VAISALA / APPLICATION NOTE

The New, Enhanced Vaisala AviMet® Low Level Windshear Alert System (LLWAS)

Windshear is a sudden change in wind speed and/or direction that results from a variety of meteorological conditions. These include temperature inversions, land and sea breezes, frontal systems, strong surface winds and, significantly, thunderstorms. Severe wind shear is defined as a rapid change in wind causing aircraft airspeed changes of greater than 15 knots or vertical speed changes of greater than 500 feet per minute.

The phenomenon associated with thunderstorms is referred to as a microburst (the vertical element is also known as a downburst). A microburst is an intense, localized downdraft of air that spreads radially on the lowest 1000 feet near the ground. A microburst has a vertical component - a powerful downdraft, and a horizontal component at the surface, and ahead and around them are vortices of circulating winds. Microbursts are associated with convective weather, cumulus congestus and cumulonimbus clouds, and grow in strength as storm clouds mature. The downbursts can normally be expected below thunderstorm clouds, but the downburst may be at an angle which adds to the unpredictability of the downburst location.

The Vaisala AviMet® Low Level Windshear Alert System (LLWAS) was specifically designed to measure and report wind shear of 15–30 knots and microbursts of over 30 knots up to 1000 feet above ground level. The Vaisala AviMet® Low Level Windshear Alert System (LLWAS) includes wind speed and direction sensors that are sited around the runway area and connected to an on-site data

collection unit. The filtered wind data from these sites are interpreted by the Vaisala AviMet® Low Level Windshear Alert System (LLWAS) algorithm to identify divergence or convergence, and to estimate the effects of the wind shear on aircraft. The sensors are placed high enough to avoid local wind interference, 15 to 30 m above the ground. The wind shear data can be displayed in one of two formats – either as text or graphically. Wind shear alerts are presented visually and audibly. The graphical display depicts the areas of wind shear in relation to the active runway(s).

To improve windshear situational awareness outside of the immediate airport area, Vaisala AviMet® Low Level Windshear Alert System (LLWAS) will now feature a map showing real-time Global Lightning Dataset GLD360 data in a large region surrounding the airport. This data can be used by Air Traffic Controllers to anticipate potential thunderstorm-induced, windshear events at the airport and avoid flying aircraft directly through dangerous thunderstorms producing turbulence, windshear, and hail.

In 2009, Vaisala launched Vaisala Global Lightning Dataset GLD360. GLD360 data is produced by a Vaisala owned and operated lightning detection network that provides uniform, high quality lightning information across the globe. Patented sensor algorithms and extreme sensitivity give GLD360 sensors the ability to detect lightning at distances up to 9,000 km. GLD360 routinely detects over 1.5 million lightning events across the world each day.

Over the past 25 years, the research community has explored the relationship between cloud-to-ground (CG) lightning and thunderstorm-induced wind shear/microbursts. On the climatological time-scale, Hallowell and Cho (2010) found a strong correlation between microburst minutes and annual lightning flash rates across the continental United States.

On the thunderstorm time-scale, Sanger (1999) found that 76% of all wind shear events at Kennedy Space Center (KSC), Florida, USA were associated with CG lightning. In addition, 78% of the strong wind shear events (or microbursts with wind speeds ≥34 knots) exhibited a distinct increase in CG lightning flash rate prior to the event. Kuhlman et al. (2010) examined microbursts produced by thunderstorms in Oklahoma, USA and found that all of the microbursts studied produced an increase in CG lightning flash rate at the time of the microburst.

For airports that currently have access to weather radars that use Vaisala signal processing and radar control or purchase a Vaisala Weather Radar, Doppler Weather Radar algorithms significantly enhance wind shear detection outside of the immediate airport area.

The advent of the weather radar in the early 1980s introduced an alternative method of detecting weather elements that included the detection of wind and wind shear. Doppler weather radar can provide wind shear detection and storm reflectivity data to air traffic controllers. Doppler weather radar rapidly scans boundary-level winds below 2000 ft. within the area of coverage at an airport. Vaisala software provides graphical and numerical alerts on wind shear events detected within this boundary-level wind field. The wind shear alerts from Doppler weather radar can be merged with Vaisala AviMet® Low Level Windshear Alert System (LLWAS) alerts to increase the probability of detection and area of coverage for wind shear events, while lowering the wind shear false alarm rate.