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USE OF THE TERMINAL AREA SIMULATION SYSTEM (TASS) TO STUDY MICROBURST WIND SHEARS

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Microburst wind shears can significantly affect aircraft performance and present a major to commercial passenger aircraft on landing approach or takeoff. A microburst is a strong, evaporatively-cooled downdraft which spreads out as it nears the ground. As a result, the aircraft entering a microburst first encounters a performance increasing headwind, followed by a loss of headwind, downdraft and tailwind, all of which act to decrease aircraft performance. Occasionally, full recovery from a microburst is not possible, resulting in an incident or accident such as the Delta Flight 191 accident at DFW airport which claimed 133 lives.

Ground-based and airborne Doppler radar and LIDAR systems are being designed to alert pilots when a hazardous windshear is present. A key element in this design effort is understanding the microburst itself. This is accomplished by means of the TASS model which was developed for NASA by Proctor (1987a,b). The time-dependent TASS model has two vesions: a two-dimensional high resolution axisymmetric model, and a three-dimensional model. The model includes a sophisticated parameterization of cloud microphysics and a friction layer, both of which are essential to a realistic simulation of the microburst phenomenon. The TASS model has been successfully tested on well-observed convective events, including the aforementioned DFW microburst of 2 August 1985 (Proctor, 1987b, 1988).

Horizontal and vertical wind output from TASS simulations were examined, since both are significant factors affecting aircraft performance. Evaluation of horizontal winds from TASS simulations show a variety of outflow intensities(u) and horizontal shears (du/dr) among the cases, as is shown in Figure 1. When the data are normalized by the maximum outflow (U/UMAX) and the radius of maximum outflow (R/RMAX), the plots show much more consistency (Figure 2). Figure 3 shows good agreement between a composite normalized radial outflow profile derived from 8 TASS microburst simulations and observational data derived from Doppler radar data by Hjelmfelt(1988).

Doppler and LIDAR sensors are designed to detect only the horizontal winds. Since vertical winds are also an important factor in aircraft performance, we investigated a method to deduce the vertical winds given the horizontal wind profile. Figures 4 and 5 show that by scaling the horizontal divergence (SCALE=0.4), a reasonable estimate of the normalized vertical wind (W/WMAX) is obtained. We propose to further investigate this relationship as it pertains to aircraft performance and to expand the investigation to asymmetric microburst cases using the three-dimensional version of TASS.

REFERENCES

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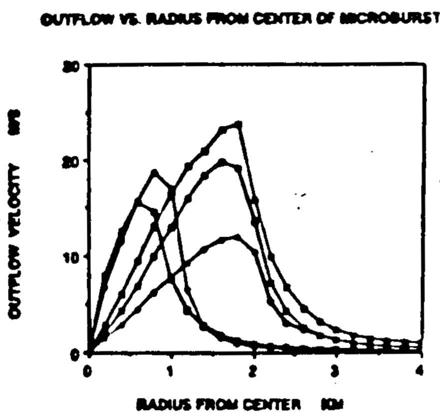

Figure 1

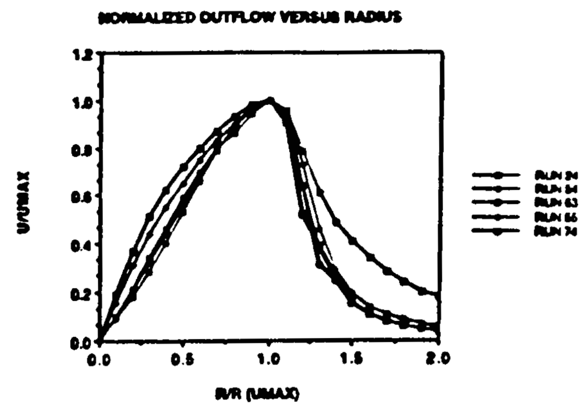

Figure 2

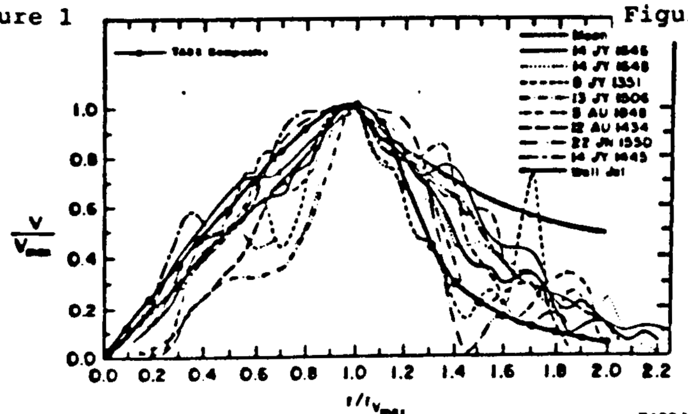

Figure 3

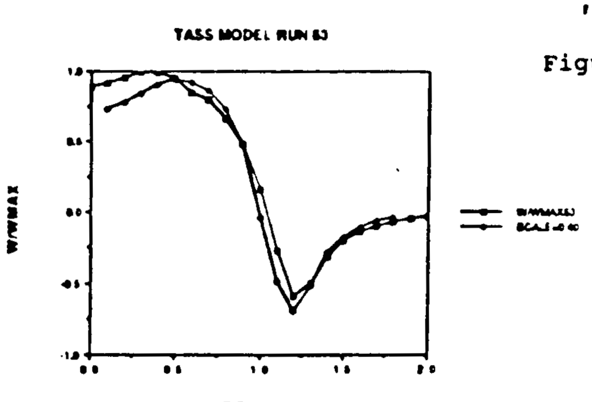

Figure 4

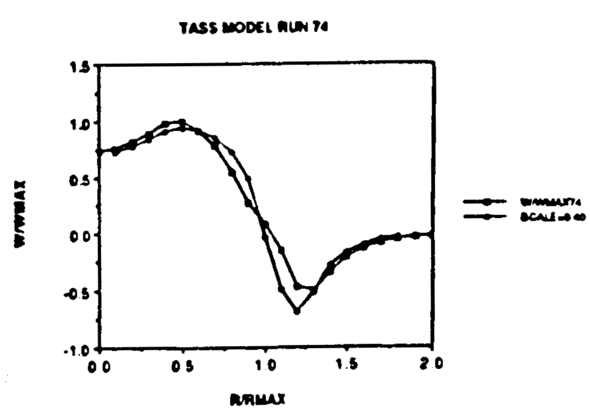

Figure 5