

# Changes in Wind Speed over Iowa

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## Introduction

The purpose of this research was to calculate wind speed trends across the state of Iowa. With over 15% of Iowa's electricity generated by wind energy (AWEA 2011), understanding changes in wind speed is very important. We used Automated Surface Observing Station (ASOS) data taken from the Iowa Environmental Mesonet (IEM) to create graphs of wind speed trends for the following cities: Omaha, Des Moines, Dubuque, Mason City, Sioux City, and Burlington. We used FORTRAN programming to create annual, seasonal, and diurnal averages of wind speed at the six locations. Trends in other variables like temperature and precipitation have been reported for stations across Iowa (ICCIC 2011) over the last thirty to fifty years. Our poster will report our findings for changes of wind speed across Iowa for these time periods.



Figure 1: Iowa's Station Map

## Data and Methodology

Wind speed measurement data was compiled from Automated Surface Observing Station (ASOS) data taken from the Iowa Environmental Mesonet (IEM) to create graphs of wind speed trends for the following cities: Omaha, Des Moines, Dubuque, Mason City, Sioux City, and Burlington. This data was processed using FORTRAN programs, and the output was used to create annual, seasonal, and statistical graphs. The graphs have a 70 year time period, allowing us to have a visual of past and present changes to wind over Iowa. For the annual trends, we used the full available time frame. For the seasonal trends, we divided each year's 12 month period with Spring being months 3-5, Summer 6-8, Fall 9-11, and Winter 12-2 and averaged over the full available time frame. We also graphed wind roses for the cities that show the percentages of winds from each direction with bins every 30 degrees. The radar graphs were compared to one another by having a past and a present 30 year average of wind direction, from 1951-1980 and 1981-2010, to see if any changes in wind direction have occurred.

## Annually Trends

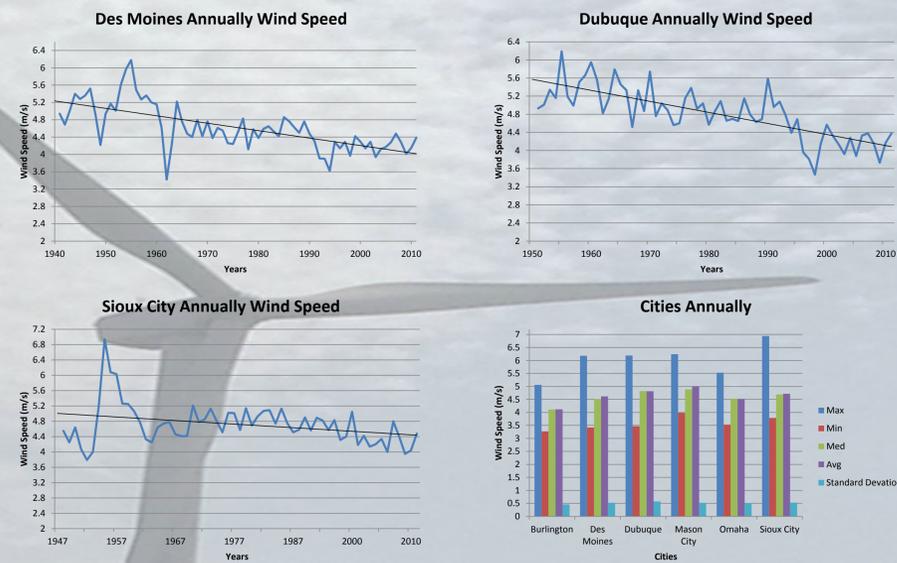


Figure 1: The figures above show the average wind speed (m/s) for the four seasons for the city of Des Moines. This data then was plotted as a line graph with a trend line used to represent the long-term movement in the data. An overall decrease can be seen for each season, although winter and spring show a slight increase over the last decade.

## Des Moines Seasonal Wind Speed Trends

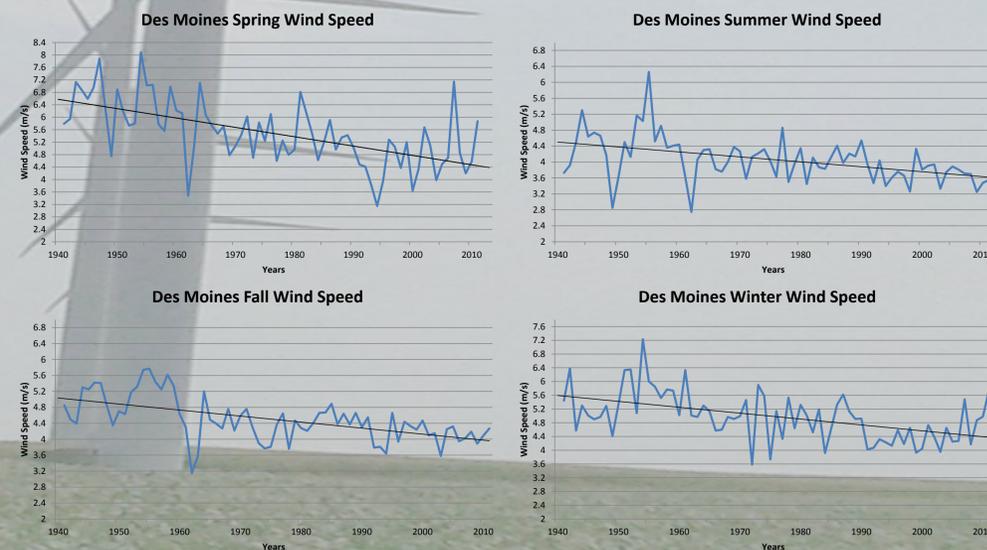


Figure 2: In these figures, the annual trend was used to show whether there has been an overall increase or decrease of the wind speed (m/s) for each city. A consistent decrease has occurred for each city over the period of record. We also used the annual data collected to find the max, min, median, average, and standard deviation of wind speed (m/s) for each city, plotted in a bar graph for easy comparison. The highest wind speeds are found in the northwest part of the state and the lowest in the southeast part of the state.

## Wind Roses Trend

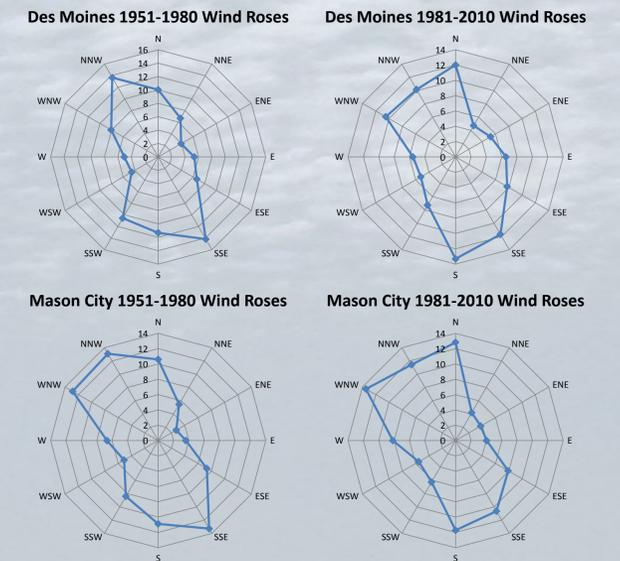


Figure 3: In these figures, wind roses were constructed to find the average wind direction (degrees) for the past period 1951-1980 and the present period 1981-2010. A comparison between the two periods shows a clockwise shift in wind direction of about 30 degrees.

## Conclusions

- Overall wind speed has decreased by about 1m/s through the time of gathered data, which has important implications for Iowa's wind energy.
- The highest wind speeds are found in the northwest part of the state and the lowest in the southeast part of the state, with the standard deviation similar across all cities.
- The seasons don't differ much in the magnitude of change, but the decrease in wind speed is again consistent.
- Wind direction has been changing, such that the average from past has shifted clockwise by about 30 degrees to the present.

## Acknowledgement

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## References

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