Visualizing Lake Michigan Wind
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Abstract
A wind resource assessment buoy, residing in Lake Michigan, uses a pulsing laser wind sensor to measure wind speed and direction offshore up to a wind turbine hub-height of 175m and across the blade span every second. Understanding wind behavior would be tedious and fatiguing with such large data sets. This paper covers graphical approaches to evaluate wind speed validity, seasonal wind speed variation, and storm systems to inform engineers about the energy potential of Lake Michigan offshore wind farms.

The WindSentinel™

On-board Monitoring Systems:
• Wave
• Current
• Water quality
• Water temperature
• Basic Wind
• Atmospheric Pressure
• Solar radiation
• Sonar & audio and...
• Laser Wind Sensor (LWS)

Project Collaborators:
A total of 65 individuals
• U.S. Department of Energy
• Federal and State Agencies
• Grand Valley State
• AXYS Technologies
• Other Universities

Location:
Mid-lake Plateau
(W43° 20' 31.20", N87° 7'12.00")

Dates:
May 7 – Dec 19, 2012

Visualize High Wind Events
Winds from hurricane Sandy registered on our device in Lake Michigan. As you can see, data degradation occurred at the highest altitude (green).

Exploration topic:
Are winds really that variable during storms?
Notice these wind speeds on July 31, 2012 vary from 1-m/s to 30-m/s

Method: create a 5-second moving window standard deviation statistic to overlay on wind speed graphic. Next, we visualize this relationship BY our data validity indicator.

Result: No, winds are not as variable as they seem. According to the data, the most variable winds are actually invalid readings by our laser wind sensor (denoted by gold and blue above). The highest valid 5-sec stddev reaches ~5, half as high as the highest invalid observation at ~10.

Visualize Seasons

BIG picture visualization:
23 Million 1-sec obs
38k 10-min aggregated obs
~500 day min and max obs

Conclusion
For wind analysts to dissect and interpret key wind attributes, visualizing the data is key. Special thanks to Dr. Zeitler and Dr. Standridge for the research opportunity.