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High-resolution terrain and landcover mapping with a lightweight, semi-autonomous, remotely-piloted aircraft (RPA): a case study and accuracy assessment

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Remotely-piloted aircraft (RPA) have evolved into a viable research tool for a range of Earth science applications. Significant technological advances driven by military and surveillance programs have steadily become mainstream and affordable. Thus, RPA technology has the potential to reinvigorate various aspects of geomorphological research, especially at the landform scale. In this presentation we will report results and experiences using a lightweight, semi-autonomous RPA for high-resolution terrain and landcover mapping. The goal was to test the accuracy of the photogrammetrically-derived terrain model and assess the overall performance of the RPA system for landform characterization. The test site was comprised an area of semi-vegetated sand dunes in the Canadian Prairies. The RPA survey was conducted with a RQ-84Z AreoHawk (Hawkeye UAV Ltd) and a low-cost digital camera. During the survey the RPA acquired images semi-autonomously with the aid of proprietary mission planning software developed by Accuas Inc. A total of 44 GCPs were used in the block adjustment to create the terrain model, while an additional 400 independent GPS check points were used for accuracy assessment. The 1 m resolution terrain model developed with Trimble's INPHO photogrammetric software was compared to the independent check points, yielding a RMS error comparable to airborne LiDAR data. The resulting orthophoto mosaic had a resolution of 0.1 m, revealing a number of geomorphic features beyond the resolution of airborne and QuickBird imagery. Overall, this case study highlights the potential of RPA technology for resolving terrain and landcover attributes at the landform scale. We believe one of the most significant and emerging applications of RPA in geomorphology is their potential to quantify rates of landform erosion/deposition in an affordable and flexible manner, allowing investigators to reduce the gap between recorded and natural morphodynamics.