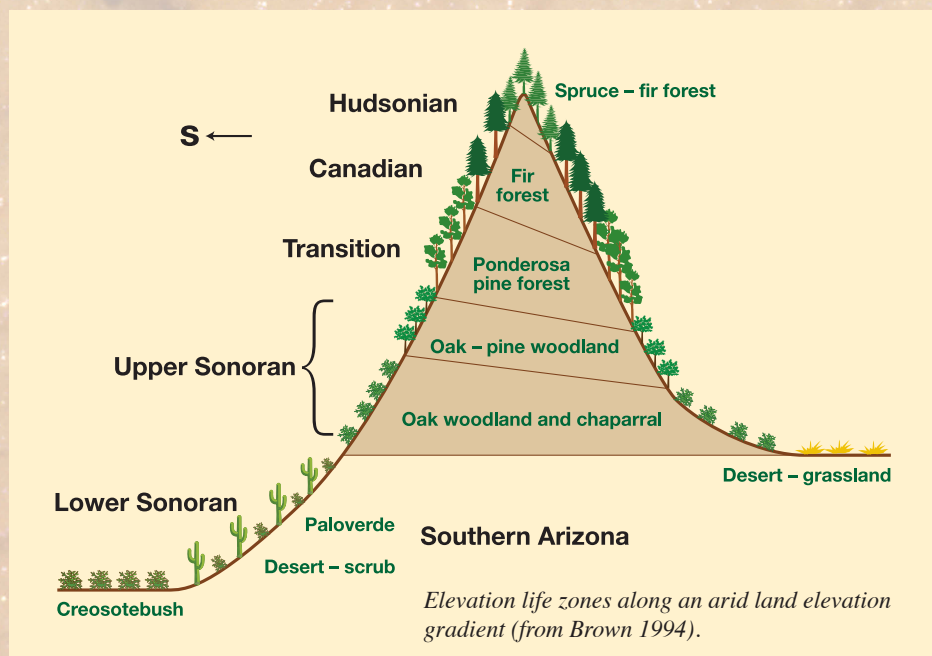


The Effects of Climate Change on Land Resources in the United States

(U.S. Climate Change Science Program Synthesis and Assessment Product 4.3)



Climate strongly influences forest productivity, species composition, and the frequency and magnitude of disturbances that impact forests. In arid lands, disturbance and land use will control the response of these areas to climate change. With robust scientific evidence showing that human-induced climate change is occurring, it is critical to understand how these sectors might be affected. The Synthesis and Assessment Product (SAP) 4.3 provides these insights, particularly focusing on effects of climate on forest and arid lands. A team of authors – experts in both of these areas of study – completed an extensive review, analysis and synthesis of the relevant scientific literature related to land resources in forested and arid lands. Below, some of the main findings from the SAP 4.3 Land Resources chapter are featured.



Findings Related to Forests

- Climate change has very likely increased the size and number of forest fires, insect outbreaks, and tree mortality in the Interior West (Colorado and the Great Basin), the Southwest, and Alaska, and will continue to do so.
- An increased frequency of disturbance is at least as important to ecosystem function as incremental changes in temperature, precipitation, atmospheric CO₂, nitrogen deposition, and ozone pollution.



- Rising CO₂ will very likely increase photosynthesis for forests, but this increase will likely only enhance wood production in young forests on fertile soils.
- Nitrogen deposition and warmer temperatures have very likely increased forest growth where adequate water is available and will continue to do so in the near future.
- The combined effects of rising temperatures and CO₂, nitrogen deposition, ozone, and forest disturbance on soil processes and soil carbon storage remain unclear.

Satellite image of the extensive attack by mountain pine beetle in lodgepole pine forests in Colorado. Pre-outbreak image taken October 2002, and post outbreak image taken August 2007. Images courtesy of DigitalGlobe Inc. (<http://digitalglobe.com/>)



Findings Related to Arid Lands



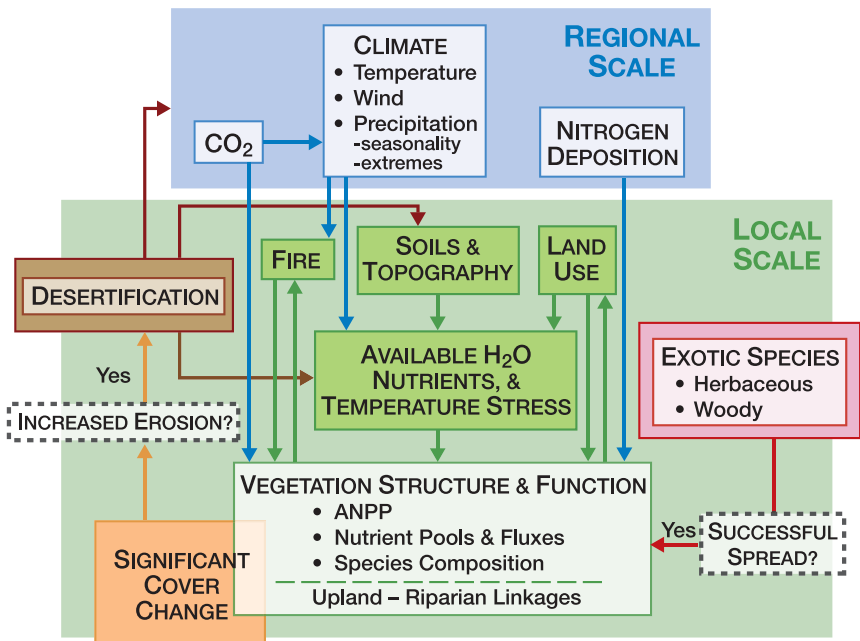
- Higher temperatures, increased drought, and more intense thunderstorms will very likely decrease the cover of vegetation that protects the ground surface, increase erosion and promote invasion of exotic grass species in arid lands.
- Climate change in arid lands will create physical conditions conducive to wildfire, and the proliferation of exotic grasses will provide fuel, thus causing fire frequencies to increase.



Joshua tree. (Photo courtesy Vanessa Carney.)

- In arid regions where ecosystems have not coevolved with fire, the probability of loss of iconic, charismatic megafauna such as saguaro cacti and Joshua trees is very likely.
- Arid lands very likely do not have a large capacity to absorb CO₂ from the atmosphere and will likely lose carbon as climate-induced disturbance increases.
- River and riparian ecosystems in arid lands will very likely be negatively impacted by decreased streamflow, increased water removal, and greater competition from non-native species.

Organizational framework for interpreting climate and climate change effects on arid land ecosystems.



Findings Related to Current Observing Systems

- Current observing systems are very likely inadequate to separate climate change effects from other effects.
- Findings in the Land Resources chapter were not based on routine monitoring with current observing systems. Rather, they relied on experiments, observations assembled from diverse sources, and long-term ecological research.
- No coordinated national network exists to monitor change associated with disturbances and alteration of land cover and land use.



Instruments for measuring exchange of carbon dioxide and water between a forest and the atmosphere. (Niwot Ridge Long Term Ecological Research Site, photo by Michael G. Ryan)



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