The elevational gradients of mountain forest loss in the 21st century

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Motivation

Mountain forests cover a small fraction of the Earth's surface, but may exert important influence on the hydrological cycles of river basins (e.g., evapotranspiration, river flow). Many montane ecosystems are currently experiencing forest loss or gain, due to direct land-use change and due to changes in climate. Previous studies revealed most deforestation and afforestation occur in the lowlands, while how forest cover changes at different altitudes in the mountains has not been fully understood. Here we present a study that aims to better understand the distribution of forest loss in mountain regions at a global level. Our analysis is expected to provide new information on how and why mountain forests are changing.

Datasets

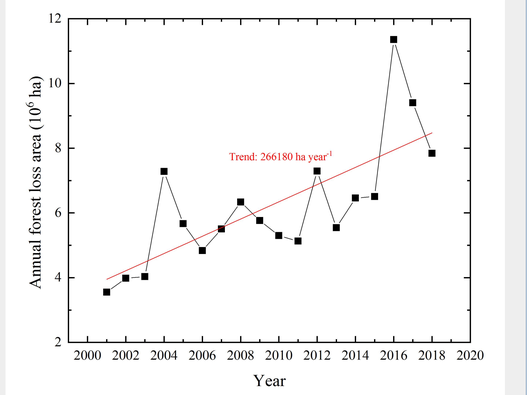
❑ **Forest loss data.**
We used the high-resolution global map of forest change from 2000-2018 (version 1.6; Hansen et al., 2013). It uses Landsat images to determine annual tree cover loss globally at a 30 m resolution.

❑ **ASTER Global Digital Elevation Model.**
We applied 30 m elevation data from ASTER Global Digital Elevation Model (version 3) to quantify the elevational features of mountain forest loss.

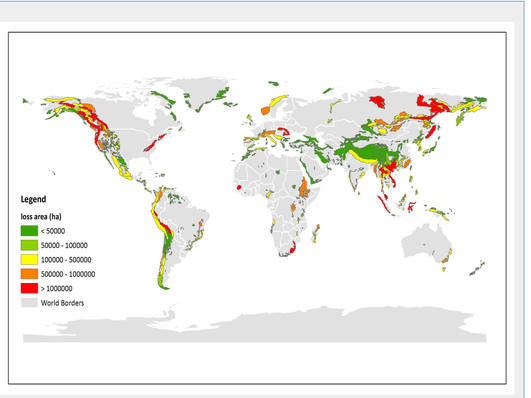
❑ **Mountain shapefiles.**
GMBA mountain inventory v1.2 provided a set of GIS files (.dbf, .prj, .shp, .shx), showing the full world-wide inventory of 1048 mountain systems, and was used to define mountain regions.

Results

➢ **Spatiotemporal change in mountain forest loss during 2001–2018**

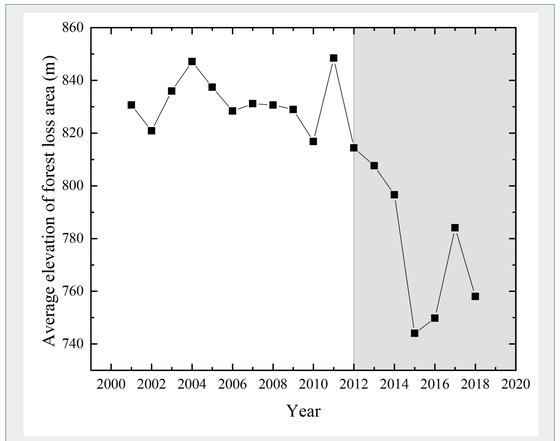


Time series of annual forest loss in the 21st century over the global mountain regions. The area of the total mountain forest in year 2000 is 1.2 billion ha.



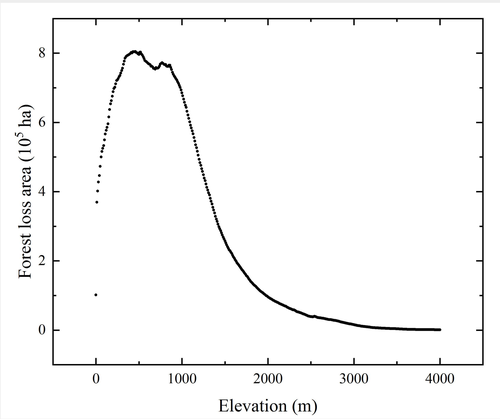
Spatial patterns of forest loss area across global mountain regions.

➢ **Recent shift of the forest loss area to lower land across global mountain regions**



Time series of the elevation of mountain forest loss in each year during 2001–2018. As shown in the grey shading above, the loss has significantly shifted to much lower land since 2012.

➢ **Relationship between elevation and forest loss area in mountain regions**



Total forest loss area at different elevations in the mountains.

Further Work

❑ To identity the drivers of these changes in mountain forest cover change
❑ To reassess the distribution of the treeline with latitudes and climate zones, as well as the treeline shifts with climate change
❑ To assess the impacts of forest cover change on river discharge in mountain regions
❑ To explain how mountain forest cover change will impact rainfall patterns in a future climate

Take Home Messages

The annual rate of forest loss in the mountain regions has significantly increased by more than 3 times during 2001–2016, but decreased in 2017 and 2018 since the peak rate in 2016.

The most heavily deforested mountains are in South Asia, Russia, USA and Canada.

The shift of forest loss area to lower land in recent years can also be perceived in the time series of the elevation of forest loss in each year.

The total areas where most forest loss occurred during 2001-2018 are at lower elevations of mountains, from 300 to 900m.

Bibliography

Hansen, M. C., et al. 2013. High-Resolution Global Maps of 21st-Century Forest Cover Change, Science, 342(6160), 850-853.

Zeng, Z., et al. 2018. Accelerating forest loss in Southeast Asian Massif in the 21st century: A case study in Nan Province, Thailand. Global Change Biology. 24(10), 4682-4695.