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Primary Research Article

Consistent response of vegetation dynamics to recent climate change in tropical mountain regions

Jagdish Krishnaswamy, Robert John, Shijo Joseph

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Abstract

Global climate change has emerged as a major driver of ecosystem change. Here, we present evidence for globally consistent responses in vegetation dynamics to recent climate change in the world's mountain ecosystems located in the pan-tropical belt (30°N–30°S). We analyzed decadal-scale trends and seasonal cycles of vegetation greenness using monthly time series of satellite greenness (Normalized Difference Vegetation Index) and climate data for the period 1982–2006 for 47 mountain protected areas in five biodiversity hotspots. The time series of annual maximum NDVI for each of five continental regions shows mild greening trends followed by reversal to stronger browning trends around the mid-1990s. During the same period we found increasing trends in temperature but only marginal change in precipitation. The amplitude of the annual greenness cycle increased with time, and was strongly associated with the observed increase in temperature amplitude. We applied dynamic models with time-dependent regression parameters to study the time evolution of NDVI–climate relationships. We found that the relationship between vegetation greenness and temperature weakened over time or was negative. Such loss of positive temperature

residual browning and greening trends in all regions, which indicate that factors other than temperature and precipitation also influence vegetation dynamics. Browning rates became progressively weaker with increase in elevation as indicated by quantile regression models. Tropical mountain vegetation is considered sensitive to climatic changes, so these consistent vegetation responses across widespread regions indicate persistent global-scale effects of climate warming and associated moisture stresses.

Citing Literature

Supporting Information