



Statistical Short-Range Guidance for Peak Wind Speed Forecasts at Edwards Air Force Base



Joseph Dreher and Winnie Crawford

NASA KSC / Applied Meteorology Unit / ENSCO, Inc., Cocoa Beach, FL

Richard Lafosse and Brian Hoeth

NOAA/NWS Spaceflight Meteorology Group / Houston, TX

Kerry Burns

Marshall Space Flight Center / Huntsville, AL



Outline



- Task Overview
- Kennedy Space Center (KSC)
Peak Wind Tool
- Edwards Air Force Base
(EAFB) Peak Wind Tool
- GUI Overview
- Summary and Future Work





Task Overview



- Exceeding peak wind thresholds important for shuttle safety
- Complex topography
- Develop GUI similar to Applied Meteorology Unit (AMU) Shuttle Landing Facility (SLF) tool (2003)
 - Marshall Space Flight Center (MSFC) collected, processed data, and calculated statistics
 - GUI delayed due to higher priority work
 - 2008: AMU tasked to complete GUI
- Provides Spaceflight Meteorology Group (SMG) climatological and probabilistic peak wind information





Background: KSC Peak Wind Tool



- Climatologies and probabilities of occurrence of mean and peak wind
- SLF Towers 511, 512, and 513
- Period of Record (POR): 1995-2001
- Stratifications
 - **All:** Tower, height and month
 - **Climatologies:** Hour, direction, and direction/hour
 - **Probabilities:** Average wind speed
- Probabilities calculated through probability density functions (PDF's)
- Gamma distribution
- Developed Excel PivotTables
- Created PC-based GUI

Requested Climatology (1995-2001)

10-MINUTE PEAK WIND STATISTICS

for Tower at During the Month of

Stratification

Hour (UTC) and Direction

Wind Statistics

	Mean	Standard Deviation	Count
Peak	<input type="text" value="14.7 kts"/>	<input type="text" value="7.9 kts"/>	<input type="text" value="2089"/>
5-Min Avg	<input type="text" value="9.8 kts"/>	<input type="text" value="5 kts"/>	<input type="text" value="2341"/>

NOTICE
The statistics shown here reflect historical peak and average wind occurrence for the period 1995-2001. They are not necessarily indicative of future winds.

EAFB Peak Wind Statistics

- Reformatted peak wind statistics from MSFC
- EAFB Towers 224, 44, 220 and 350
- POR: 1997-2004
- MSFC provided 2-minute average and 10-minute peak
- Stratifications
 - **All:** Tower and month
 - **Climatologies:** Hour, direction, and direction/hour
 - **Probabilities:** Average wind speed
- Generalized Extreme Value (GEV) distribution
- SMG recommended not including Tower 350 in GUI
 - Missing parametric values
 - Did not fit GEV distribution well
 - Location well south of runway

EAFB Tower Locations





EAFB GUI



- Visual Basic for Applications code
- Runs through Macro within Excel
- Pulls data from PivotTables

The screenshot shows the 'Choose Analysis' dialog box with the 'Climatology' tab selected. The title bar reads 'Choose Analysis'. Below the tabs, the text 'EAFB 10-MINUTE PEAK WIND CLIMATOLOGY' is displayed. The 'Tower' dropdown is set to '224' and the 'Month' dropdown is set to 'Jan'. Under the 'Choose Stratification' section, the 'Hour (UTC)' radio button is selected, with a dropdown menu showing '0000'. The 'Direction' radio button is unselected, with a dropdown menu showing '1 - 10 Deg' and the text 'True North' to its right. The 'Direction / Hour' radio button is unselected, with a dropdown menu showing '1 - 45 Deg' and the text 'Direction' to its right, and another dropdown menu showing '0000' and the text 'Hour' to its right. At the bottom, there are two buttons: 'Get Climatology...' and 'Cancel'.

The screenshot shows the 'Choose Analysis' dialog box with the 'Probability' tab selected. The title bar reads 'Choose Analysis'. Below the tabs, the text 'EAFB 10-MINUTE PEAK WIND PROBABILITY' is displayed. The 'Tower' dropdown is set to '224' and the 'Month' dropdown is set to 'Jan'. Under the 'Choose Distribution' section, the 'Empirical' radio button is selected, with a dropdown menu showing '2' and the text 'Select the 2-min Average Speed in Knots' to its right. The 'Model' radio button is unselected, with a dropdown menu showing '2'. At the bottom, there are two buttons: 'Get Probabilities...' and 'Cancel'.



Requested Climatology

Hour

Direction (10° sectors)

Requested Climatology (1997-2004) ✕

10-MINUTE PEAK WIND STATISTICS

for Tower at During the Month of

Stratification

Hour and Direction

Wind Statistics

	Mean	Standard Deviation	Count
Peak	<input type="text" value="13.6 kts"/>	<input type="text" value="7 kts"/>	<input type="text" value="1643"/>
2-Min Avg	<input type="text" value="8.8 kts"/>	<input type="text" value="4.9 kts"/>	<input type="text" value="1643"/>

NOTICE
The statistics shown here reflect historical peak and average wind occurrence for the period 1997-2004. They are not necessarily indicative of future winds.

Requested Climatology (1997-2004) ✕

10-MINUTE PEAK WIND STATISTICS

for Tower at During the Month of

Stratification

Hour and Direction

Wind Statistics

	Mean	Standard Deviation	Count
Peak	<input type="text" value="15 kts"/>	<input type="text" value="7.3 kts"/>	<input type="text" value="3578"/>
2-Min Avg	<input type="text" value="10.9 kts"/>	<input type="text" value="5.3 kts"/>	<input type="text" value="3520"/>

NOTICE
The statistics shown here reflect historical peak and average wind occurrence for the period 1997-2004. They are not necessarily indicative of future winds.



Requested Climatology

Direction (45° sectors) and Hour

Requested Climatology (1997-2004)

10-MINUTE PEAK WIND STATISTICS

for Tower at During the Month of

Stratification

Hour and Direction

Wind Statistics

	Mean	Standard Deviation	% of Total in Hour
Peak	<input type="text" value="15.3 kts"/>	<input type="text" value="6.2 kts"/>	<input type="text" value="41.3"/>
2-Min Avg	<input type="text" value="10.4 kts"/>	<input type="text" value="4.5 kts"/>	<input type="text" value="42"/>

NOTICE
The statistics shown here reflect historical peak and average wind occurrence for the period 1997-2004. They are not necessarily indicative of future winds.



Requested Probabilities

Empirical

Requested Probabilities (1997-2004)
✕

10-MINUTE PEAK WIND STATISTICS

for Tower at During the Month of

When the 2-Minute Average Wind Speed is

Peaks and Probabilities

Peak Speed (kts)	12	13	14	15	16	17	18	19	20	21	22	23
Probability (%) Meet or Exceed	100	100	92	68	43	26	17	10	6	4	2	2
Probability (%) Occurrence	0	8	24	25	17	9	7	3	3	1	1	0

"N/A" in any row for the Empirical distributions indicates that a particular peak speed was not observed, and for the Modeled distributions that a particular peak speed was outside the estimated distribution.

NOTICE

The probabilities shown here reflect historical peak wind occurrence for the period 1997-2004. They are not necessarily indicative of future winds.

Retrieve Another Probability Range



Requested Probabilities

Modeled

Requested Probabilities (1997-2004) X

10-MINUTE PEAK WIND STATISTICS

for Tower at During the Month of

When the 2-Minute Average Wind Speed is

Peaks and Probabilities

Peak Speed (kts)	12	13	14	15	16	17	18	19	20	21	22	23
Probability (%) Meet or Exceed	100	100	92	67	42	25	14	8	5	3	2	1
Probability (%) Occurrence	0	8	24	25	18	10	6	3	2	1	1	0

"N/A" in any row for the Empirical distributions indicates that a particular peak speed was not observed, and for the Modeled distributions that a particular peak speed was outside the estimated distribution.

NOTICE

The probabilities shown here reflect historical peak wind occurrence for the period 1997-2004. They are not necessarily indicative of future winds.

Retrieve Another Probability Range



Summary



- Developed GUI using Microsoft Visual Basic
 - Displays climatological and probabilistic peak wind information for 3 runway towers at EAFB
 - Tool mimics KSC SLF GUI
 - Climatology stratified by hour, direction, and direction/hour
 - Empirical and modeled probabilities of exceeding certain peak wind thresholds
- Delivered GUI to SMG forecasters in October 2008





Questions?