A Model of Precipitation Rates in Kentucky, 1965 – 1996

Kevin B. Cary

Abstract: Hourly precipitation data from thirty cooperative stations in Kentucky from 1965 to 1996 were used to determine the diurnal distribution of precipitation rates. Descriptive summaries for the diurnal distribution for each climate division in Kentucky and for Kentucky as a whole were calculated. In each case, the trends were similar. Precipitation rates increased into the afternoon and then decreased until sunrise.

A stochastic model was developed to estimate mean seasonal precipitation rates in Kentucky by using regional and localized parameters. More than half of the variation ($r^2 = 0.57$) in precipitation rates can be explained by the following variables: 1) Distance away from the moisture source, the Gulf of Mexico; 2) Roughness of topography; 3) Degree of urbanization.

Precipitation rates decrease in a northeasterly direction across Kentucky as air moves farther away from the Gulf of Mexico along its path of migration. The maritime tropical air mass migrating out of the Gulf of Mexico loses its water vapor over its path of migration. As a result, less water vapor is available for precipitation processes in areas farther away. As a precipitation event moves over rougher terrain and more urbanized areas, precipitation rates decrease as well. A rougher terrain absorbs more solar radiation because it has more surface area. An urbanized area absorbs more solar radiation because of the urban structures (e.g., buildings, asphalt, roofs). As a result, both will radiate more heat causing the air to be buoyant at the surface to either enhance convection or increase vertical air motions. This will cause an increase in air resistance acting upon precipitation falling. Therefore, causing a decrease in the amount falling to the surface per hour.