ANALYSIS OF PEAK WINDS IN THE KENNEDY SPACE CENTER-CAPE CANAVERAL AIR FORCE STATION WIND TOWER NETWORK

BACKGROUND
• The peak winds near the surface are an important forecast element for vehicle launch and landing operations. There are defined peak wind thresholds that cannot be exceeded in order to ensure the safety of personnel and equipment during these operations.
• The 45th Weather Squadron (45 WS) and the Spaceflight Meteorology Group (SMG) indicate that peak winds are a challenging parameter to forecast.
• The AMU was tasked to develop short-range peak-wind forecast tools to be used in support of launch and landing operations.

DATA
• 5-minute average and peak wind speed and direction observations from the Kennedy Space Center/Cape Canaveral Air Force Station (KSC/CCAFS) wind tower network.
• Data were from wind sensors at the 7 towers used to make operational decisions for the 4 main space lift programs at KSC/CCAFS: Shuttle, Atlas, Delta, Titan.
• Period of Record: January 1995 – December 2001, 7 years
• Over 700,000 observations per sensor

CLIMATOLOGY
• Data first stratified by tower/height combination and month
• Stratified in 3 ways to calculate climatologies:
  • Hour
  • Direction in 10° bins
  • Direction in 45° bins, then hour (bins narrower than 45° produced stratifications with too few observations for reliable calculations)
• Calculated means and standard deviations
• Number of observations in calculations recorded
• Images shown are the March climatologies for Tower 0393 at 60’, located 1250’ NW of Shuttle Launch Pad 39A

RESULTS AND CONCLUSIONS
Parameter Estimation for Higher Average Speeds
• Average speeds with < 600 observations in the POR were ~ > 20 kts for most sensors – but are operationally significant
• Tests were conducted to estimate Weibull parameters for the average speeds with < 600 observations
• Results indicated that the estimates may not be accurate

Final Products for Operations
• Microsoft® Excel Pivot Charts of
  • Climatologies
  • Empirical peak speed PDFs for all average speeds observed at sensor
  • Estimated Weibull peak speed PDFs for average speeds > 600 observations in the POR
• These products will provide forecasters with information about the past behavior of peak and average winds, and may be a helpful tool in forecasting peak winds for operations

Q U A L I T Y  C O N T R O L
• 5 data quality control routines were used to flag questionable data:
  • Impossible value check
  • Within 10 standard deviations of mean
  • Peak-to-average wind speed ratio limit
  • Vertical consistency between sensors at same tower/different levels
  • Temporal consistency at individual sensors
• Only 0.6 – 2.1% of data per sensor flagged by the routines, most data good and available for analysis

PROBABILITY DISTRIBUTIONS
• Probabilities of meeting/exceeding specific operational wind speed thresholds were calculated to:
  • Yield a greater understanding of peak speed behavior with average speed, and
  • Produce a method for forecasters to determine probability of meeting/exceeding a specific 5-minute peak speed given a 5-minute average speed
• Empirical PDFs of peak speed with average speed created
• Tests conducted to fit a theoretical distribution to the empirical PDFs
• Images shown are the January PDFs for Tower 0397 at 60’, located 1250’ NW of Shuttle Launch Pad 39B

MAP OF TOWERS IN STUDY

FINAL PRODUCTS FOR OPERATIONS

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