The Importance of Measuring Mid-Air Winds for Airborne Operations

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Imagine being a paratrooper, one minute away from exiting an aircraft, with your jumpmaster echoing that winds are only three knots. Thirty seconds later, after exiting the aircraft, you feel betrayed and confused as you drift quickly across the sky. Most paratroopers can recall a static line jump where their descent felt faster than the reported wind speed. Mid-air winds range from the drop altitude, approximately 1,500-1,000-feet above ground level (AGL), to the surface winds, approximately 200-feet AGL (about tree-top level). However, for military static line operations, the Army only requires jumpmasters to observe surface-level winds when determining whether it is safe to release paratroopers.[1]

Mid-air winds encompass most of a static line jumper's flight, but currently there is little emphasis on the importance of monitoring how it affects paratroopers. This results in paratroopers assuming they will experience three knot winds for their entire descent instead of understanding this figure only pertains to surface winds. While there is a lack of quantifiable evidence, experiences shared across the airborne community demonstrate the need for researching the effects of mid-air winds on static line airborne operations. Efforts to initiate quantitative and qualitative studies on mid-air winds can create a path forward that could improve point of impact (PI) accuracy, reduce airborne-related injuries, and reduce costs associated with these injuries.

Paratroopers assigned to 2nd Battalion, 503rd Parachute Infantry Regiment, 173rd Airborne Brigade, descend onto Juliet Drop Zone in Pordenone, Italy, on 22 March 2023. (Photo by Paolo Bovo)

Purpose

Inaccuracy and injuries continue to play a role in the risk assessment for conducting airborne operations, which increases the reasoning to monitor mid-air winds during static line operations. Although there is a prevailing belief among the airborne community that faster winds at elevation can cause a faster horizontal drift for paratroopers during landing, substantiated data is extremely limited. Two anecdotal cases from 2022 and 2023 highlight the potential impact, but further research is necessary to draw definitive conclusions. During both airborne operations, mid-air winds exceeded 25 knots, but surface winds remained within tolerance. In both instances, six experienced jumpers exited with MC-6 parachutes, which are steerable canopies with 10-knot forward drift capability. Even though the jumpers assumed the appropriate parachute landing fall (PLF) positions, they all drifted backward quickly and landed with extreme force. Most required some form of medical attention. If these same paratroopers exited with a T-11 parachute, the potential injuries could have been exponentially worse.

To prevent injuries and mitigate risk, the Army spends the most resources and training on individual paratrooper actions during airborne operations. Soldiers receive three weeks of training on proper methods throughout their entire descent to the body posture and process for proper PLFs. Paratroopers then perform basic airborne refresher training at every new unit and sustained airborne training before every single jump. When the Army approves new parachutes, equipment, or techniques, it spends a lot of resources and time preparing paratroopers before execution.

In my opinion, the Army needs to dedicate more resources and equipment to observing and measuring wind for static line operations. The two main contributing factors affecting PI and release point (RP) are the drop altitude and wind speed, but the Army only dedicates personnel and equipment to measuring surface wind. During most airborne operations, the drop zone safety officer (DZSO) or drop zone safety team leader (DZSTL) uses only an anemometer to measure surface-level winds and wind direction. Personnel airborne operations can only occur if the surface winds remain within a 13-knot wind tolerance.[2] This is one of the prevention methods in place to reduce the number of paratrooper injuries.

Mid-air observations and calculations need equivalent emphasis to individual training for paratroopers. The Army currently has a regulatory process to measure mid-air winds, and the necessary equipment is within the supply system and available at most airborne organizations. Additionally, there are advances in technology available that provide fast, real-time updates on mid-air winds to ensure airborne operations remain seamless. As the Army continues to improve airborne equipment and types of training, the methods and ways to measure factors affecting operations need to evolve as well.

Background

For static line airborne operations, the PI location for personnel is 300 yards from the lead edge of the drop zone during the daytime and 350 yards at night.[3] To achieve the standard, the Army relies on two systems that estimate the release point to achieve the desired personnel PI. Most fixed-wing aircraft utilize the computed air release point (CARP) system, and rotary-wing aircraft use the verbally initiated release system (VIRS).

CARP is based on average parachute ballistics and fundamental dead reckoning principles.[4] From the parachute type to the wind speed and direction of drift, the CARP system analyzes many factors. After each pass, the DZSO updates the aircrew on the actual point of impact to validate calculations or propose adjustments. Rotary-wing airborne operations rely on a DZSTL to estimate the RP and PI through VIRS. After determining wind drift, the DZSTL then radios to the aircrew when to release the paratroopers.

The Way Ahead

As safety and risk mitigations continue to increase in urgency, the implications of mid-air winds are too important to ignore. The Army has a method to estimate a paratrooper's total wind drift, but it only needs one slight modification. It determines the total wind drift by inputting data into the wind drift formula [wind

Paratroopers release a pilot balloon during an airborne operation in Germany on 7 September 2023. (Photo by Kevin Sterling Payne)

drift (D) = velocity (V) x altitude (A) x load drift (K)]. Multiplying velocity (surface winds) by drop altitude and load drift (a constant for personnel) produces the estimated overall drift experienced by a paratrooper on that airborne operation.[5] This means airborne operations from 1,000 feet AGL (expressed as A=10), 11 knots surface winds (V=11), and a load drift (which is a 3-meter constant for personnel airdrop, K=3) would produce an expected 333 meters of wind drift per individual paratrooper using a non-steerable category. The two main issues with this practice are the use of surface winds for velocity instead of total winds and using these calculations only for rotary-wing airborne operations.

To measure the total expected wind drift, replace surface winds with the mean effective wind (MEW) for velocity in the same formula (D = KAV). The MEW calculates the average wind speed between surface-level and drop-altitude winds. A DZSTL can calculate the MEW using a helium balloon called a pilot balloon (PIBAL). The DZSTL releases the PIBAL, observes its flight path, and annotates the elevation angle based on the PIBAL conversion table.[6] The number produced from the conversion table represents the average wind speed during a paratrooper's entire descent. If the PIBAL is unavailable or if a unit wants a more expedient method to monitor total wind drift throughout the day, there are other available options. A wind streamer is the second option available within the Army supply system. Dropped out of the aircraft, a wind streamer measures the RP to PI to determine total wind drift.

The wind streamer and PIBAL are great options, but units may not always be able to delay lifts or use available aircraft time to utilize one of these methods to monitor mid-air winds. With advances in technology,

A paratrooper checks wind metrics during an airborne operation in Germany as part of exercise Saber Junction on 19 September 2018. (Photo by SGT Jennifer Amo)

certain applications such as Windsaloft provide real-time data with accurate wind measurements from 1,000 feet AGL and above.[7] Although 1,000 feet AGL is the lowest available wind reading on Windsaloft, it provides enough information to gain a quick average of the total wind drift to improve calculation accuracy.

The MEW wind speed factor provides a more realistic wind drift for paratroopers because it includes the average winds from their RP to PI. Maintaining the same constants with the D=KAV formula and increasing velocity by one knot to include total winds produce an overall change in PI by at least three meters for every paratrooper. The slightest increase in drop altitude or wind speed, the greater the drift effect.[8] Drop altitude winds typically range from a few knots to more than 10 knots higher than surface winds depending on the atmosphere and location. This slight difference could result in a 3-knot disparity in PI, which results in a significant difference in landing location (at least 30 meters) per paratrooper. Using the appropriate velocity calculations can help prevent paratroopers landing off of the drop zone or may even save them from a potentially devastating injury.

Recommendations

Combining the available equipment and weather applications would allow Army airborne forces to begin observing winds immediately. Mandating units to incorporate mid-air wind observations over the next few years demonstrates the emphasis on risk mitigation while validating any potential effects. If research determines mid-air winds produce an effect on paratrooper landings, the Army could begin incorporating protocols into airborne operations seamlessly starting tomorrow. Updating regulations to incorporate mid-air wind tolerances could reduce the number of airborne-related injuries. Current operations will become more efficient and improve requirements for future airborne equipment. Long-term effects when accounting for mid-air wind includes increased longevity and survivability for personnel and equipment.

Conclusion

As the military emphasizes safety and efficiency, assessing the effects of mid-air winds must become a priority to ensure success for current and future operations. Surface winds can no longer be the only level of wind monitored during an operation, especially with unknown implications of mid-air winds and the ease of available technology. Including mid-air winds in total wind drift calculations can increase PI accuracy and mitigate airborne-related injuries.

Notes

[1] Training Circular 3-21.220, *Static Line Parachuting Techniques and Training*, October 2018, 22-9.
[2] Field Manual (FM) 3-99, *Airborne and Air Assault Operations*, March 2015, 3-10.
[3] FM 3-21.38, *Pathfinder Operations*, April 2006, E-4.
[4] Air Force Manual (AFMAN) 11-231, *Computed Air Release Point Procedures*, November 2020, 11.
[5] FM 3-21.38, 128.
[6] Ibid., 145.
[7] Mark Schulze, "Windsaloft," https://windsaloft.us/.
[8] AFMAN 11-231, 26.

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