On the question of lateral drift under high winds, and the possibility of a lower deployment altitude.

As has been mentioned previously, due to the fact that our rocket - with its' somewhat large sized chute - will drift outside our recovery area should the wind speed exceed 15 mph. The problem of what to do if the wind speed exceeds this limit, curtailing our launch opportunity, needs to be addressed. Should the Range Safety Officials (RSOs) allow it, we could go ahead with our launch if a lower deployment altitude for the main chute is allowed. By lowering the deployment altitude, the descent time is reduced, which thereby reduces the time the cross-wind can act on the descending rocket.

An extremely simplistic estimate of this altitude can be determined by assuming a vertical ascent to an altitude of 5280 feet, followed by drogue chute deployment. The drogue chute descent is taken to be essentially vertical down to a deployment height that would ensure that the rocket does not carry out of the safe range of R = 2600 feet. Determination of this low deployment height h begins with the understanding that the time that the cross-wind acts on the rocket, descending under a main chute, is the same time it will it will take to descend vertically from this height. In essence, we have two parametric equations;

$$h = v_M t$$
$$R = v_d t$$

Where v_M is the descent speed of rocket under the main chute, or 18 ft/s. The traversing wind speed v_d is taken to be 25 miles per hour (very extreme), or 37 ft/s. These equations can be combined together to yield our simplistic estimate…

$$h = \frac{v_M}{v_d} R = \frac{18\,ft/s}{37\,ft/s}(2600\,ft) = 1320\,ft$$

This works out to be ~1200 feet lower in deployment!

As has been mentioned, this was an extremely simplistic estimate because it does not take into account the horizontal distance that the rocket travels during the drogue chute descent – which leads to even lower deployment altitude of ~200 feet! Nor does the above take into account the fact that the ascending rocket will experience an asymmetric torque which tends to rotate the rocket into the wind – this actually increases our possible main chute deployment altitude. This torque is due to placement of the fins on the rocket, the cross-wind acting on the fins, and is commonly referred to as 'weather cocking'. This effect causes the rocket to travel a distance downrange, which allows for more lateral drift back up-range, and allows us a greater deployment altitude.

A better estimate can be determined by using our simulation route, which takes into account all of these factors. We ran the OpenRocket routine, under the maximum wind condition of 15 miles per hour (its maximum allowable launch constraint), using varying deployment heights from an initial altitude of 1950 feet and decreasing it by 50 feet. From each run we obtained a lateral drift distance and compared that value to the maximum allowable drift distance. We did each altitude for five separate flights and took the average. Following this procedure, we determined that a safe deployment altitude for our main chute, under high winds, would be 1150 feet. This late deployment altitude yielded an average lateral drift distance of 2598 feet, which is less then the maximum of 2600 feet.

deployment altitude (ft)	drift (m)	drift (ft)
1950	1017	3337
1900	1001	3284
1850	1002	3287
1800	949	3114
1750	957	3140
1700	879	2884
1600	891	2923
1500	863	2831
1450	858	2815
1400	844	2769
1350	818	2684
1300	805	2641
1250	806	2644
1200	792	2598
1150	779	2556