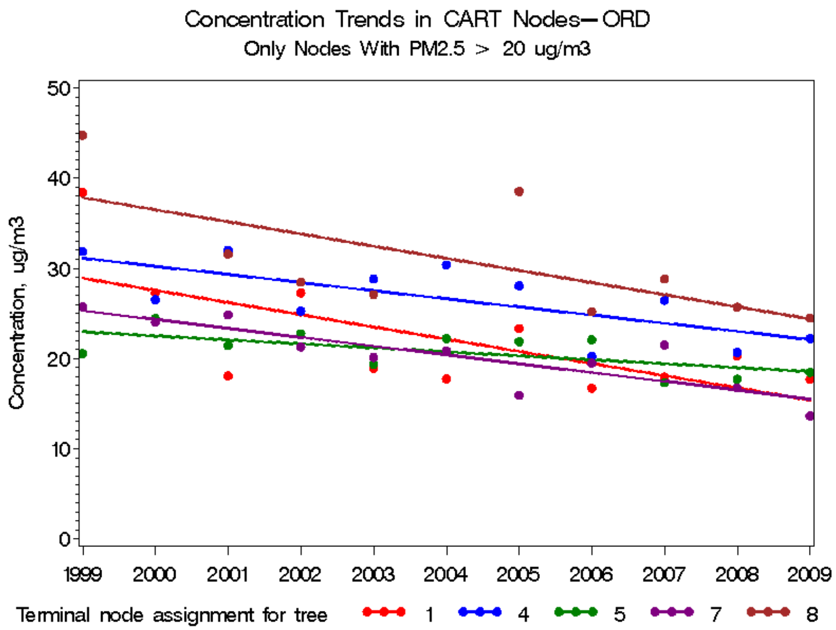
Summary of CART Analysis for PM2.5 Meteorologically Adjusted Trends (2010 update)

A classification and regression tree analysis (CART) was conducted for PM2.5 data from long-running monitors in eight Midwestern urban areas: Chicago, Cincinnati, Cleveland, Detroit, Indianapolis, Milwaukee, Minneapolis, and St. Louis. Data were from the 24-hour federal reference method monitors, extracted from EPA's Air Quality System. Meteorological data were from the National Weather Service collected at airports in each urban area, as well as upper air data from the nearest upper air site to each urban area. As in previous analyses, the goal was to develop a regression tree for each area that categorizes days by the meteorological conditions associated with high and low PM2.5 concentrations. The resulting regression trees for the eight Midwestern urban areas are provided in Attachment I. Then the high-concentration branches of those trees are used to examine trends over the 1999-2009 period. By looking at trends only in days with similar meteorological conditions, the trends are free from the influence of year-to-year weather variations. Annual conditions that are hotter or cooler than normal, or wetter or dryer than normal, can significantly impact air quality. By controlling for these meteorological variations, the remaining trend is presumed to be due to changes in emissions of PM2.5 or its precursors.

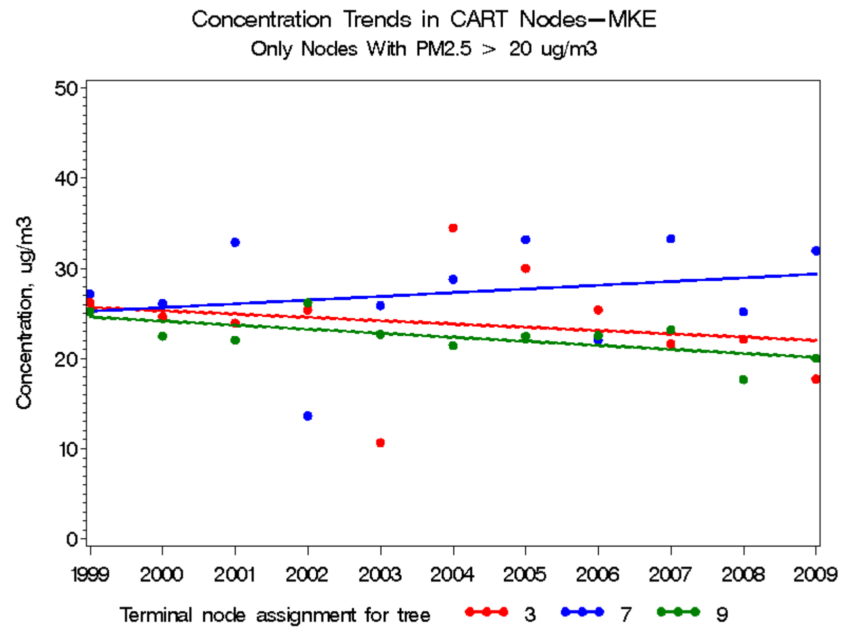
CART results were very similar to previous analyses done on earlier years of PM2.5 data. High PM2.5 is most strongly associated with extended periods of slow wind speeds (stagnant air masses) as well as southerly wind directions; warm temperatures in the summer and temperatures around freezing in the winter; and temperatures and pressures that are increasing from previous days. The specific results for each city differ slightly in the particular variables selected and decision points for those variables, but were overall quite consistent.

Trends in all eight urban areas were consistently downward; these results appear to show that regional emission reductions of SO2 and NOx in recent years have had a measureable impact on PM2.5. Minneapolis had only one trend line because the analysis was restricted to days greater than 20 ug/m3 and the generally low concentrations there meant that only one node of the CART tree met that condition. Milwaukee had one node (of three) with an increasing trend; this may be from an actual emissions increase or it may be a statistical anomaly. Otherwise, all high PM2.5 nodes of the CART trees had declining PM2.5 concentrations, as shown in the figures that follow.

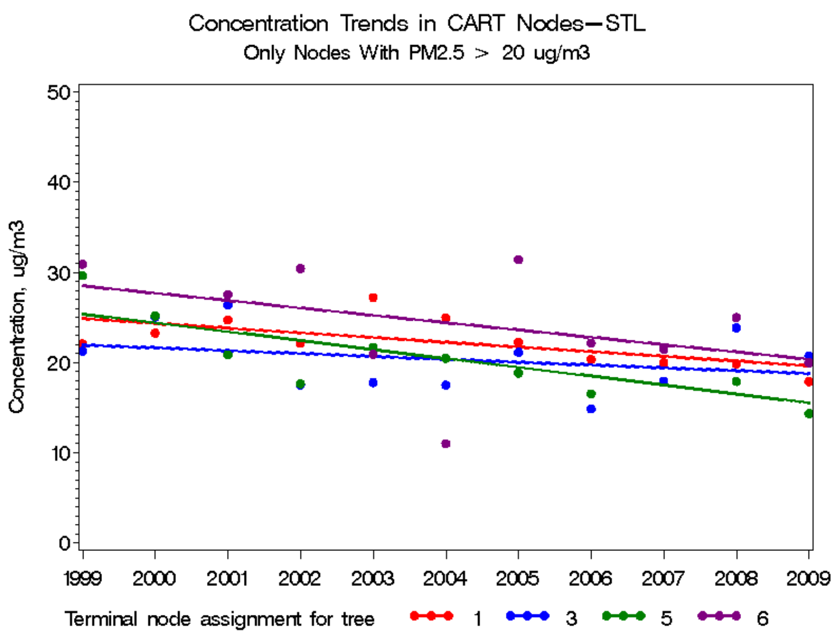
Chicago



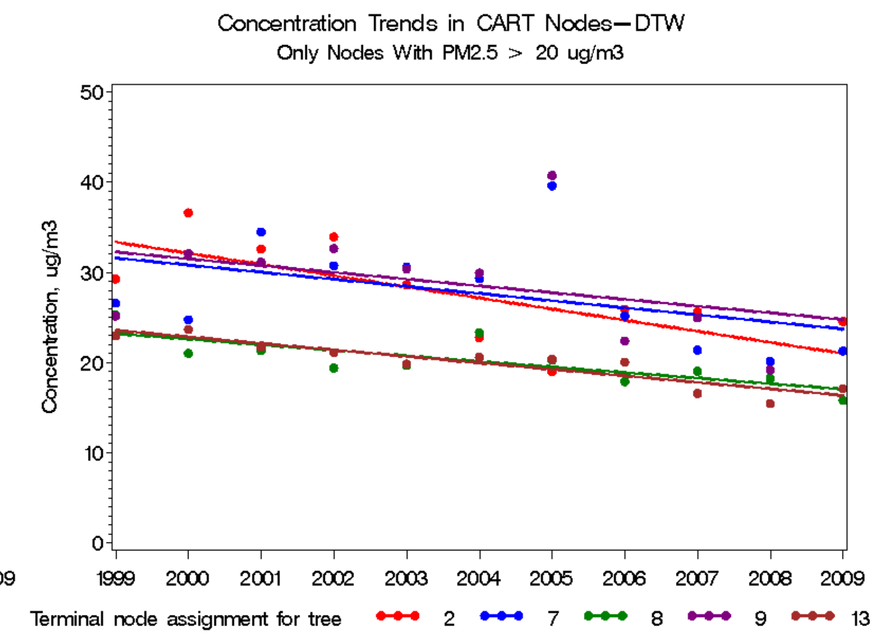
Milwaukee



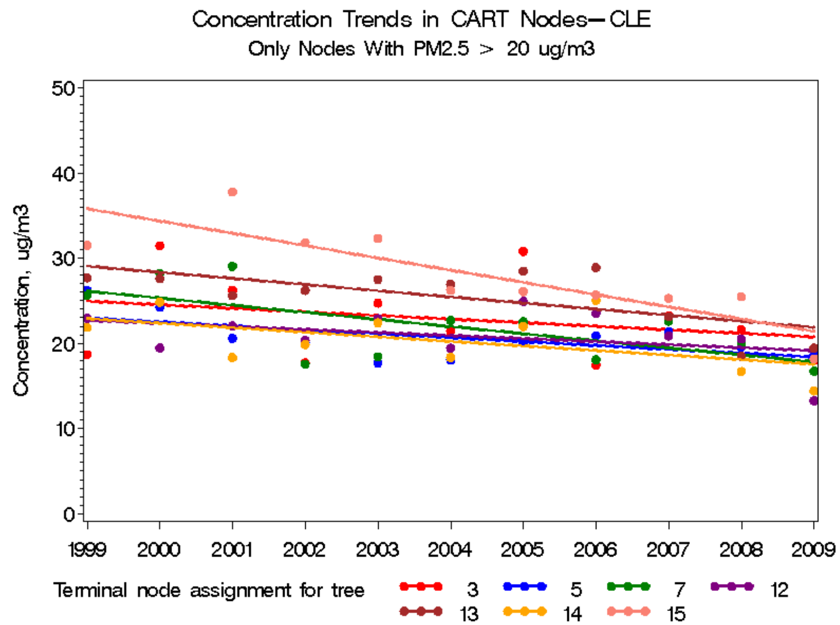
St. Louis



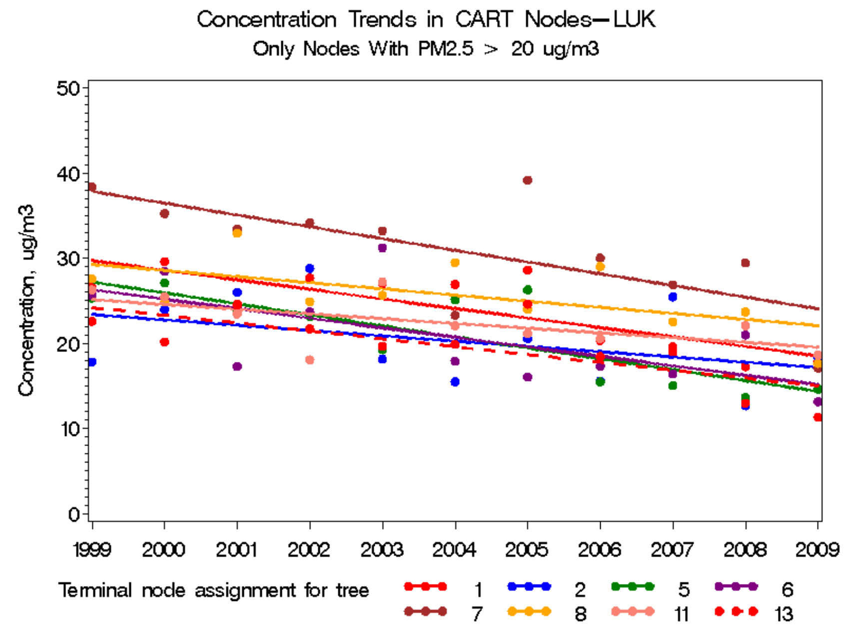
Detroit



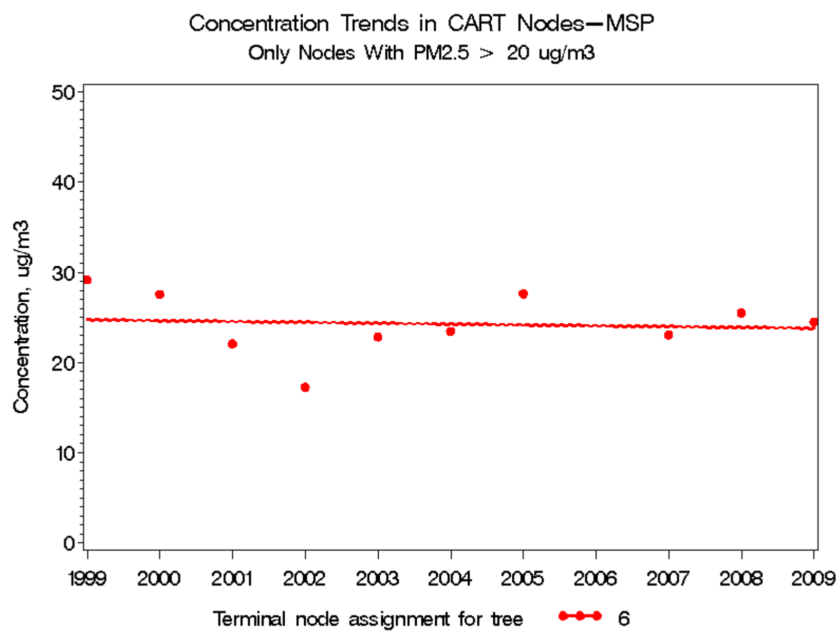
Cleveland



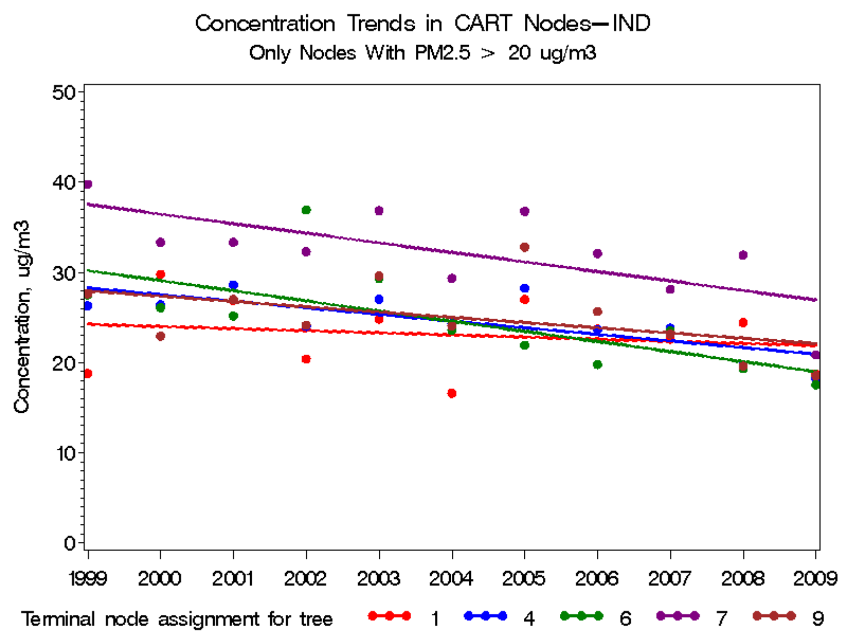
Cincinnati



Minneapolis

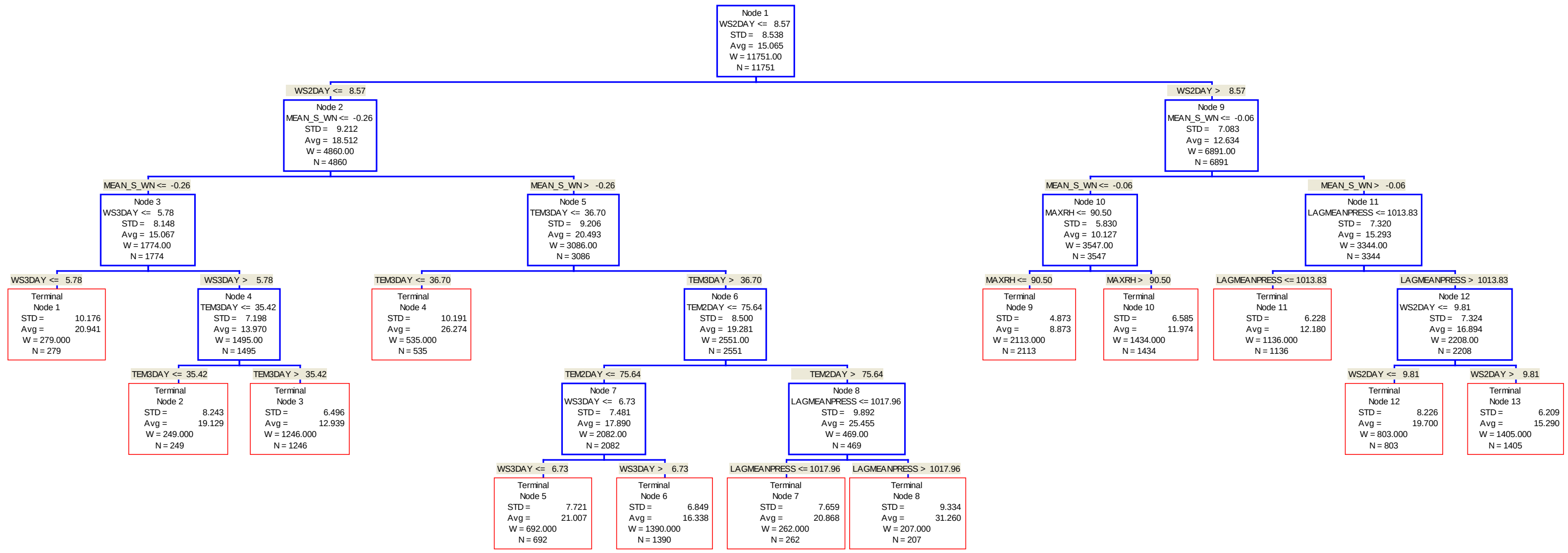


Indianapolis

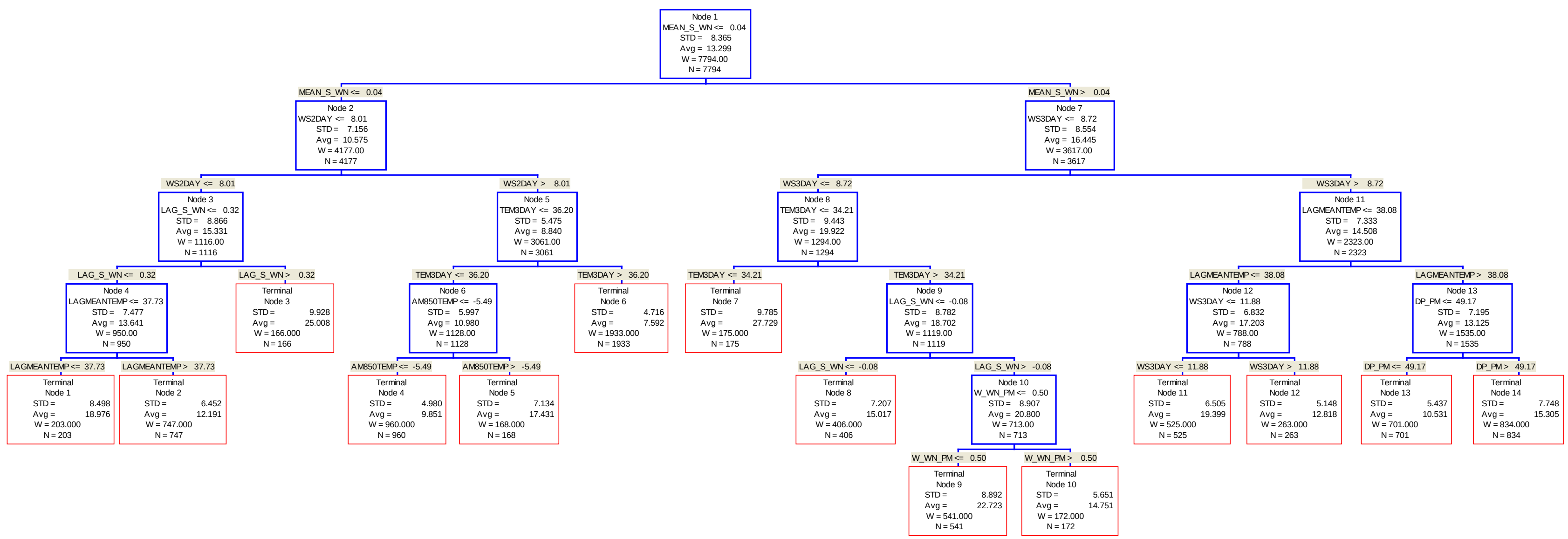


Attachment I – Regression Trees

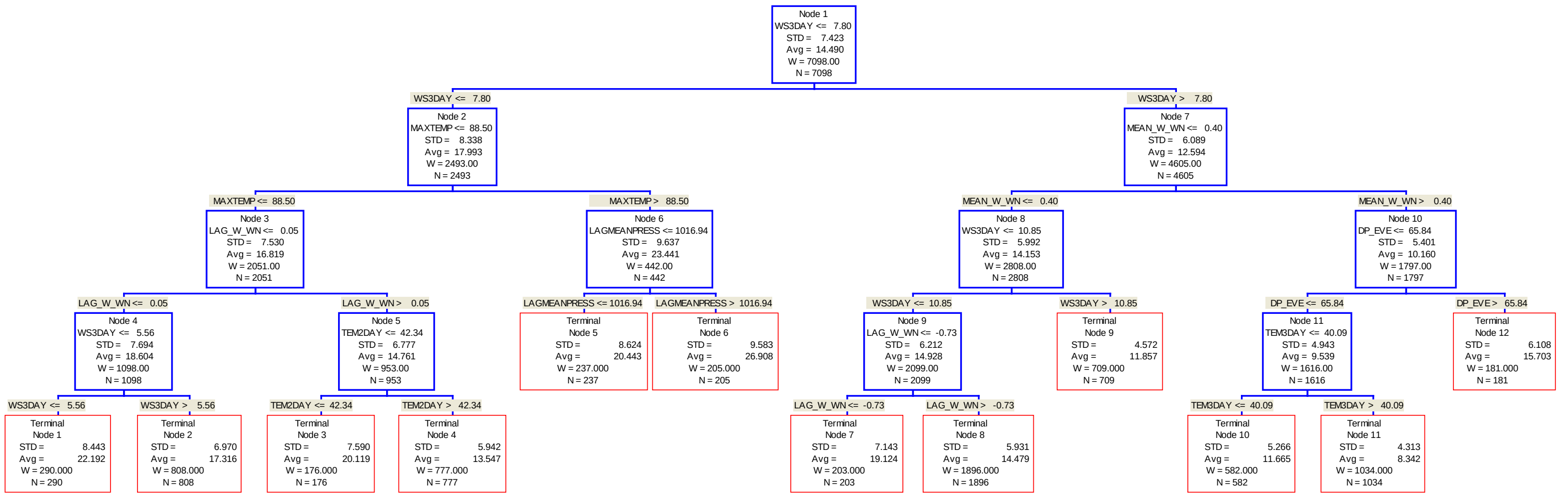
Chicago



Milwaukee



St. Louis



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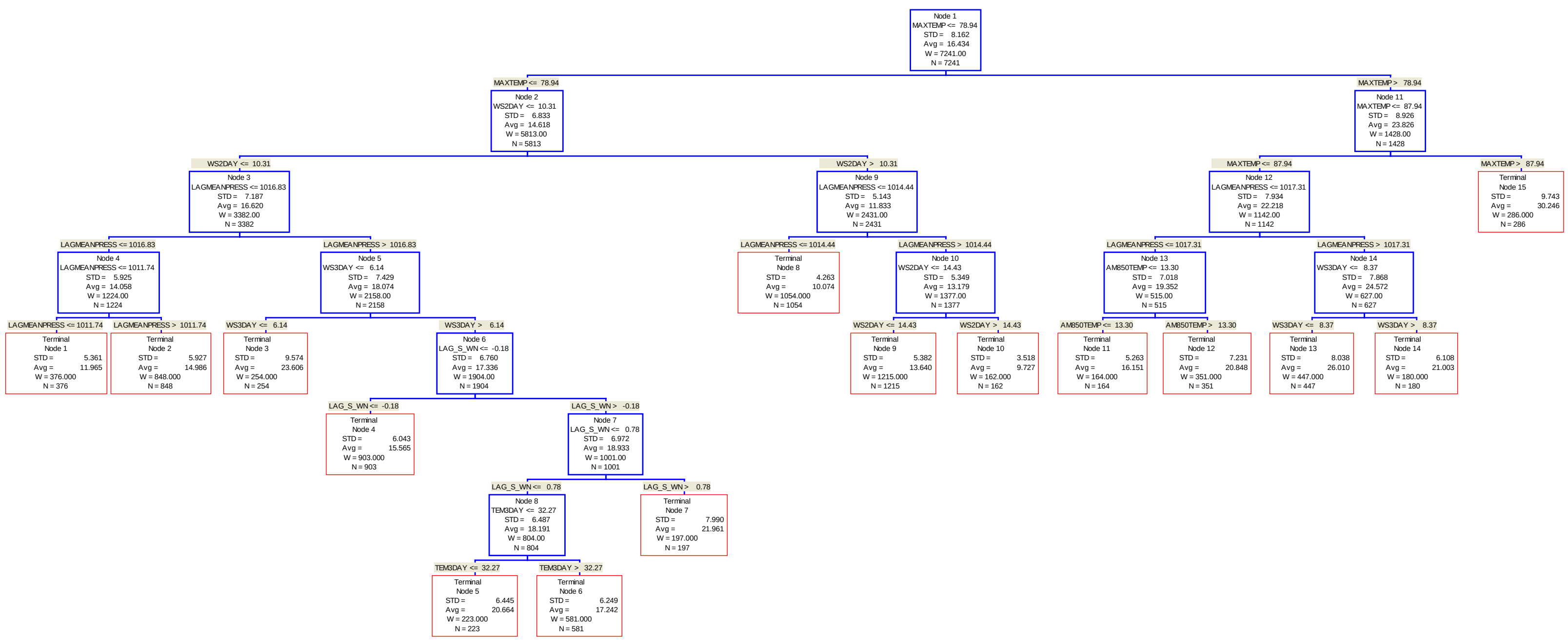
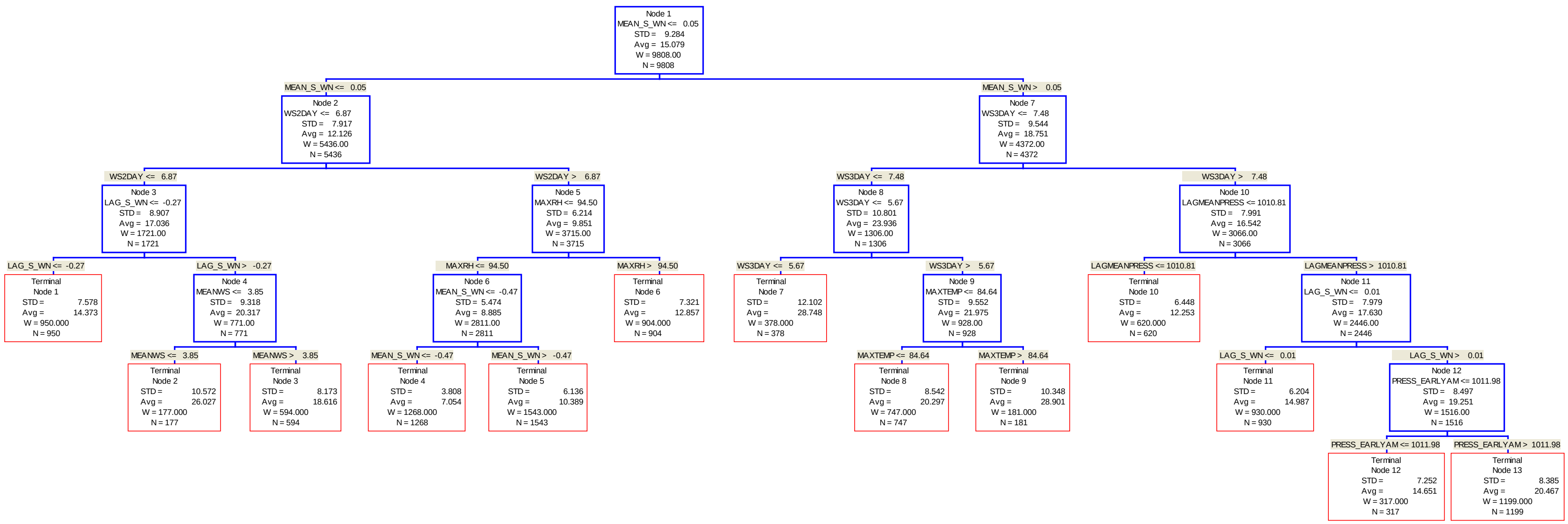
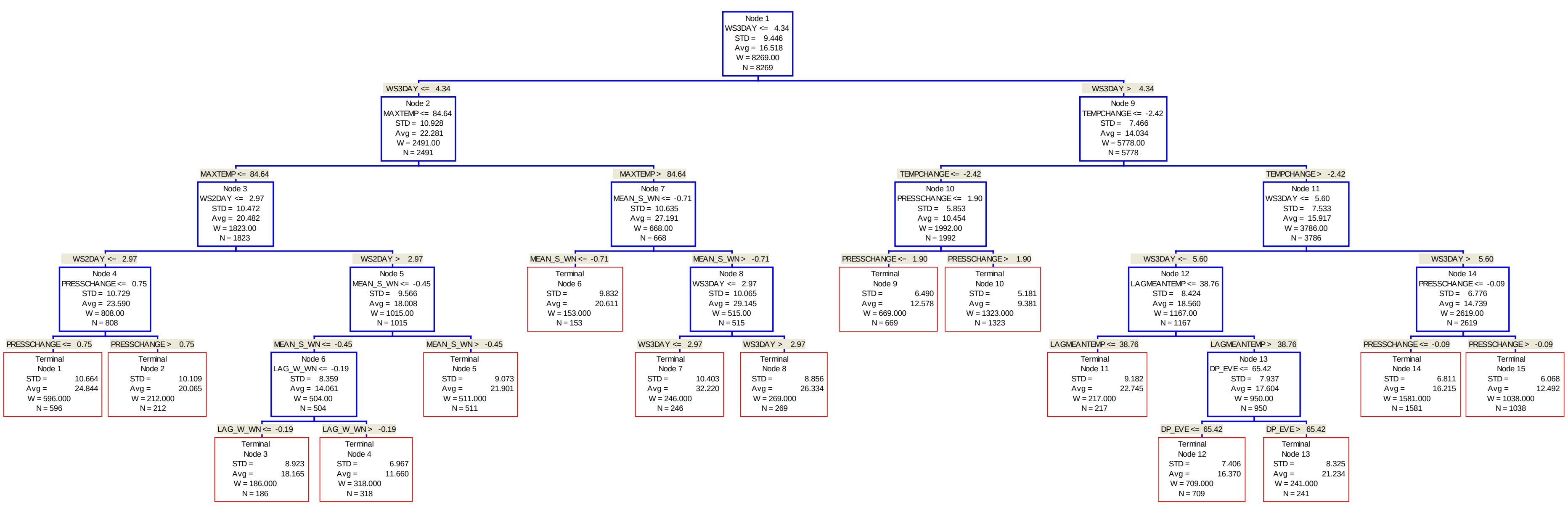


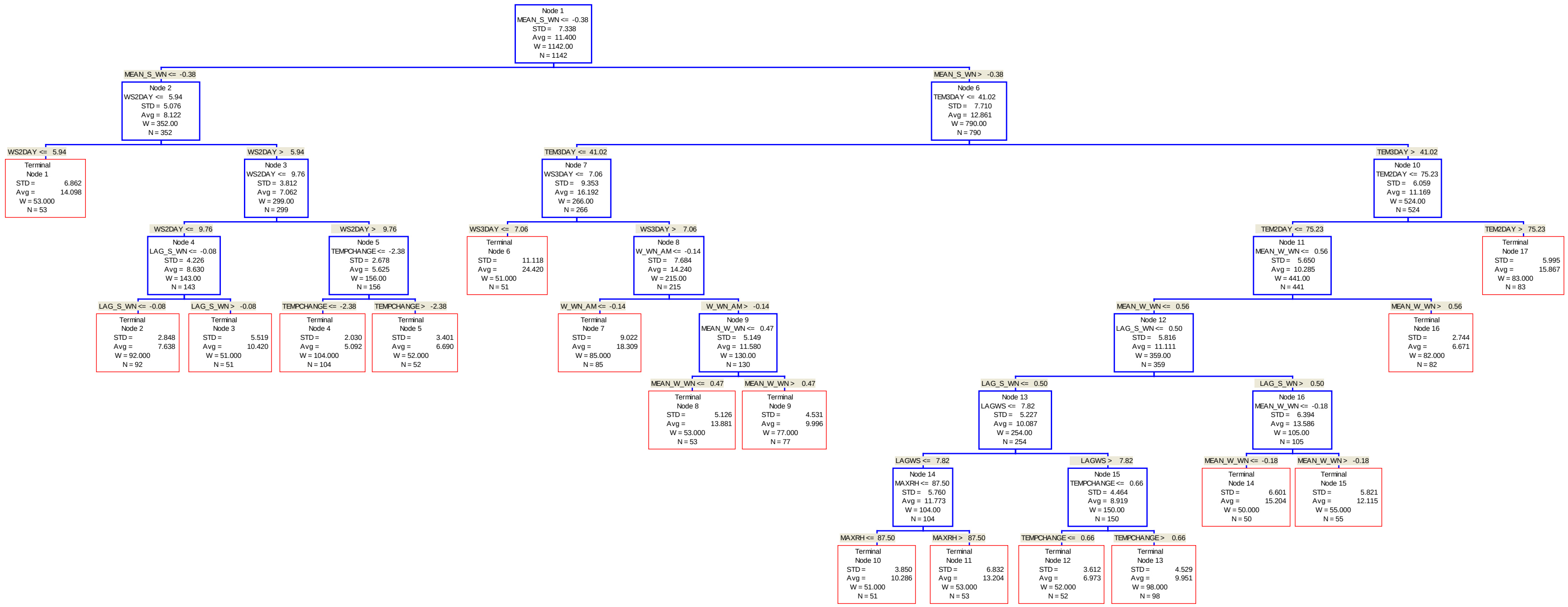
Cleveland



Cincinnati



Minneapolis



Indianapolis