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MOSEP: A Multi-Sensor Platform for Environmental Monitoring: Bridging the Scale Gap in Precipitation Measurement

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The cryosphere's dynamic processes, from snow accumulation and avalanche activity to glacier calving, demand innovative monitoring solutions that offer both high spatial and temporal resolution. Current advancements in sensor technology are revolutionizing environmental monitoring. Our research introduces MOSEP (Modular Multi-Sensor System for Environment Perception), a novel, adaptable multi-sensor platform employing sensors traditionally used in autonomous vehicles, repurposed for environmental monitoring. This system integrates lidar, camera, radar, and a weather station powered by a Raspberry Pi 4 and equipped with open-source software for detailed environmental analysis. Previously utilized for mapping applications with automotive lidar, GPS, and an IMU, our platform has been enhanced with additional sensors to complement the lidar, notably radar and camera. The automotive sensors' high temporal resolution enables the observation of rapid environmental changes, offering an affordable and effective alternative to traditional geophysical sensors like TLS, particularly with the additional benefits of sensor fusion.

In cryospheric applications, the camera, radar, and lidar can work together to monitor surface changes, snow depth, accumulation rates, and potentially detect avalanches or other mass movements. The platform's flexibility and mobility are particularly advantageous for studying small-scale features and processes that are otherwise difficult to capture with satellite methods due to their coarse resolution and infrequent revisit times. While we have shown that lidar-based mapping using SLAM algorithms is effective, current research focuses on sensor performance in adverse weather conditions and the capability to detect and quantify weather effects. Traditional precipitation measurements face a 'scale gap,' with satellite and weather radar observations offering extensive spatial coverage at low resolution and rain gauges providing high accuracy at specific locations. Automotive sensor and specifically lidar could help bridge this gap especially in complex terrain. The inclusion of a camera assists in differentiating meteorological phenomena, such as rain from snowfall. However, the 'black box' nature of automotive sensors also present challenges. A measurement campaign was conducted last fall, and this contribution will present preliminary results alongside an overview of the latest hardware and software enhancements.

By introducing the novel use of easily accessible automotive sensors for environmental monitoring, our work contributes to the evolving field of cryospheric research, emphasizing the potential for cross-disciplinary innovation and the development of scalable, cost-effective environmental sensing networks.