Title of the symposium:

Past, present, and future resilience of forest landscapes: Unpacking effects of multi-scale climate change

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Symposium abstract

The resilience of Earth's forests may be severely eroded by climate change during this century. In fact, growing evidence suggests that trends in mean decadal climate could fundementally alter forests at regional to global scales. Yet, these broadscale projections likely do not fully capture the potential effects of 21st century climate on forests. Beyond mean trends, key climate drivers all have their own dynamic patterns of shorter-term variability across multiple spatial scales, and future changes in climate variability, rather than mean trends, may be more influential on forests at landscape scales. However, limitations of past records and uncertainties about future dynamics currently constrain our understanding. We propose a session where speakers will unpack the relationship between multi-scale climate change and forest-landscape resilience: Specifically, we will address two questions:

1. How and why has climate change at multiple scales (from extreme events to long-term transient changes) influenced past and current resilience of forest landscapes?
2. How can we better anticipate 21st century changes in climate and potential consequences for forest landscapes?

Climate is and always has been defined by nonstationarity and variability across spatial scales of meters to continents and temporal scales of seasons to millennia. The relative importance of climate for shaping forest dynamics depends on scale. In subalpine forest landscapes of western North America, for example, mean temperature has varied substantially during the Holocene with little change in stand structure or species composition. However, early tree regeneration is critical to ensure forest recovery following wildfires, and spatial heterogeneity in soil moisture or the occurrence of an unusually severe seasonal drought can cause tree regeneration failure, shaping successional trajectories for decades. A key challenge is to untangle how and why spatial and temporal climate variability, versus mean climate trends, has shaped the resilience of past and current forest landscapes, and how the consequences of that finer scale variability aggregate to alter regional to global forest outcomes.

To better understand where and why forest resilience may erode in this century, we must begin to anticipate how climate is likely to change across spatial and temporal scales. However, decadal predictions of mean climate trends remain highly uncertain, let alone variability around the mean. Further, future effects of climate on ecosystems may be difficult to predict as climate and ecosystems become increasingly novel and not well represented in the historical record, or if reciprocal forest-atmosphere feedbacks develop. Thus, it will be essential to identify a suite of approaches that can better constrain

projections of future climate, mechanistically determine how forest landscapes will respond, and assess whether forest responses could feedback to further alter climate patterns.

We will convene a diverse group of landscape ecologists and ecological climatologists who study forests on different continents and employ different methodological approaches to unpack the multi-scale effects of past, current, and future climate on the resilience of forest landscapes. Limitations exist with making inference from imperfect reconstructions of past dynamics and there is great uncertainty about the future. However, by simultaneously looking behind and ahead, we hope to provide a holistic and more complete perspective on climate change and forest resilience, shaping a new interdisciplinary research agenda.

How your symposia will improve landscape ecology science?

Our proposed symposium on climate change and resilience of forest landscapes is uniquely interdisciplinary and will address several key challenges/future directions in landscape ecology, including the ecological consequences of changing climate and disturbance in the Anthropocene, interactions among multiple drivers of forest ecosystems, scaling ecological pattern and process, and the provision of ecosystem services. It is likely to be of wide interest to landscape ecologists studying a variety of systems.

Changing climate is a key driver of forest landscape change but has also become a focal point in the broader landscape ecology literature. Better characterizing how climate may change in the future at multiple scales and its effects on past and future forest resilience will likely provide useful insights for research in other complex and hierarchically structured landscapes. Furthermore, the study of forest resilience inherently requires accounting for the contingent effects of multiple climate drivers simultaneously, and researchers have identified promising approaches with experiments and modelling. Sharing lessons learned from forests across multiple continents could help formalize strategies for studying effects of multiple drivers in other landscapes.

The scaling of pattern and process has long been a grand challenge in landscape ecology and its importance is only growing with the intensification of environmental and anthropogenic drivers that operate at different spatial scales. Our symposium will summarize the state of the science with respect to the multi-scaled nature of ecological resilience and will highlight key advances in climate and forest-resilience modeling that allow us to scale from meters to the globe. Furthermore, we will address the importance of considering the multi-scaled nature of changes in the climate system, from extreme events (days to months) to long-term transient changes (decades to centuries).

Forests are essential to humanity because of the ecosystem services that they provid at local

to global scales. Forests around communities have long served as a socio-economic spine, providing food, timber, and clean water. At continental scales, forests are important for climate regulation, due to their carbon-storage capabilities and radiative properties. The study of forest resilience is intimately tied to ecosystem-service science because forest responses to environmental and anthropogenic drivers of change will affect the availability of these critical ecosystem services.

In summary, the proposed symposium has the potential to strongly shape the next chapter of forest resilience research, but also will address several frontier topics in the science of landscape ecology. As a result, the symposium is likely to be of considerable interest to meeting attendees and could be highly influential.

Broad thematic areas

Broad thematic areas 1st choice: Vegetation science and landscape ecology

Broad thematic areas 2st choice: Future: scenarios and new landscapes

Free Keywords

Climate change, climate variability, extreme climate events, scale, forest landscape, ecological resilience