Submitted Abstract

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Title	Decadal Alpine Treeline Dynamics Modelled Using Landsat Timeseries Amidst Rapid Climate Change In Australia: A Song Of Ice And Fire.
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Abstract

Alpine ecosystems are characterised by low temperatures and short growing seasons, but the stability of these ecosystems is threatened by climate change. Climate-induced dynamics in alpine vegetation have been recorded globally with changes in diversity, vegetation cover type, and composition, including in the Australian Alps. However, insights into these dynamics in Australia have been gleaned solely from field studies at small spatial scales. Here, climate data and LANDSAT imagery were assessed for Australia's highest and most diverse alpine area that surrounds Mount Kosciuszko (455 km2). Climatic changes were assessed using gridded climate data (5 x 5 km) for mean annual temperature (1910-2019) and seasonal precipitation (1900-2019), and changes in snow cover were assessed from snow course records (1954-2021). A vegetation cover timeseries (1990, 2000, 2010, 2020) was modelled with an optimised RandomForest supervised classification using recursive feature selection. Over time, mean temperatures (0.1 °C/decade) and summer precipitation (6.5 mm/decade) have increased whereas snow cover (12.74 metre-days/decade) and winter precipitation (9.7 mm/decade) have declined. Subsequently, there were considerable vegetation dynamics between 1990 and 2020 with the cover of treeline snowgum woodlands increasing (+134.8%) via densification and in-filling at lower elevations, but not treeline advance. Treeline subalpine woodlands replaced large tracts of dry alpine heath (36.4 km2) and wet alpine heath (38.0 km2) while there was less change in cover of grassland vegetation types. The study area also experienced a landscape-level fire in 2003 (268.4 km2 burnt or 59%), with the cover of treeline subalpine woodlands increasing at a greater rate in burnt (+1.70 km2 per annum) verses unburnt (+0.73 km2 per annum) areas between 2000 and 2020. Evidently, the rate of change in the climate of the study area has increased through time and is mirrored by vegetation cover and zonation dynamics with the proliferation of treeline subalpine woodlands (+70.6 km2) and advance of dry (+33.5 m) and wet (+12.89 m) shrubline, while in burnt areas there was treeline retreat (-9.2 m) as well as dry (-16.5 m) and wet (-5.3 m) shrubline suppression. Warmer temperatures, variable precipitation, and declining snow cover also increase the frequency and severity of fires, which may be compounded by increasing fuel loads from the proliferation and advance of woody vegetation in alpine areas. In the coming decades, alpine vegetation may be impacted by climate change both incrementally, through relatively gradual changes in abiotic conditions, and transformatively, through landscape-level disturbance from fire.