The elevation-dependence of snowfall in the Appalachian Ridge and Valley Region of Northeast Pennsylvania

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Northeast Pennsylvania including the cities of Wilkes-Barre and Scranton is located in an area typical of the Appalachian Ridge and Valley Region, characterized by long northeast-to-southwest oriented ridges running parallel to broad valleys. Snowfall in this area often varies considerably in short distances due to differences in elevation; however there are times when elevation does not appear to substantially affect snowfall totals. In order to study the impact of elevation on snowfall in this region, a collection of 40 snow events in northeast Pennsylvania from 2005-2014 was studied. The median high-elevation versus low-elevation snowfall ratio for the 40 events in the study was 1.25, however, several events were identified that departed substantially from the average. The primary goal of this study is to give forecasters an understanding of factors that modulate the impact of elevation on snowfall in the Appalachian Ridge and Valley Region, including northeast Pennsylvania.

In order to illustrate factors that helped to determine differences in the dependency of snowfall on elevation for this area, nine events with a large elevation dependency were compared to twelve events with a relatively small elevation dependency.   Composite analyses indicated that high elevation dependency was most likely during events with relatively high-amplitude flow patterns and deep surface cyclones along the east coast. Composites of low dependency cases also indicated low pressure along the east coast; however, the flow was less amplified. Examination of model forecast soundings showed that large elevation dependency was most likely for events with strong lower-tropospheric winds. Large elevation dependency was also most likely when surface temperatures at Avoca, Pennsylvania exceeded 30 °F. A relatively weak, inverse correlation was found between elevation dependence and lower-tropospheric stability. The Froude number, which is a function of wind speed, wind direction and stability, was shown to be a useful parameter for determining the impact of elevation on snowfall. A regression equation was developed to aid forecasters with determining the impact of elevation on snowfall. Two case studies were shown that compared the output of the equation to forecasts from a high resolution model ensemble and observations. It was shown that output from the regression equation can be used in conjunction with high resolution model guidance to realistically assess the impact of elevation on snowfall in northeast Pennsylvania.