Will climate change shift tropical montane cloud forests upwards on islands?

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Abstract

Island tropical montane cloud forests (TMCFs) host a disproportionally high share of the global biodiversity and provide critical ecosystem services to vulnerable insular societies. However, this ecosystem is imperiled by anthropogenic impacts including climate change that might push TMCFs towards higher elevations. The elevation at which TMCFs start varies greatly among islands and may depend on topographically driven local climate, which may in turn be influenced by large-scale climate. Thus, a necessary prerequisite to assessing the vulnerability of island TMCFs to climate change is to determine the role of island features versus regional climate in influencing local climate at the lower TMCF ecotone. An extensive literature review of the elevation at which island TMCFs start was undertaken. This elevation was modelled as a function of the altitude of the lifting condensation level (LCL) imposed by regional climate, island maximum elevation and upwind forest loss over the past 15 years. The elevation of the lower TMCF boundary was found to have been reported for 93 islands worldwide. TMCFs start from as low as 300 m on the small islands of Kosrae (Micronesia; maximum elevation = 628 m) and Aneityum (Vanuatu; 852 m) to a maximum of 1,600 m on the large islands of Cuba (1,974 m) and Hispaniola (3,175 m), providing a spectacular example of the 'Massenerhebung effect'. Both regional climate (LCL altitude) and island features (maximum elevation) influenced the elevation of the lower TMCF boundary, and these variables together accounted for 79% of the variance. On islands, climate change is likely to cause significant but small upslope shifts of the LCL and subsequently of TMCF lower boundary elevation in the future (+4.4 m for each 1∘C increase in temperature). TMCF clearing and biological invasions might appear to be more pressing threats.

Keywords: global change, Lifting cloud layer, tropical montane cloud forest

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