Altitudinal shifting of major forest tree species in Italian mountains under climate change

Sergio Noce¹,², Cristina Cipriano¹,², and Monia Santini¹
¹Impacts on Agriculture, Forests and Ecosystem Services (IAFES) Division, Institute for Climate Resilience (ICR), Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici, Viterbo, Italy (sergio.noce@cmcc.it)
²National Biodiversity Future Center (NBFC), Palermo, Italy

Climate change has profound implications for global ecosystems, particularly in mountainous regions where species distribution and composition are highly sensitive to changing environmental conditions. Understanding the potential impacts of climate change on native forest species is crucial for effective conservation and management strategies. Despite numerous studies on climate change impacts, there remains a need to investigate the future dynamics of climate suitability for key native forest species, especially in specific mountainous sections. This study aims to address this knowledge gap by examining the potential shifts in altitudinal range and suitability for forest species in Italy's mountainous regions. By using species distribution models, through MaxEnt we show the divergent impacts among species and scenarios, with most species experiencing a contraction in their altitudinal range of suitability whereas others show the potential to extend beyond the current tree line. The Northern and North-Eastern Apennines exhibit the greatest and most widespread impacts on all species, emphasizing their vulnerability. Our findings highlight the complex and dynamic nature of climate change impacts on forest species in Italy. While most species are projected to experience a contraction in their altitudinal range, the European larch in the Alpine region and the Turkey oak in the Apennines show potential gains and could play significant roles in maintaining wooded populations. The tree line is generally expected to shift upward, impacting the European beech, a keystone species in the Italian mountain environment, negatively in the Alpine arc and Northern Apennines, while showing good future suitability above 1,500 meters in the Central and Southern Apennines. Instead, the Maritime pine emerges as a promising candidate for the future of the Southern Apennines. The projected impacts on mountain biodiversity, particularly in terms of forest population composition, suggest the need for comprehensive conservation and management strategies. The study emphasizes the importance of using high-resolution climate data and considering multiple factors and scenarios when assessing species vulnerability. The findings have implications at the local, regional, and national levels, emphasizing the need for continued efforts in producing reliable datasets and forecasts to inform targeted conservation efforts and adaptive management strategies in the face of climate change.