

The key to safer, more efficient airport operations



Mitigating the impact of severe weather events at airports with meteorology, measurement expertise, and solutions.

A tailored solution for every challenge

No two airports are the same. Because each faces its own unique set of weather-related challenges, there is no one-size-fits-all solution when it comes to weather observations and severe weather mitigation. Severe weather is broadly defined as weather that makes aviation operations difficult or even impossible, and includes wind, rain, and thunderstorm-related phenomena.

Certain airports are more prone to these kinds of events. For example, those in coastal locations or close to mountain ranges can often experience rapidly changing wind conditions. Although these cannot be avoided, increasing the understanding of the weather environment at an airport can increase safety during periods of restricted operations and keep the length of any disruptions such as runway closures to a minimum. As with any weather-related event that poses a risk, the key is situational awareness.

With 40 years of experience in working with aviation customers around the world, Vaisala has the knowledge and capabilities to combine precisely the right set of technologies into a tailored solution. These give individual airport operators the ability to effectively monitor and anticipate severe weather conditions, and minimize their impact on both air and ground operations.



The unpredictable conditions caused by wind shear can have a significant impact on airport safety and efficiency.

Low-level wind shear

Low-level wind shear is typically the result of a thunderstorm or severe convective storm creating a downburst – a descending air mass that can create a divergent wind field over the runway area. Wind shear can be very dangerous during takeoff and landing, as it can drastically alter the lift, airspeed, and stability of aircraft. In extreme cases it can exceed aircraft climb capabilities and result in a crash. Wind shear events occur thousands of times at airports around the world every year, and can affect the arrival and departure rates as inbound and outbound traffic are held until the event is over.

The typical way to measure low-level wind shear is with wind sensors attached to several masts. These masts are installed at a distance of up to a kilometer on either side of the runway path and up to five kilometers beyond each end of the runway. The sensors send data to the airport's weather observation system (AWOS), which is equipped with a wind shear (LLWAS) algorithm. With access to this kind of data, air traffic

controllers are fully aware of the situation and can inform pilots and take appropriate action.

Terrain-induced wind shear and convective turbulence

The terrain surrounding an airport plays a key role in determining wind behavior. Features like mountains, high hills, and valleys close to airports can cause terrain-induced wind shear, resulting in an extremely unpredictable wind field. This unpredictability can have a significant impact on operational safety, with highly changeable conditions making safe takeoff and landing challenging or, in the worst case, even impossible on certain runways.

Convective turbulence is an umbrella term for the turbulence and high, unpredictable winds generated in the vicinity of a thunderstorm or strong convective cloud. As with other wind-related phenomena, it can pose a significant safety risk to airport operations, impacting efficiency by necessitating a slowdown or

temporary halt in take offs and landings, or perhaps a change in the approach pattern to steer traffic away from danger.

Measuring this phenomenon on the aircraft glide path is difficult, and by the time it is observed, it may already be too late to take any mitigating action. One potential solution is nowcasting, where weather radar, satellite, and observational data are used to provide a short-term forecast of an event. When air traffic managers are aware of an impending wind shift, they can more effectively change their runway configuration and alert pilots in order to maintain safety and capacity.



Heavy rain can result in poor visibility, aquaplaning, and even damage to aircraft engines.

Rain-related issues

Heavy rain in the vicinity of an airport causes many of the same kinds of problems as it does for road traffic. An aircraft taking off or landing on a runway covered in water can experience aquaplaning – when a layer of water builds between the aircraft wheels and the runway surface, leading to a loss of traction and potentially causing the aircraft to slide off the runway. Although aquaplaning is seldom the cause of fatal accidents, aircraft recovery can be an extremely costly and time-consuming process that can close a runway for a considerable period of time, resulting in a significant impact on airport operations.

Furthermore, when the depth of water on a runway exceeds 10 mm, there is the risk of water being sucked into the aircraft engine and causing damage. The depth of the water layer on a runway can be calculated using an advanced algorithm and real-time data on rain intensity collected by rain gauges located next to the runway. The calculation is calibrated using remote-sensing equipment.

The ability to provide pilots with up-to-date information about runway conditions is an extremely valuable tool. With pre-warning of these kinds of severe weather events, air traffic controllers and other operations staff can plan ahead and minimize their impact. Furthermore, the cost of delaying flights by what may be a matter of minutes is small in comparison to that of recovering an aircraft that has slid off the runway.

Hail events

In the most extreme conditions, hail can result in significant damage to aircraft and ground-operations vehicles. For example, a sufficiently strong hailstorm can severely damage the cockpit windshield and the weather radar equipment housed in the aircraft nose, resulting in an aircraft being out of service for an extended period, with costly financial implications for the airline. With sufficient advanced warning of an approaching front containing hail, air traffic control teams can adjust approach patterns to steer traffic safely around the problem area.

It is possible to differentiate the various forms of precipitation including hail and heavy rain using the Vaisala Interactive Radar Information System (IRIS™), which incorporates unique hydrometeor-classification algorithms. Armed with this information, air traffic control personnel have a much clearer picture of what potential problems the weather may bring and the mitigating actions they may need to take. This information can be provided through the familiar AWOS interface already in place at the airport.



Lightning poses a huge safety risk for both ground operations and air traffic.

Lightning-related risks

There are two main ways in which lightning can impact aviation: the significant risk it poses to the safety of airport ground operations – especially aircraft refueling – and the potential for strikes on airborne traffic. With a huge number of ground staff working outdoors with no cover – handling baggage, marshaling and refueling aircraft, and carrying out catering operations – electrical storms are the cause of several casualties every year at airports around the world.

Observations of cloud-to-ground lightning close to the terminal area generally result in a halt in operations due to the risk of injury or death from lightning strikes. For airborne traffic, although it is extremely rare for a lightning strike to cause significant damage or lead to a crash, any aircraft struck by lightning must be taken out of operation and

thoroughly inspected, which can be a costly and time-consuming process for the airline. Lightning activity can be detected using the Vaisala Global Lightning Detection Network, with data, nowcasts, and alerts being displayed via the AWOS.

When an airport can take advantage of tools such as lightning detection systems, weather radar, and nowcasting to gain a better understanding of where a convective storm is and what potential problems it may cause, it can prepare properly. Personnel can make informed decisions based on hard facts about how to brief pilots and ground staff and adjust operations accordingly. For example, refueling can be halted at exactly the right time and for no longer than necessary, and pilots are prepared well in advance for any potential problems they may face on approach and during landing or takeoff.

The full-chain partner for airports

For aviation-related operations, Vaisala offers a unique combination of knowledge, experience, and technical capabilities. In addition, we are also able to call on the resources and knowledge of our extensive partner network to develop the optimal solution for each individual airport. With 40 years of experience working with aviation customers around the world, we have unmatched know-how and experience in helping solve airports' weather-related challenges.

Our extensive applied meteorology and advanced weather-algorithm capabilities mean we can offer an unrivalled level of expertise in relation to measuring, monitoring, and mitigating the impact of weather phenomena of all kinds. Airports of all different sizes in a wide variety of locations rely on our proven lightning detection, weather radar, surface sensor, and display system solutions to improve safety, decision-making, and efficiency.

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For more information, visit www.vaisala.com or contact us at sales@vaisala.com

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