Scientists Reveal Main Contributor to Treeline Distribution in Rocky Mountains

Mass elevation effect (MEE) has been qualitatively considered to influence the elevational distribution of treelines in large mountains. In a recent study, researchers from the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences revealed how MEE has contributed to the high treeline distribution in the Rocky Mountains in North America.

According to ZHANG Baiping, the lead scientist, MEE is virtually the heating effect of mountain massifs. It can be defined as the temperature difference on a given elevation between inside and outside of a mountain mass. However, this effect and its implications for mountain altitudinal belts have not been well studied until recently.

With the support from the National Natural Science Foundation of China, ZHANG's group has carried out in-depth studies into the conceptualization and quantification of MEE in the world's main mountain ranges and plateaus including the Tibetan Plateau, the Alps, Scandinavia, the Andes, the Rocky Mountains and the New Zealand mountains. The group has also developed MEE models with three factors, namely mountain base elevation (MBE), latitude and hygrometric continentality on a global scale. They found that the altitudinal distribution of global treelines can be more accurately modeled when MEE was taken into consideration.

"MBE usually acts as the primary factor for the magnitude of MEE and, to a great extent, could represent MEE. MEE leads to higher treelines in the interior than in the outside of mountain masses", said ZHANG.

"It makes montane forests to grow at 4,800-4,900 m, snowlines to develop at 6,000 m in the southern Tibetan Plateau and the central Andes, and large areas of forests to live above 3,500 m in a lot of high mountains of the world", he said.

The result showed that MEE contributes the most to treeline distribution pattern. Without MEE, forests could only develop upmost to about 3,500 m above sea level and the world's ecological pattern would be much simpler.

The Rocky Mountains are the highest and most extensive in North America. Their MEE should be strong and responsible for the high elevations of treelines in the interior of the mountain range.

The scientists calculated the temperature difference (ΔT) between the inner and outer Rocky Mountains at the same elevation and developed a MEE model for the Rocky Mountains. They discovered that ΔT was mostly between 2.1 and 4.1°C in the Colorado Rockies and the southern Wyoming area and that treeline was higher in the interior than in the outside of the mountain range, by 700-1,400 m.

It was further revealed that MBE contributed most to MEE both in the whole range (45.65%) and in the Colorado Rocky Mountains (55.21%).

This work was supported by the Innovation project of State Key Laboratory of Resources and Environmental Information System (LREIS) and the National Natural Science Foundation of China. Their paper has been published in the journal of Physical Geography.