Spatial co-registration of ultra-high resolution visible, multispectral and thermal images acquired with a Micro-UAV over Antarctic moss beds

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Abstract:
In recent times, the use of Unmanned Aerial Vehicles (UAVs) as tools for environmental remote sensing has become more commonplace. Compared to traditional airborne remote sensing, UAVs can provide finer spatial resolution data (up to 1 cm/pixel) and higher temporal resolution data. For the purposes of vegetation monitoring, the use of multiple sensors such as near infrared and thermal infrared cameras are of benefit. Collecting data with multiple sensors, however, requires an accurate spatial co-registration of the various UAV image datasets. In this study, we used an Oktokopter UAV to investigate the physiological state of Antarctic moss ecosystems using three sensors: (i) a visible camera (1 cm/pixel), (ii) a 6 band multispectral camera (3 cm/pixel), and (iii) a thermal infrared camera (10 cm/pixel). Imagery from each sensor was georeferenced and mosaicked with a combination of commercially available software and our own algorithms based on the Scale Invariant Feature Transform (SIFT). The validation of the mosaic's spatial co-registration revealed a mean root mean squared error (RMSE) of 1.78 pixels. A thematic map of moss health, derived from the multispectral mosaic using a Modified Triangular Vegetation Index (MTVI2), and an indicative map of moss surface temperature were then combined to demonstrate sufficient accuracy of our co-registration methodology for UAV-based monitoring of Antarctic moss beds.

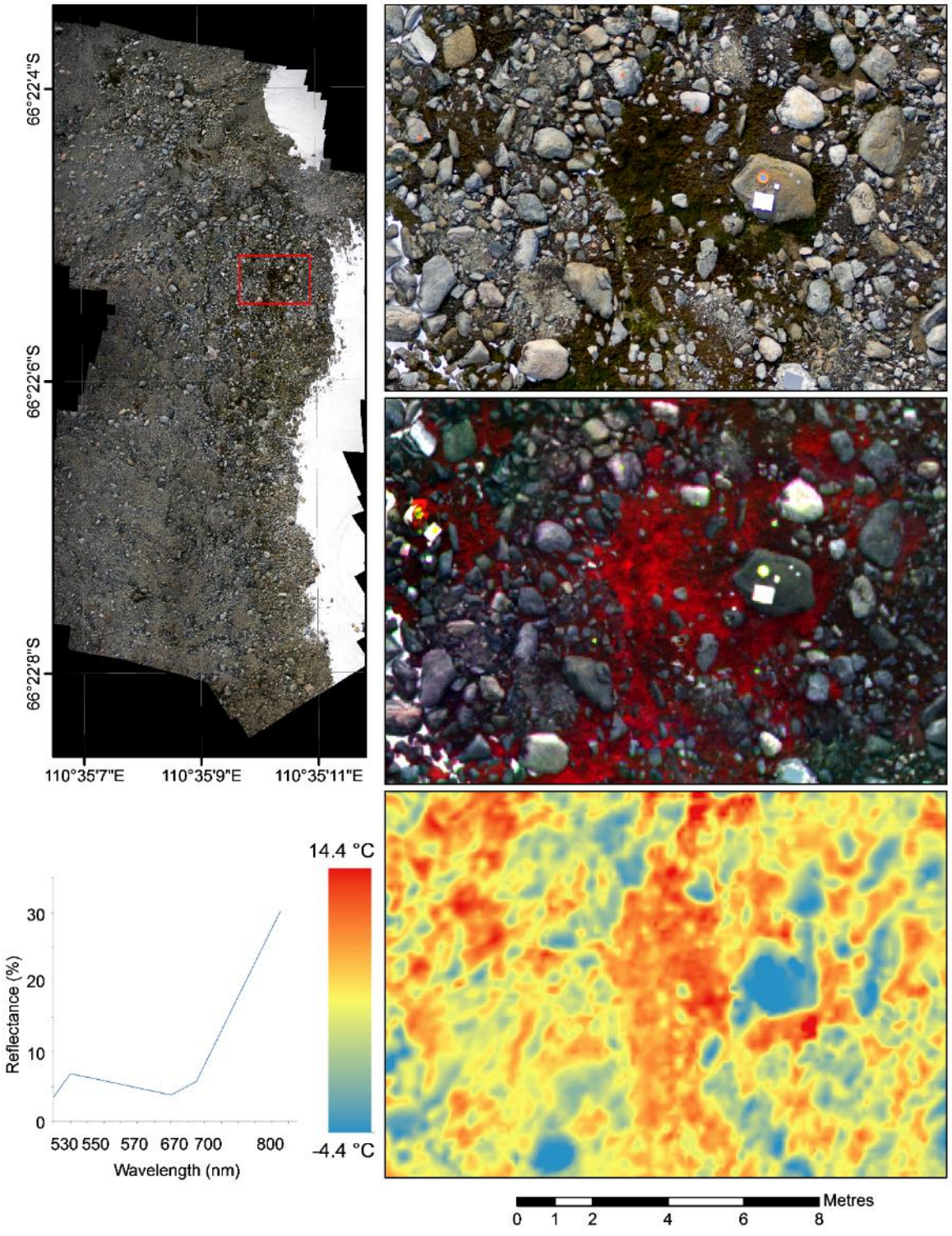

*Figure 1. Robinson Ridge study site, Antarctica: (**a**) RGB orthomosaic of entire area, (**b**) RGB image subset, (**c**) multispectral image subset, (**d**) thermal infrared image subset, and (**e**) typical multi-spectral reflectance function of a healthy Antarctic moss turf.*