Terrestrial Ecosystem Response to Interdecadal Climate Variability in the Western United States

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Abstract

We argue that the most important climatically-driven terrestrial ecosystem changes are concentrated in annual- to decadal-scale episodic events. These rapid ecosystem responses to climate change are manifested as regionally synchronized disturbance events (*eg*, floods, fires, and insect outbreaks) and increased drought-caused plant mortality rates. Ecological experiments and simulation models of climate change impacts, however, most commonly focus on relatively constant, slower, and smaller-scale processes (*eg*, plant growth and competition), while regional-scale disturbance and mortality events are treated only anecdotally. Regional-scale, climate-driven vegetation changes are partly a function of interdecadal climate shifts caused by changes in persistent features of the atmosphere, such as the SO, PNA, and the breakdown in monsoonal circulation. In the United States, decadal-scale climatic shifts with broad-scale impacts on terrestrial ecosystems include the change in Pacific climate since 1976 and the multi-year subcontinental-scale droughts of the 1930s (Dust Bowl) in the Great Plains and the 1950s in the North American subtropics. The 1950s drought culminated in widespread vegetation die-off in the southwestern United States. Recent improvement in rangeland conditions and increased wildfire number and area burned in the western United States may be more closely related to the post-1976 climate shift than to management activities. The value of high-resolution proxies several times longer than the instrumental record is highlighted by the need to determine if these changes are unique to the 20th century or if they fall within the envelope of long-term, natural variability. We will describe several examples of multi-century, regional to subcontinental-scale patterns of disturbance and tree demographic responses to climate change in the western United States. These perspectives suggest a new framework for observing and interpreting past and current ecosystem response to climate change patterns across multiple spatial and temporal scales.

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