Vandenberg Air Force Base Upper Level Wind Launch Weather Constraints

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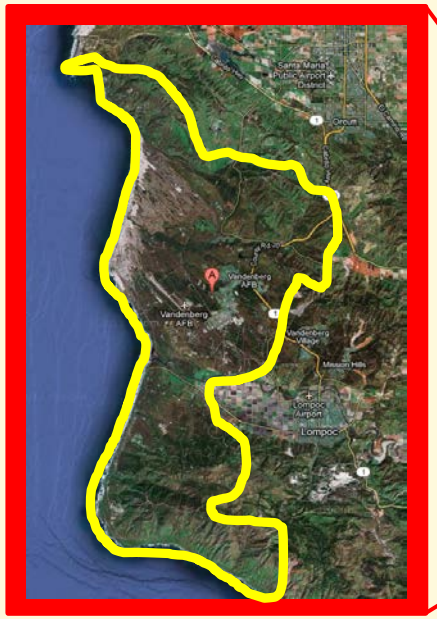
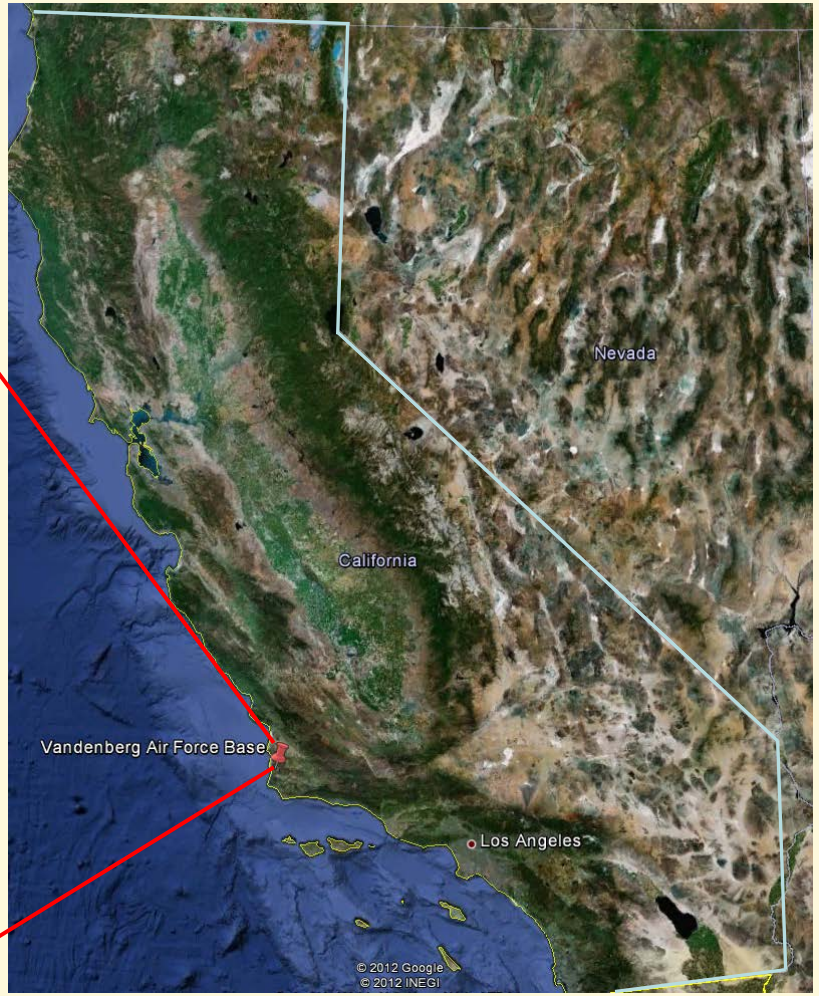
Overview

- 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

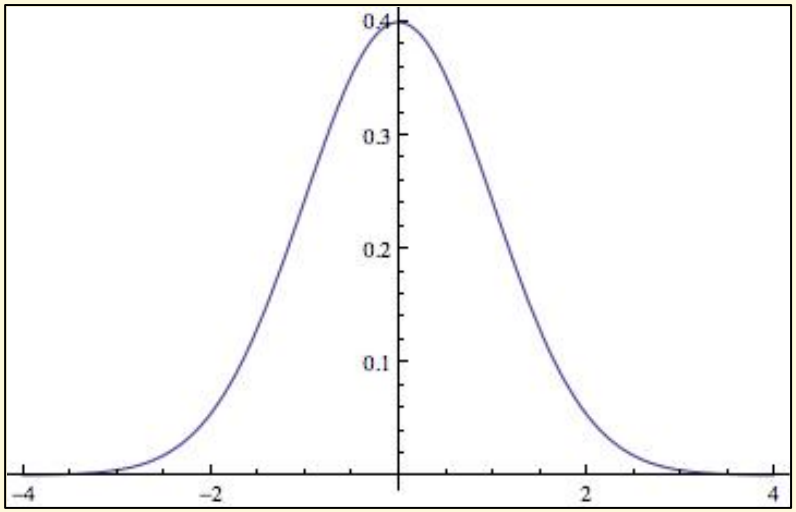
Summary of calculations used to determine 1000-ft shear	
Variable Description	**Formula**
u-component wind	u = Wspd*cos(270 – Wdir)*pi/180
v-component wind	v = Wspd*sin(270 – Wdir)*pi/180
u-component shear	u-shear(Layer) = u(Upper) – u(Lower)
v-component shear	v-shear(Layer) = v(Upper) – v(Lower)
Shear of layer	Shear(Layer)= Sqrt(u-shear^2 + v-shear^2)

- **Processing**
  - Interpolated to consistent 1000-ft height levels
  - Stratified into four sub-seasons
    - » 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

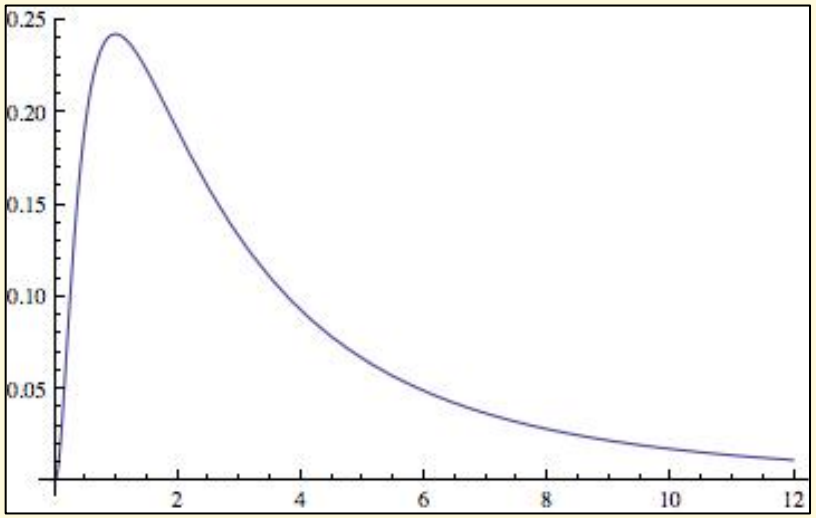
Historical Data cont'd…

Determining Data Distributions

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

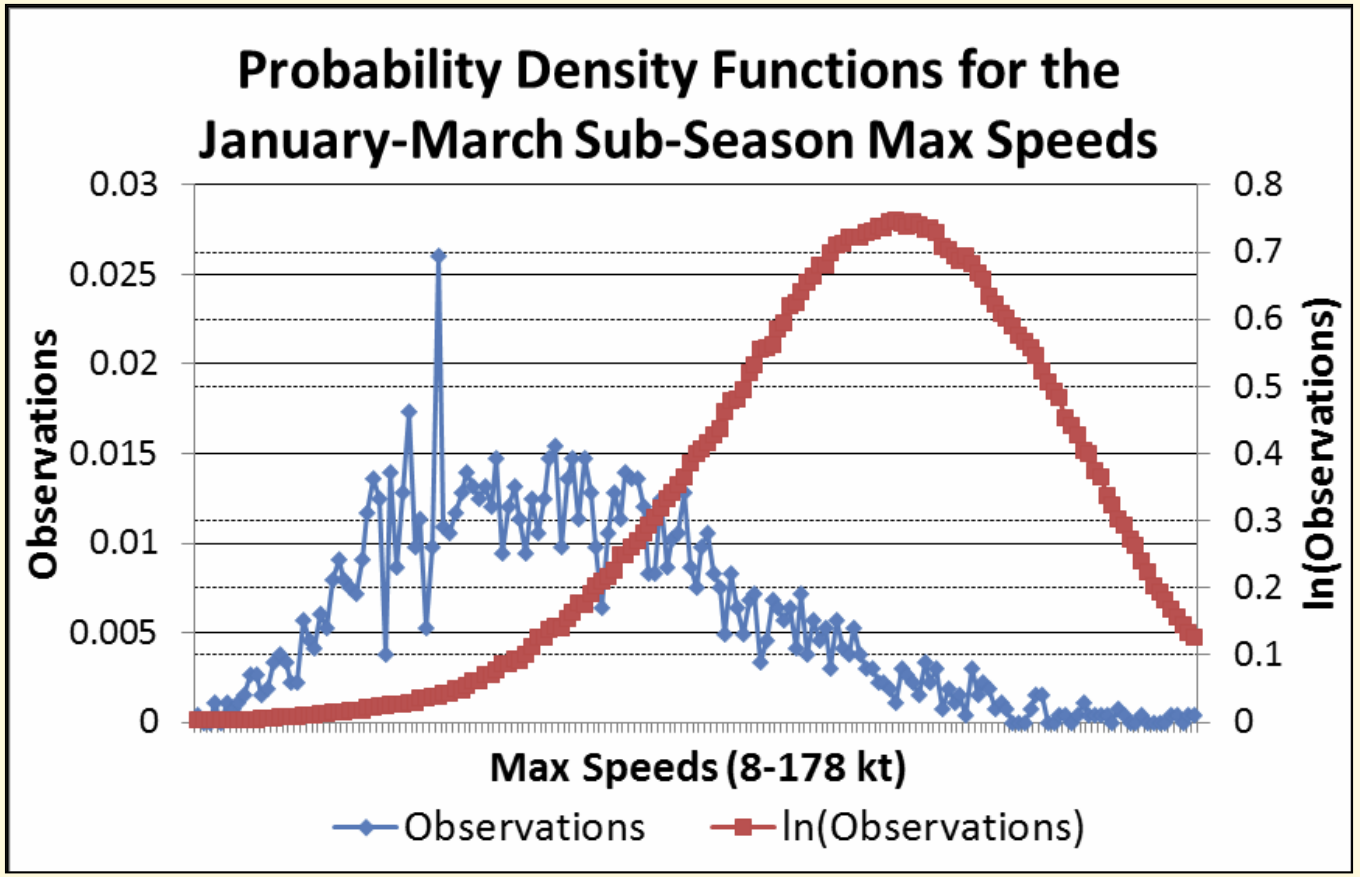


- ***Log-normal*** - often observed in nature with wind features (Smith and Merceret 2000)



Historical Data cont'd…

Determining Data Distributions

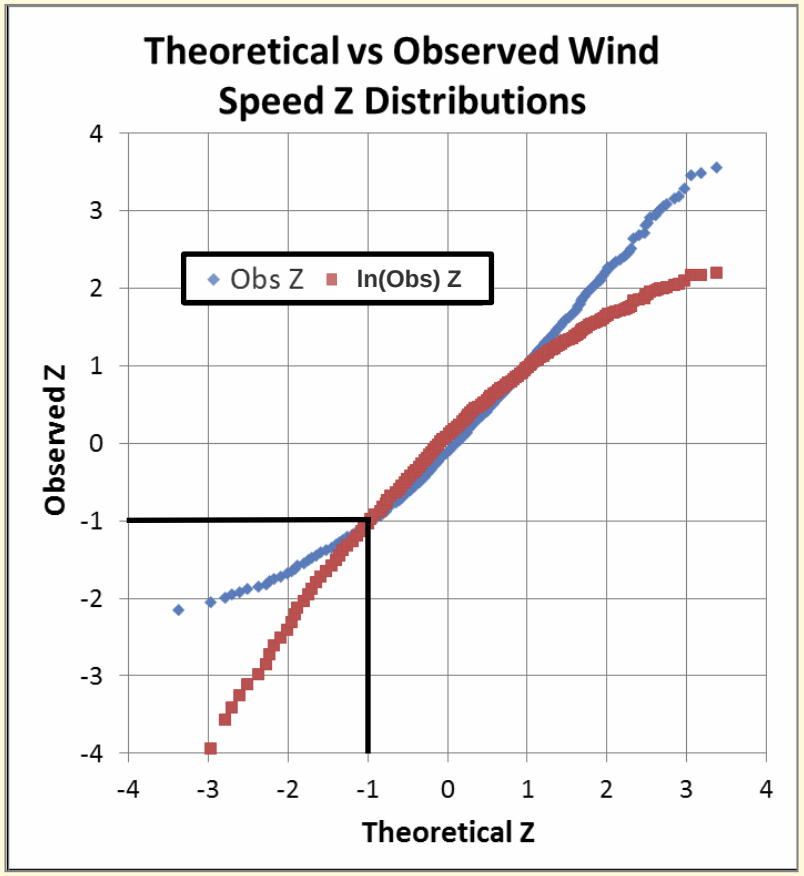


Historical Data cont'd…

Determining Data Distributions

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

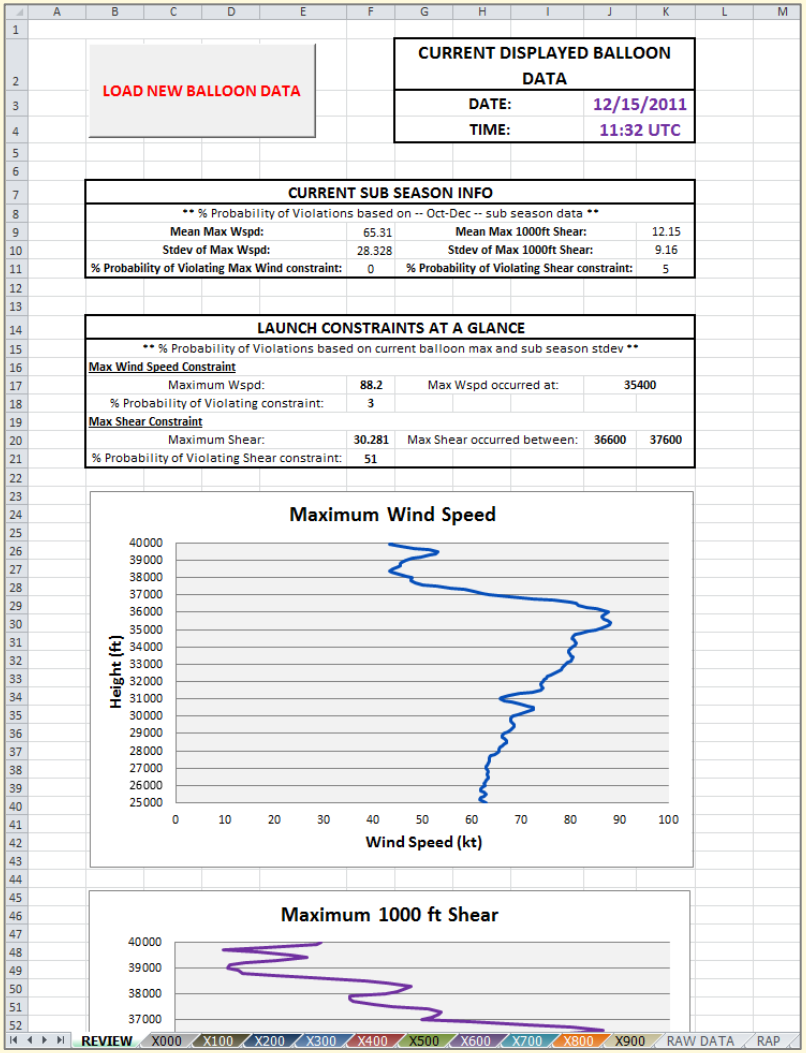
Max Wind Speed	**GAUSSIAN**
Max Shear	**LOG-NORMAL**



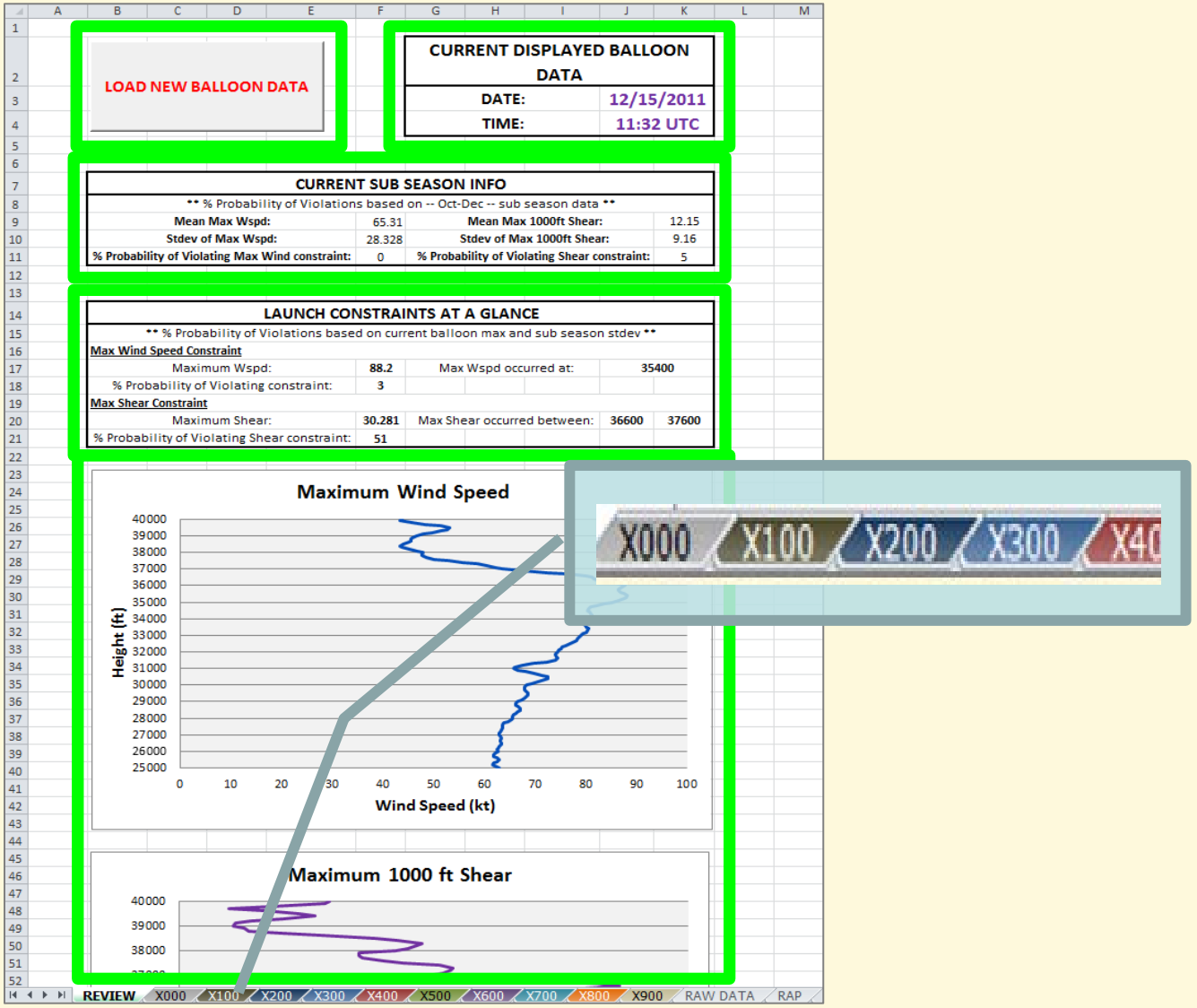
(-1,-1) = 42 kts

Excel Graphical User Interface

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

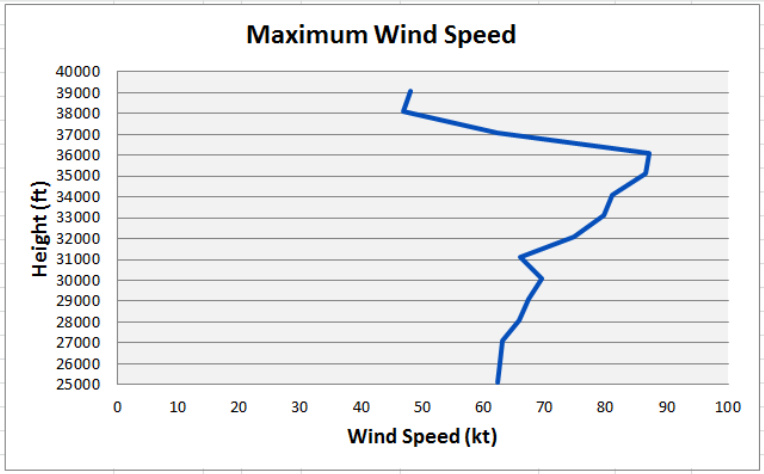


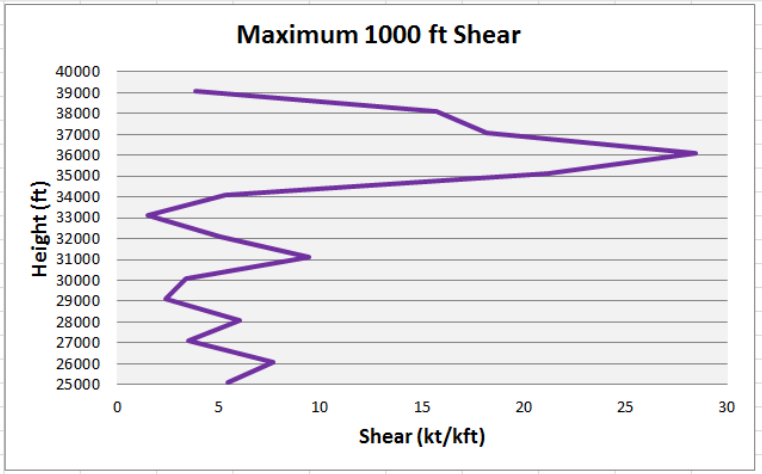
Excel Graphical User Interface



Excel Graphical User Interface

Heights(ft)	Temp(C)	RH	WDir	WSpd(kt)	1000 ft Shear
25100	-37.6	3	293	62.2	5.458
26100	-40.1	4	288	62.6	7.678
27100	-42.5	5	281	63	3.512
28100	-45.1	6	283	65.7	6.018
29100	-47.9	8	288	67.3	2.415
30100	-50.3	9	287	69.4	3.4
31100	-51.5	11	287	66	9.445
32100	-52.5	13	290	74.7	5.081
33100	-55.3	17	291	79.6	1.5
34100	-58.2	22	291	81.1	5.3
35100	-61.2	27	291	86.4	21.141
36100	-60.7	23	305	87	28.447
37100	-59.1	16	316	62.3	18.134
38100	-61.6	11	306	46.8	15.691
39100	-63	9	287	48	3.863
40100	-61.3	7	284	45	





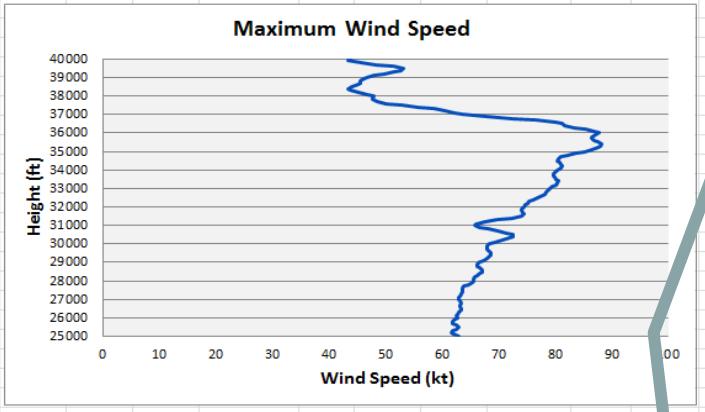
Excel Graphical User Interface

LOAD NEW BALLOON DATA

CURRENT DISPLAYED BALLOON DATA	
DATE:	12/15/2011
TIME:	11:32 UTC

CURRENT SUB SEASON INFO			
** % Probability of Violations based on -- Oct-Dec -- sub season data **			
Mean Max Wspd:	65.31	Mean Max 1000ft Shear:	12.15
Stdev of Max Wspd:	28.328	Stdev of Max 1000ft Shear:	9.16
% Probability of Violating Max Wind constraint:	0	% Probability of Violating Shear constraint:	5

LAUNCH CONSTRAINTS AT A GLANCE				
** % Probability of Violations based on current balloon max and sub season stdev **				
Max Wind Speed Constraint				
Maximum Wspd:	88.2	Max Wspd occurred at:	35400	
% Probability of Violating constraint:	3			
Max Shear Constraint				
Maximum Shear:	30.281	Max Shear occurred between:	36600	37600
% Probability of Violating Shear constraint:	51			

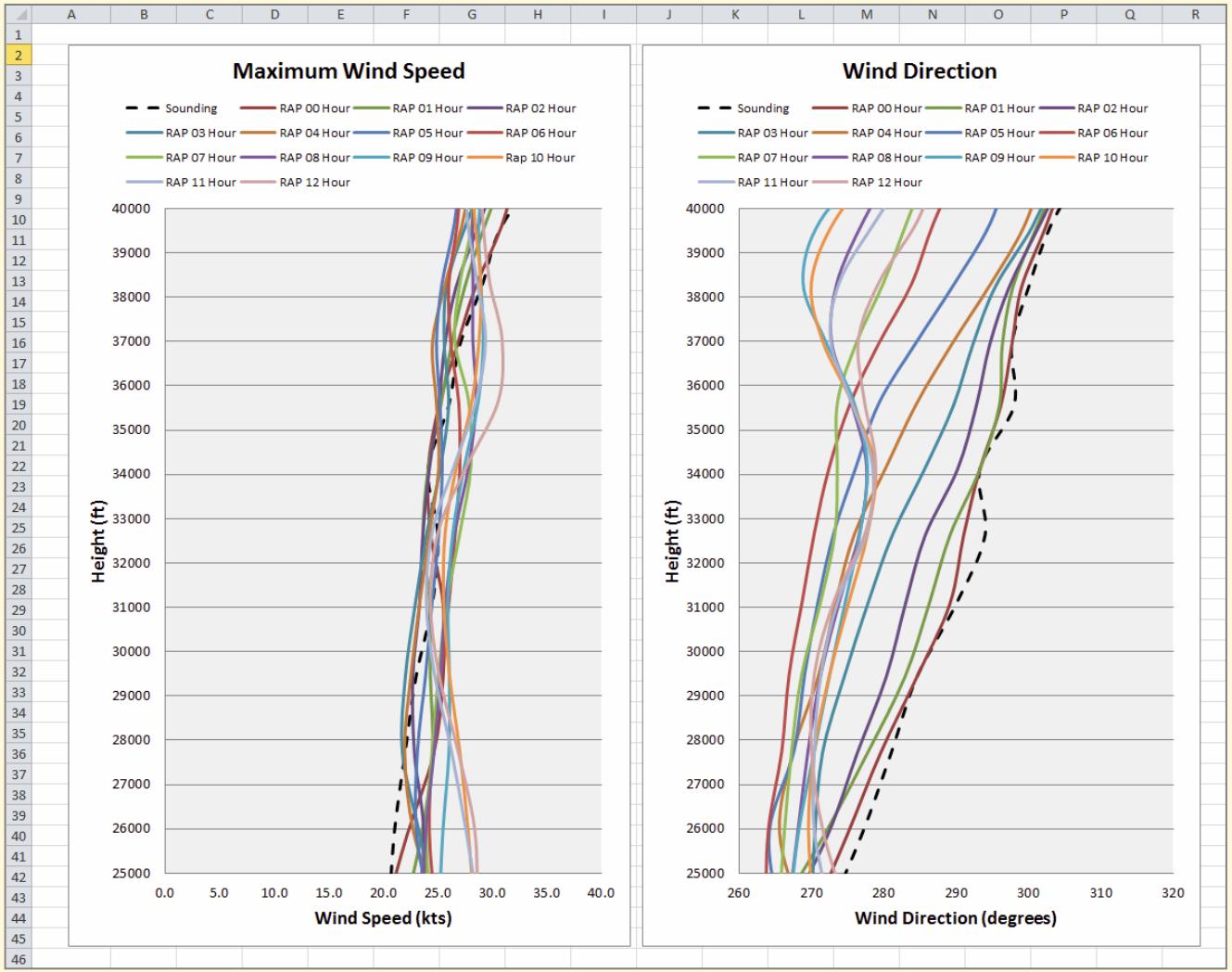


REVIEW | X000 | X100 | X200 | X300 | X400 | X500 | X600 | X700 | X800 | X900 | RAW DATA | RAP

Excel Graphical User Interface

- **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



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