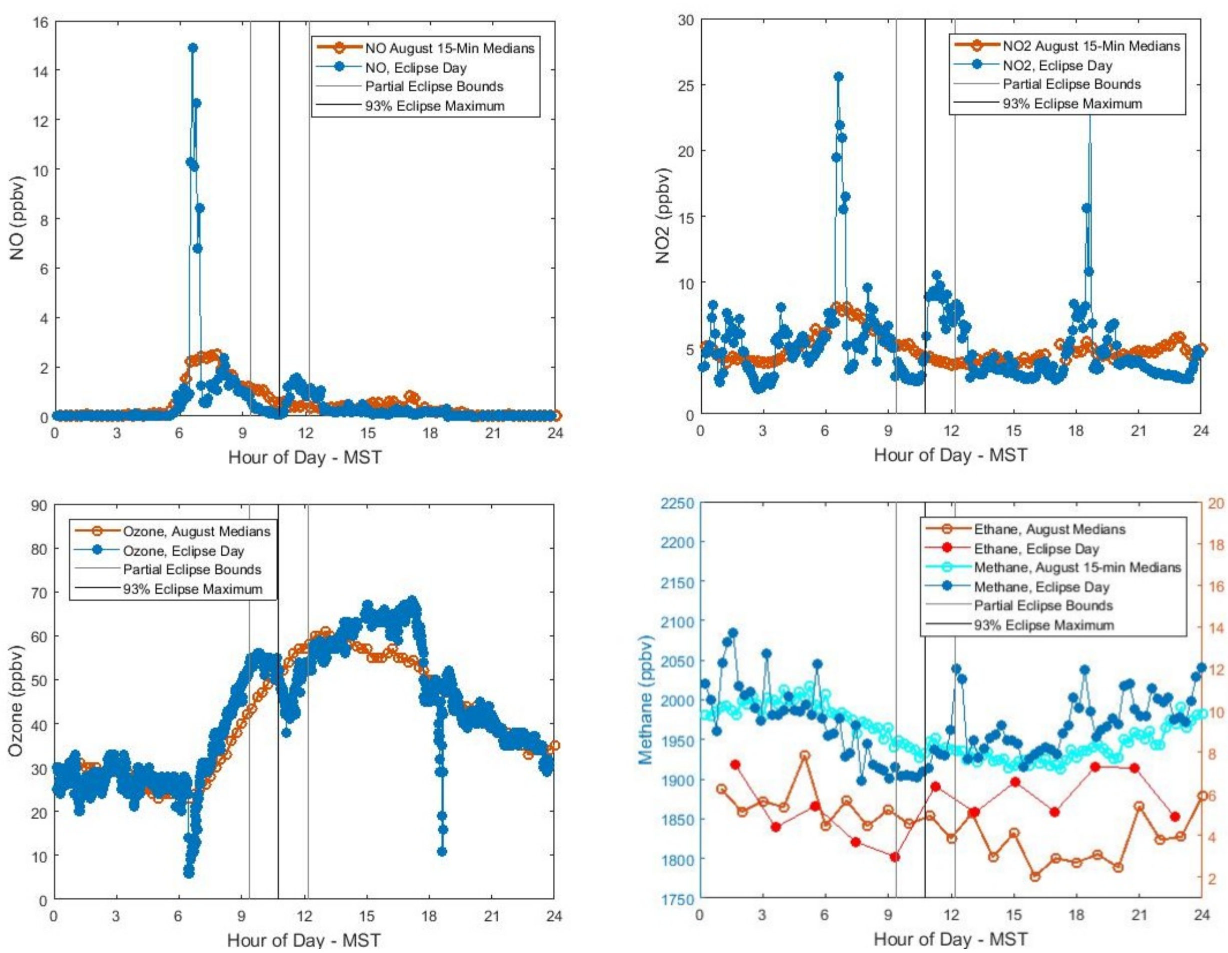

Figure 1. Diurnal cycle of trace gases on the eclipse day August 21 (filled circles) in comparison with the median diurnal cycle for August 2017 (excluding August 21) (open circles) for **(a)** NO **(b)** NO_2, **(c)** ozone, **(d)** methane and ethane. The time window of the eclipse is indicated by the vertical grey lines (eclipse start and end), and the maxima of the eclipse is indicated by the black line.