



An Analysis of Peak Wind Speed Data from Collocated Mechanical & Ultrasonic Anemometers

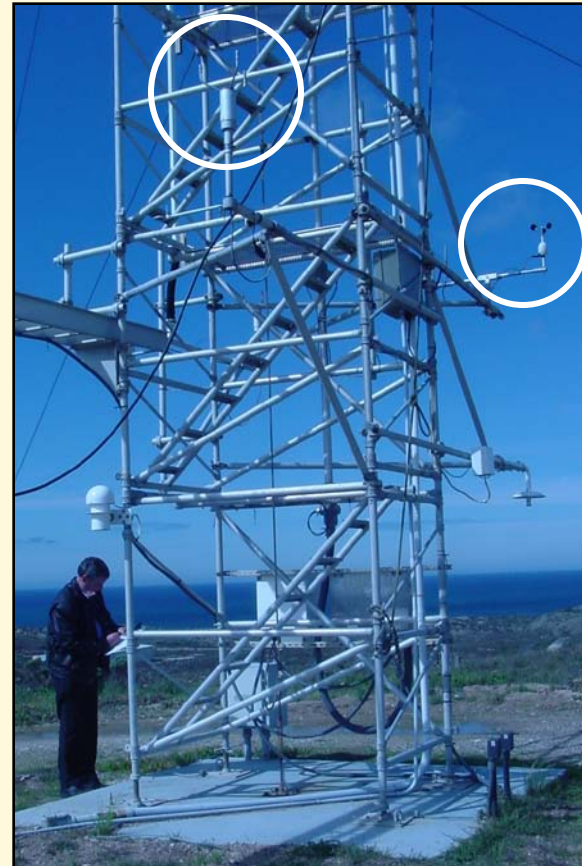
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- Motivation
- Instruments and Data
- Analysis Method
- Results
- Summary
- Potential Impact on Operations





Motivation

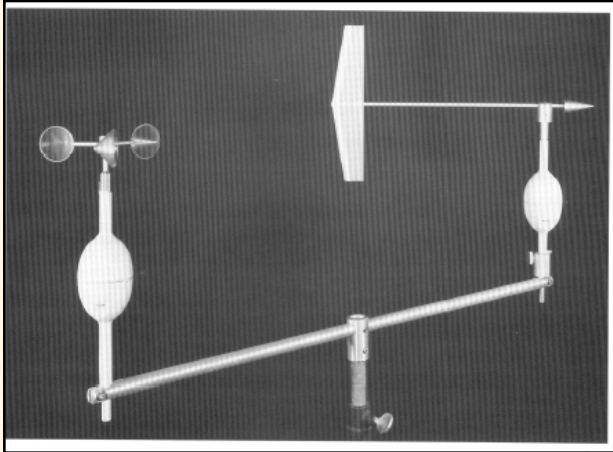
- Consistency of wind measurements important in decision-making for space operations
 - Launch and landing
 - Personnel Safety
 - Toxic dispersion
- Range Standardization and Automation (RSA) Program
 - Kennedy Space Center/Cape Canaveral AFS (KSC/CCAFS, FL)
 - Vandenberg Air Force Base (VAFB, CA)
- Replacing mechanical with ultrasonic
- Determine effect of new instrumentation on measured average and peak wind speeds



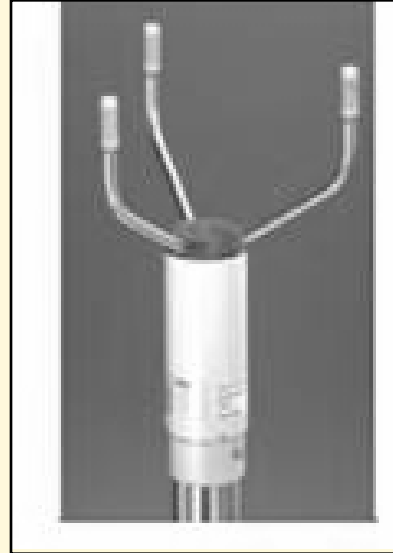
Instruments and Data

VAFB

Cup-and-vane ["Legacy"]

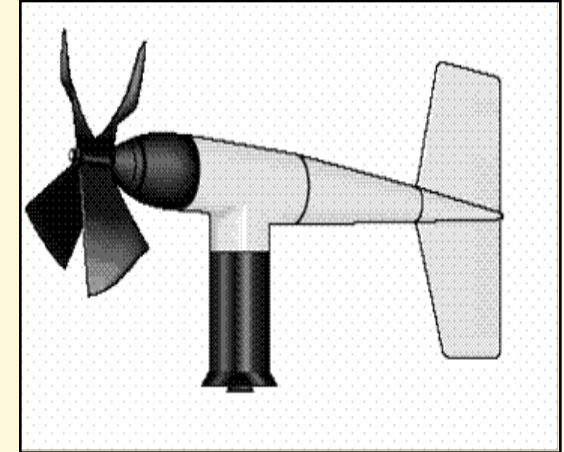


Ultrasonic ["RSA"]



KSC/CCAFS

Propeller-and-vane ["Legacy"]

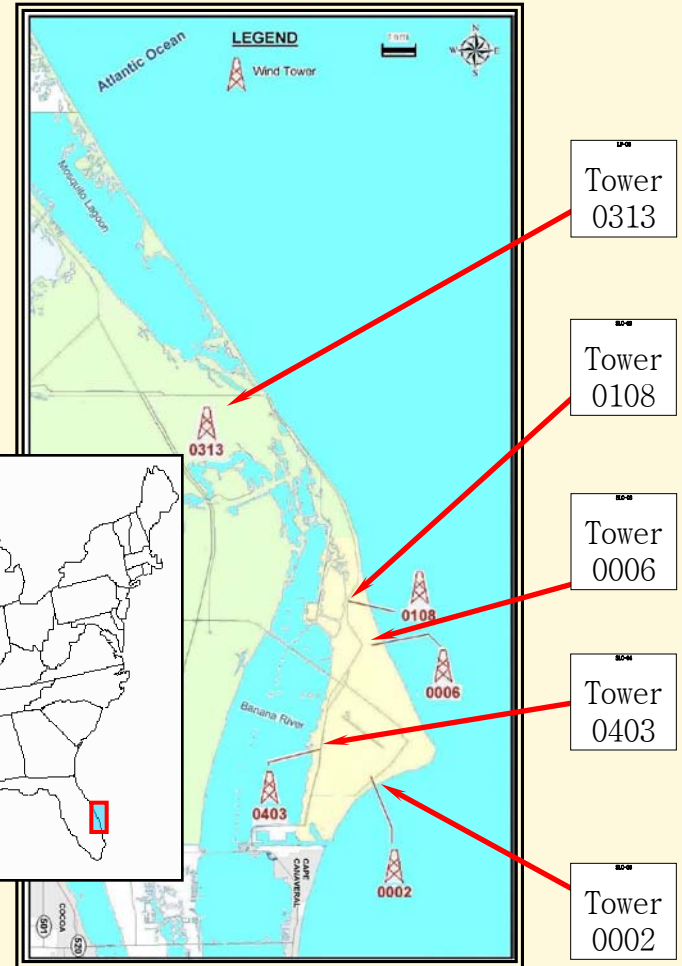
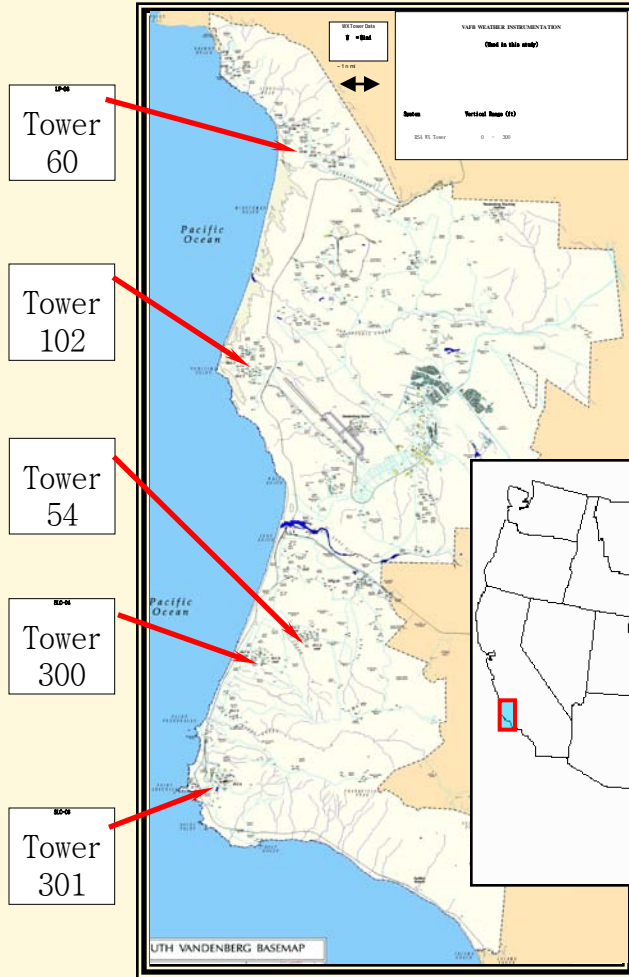


- One-minute averages/peaks computed and archived
 - Instruments output one observation per second
 - Highest one-second speed is the peak
- Period-of-Record: May – June 2005

Wind Towers

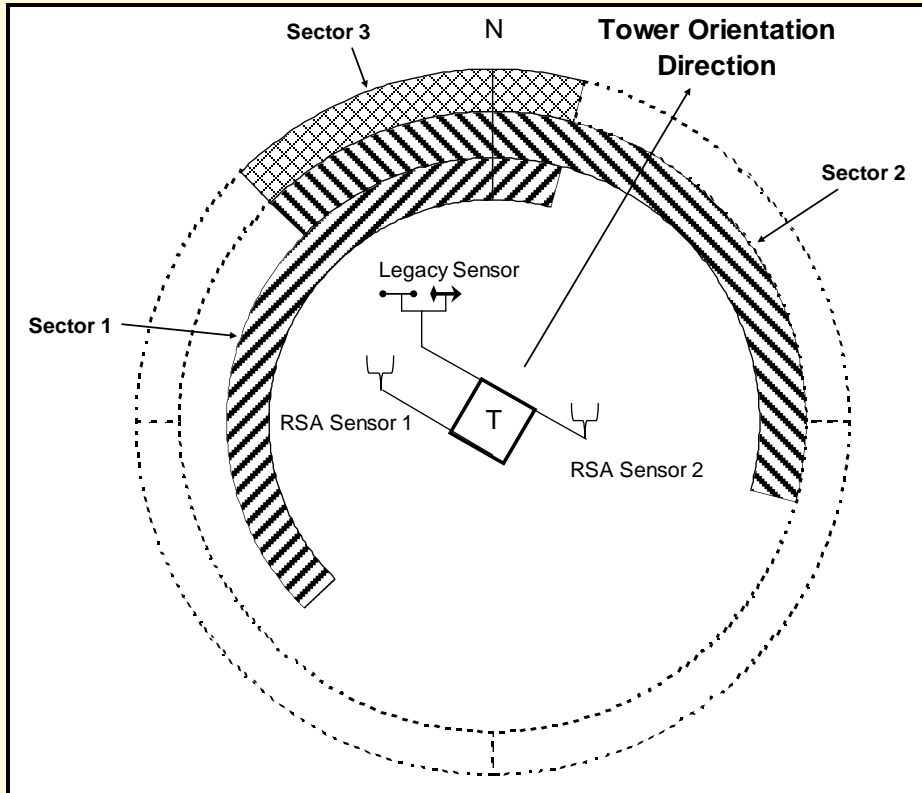
5 at VAFB

5 at KSC/CCAFS



Wind Sector Filters

VAFB Filter

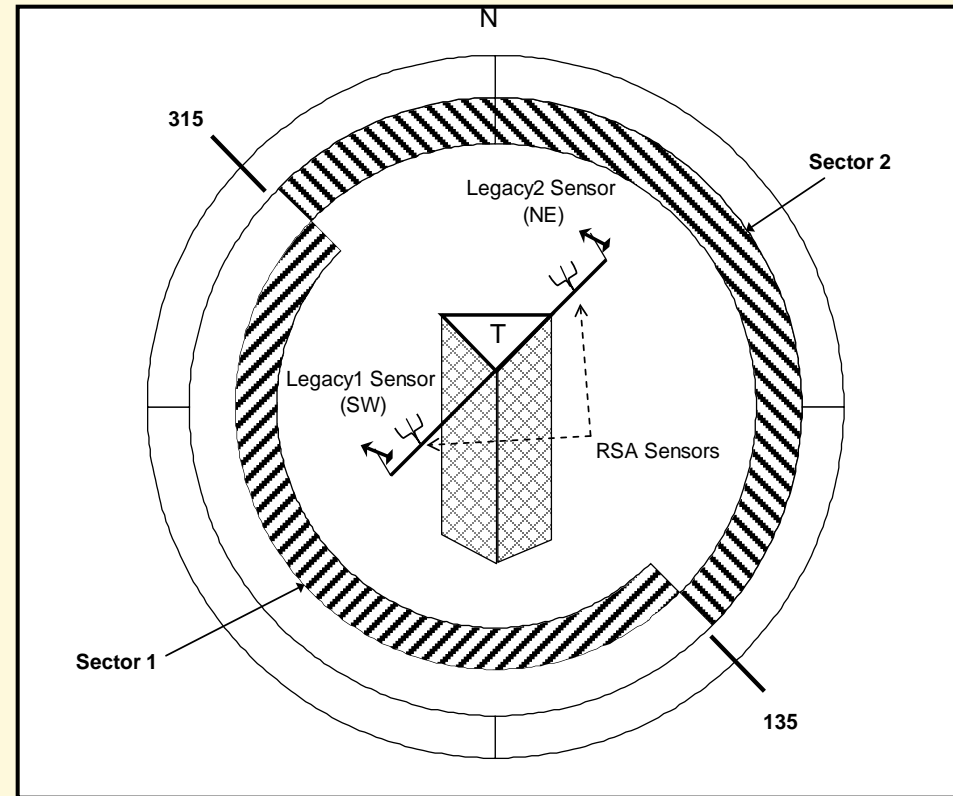


- 5 Towers
- 34 Sensor pairs
- Heights 12–300 ft AGL
- ~ 185,000 minutes of data
- Sector 1: Legacy vs. RSA 1
- Sector 2: Legacy vs. RSA 2
- Sector 3: RSA 1 vs. RSA 2

Wind Sector Filters

KSC/CCAFS Filter

- 5 Towers
- 19 Sensor pairs
- Heights 12–495 ft AGL
- ~ 350,000 minutes of data
- Sector 1:
Legacy 1 vs. SW RSA
- Sector 2:
Legacy 2 vs. NE RSA





Analysis Method

- Do not want to contaminate results with sensors that may not be working properly
- For each sensor pair compute:
 - Differences and RMS of 1-minute speeds and directions
 - Conditional average wind speed:
 - Given Legacy one-minute averages at 1 kt, compute average RSA wind speed
 - Follow above step at 1 kt intervals to highest observed one-minute average wind speed
- From these statistics, find the most consistent sensor pairs
- For these sensor pairs, compute conditional statistics of average and peak wind speed data

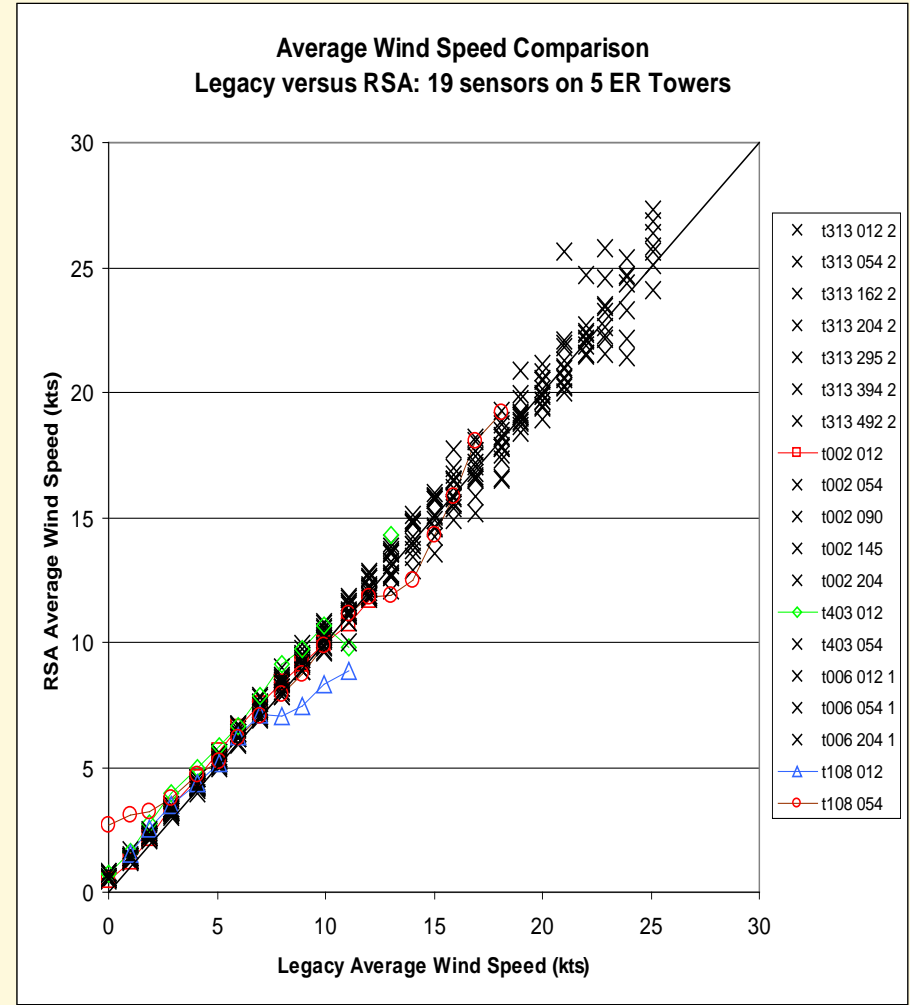
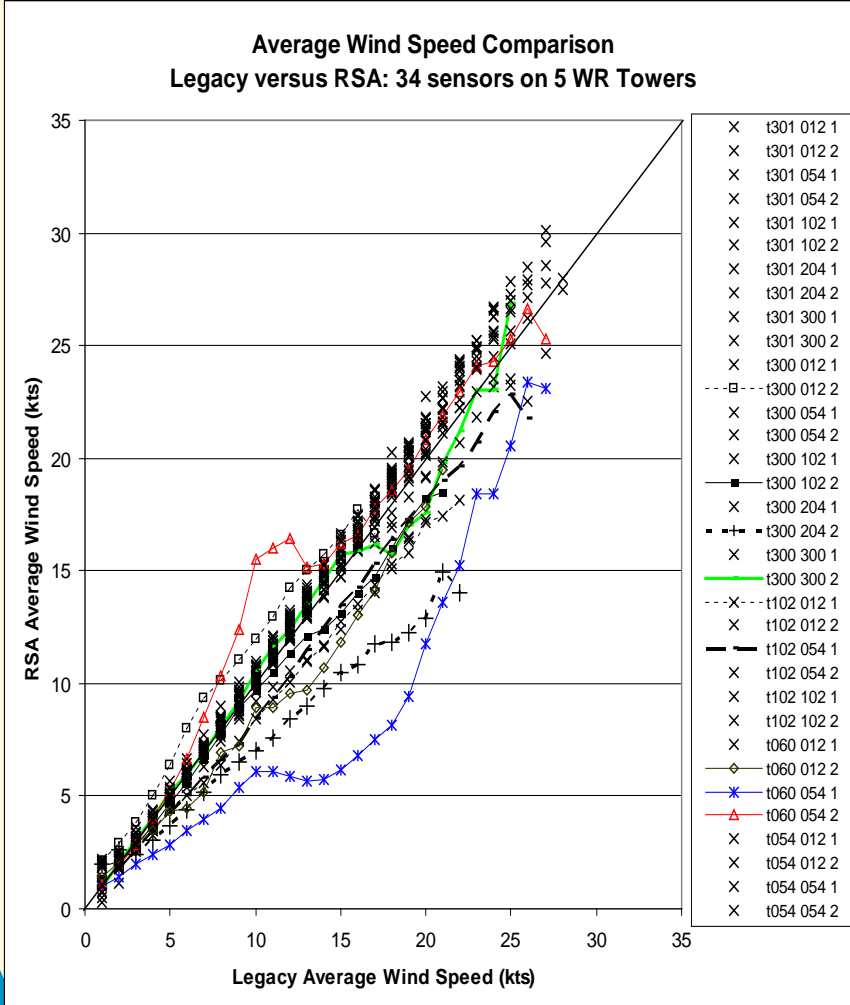


Consistent-Pair Analysis



VAFB

KSC/CCAFS

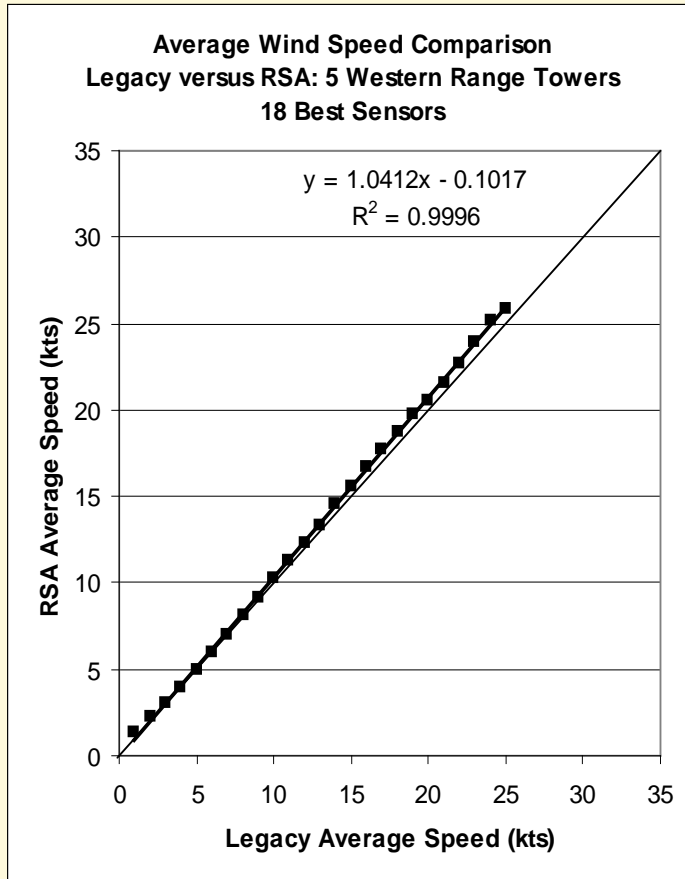




Average Wind Speed Comparison

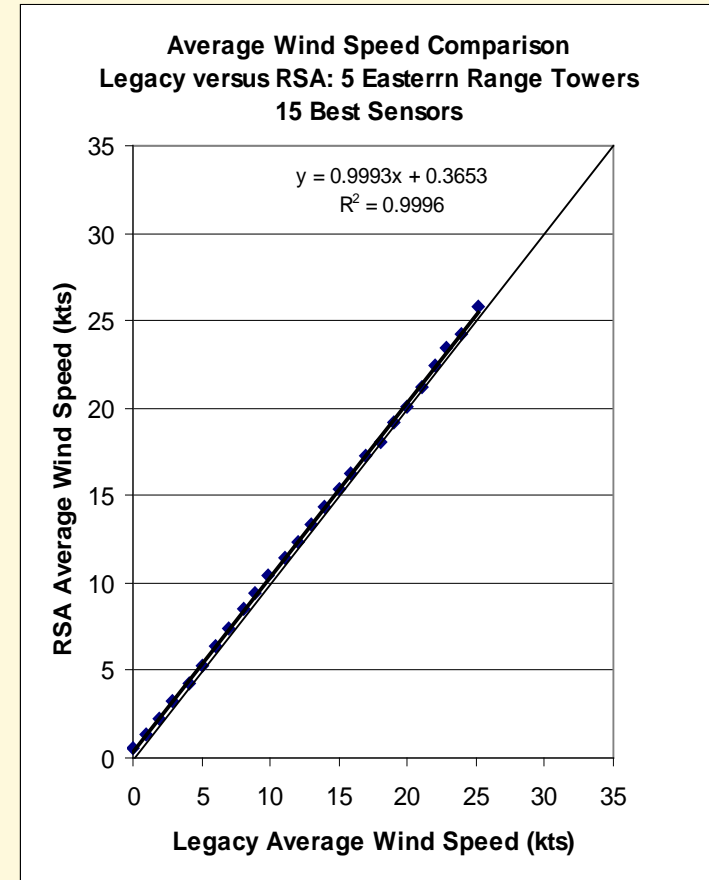


VAFB



Sample size: 87,894

KSC/CCAFS



Sample size: 171,726

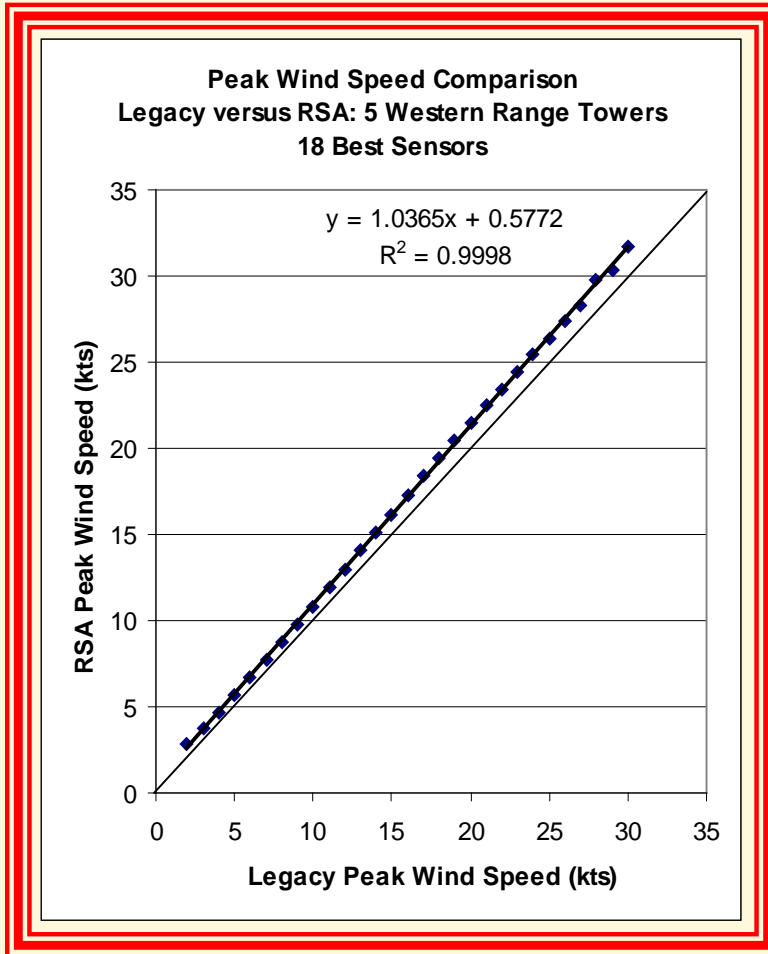


Peak Wind Speed Comparisons

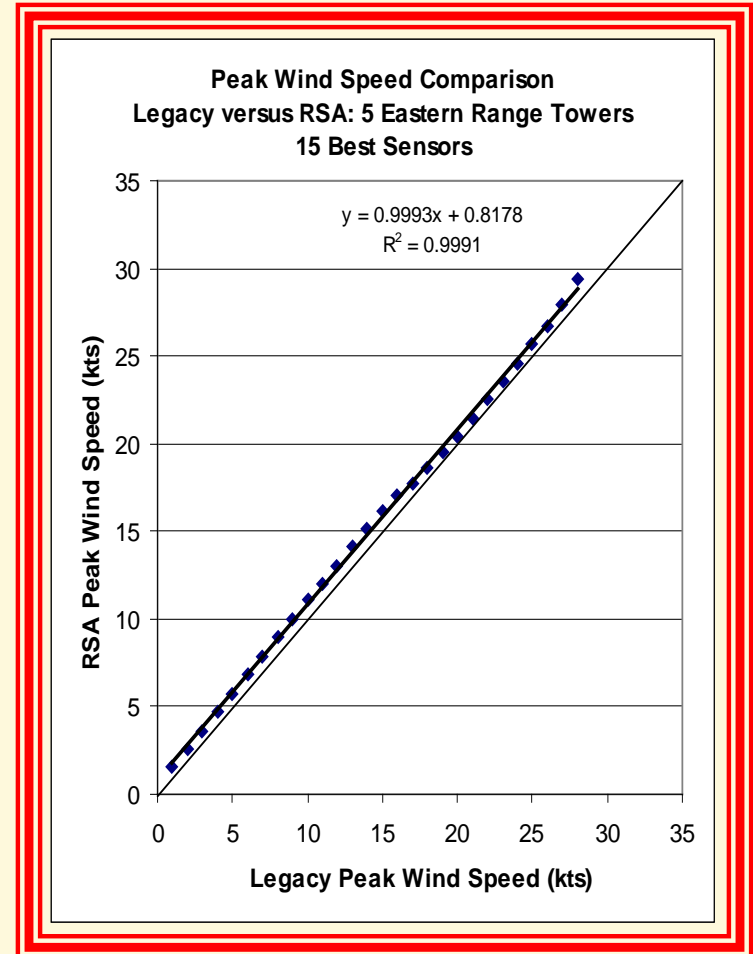


VAFB

KSC/CCAFS



Sample size: 87,894



Sample size: 171,726



Conclusions



Summary of Sensor Comparisons

- 18 RSA/Legacy sensor pairs at VAFB and 15 at KSC/CCAFS
- Linear regressions of trend (VAFB) and offset (KSC/CCAFS) estimate RSA peak given the Legacy peak

Mechanical Peak (kt)	VAFB Ultrasonic Peak (kt)	CCAFS Ultrasonic Peak (kt)
15	16.1	15.8
20	21.3	20.8
25	26.5	25.8
30	31.7	30.8

Potential Impact on Operations

Given a 20 kt peak wind launch constraint at KSC/CCAFS (based on May – June 2005 data):

- Launch availability from mechanical sensor data 95.2%
- Launch availability from ultrasonic sensor data 92.3%
- Ultrasonic sensor data would decrease launch availability
- More conservative

Final Reports online at: <http://science.ksc.nasa.gov/amu/>