

On the Gust characterization for wind biasing the rocket launches

S. SATHEESH KUMAR ⁽¹⁾ and T. NARAYANA RAO ⁽¹⁾

(1) National Atmospheric Research Laboratory, Box 123, SVU Campus, Tirupati-517502, Andhra Pradesh, India.

An aerospace vehicle's response to atmospheric disturbances, especially wind, must be carefully evaluated to ensure that the design will meet its operational requirements. In the designs that use wind-biased trajectories, it is considered best to be cautious with the excessive wind loading that dictate the operational constraints of the vehicle, to maximize vehicle performance flexibility. Therefore, a sudden increase in the wind speed, otherwise, a Gust, plays a significant role in wind biasing the launch operations. For this purpose, several gust models are being used globally, based on a few air-craft measurements. A gust model is primarily characterized by its shape, amplitude and width. An attempt has been made to quantify the Gust magnitude with a specially designed experiment with Indian MST radar. To choose proper radar parameters for the proposed new experiment, Monte-Carlo simulations are performed by varying experimental parameters and examining their impact on estimated winds. Also, it is decided to identify GUST independently in each wind component. Accordingly the beam scan strategy is adopted, in which beams are pointed sequentially in the following directions: 4 beams toward east followed by zenith and then by 4 beams toward south.

A total of 4 campaigns with duration of 7 days (except in summer) each have been conducted covering all seasons during 2015-2016 (Table 2). During each campaign, radar is operated in the special mode for GUST for about an hour in the morning and evening. Several quality control techniques (like continuity, SNR, etc.) have been adopted to remove bad data points. To obtain fluctuating wind components, the background mean wind needs to be removed. Consensus averaging is used to estimate the background mean wind. The statistics related to the occurrence of wind fluctuations and Gust characteristics (gust height, amplitude and width) are presented. The % exceedance plots clearly show that only for 1% of zonal and meridional wind data exceed 7 ms^{-1} , indicating that it can be used as conservative Gust amplitude.