



Vandenberg Air Force Base Upper Level Wind Launch Weather Constraints

Jaclyn Shafer NASA Applied Meteorology Unit ENSCO, Inc. Cape Canaveral Air Force Station, Florida

Tyler Brock USAF 30th Operational Support Squadron Vandenberg Air Force Base, California

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- Background
- Historical Data
- Excel GUI
- Summary









Background



• Objective:

Analyze historical VAFB sounding data to determine Probability of Violation (PoV) for max wind speed and shear constraints

• Goal:

Develop a GUI to calculate real-time PoV for each wind constraint on launch day







Historical Data



Collection

- 1994 2011
- VAFB soundings from NOAA ESRL archive

Variable Description	Formula
u-component wind	u = Wspd₊cos(270 – Wdir)₊pi/180
v-component wind	v = Wspd₊sin(270 – Wdir)₊pi/180
u-component shear	u-shear(Layer) = u(Upper) - u(Lower)
v-component shear	v-shear(Layer) = v(Upper) - v(Lower)
Shear of layer	Shear(Layer)= Sqrt(u-shear ² + v-shear ²

Summary of calculations used to determine 1000-ft shear

Processing

- Interpolated to consistent 1000-ft height levels
- Stratified into four subseasons
 - » Jan Mar Apr Jun
 - » Jul Sep Oct Dec
- Determined max wind speed per sounding per sub-season
- Calculated multiple intervals for 1000-ft shear and determined max values per sounding per sub-season







Historical Data cont'd... Determining Data Distributions



 Gaussian – most common distribution in classical statistics and many applications in the atmospheric sciences (Wilks 2006)



 Log-normal - often observed in nature with wind features (Smith and Merceret 2000)







Historical Data cont'd... Determining Data Distributions





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Historical Data cont'd... Determining Data Distributions



- Normalized datasets
- Calculated first
 four moments
- Repeated for each sub season
- Excel PoV formulas

Max Wind Speed	GAUSSIAN
Max Shear	LOG-NORMAL



(-1,-1) = 42 kts





Excel Graphical User Interface MU Applied Meteorology

- Developed using Visual Basic for Applications
- Displays critical sounding data
- 13 worksheet tabs

			CURRENT DISPLAYED BALLOON DATA								
LOAD NEW B	ALLOON DATA			DATE:		12/15	5/2011				
				TIME		11.3	2 LITC				
						11.0	2010				
	CURRE		SEASON I	NFO							
••	% Probability of Violatio	ons based	on Oct-De	c sub :	season data	••					
Mea	n Max Wspd:	65.31	N	lean Max	1000ft Shear	r:	12.15				
Stdev	of Max Wspd:	28.328	Std	ev of Ma	x 1000ft She	ar:	9.16				
% Probability of Vio	lating Max Wind constrain	: 0	% Probabili	ty of Viol	lating Shear o	onstraint:	5				
	LAUNCH CO	ONSTRAI	NTS AT A	GLAN	CE						
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	А	В	С	D	E	F	G	Н	1	J	K	L	М	N	0	Р	Q	R	S
1	Heights(ft)	Temp(C)	RH	WDir	WSpd(kt)	1000 ft Shear													
2	25100	-37.6	3	293	62.2	5.458													
3	26100	-40.1	4	288	62.6	7.678													
4	27100	-42.5	5	281	63	3.512													
5	28100	-45.1	6	283	65.7	6.018													
6	29100	-47.9	8	288	67.3	2.415													
7	30100	-50.3	9	287	69.4	3.4													
8	31100	-51.5	11	287	66	9.445													
9	32100	-52.5	13	290	74.7	5.081													
10	33100	-55.3	17	291	79.6	1.5													
11	34100	-58.2	22	291	81.1	5.3													
12	35100	-61.2	27	291	86.4	21.141													
13	36100	-60.7	23	305	87	28.447													
14	37100	-59.1	16	316	62.3	18.134													
15	38100	-61.6	11	306	46.8	15.691													
16	39100	-63	9	287	48	3.863													
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9			Mea	an Max Wspd:		65.31		Mean Ma	x 1000ft Shear	r:	12.15			-
10			Stdev	of Max Wspd	:	28.328		Stdev of M	ax 1000ft Shea	ar:	9.16			
11		% Probability of Violating Max Wind constraint				0	% Proba	bility of Vi	olating Shear o	onstraint:	5			
12														_
13														-
14		•	• % Pro	Lability of Vi	olations base	d on curr	rent ballo		nd sub seaso	n stdev **				-
16		Max Wind S	Speed Co	onstraint				err max ar						-
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18		% Prob	ability	of Violating o	onstraint:	3								
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Model Data

- Provide added insight for Launch Weather Officers (LWOs) on launch day
- Rapid Refresh (RAP) Model
 - » Developed for short-term weather forecasts
 - » Replaced Rapid Update Cycle (RUC) May 2012
 - » Updated Hourly



Excel Graphical User Interface MU





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Summary



Collected and processed historical VAFB sounding data

- Stratified data into four sub-seasons
- Determined data distribution of max wind speed and shear datasets
- Calculated PoV per sub-season for each wind constraint

• Developed GUI in Excel using VBA

- Displays current sounding data
- Calculates PoV for each constraint based on current sounding
- Includes forecast sounding data from RAP

