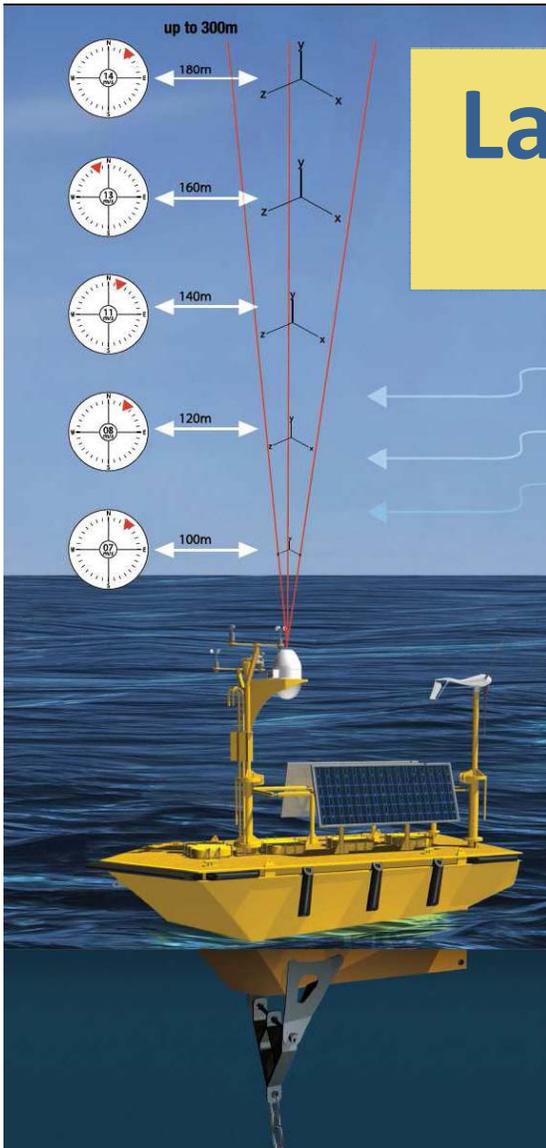


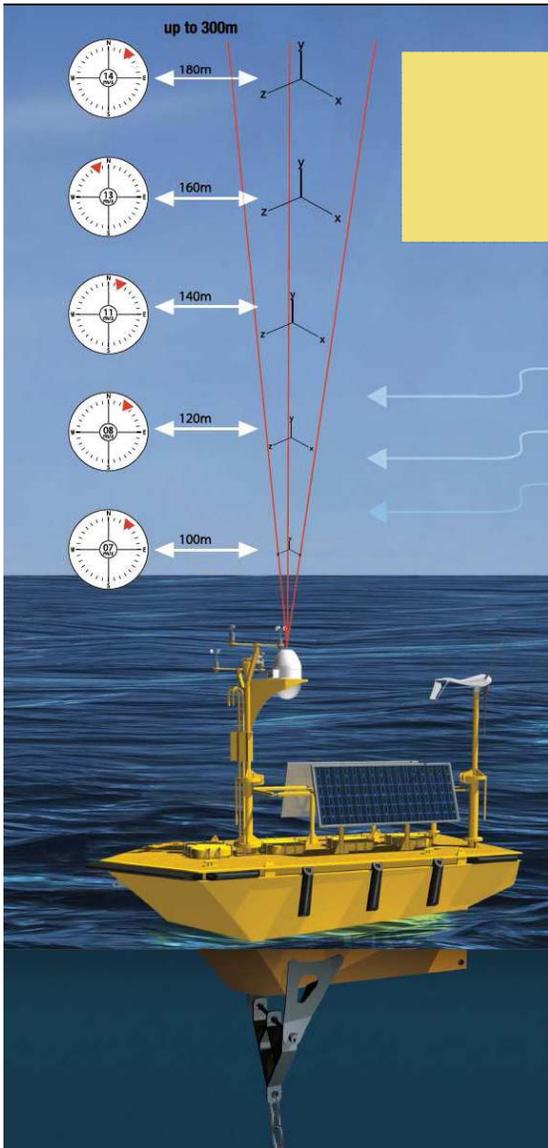
Lake Michigan Offshore Wind Assessment Project

- A Research Partnership Project of:
- *Grand Valley State University*
Michigan Alternative and Renewable Energy Center (MAREC)
 - *University of Michigan*
Michigan Memorial Phoenix Energy Institute (MMPEI)
 - *Michigan Natural Features Inventory*
of Michigan State University Extension



Project Goals

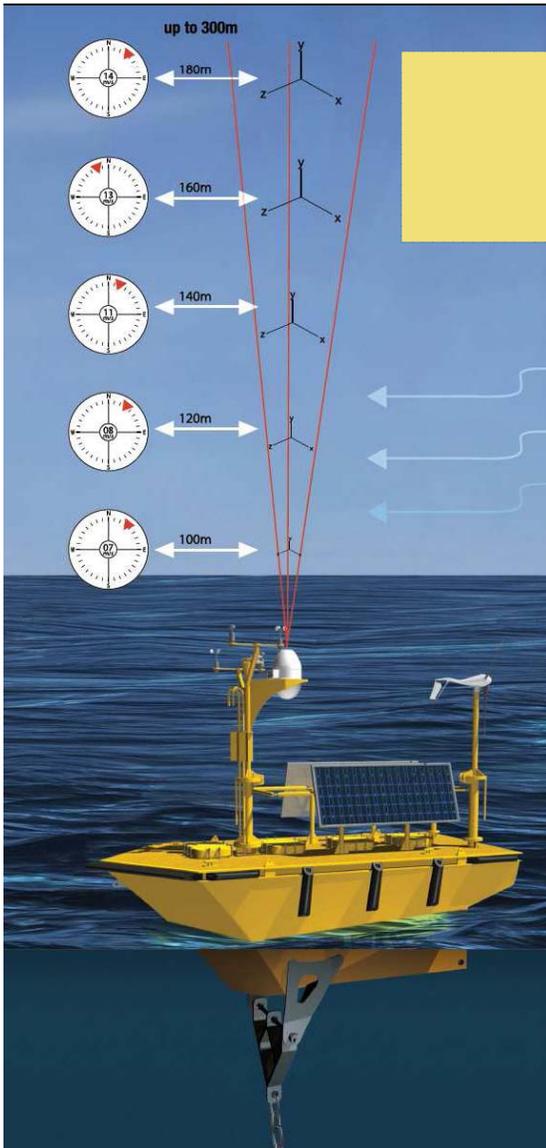
- To collect and analyze wind data essential to the consideration of future wind industry development on the Great Lakes
- To develop real-time and hub-height offshore wind data called for by prior Great Lakes wind assessment studies
- To advance the work and efforts of the Mich. Great Lakes Offshore Wind Council (GLOW)



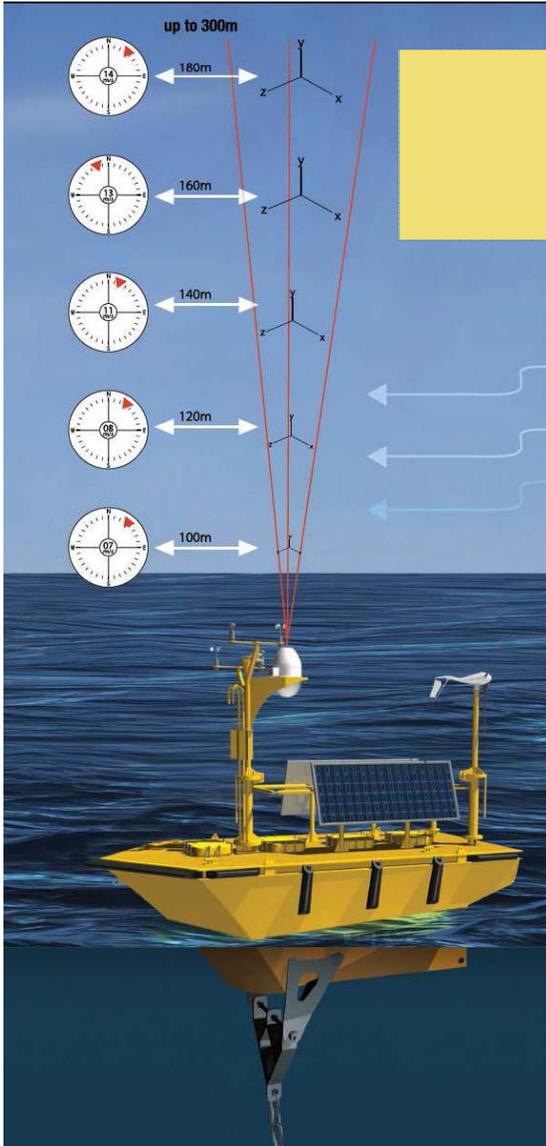
Research Objectives

Project provides a unique opportunity to conduct high quality multi-disciplinary research on the Great Lakes

- To conduct a real-time wind assessment of Lake Michigan and to develop a greater understanding of the GL wind resource overall
- To validate the use of laser wind sensor technology on a buoy platform in an offshore environment
- To provide an objective basis for future public policy related to wind energy development



Funding Support

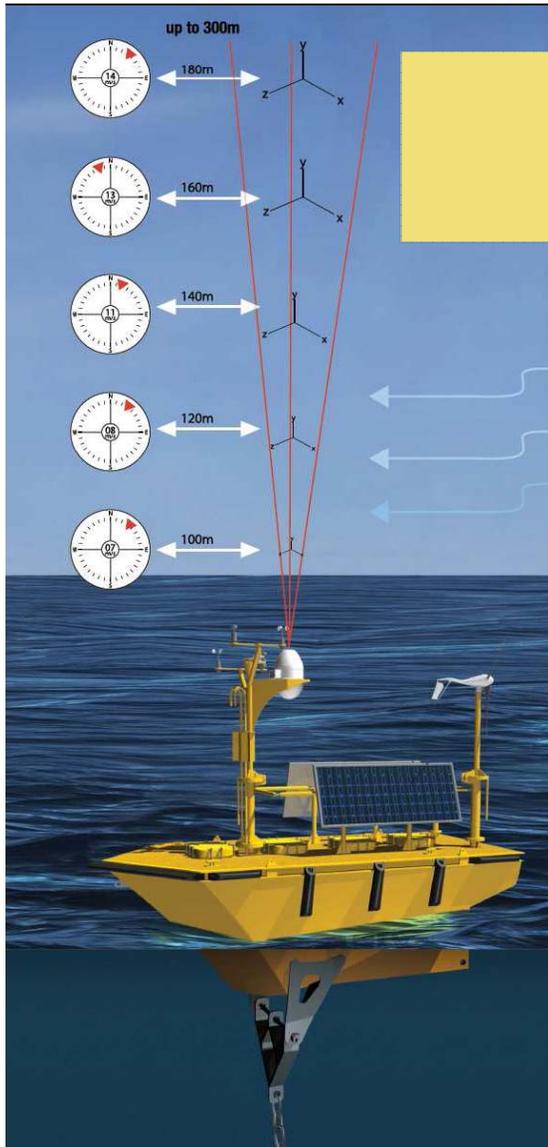


U.S. Dept. of Energy -	\$ 1,427,250
MI Public Service Commission -	\$ 1,316,177
University of Michigan -	\$ 334,272
We Energies of Wisconsin -	\$ 250,000
Sierra Club -	\$ 30,000

Project Total: \$ 3,377,892



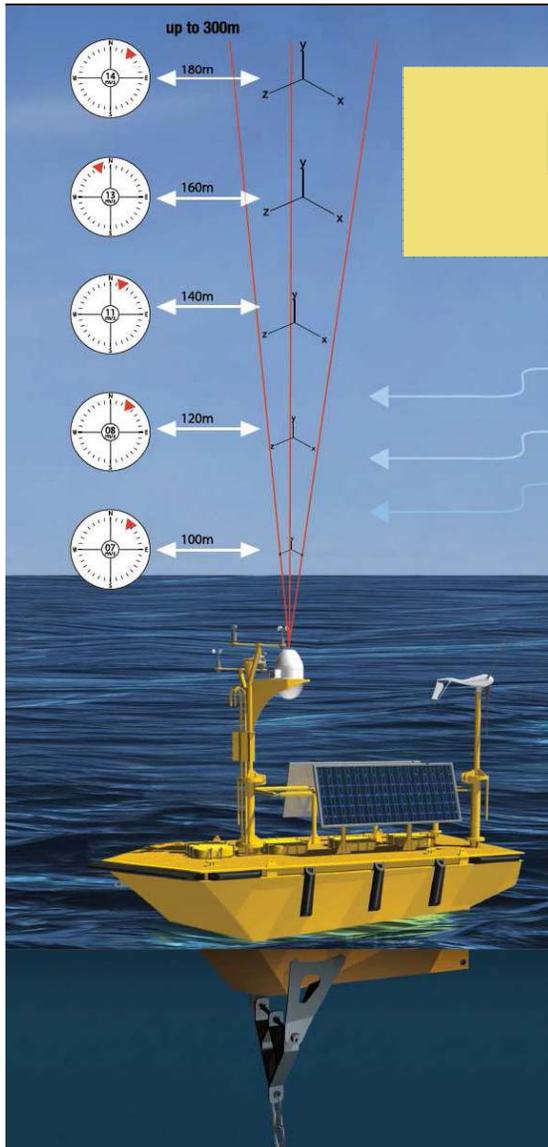
Research Technology



- ❖ **AXYS WindSentinel** remote sensing buoy
 - 6m x 3m multi-compartment hull design
 - powered by wind, solar, batteries and back-up diesel generator
 - developed for extreme marine environments
- ❖ **Vindicator Laser Wind Sensor** developed by Catch the Wind Inc.
 - all fiber optic, motion compensated laser wind sensor
 - derived from aerospace application, able to absorb heavy vibration and high motion



Key AXYS Buoy Technology

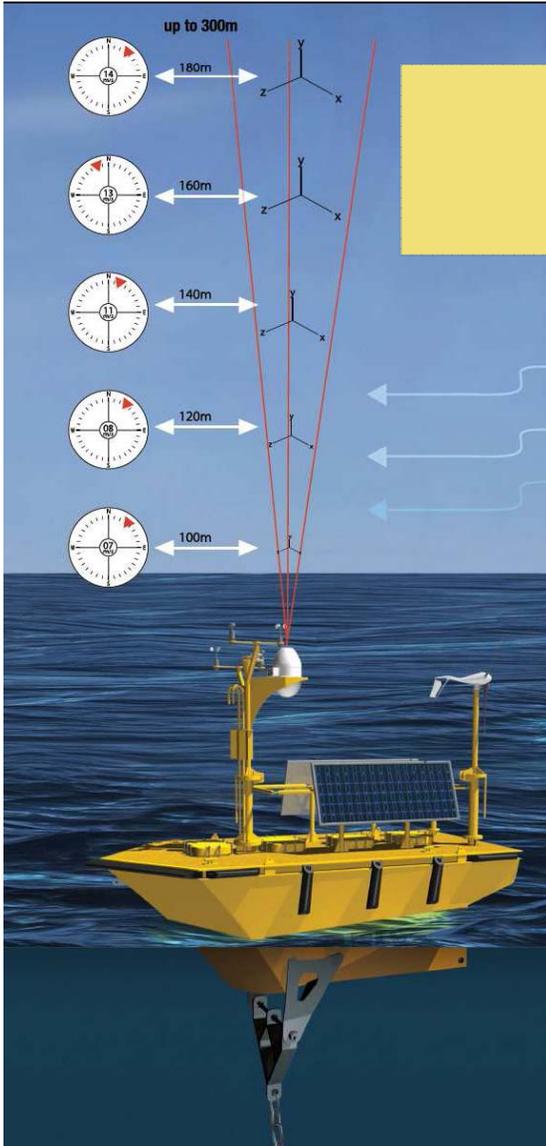


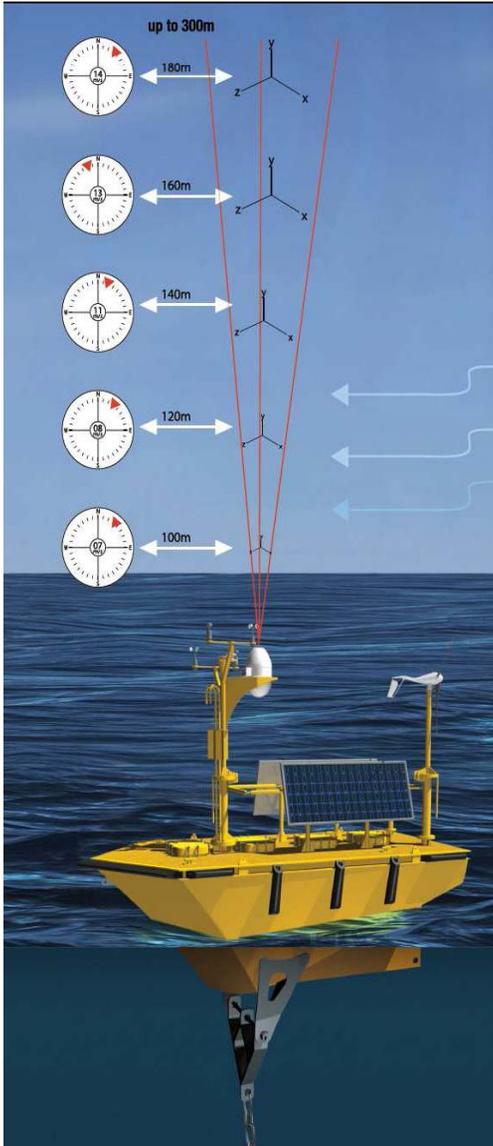
- ❖ Remote Data Transmission – Watchman500 Datalogger and Controller
- ❖ Year-around data collection system 24/7/365
- ❖ Remote sensing for all on-board technology
- ❖ Full range of telemetry transmission options
- ❖ GPS monitoring system & full range motion sensor
- ❖ Directional wave monitoring & compass orientation
- ❖ Full range of meteorological sensors
- ❖ Acoustic sonobat bird and bat detection system
- ❖ Current sensor / acoustic doppler profiler

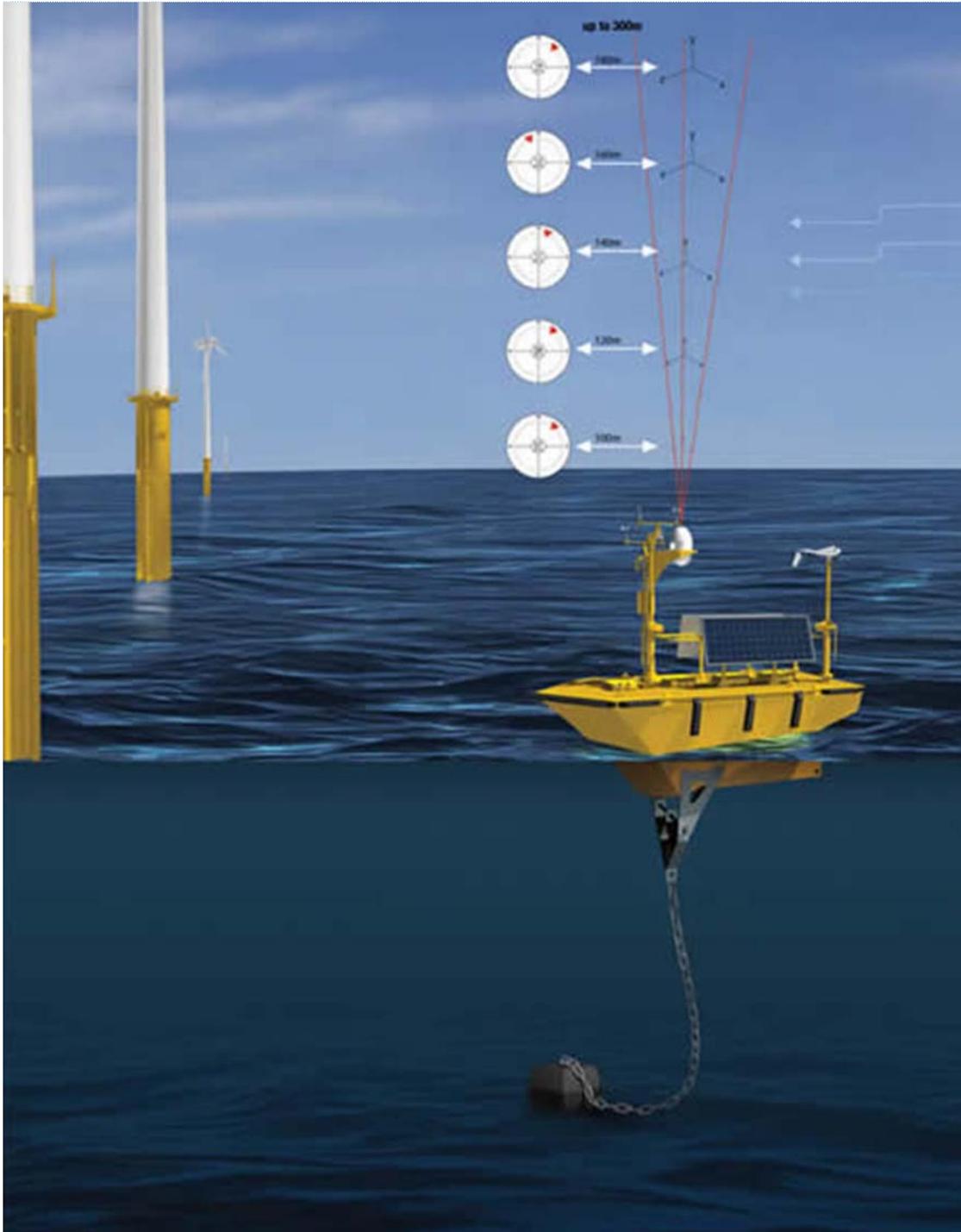


Key Vindicator Laser Technology

- ❖ Solid-state laser wind sensor designed for high motion environment – very high update rate
- ❖ Accurate three-dimensional vector wind measurement in all conditions and environments
- ❖ Sensing range – 150 meters vertically with up to six simultaneous measuring points
- ❖ High data update rates (1000 pulses per second) compensates for the motion of the platform
- ❖ Vindicator operates in broad temperature range from -40°C to +55°C

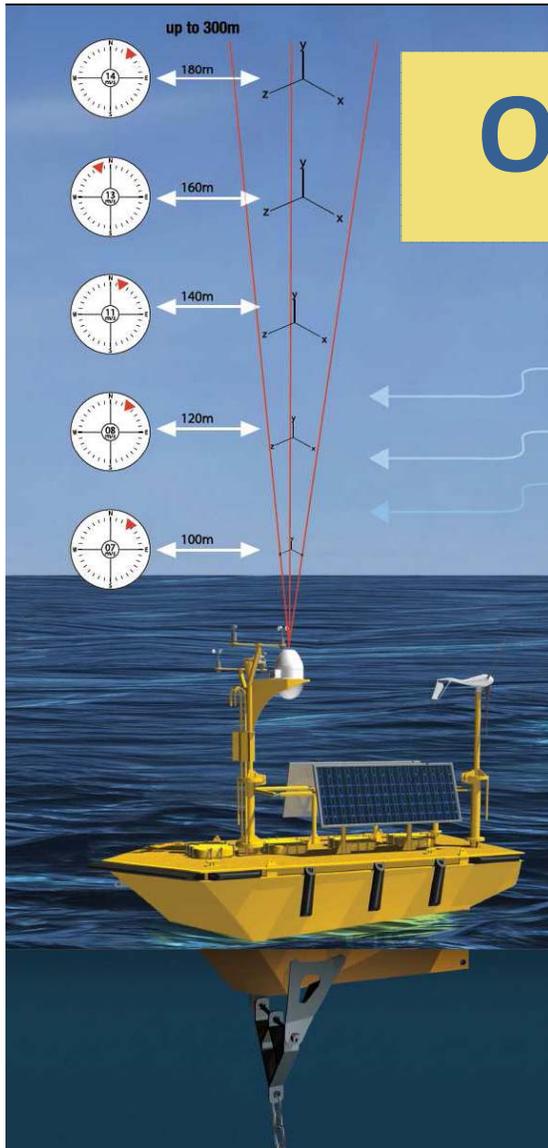






AXYS WindSentinel Laser Wind Resource Assessment Buoy

Overall Research Strategy

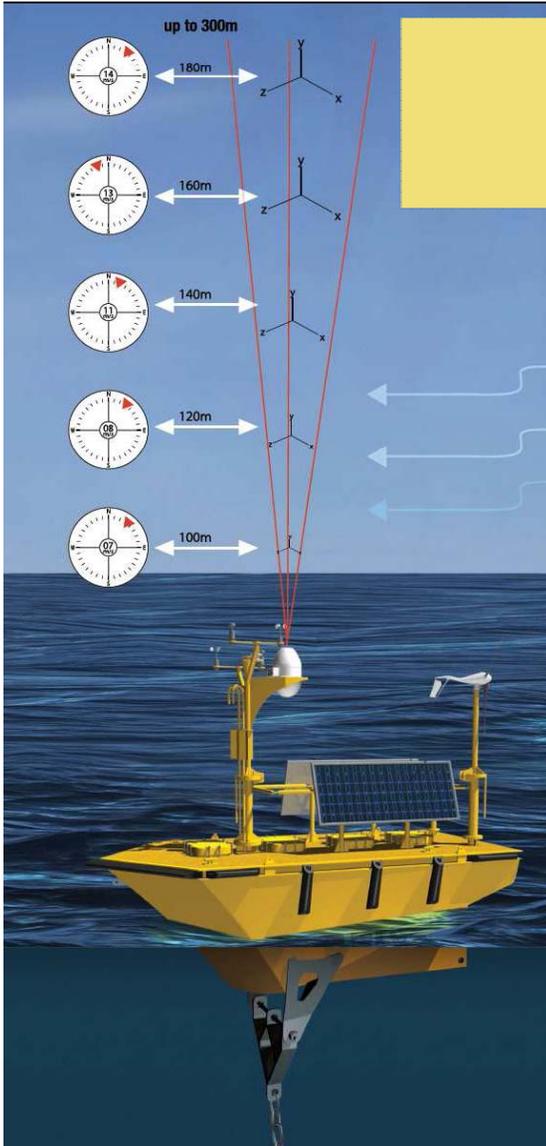


- Research period beginning September 2011 through December 2013
- Southern half of Lake Michigan including near shore and mid-lake plateau locations
- Correlation studies with NOAA facilities and Michigan Tall Towers project
- Extended season research from early March to mid-December, ice-season permitting

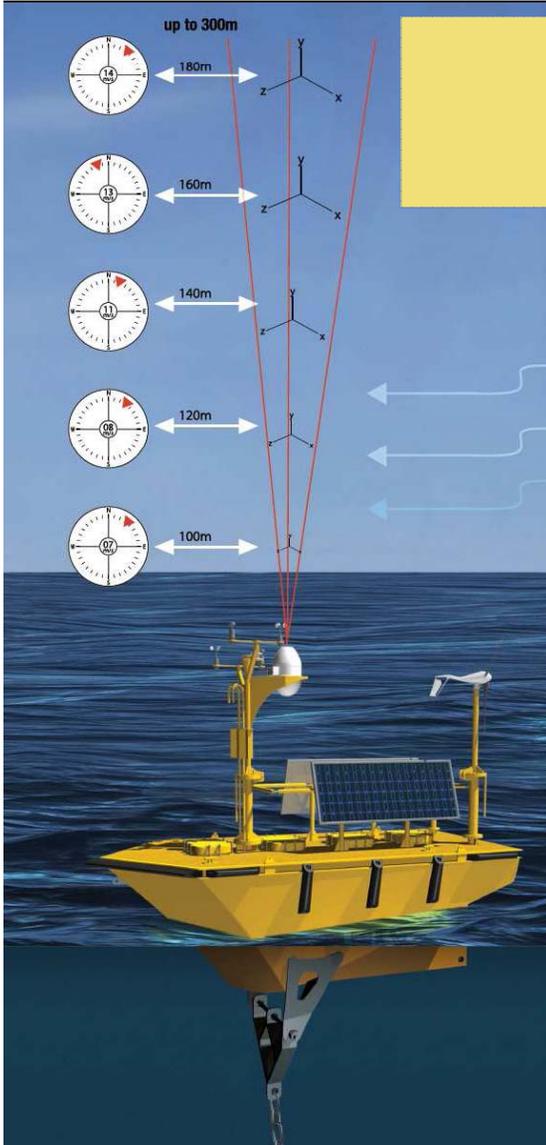


Research Tasks - GVSU

- Project management and administration
- Coordination of Research Leadership Team
- Data flow management and pre-lim. assess.
- Statistical modeling and analysis
- Thermo-fluid /computational fluid dynamic (CFD) modeling
- Conduct sound propagation field test
- Social, economic and policy analysis



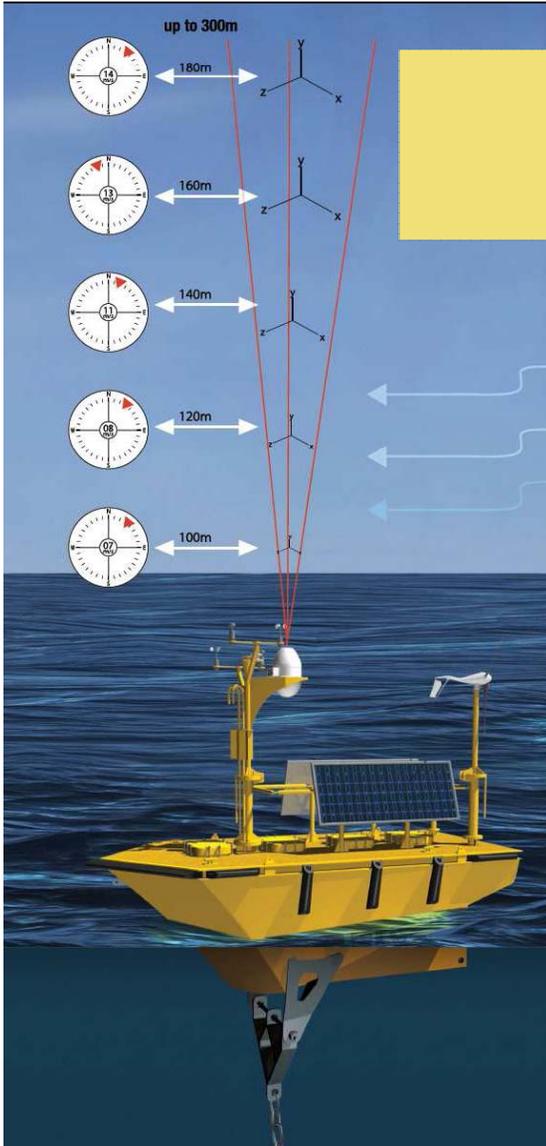
Research Tasks - UofM



- Wind data collection and analysis
- Wind correlation studies
- Offshore wind modeling
- Underwater site assessment, acoustic mapping, bathymetry studies
- Wind, wave and ice climatology
- Statistical modeling and analysis
- Ice accretion study



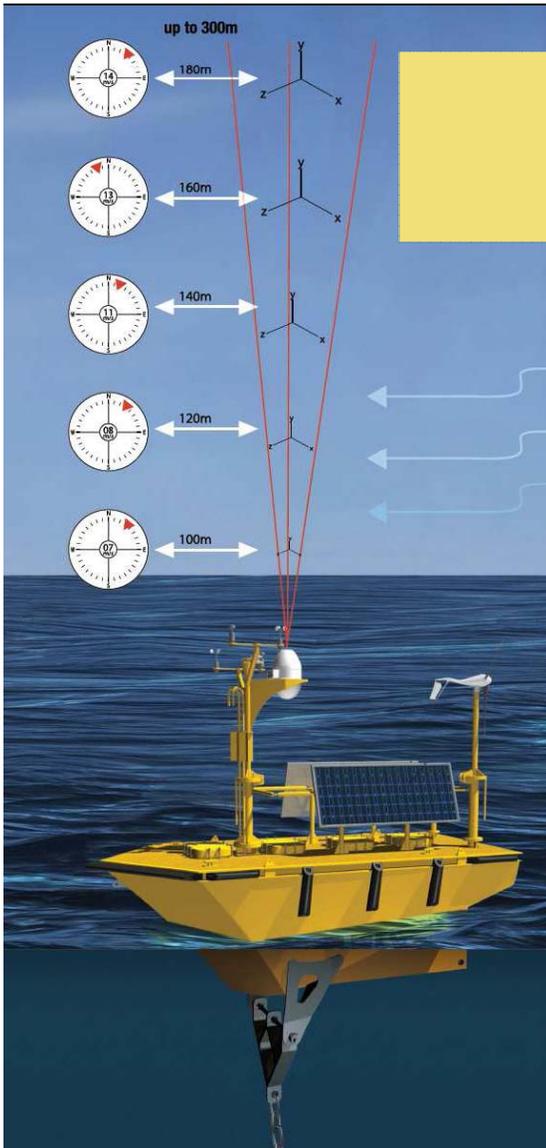
Research Tasks - MNFI



- Avian environment analysis
- Inventory of bird and bat species and calls
- Analysis of bird and bat data from offshore sites to quantify species and densities of biota at sites



Research Highlights

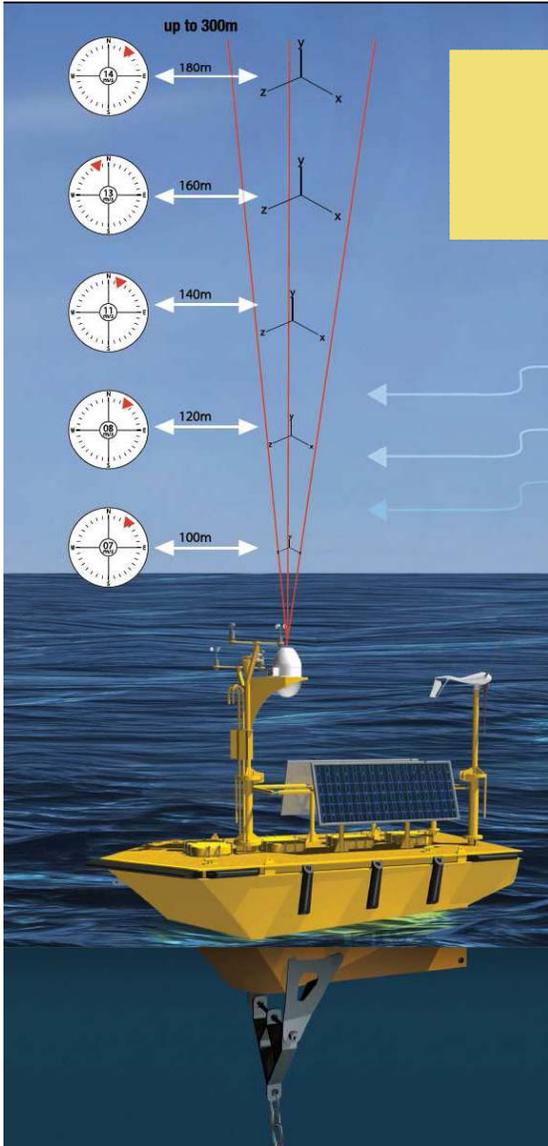


- First time offshore laser wind assessment will be conducted anywhere on Great Lakes
- Project will provide real-time, hub height, wind data at locations never studied before
- Will support studies of impact of offshore wind generating equipment on habitat, natural resources and lake bed environment
- Will provide opportunity to evaluate deployment, permitting & regulatory process



In Closing:

- ❖ We launch this offshore wind assessment project with great appreciation extended to all who made this possible.
- ❖ This project is designed to benefit the people of Michigan and of the Great Lakes. The research process will be transparent and all will benefit from the results
- ❖ Stay tuned for launch day!





Thank You!

