



Very High Frequency 3D Wind Measurements from New Low-Cost Sensors

Christoph Feichtinger¹, Rene Hörschinger¹, Thomas Lumesberger¹, Daniel Stanka², and Manfred Dorninger²

¹Windpuls GmbH, Research and Development, Linz, Austria (c.feichtinger@windpuls.com)

²University of Vienna, Department of Meteorology and Geophysics, Vienna, Austria (manfred.dorninger@univie.ac.at)

Understanding three-dimensional wind patterns and turbulence in complex terrain remains a significant challenge in atmospheric sciences due to the variability and unpredictability of airflow in such environments. This study introduces and explores the innovative application of newly developed, low-cost sensors designed for very high-frequency three-dimensional wind measurements. A particular emphasis is placed on the Windpuls sensor technology, which represents a significant advancement in the field due to its affordability, portability, and precision.

The research highlights the ability of these compact sensors to accurately capture fine-scale wind dynamics in highly complex terrains, offering an unprecedented combination of spatial and temporal resolution. Traditionally, acquiring such detailed wind data has required expensive and stationary equipment, often impractical in rugged landscapes. In contrast, the Windpuls system enables flexible deployment, including on moving platforms such as vehicles and gondolas, allowing for dynamic wind profiling across varied terrains. This flexibility significantly broadens the scope of observational possibilities, especially in remote or difficult-to-access areas.

Preliminary findings from a unique experimental setup using gondola-mounted sensors in the Alpine region are presented. These initial results reveal valuable insights into vertical wind profiles, gust structures, and turbulence characteristics in mountainous areas, which are critical for applications such as aviation safety, renewable energy planning, and climate modeling. Although the current study focuses on Alpine regions, the sensor technology has broad application potential in coastal zones, urban canyons, and forested landscapes.

In this presentation, we detail the sensor's technical specifications, calibration and validation procedures, and share key findings from our initial field campaigns. The results demonstrate that this innovative sensor system offers a transformative approach to atmospheric monitoring and has the potential to significantly enhance our understanding of microscale wind phenomena in a wide range of complex environments.