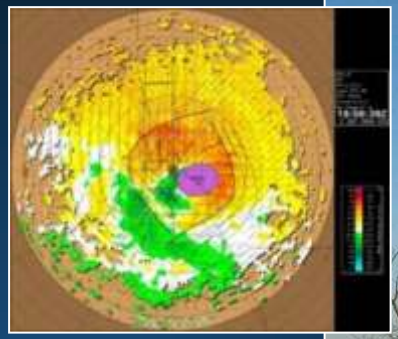
WindTracer® LIDAR and Wind Forecasting

March 30, 2012

LOCKHEED MARTIN

WindTracer® – 3D Volume Wind Sensing

- **Long-range Doppler LIDAR**
  - ***Provides wind speed/direction, spectral width, aerosol backscatter***
  - ***24/7/365 operational use at airports in Asia, USA, Europe***
  - ***Used for aviation safety, defense/security, research, wind energy worldwide***
- **Unique capability**
  - ***Wind measurement range: 400 m to 15 km (typical)***
  - ***Range resolution: 60 m***
  - ***Scanning: 0 to 360° azimuth, -5° to +185° elevation***
  - ***Velocity accuracy at maximum range: < 1 m/s***



WindTracer® History

- **2002 –First WindTracer® installation (Hong Kong)**
- **Today – Multiple units installed for aviation, security/defense, research, wind energy**

Hong Kong Airport

Hong Kong Airport (2)

Tokyo (Haneda) Airport

Tokyo (Narita) Airport

London (Heathrow) Airport

San Francisco Airport (SFO)

St. Louis Airport (STL)

Las Vegas Airport (LAS)

Atlanta Airport (ATL)

Arizona State University

New York Airport (JFK)

Karlsruhe University, Germany

Dugway Proving Grounds, Utah

Dept. of Environmental Conservation, Australia

Pentagon, Washington DC

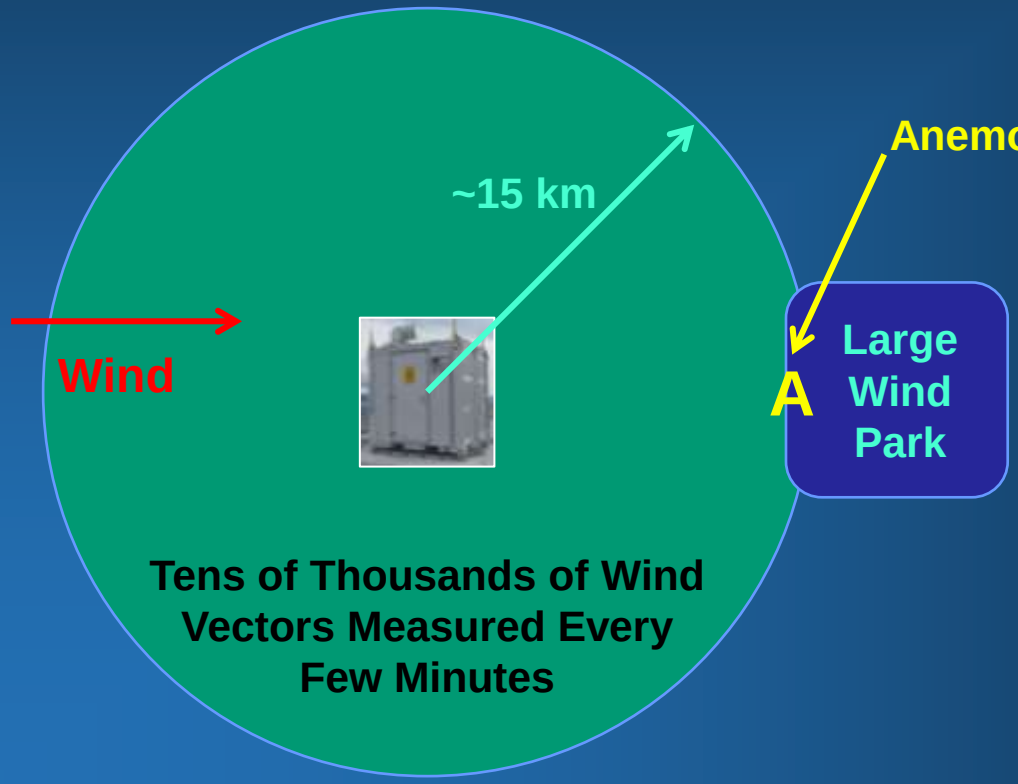
Gust Front at McCarran Airport, Las Vegas: 3 Aug 05

Las Vegas Gust Front.avi

Saving Lives – Detecting Aviation Wind Hazards

39 Day Wind Forecasting Trial in the USA

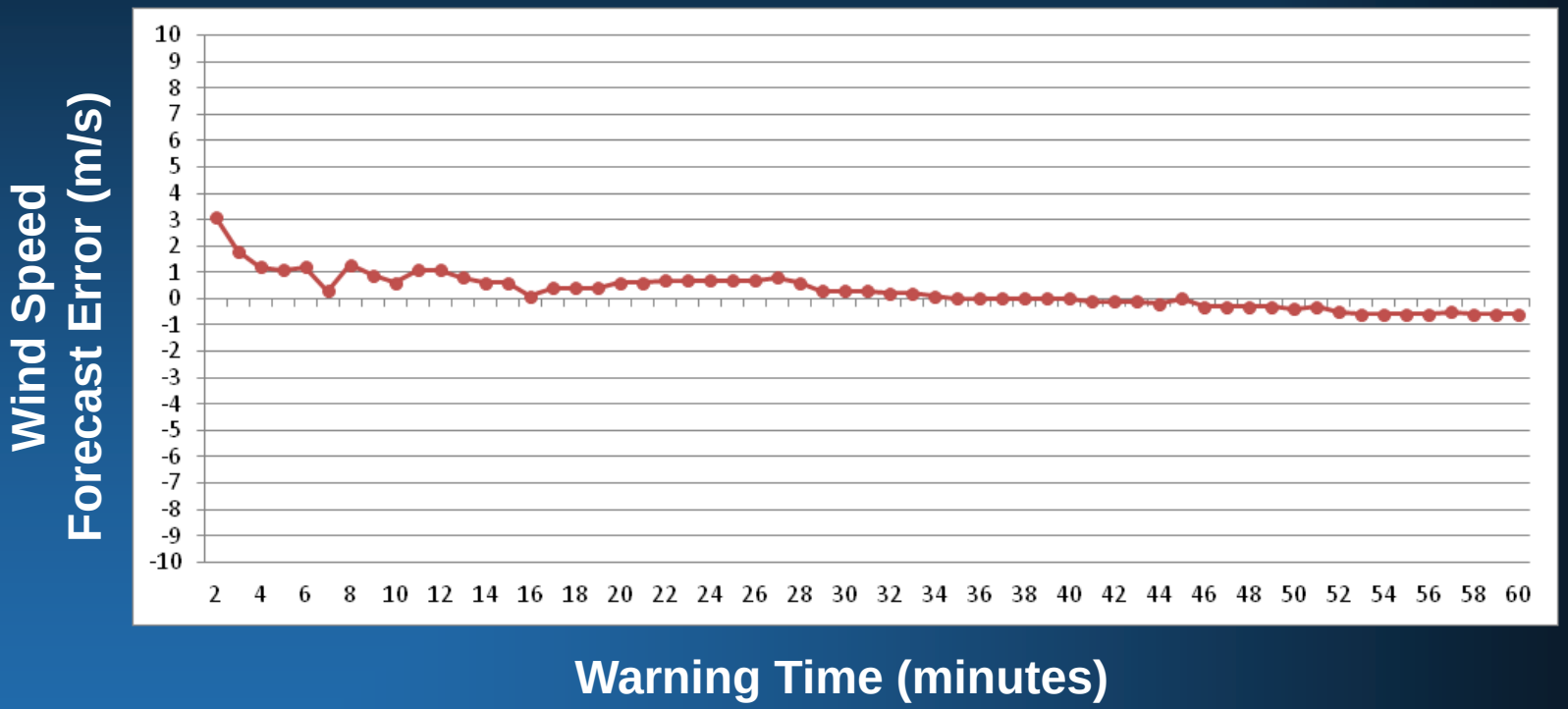
- **Measurement period: 9/24/11 to 11/1/11**
- **Wind park in very complex terrain; wind from west most of time**
- **One WindTracer® located ~15 km west of park and anemometers**
- **Forecasting Method: Propagate wind vectors to park and calculate median; no numerical weather modeling**



Expectation: WindTracer® range limits forecast warning time

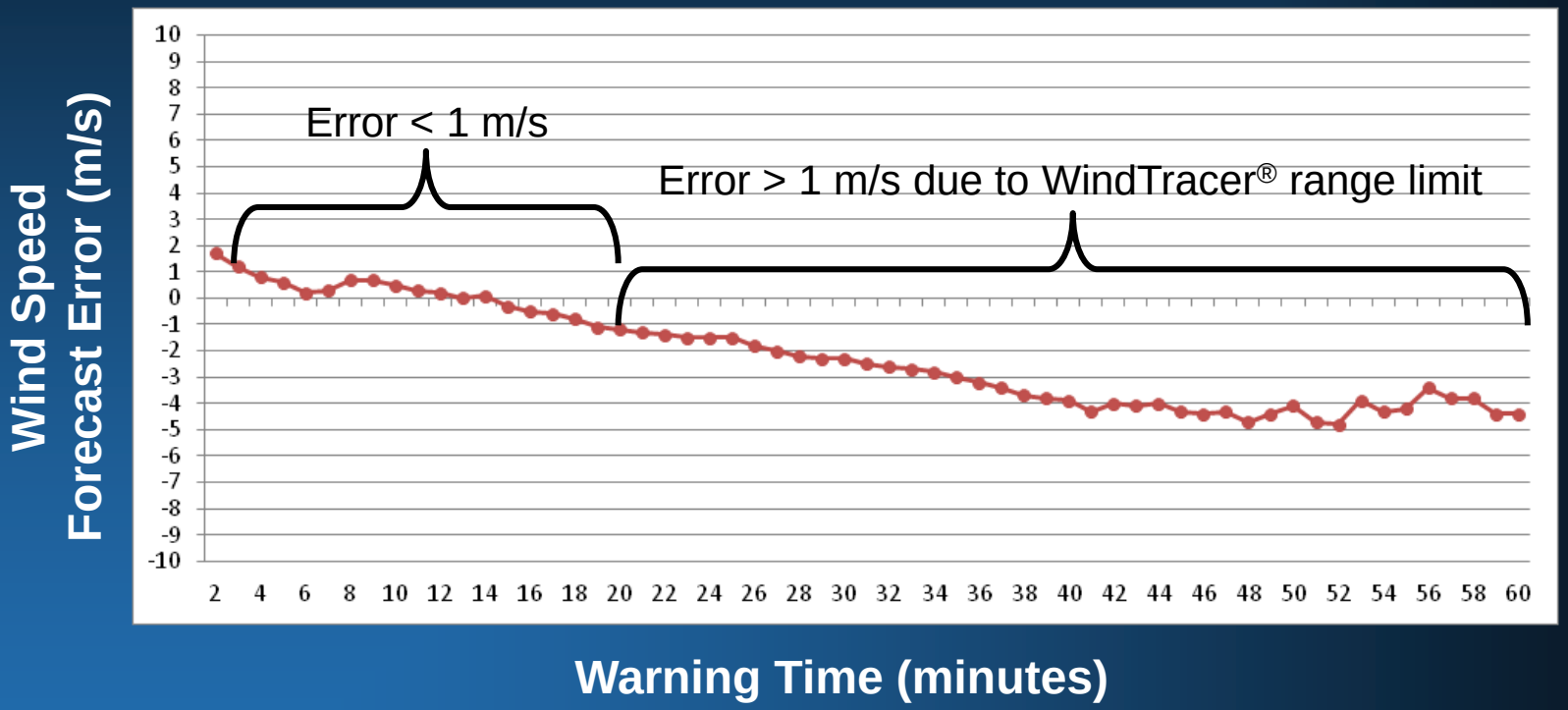
- **5 m/s wind travels 30 km in 100 min**
- **10 m/s wind travels 30 km in 50 min**
- **15 m/s wind travels 30 km in 33 min**

Forecasting Results on Typical Low Wind Day: 9/24/11: Average Wind Speed = 4.4 m/s



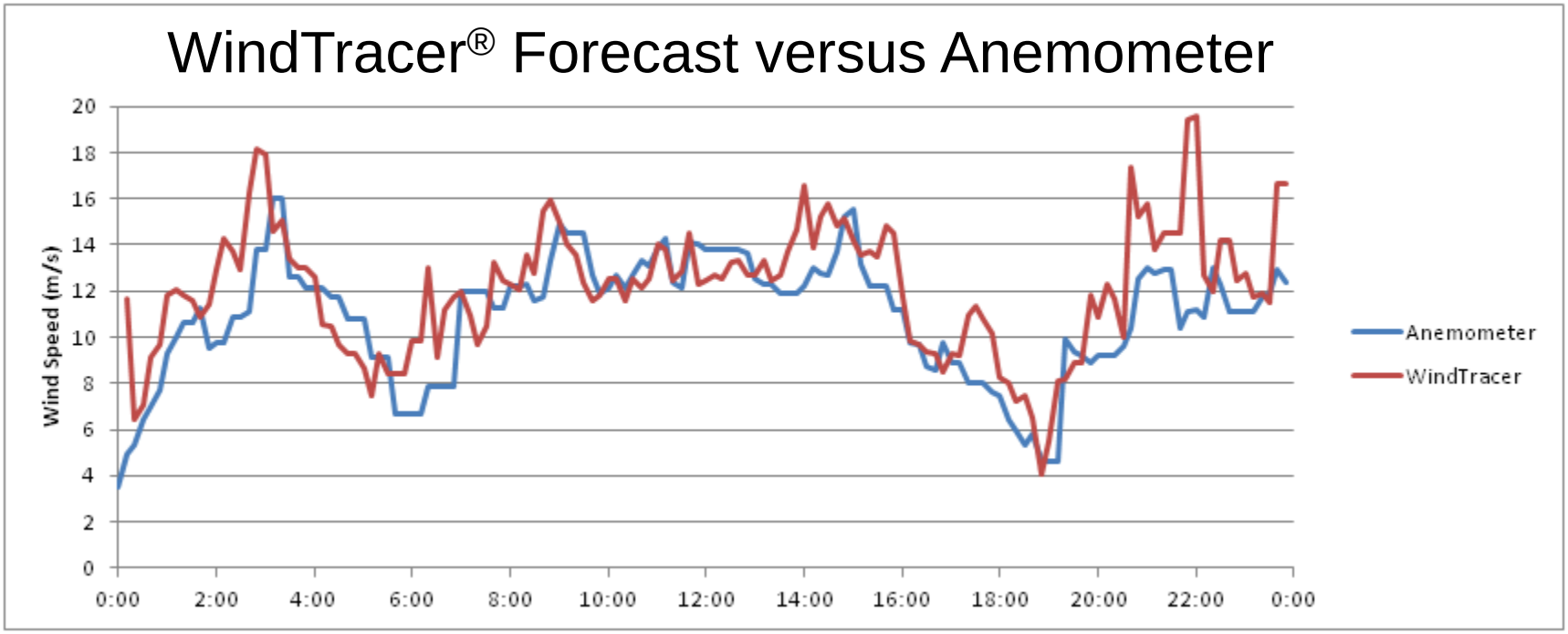
Wind forecast error <1 m/s with at least 60 minutes warning

Forecasting Results on Typical Higher Wind Day: 9/25/11: Average Wind Speed = 10.9 m/s



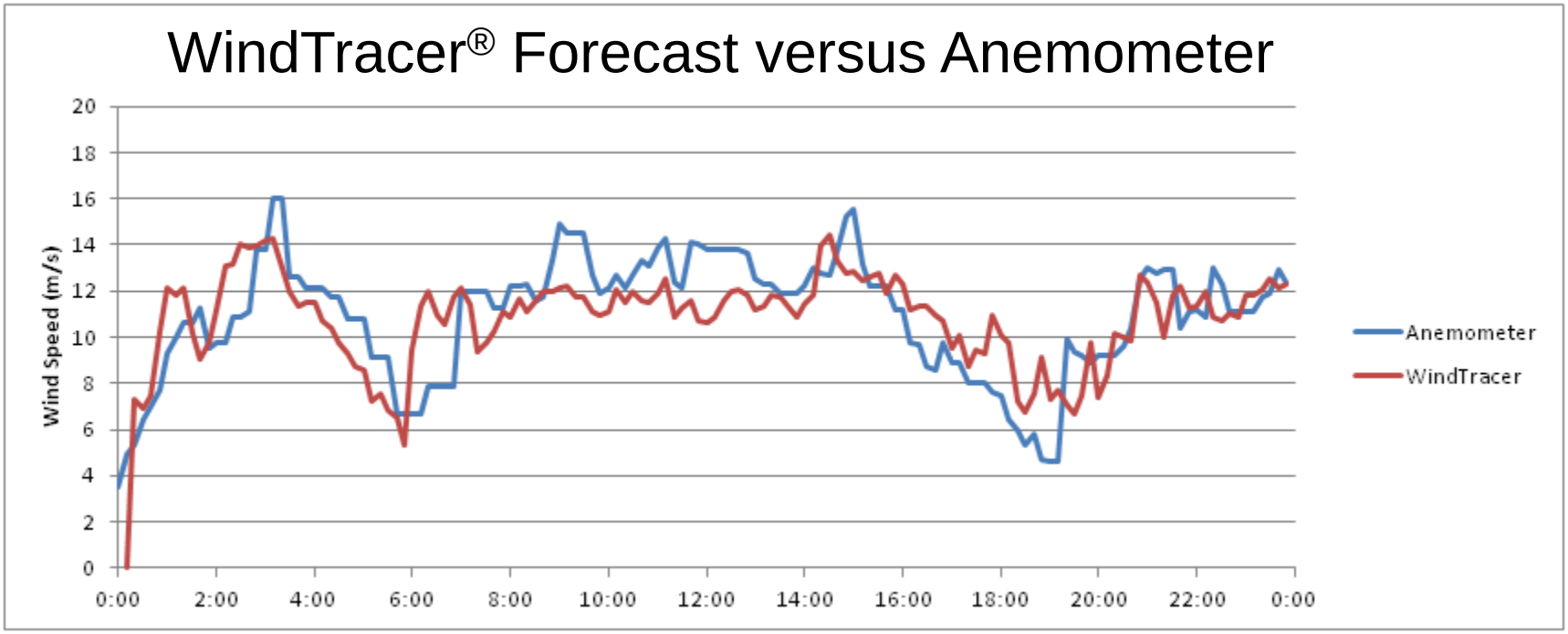
Wind forecast error <1 m/s with 20 minute warning

Detailed Results:
9/25/11 – 0 to 10 minute forecasts



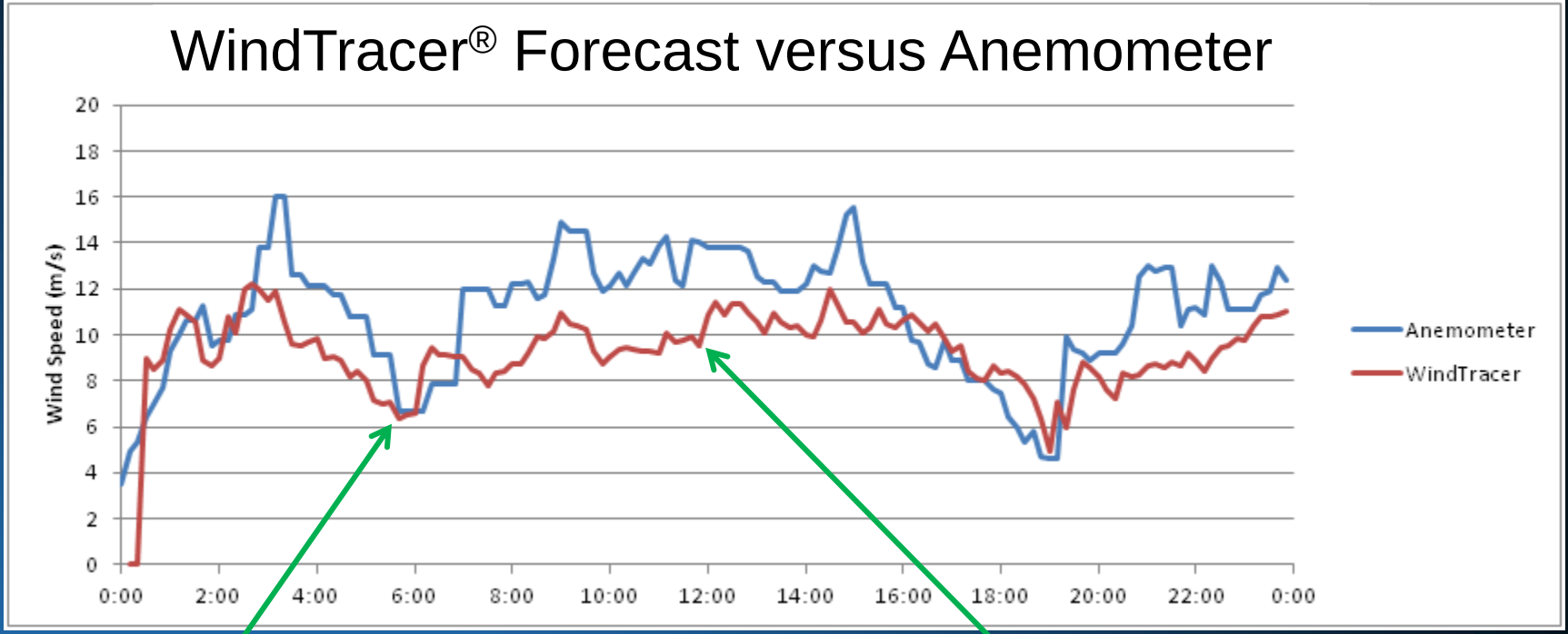
Error ~1 m/s throughout day; all wind ramps forecasted

Detailed Results:
9/25/11 – 10 to 20 minute forecasts



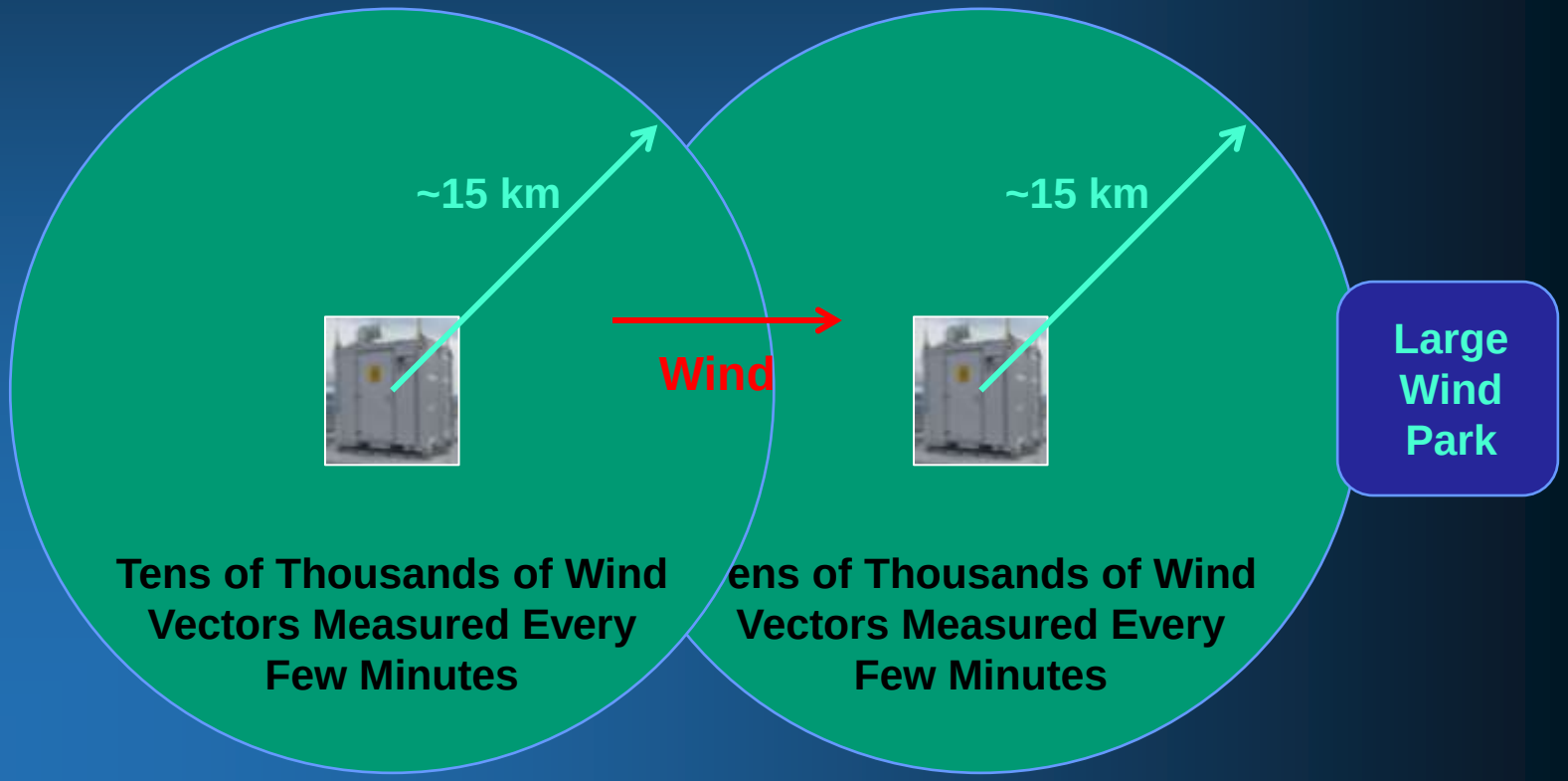
Error ~1 m/s throughout day; all wind ramps forecasted

Detailed Results:
9/25/11 – 20 to 30 minute forecasts



For slower winds, all vectors pass through measurement area in < 30 minutes so WindTracer® predicts correctly

For faster winds, many vectors pass through measurement area in < 30 minutes so WindTracer® under predicts

Next Steps

- **Extend forecasts to 60 min at higher wind speeds: use multiple WindTracers® in sequence**
- **Extend forecasts to multiple hours: assimilate WindTracer® data into NWP models**