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Assessing the applicability of UAV-borne optical and hyperspectral imagery for species and plant traits mapping in a tropical alpine ecosystem (Paramo)

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Ongoing changes in climate coupled with the effect of increasing anthropogenic pressures in alpine regions makes understanding and monitoring species responses and distribution urgent conservation priorities. At the top of the Northern Andes, tropical alpine ecosystems are known as paramos, highly diverse ecosystems and crucial providers of services for more than 30 million people that depend on them for water. Such ecosystems are very sensitive to climate change and can be rapidly affected by any variation in temperature and precipitation at multiple scales. At the local scale, microclimatic changes might affect plant physiological functions, which at larger scales influences community structure and composition. We explored the applicability of UAV-borne optical and hyperspectral imagery to identify a selected set of 10 common paramo species and track changes in its traits at a combination of microclimate resolution and landscape extent. We took UAV-borne optical and hyperspectral images of the 10-ha study area and collected plant cover data on 5 plots for calibration and another 5 plots for independent validation. Mapping plant communities (e.g. frailejonales, shrubs, grasslands) using both optical and hyperspectral imagery was possible as well as the variation in traits per community and among communities. Three species from the genus Espeletia, endemic to the paramo, could be differentiated from one another using hyperspectral imagery. Hyperspectral data was also useful for the identification of some of the grasses, which are commonly difficult to identify in the field. Optical imagery allowed high observer based-mapping accuracy, while hyperspectral imagery was reliable for mapping using modeling approaches (e.g. Maxent). Our study suggests that UAV-borne optical and hyperspectral imagery have a great potential for species and plant traits mapping in the Paramo, and thus provide a valuable addition to field data to monitor species response to global changes from the plant to the landscape scales. Studies at larger extents and in other paramos would allow exploring the variation in spectral signatures among sites.