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A warning to tropical mountains

Jagadish Krishnaswamy, Oct 29, 2013, DHNS 21:02 IST

CLIMATE CHANGE



Climate warming in recent decades, which is largely attributed to human activities, has affected vegetation in tropical mountain regions of the world, says Jagadish Krishnaswamy.

Natural vegetation in different parts of the world, whether it is on the high mountains, tropical rain forests or deserts, has evolved in a particular climate with specific precipitation and temperature characteristics. There have been major changes in climate at time-scales of tens of thousands of years in some regions due to glaciation and deglaciation cycles. However, climate characteristics often remain relatively stable for over several thousands of years, enabling distinctive vegetation types to evolve and maintain itself. Major changes in climate over shorter periods of time can thus have major impacts on the vegetation and all other biodiversity that exist in specific biomes or regions.

Climate warming in recent decades, which is largely attributed to human activities, has affected vegetation in tropical mountain regions of the world, according to the joint study conducted at the Ashoka Trust for Research in Ecology and the Environment (ATREE) in Bangalore, the Indian Institute of Science Education and Research (IISER) in Kolkata and Center for International Forestry Research (CIFOR) in Indonesia, published in the journal Global Change Biology.

Satellite data obtained during 1982-2006 for tropical mountain regions of the world was used to measure changes in 'greenness', a measure of photosynthetic activity of vegetation, and these changes were compared with trends in temperature and rainfall.

'Browning' is the reverse of 'greening' and indicates loss of photosynthetic activity. The maximum greenness attained at any site in each year of the record was first examined.

It was found that tropical mountain forests first became greener with time, and then suddenly reversed to become browner starting in the mid-1990s, in all tropical mountain regions around the globe. During the same period, almost all the tropical mountains in the world became significantly warmer, but rainfall trends were less obvious and patterns were more complicated.

It was expected to see the impact of these climatic changes on mountain vegetation and yet, the strength and consistency of changes across far-flung regions of globe were found to be surprising. After all, mountains in Central America are so different in terms of vegetation and climate to mountains in the Himalayas. It is well-known that temperature and moisture, and seasonal changes in these climatic variables have a strong influence on the vegetation, but it was found that the very nature of this vegetation-climate relationship is undergoing a dramatic change in all regions. In the 1990s, scientists reported that elevated temperatures and reduced input of moisture from decreased frequency of misty days are causing a drought-like condition in the mountains of Central America.

The results of this study, on changes in vegetation, suggest that such climate change phenomena may be more widespread in all tropical mountain regions. Furthermore, it was found that after the effects of temperature and precipitation was accounted for, there were residual greening and browning evident in these mountain regions, suggesting that other regional and global environmental changes such as pollution, aerosols, nutrient deposition or increased photosynthetic activity due to enhanced CO2 are likely to be driving vegetation response in tropical mountains.

Climate models also predict that the earth's climate will become more variable among seasons and that extreme climatic events such as heat-waves, cold-spells, droughts or cyclones are likely to occur with greater frequency.

A study on seasonal fluctuations in temperature and rainfall in each year found that they were

increasing from year to year. Moreover, vegetation is responding to these seasonal fluctuations in climatic parameters with matching changes in greenness.

The study also examined whether in the higher elevations there would be greater tendency for greening as predicted by some models, as warming would ease the climatic constraints on vegetation activity. Indeed, it was found that browning rates decreased with elevation and greening was more evident at the highest elevation.

The full consequence of these changes are not immediately apparent, but this serves as an early warning for possibly serious impacts in tropical mountains. Because environmental conditions change rapidly as one goes up mountains, most plant and animal species are delicately poised.

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Yet, tropical mountains are repositories of enormous biodiversity. Global climate change can severely disrupt the delicate balance of life in these regions and the climatic conditions in tropical mountains that are in great danger of disappearing entirely.

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