

Public Abstract

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Graduation Term:SS 2009

Department:Soil, Environmental & Atmospheric Sciences

Degree:MS

Title:Classification of Air Pollution Regimes in the Missouri Region

High air pollution concentrations are a major problem facing larger cities across the world. One such type of pollution is ground level ozone, which is formed through a reaction with heat or sunlight and nitrogen oxides. Ground level ozone has been shown to have adverse health and environmental impacts, such as irritation of the respiratory system or reduction in crop production.

High levels of ground level ozone have been linked to large-scale weather patterns both at the surface and in the upper atmosphere. For this reason, the main focus of this study was to analyze the atmospheric conditions that are associated with high concentrations of ground level ozone in Missouri. This information can be useful for air pollution forecasting in the state of Missouri and for air pollution modeling. Knowing the conditions favorable for the formation of ground level ozone could also provide a basis for pollution control and mitigation in Missouri.

The main objective was accomplished in three steps. First, an Air Quality Index for ground level ozone in Missouri was created using Environmental Protection Agency (EPA) procedures to help locate times when high ozone concentrations took place. Next, mixing heights, transport wind speeds, and ventilation rates were analyzed to determine their contributions to these high ozone concentrations. Finally, surface weather features and 500mb weather features were examined for each high pollution day to locate patterns at both levels.

Overall, the air quality in Missouri was found to be favorable. Only a few high ozone concentrations were found to have occurred during the ten-year study period. Mixing heights over Missouri were found to be fairly constant. However, using only mixing heights to predict high ozone days lacked reliability. In contrast, transport wind speeds were found to be highly variable. Overall, they offered a more reliable representation of when high ozone days would occur and were the most influential variable in the ventilation rate calculation. Ventilation rates also proved to be highly variable due to the fact that they are highly dependent on the transport wind speed. At the local level, ventilation rates were a reasonable indicator of when high ozone days would occur. Also, on the synoptic scale, ventilation rates were not as reliable at indicating when high ozone days would take place. At the surface, seven categories were found to be High to the North, High to the Northeast, High to the East, High to the Southeast, High to the South, High Over Missouri, and Miscellaneous Surface Features. At 500mb, four categories were found to be Ridge axis to the West, Ridge axis to the East, Ridge axis to both the East and West, and Zonal Flow.