

Kentucky Wind Directions and Magnitudes: A Tool for Siting Barns

Josh Jackson, Morgan Hayes, Matt Dixon, Biosystems and Agricultural Engineering

Wind is variable in time and space. This is especially true across the commonwealth of Kentucky, considering the geographical variety from the Eastern Kentucky mountains to the flatter grain-production region in Western Kentucky. In particular, there is a region of potentially variable wind around Cincinnati, near the Ohio River. In trying to account for this variability, monthly wind maps across the commonwealth of Kentucky have been developed using the past 30 years of recorded wind data. These data can be used to assist in site evaluations for barns and planning farmstead layouts. Knowing wind speed and direction will help optimize the natural ventilation taking place within agricultural buildings.

One important note is that wind speeds are typically measured at 10 m (30 ft) above the ground. Wind speed at ground level is lower than that measured at 10 m; the topography will affect how much that wind speed is reduced at heights closer to the ground. In order to guarantee better ventilation in naturally ventilated barns, higher wind speeds approaching a barn will increase the potential ventilation rate. Choosing locations on a hill and not surrounded by trees will increase air speeds that do enter the

barn, thereby increasing the ventilation rate through those barns. Figure 1 shows how wind speeds are typically influenced by height above ground level.

One method to determine wind speed and direction locally is to download a wind rose from a local weather station. Wind roses demonstrate percent of time when wind comes from each of the various directions over the whole year or for specific months depending on the wind rose chosen. The cardinal directions on the wind rose indicate the wind coming from north, south, east, and west. In this example (figures 2 and 3) the wind rose includes 16 directions. Each direction is portrayed like petal on a flower; hence the name wind rose. The larger the petal, the higher the frequency that the wind comes from that specific direction during the period of time described in the wind rose. The wind rose has concentric circles that note 5 and 10 percent as the frequency that a wind will come from a specific direction. Wind roses can be developed to include wind direction and magnitude for a specific month (Figure 2) or can include the entire year (Figure 3). Wind roses also break down wind speeds into different categories. Typically, the wind rose will include these wind speed

categories as a legend noting either a mile-per-hour or meter-per-second wind speed as the descriptive unit. Typically, the lowest wind speeds are in the center of the wind rose and the higher speeds are further from the center. The specifics for downloading a wind rose are available at: <http://weather.uky.edu/windrose.php>.

Across the state of Kentucky, approximately 30 years of hourly weather data (1987-2017) from eight different stations was collected and interpolated to provide an approximately 18 mile by 20 mile grid across the state. The figure (4 a-l) provide monthly variation across entire state demonstrating average wind speed and direction. While these figures don't show the variability in wind speed they are still useful in siting new barns and selecting correct orientations to take advantage of average wind directions and anticipating wind speeds typical in different areas of the state. Keep in mind, these figures are interpolated from larger weather stations, localized weather patterns could be influenced by mountains, bodies of water, large buildings, or other geographical figures.

There are couple trends in these figures that should be noted. Summer wind speeds on average were lower than winter wind speeds. This is typical across the US but can be a challenge when naturally ventilated barns depend on wind speed for cooling effect during hot summer months. These lower summer wind speeds makes utilizing these data for proper barn orientation even more critical during the planning stages. The wind direction is primarily from the south or southwest throughout the state, when planning for opening on barns we want to ensure that the sidewalls are oriented to take advantage of this wind direction. There are slight variations in wind direction by month, but in most areas predominant wind will remain from the south or southwest.

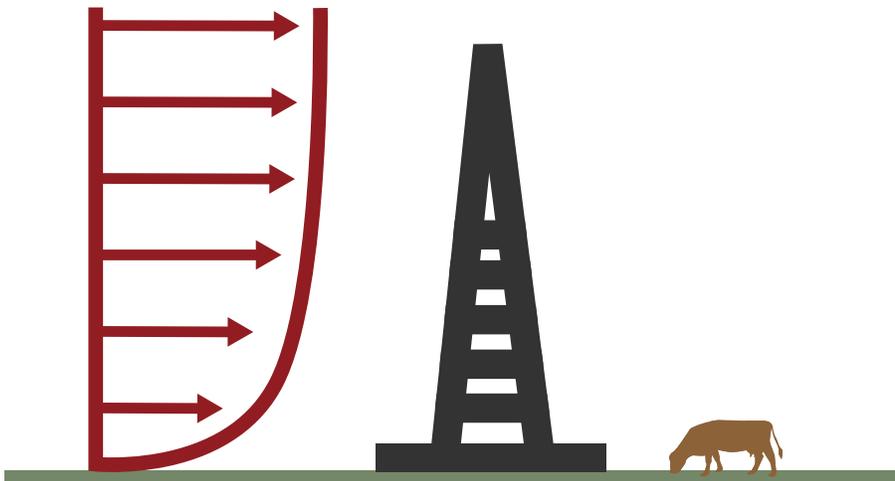


Figure 1. Red arrows indicate wind speed as it is affected by height. The weather station sensors will be located at 10 m (30 ft) above ground level.

BOWLING GREEN WARREN CO AP (KY) Wind Rose

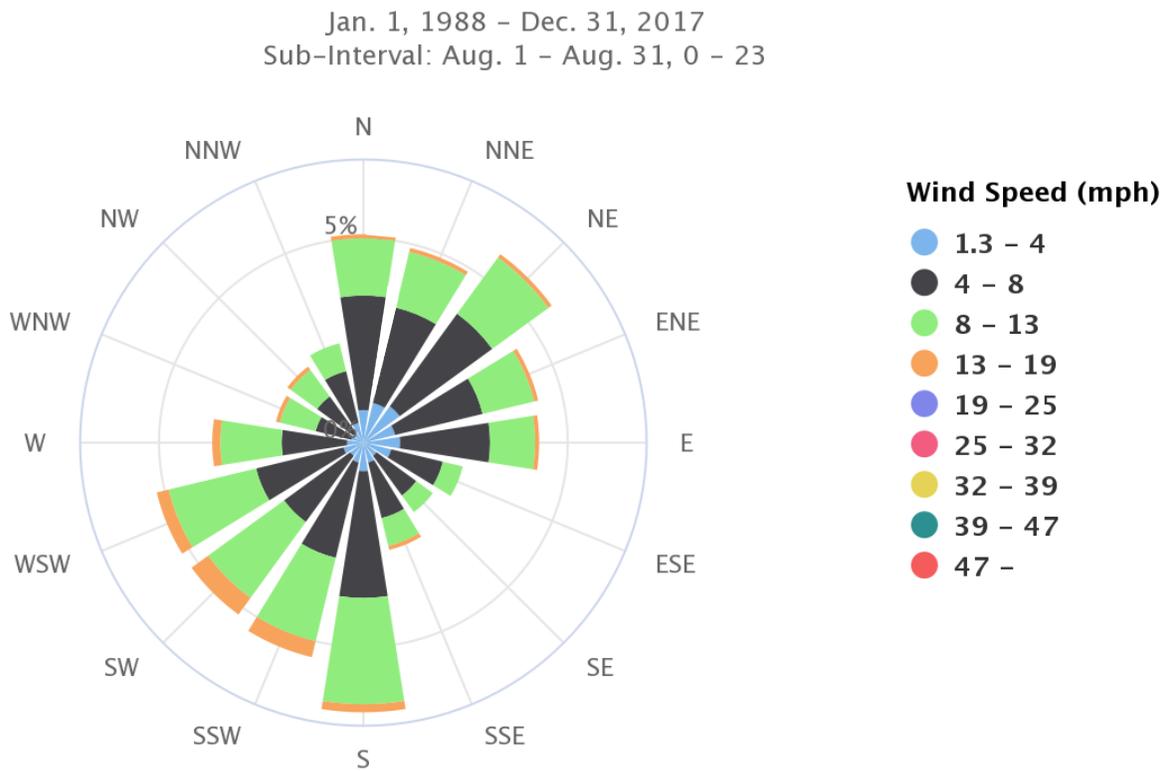


Figure 2. Wind rose for Bowling Green, KY, specifically for the month of August.

BOWLING GREEN WARREN CO AP (KY) Wind Rose

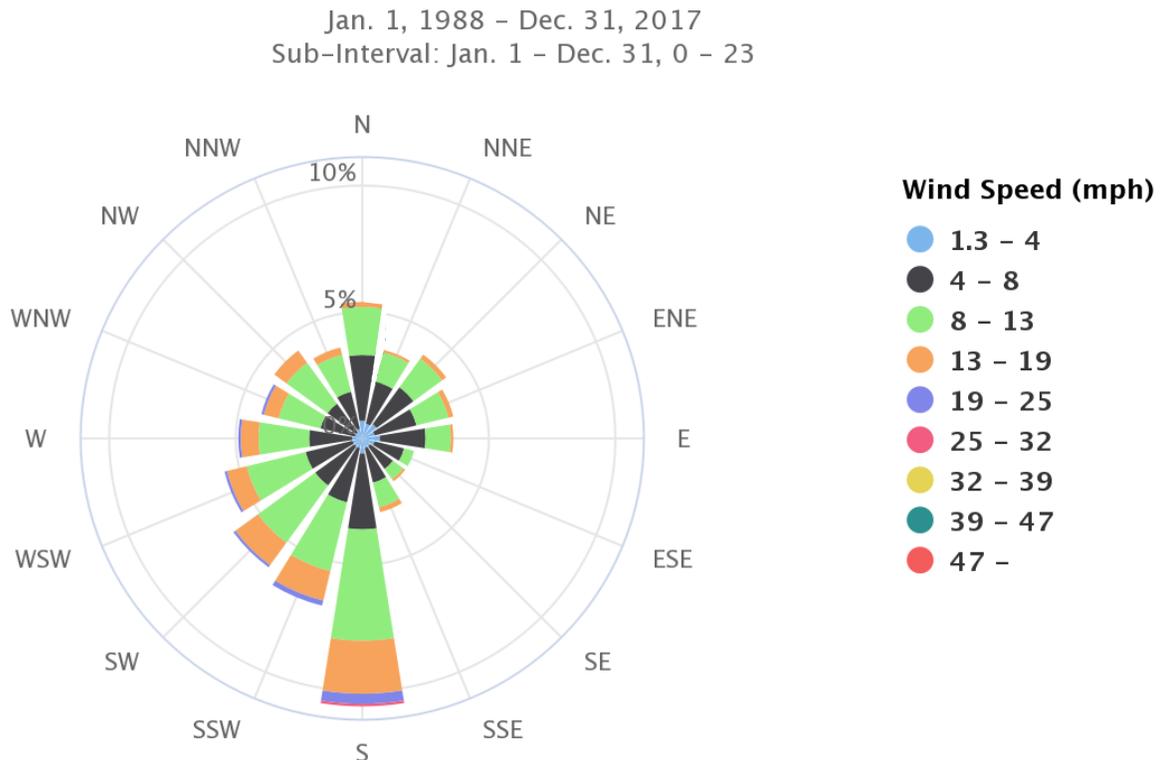


Figure 3. Wind rose for Bowling Green, KY, over the entire year.

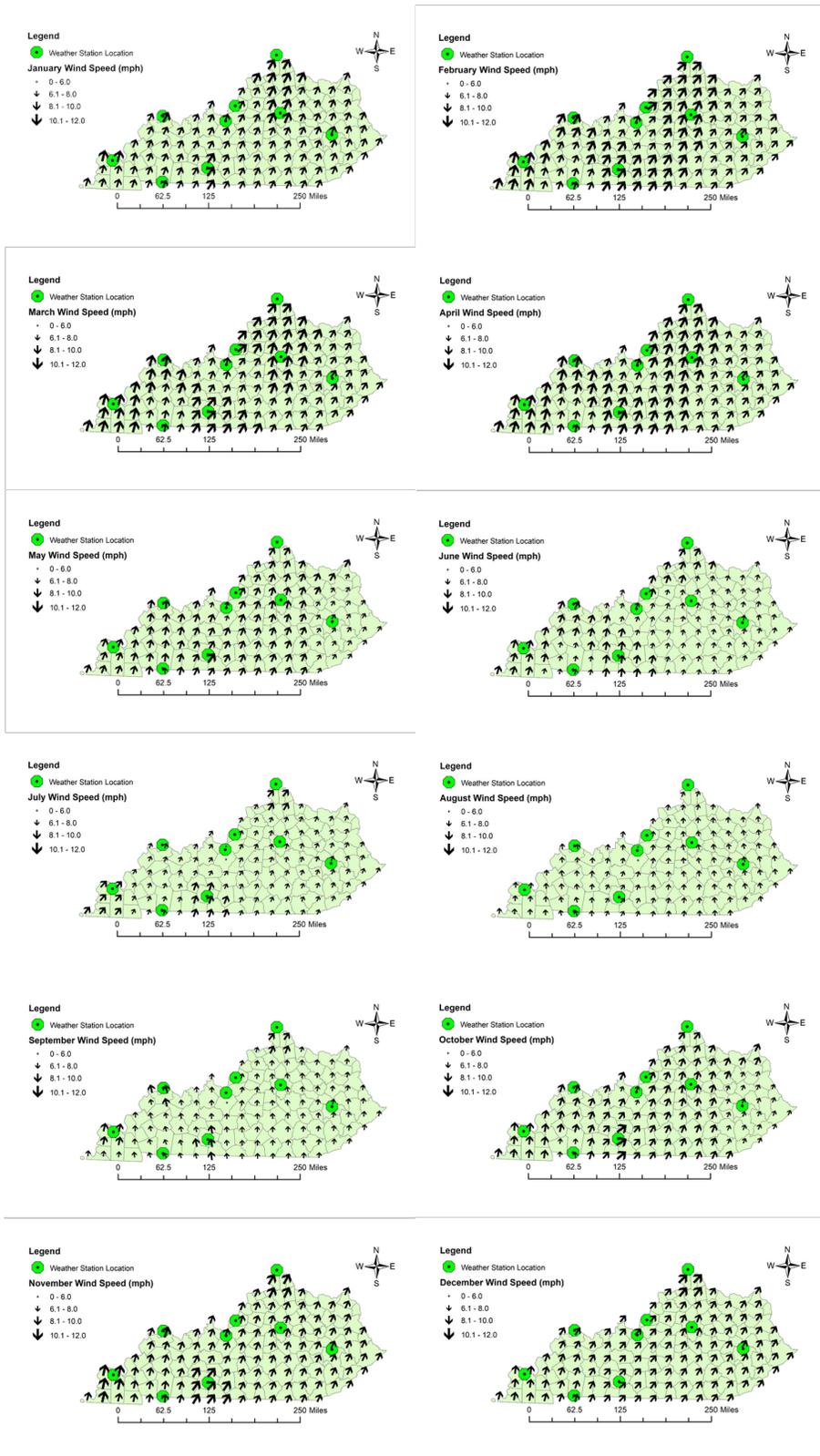


Figure 4. Maps of wind speeds and directions by month across the state of Kentucky based on 30-year weather data.

Educational programs of Kentucky Cooperative Extension serve all people regardless of economic or social status and will not discriminate on the basis of race, color, ethnic origin, national origin, creed, religion, political belief, sex, sexual orientation, gender identity, gender expression, pregnancy, marital status, genetic information, age, veteran status, or physical or mental disability. Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Nancy M. Cox, Director, Land Grant Programs, University of Kentucky College of Agriculture, Food and Environment, Lexington, and Kentucky State University, Frankfort. Copyright © 2019 for materials developed by University of Kentucky Cooperative Extension. This publication may be reproduced in portions or its entirety for educational or nonprofit purposes only. Permitted users shall give credit to the author(s) and include this copyright notice. Publications are also available on the World Wide Web at www.ca.uky.edu.
 Issued 5-2019

References

Climate Data: NOAA/FAA/DoD: Automated Surface Observing System (ASOS)/Automated Weather Observation System (AWOS) hourly data obtained from the Midwestern Regional Climate Center, cli-MATE (MRCC Application Tools Environment, on /CLIMATE/.

Wind Roses: cli-MATE, Midwestern Regional Climate Center. Illinois State Water Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign. Available: <http://mrcc.illinois.edu/CLIMATE> accessed on: 16/04/2019.