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Post-drought recovery of vegetation across global terrestrial ecosystems

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Drought is an intermittent disturbance of the terrestrial ecosystems that has profound impacts on carbon storage, water resources and other ecosystem services. Yet the patterns of ecosystem recovery from droughts and the influencing factors remain poorly understood. Here we evaluated the post-drought recovery time, i.e. the time required to revert to the pre-drought state, of both flux tower-based and remote sensing-based gross primary productivity (GPP) across global terrestrial ecosystems. The drought events were respectively defined by two widely used drought metrics, i.e. Palmer Drought Severity Index (PDSI) and Standardized Precipitation–Evapotranspiration Index (SPEI). We found that arid biomes tend to show mild response to drought (i.e. slight decrease in GPP) and rapid recovery from drought. It is understandable as plant species in arid regions would not survive with long drought recovery time given the more frequent and severe droughts. Humid biomes exhibit the similar drought response and recovery patterns, but with different physiological mechanisms from those operating in arid biomes. On the contrary, semi-arid and semi-humid biomes show the most substantial reduce in GPP during drought events and take the longest time to recover from drought. This implies that plants in these regions may be exposed to higher risk to be a chronic state of incomplete recovery with adverse consequences for the land carbon sink. These results are consistent among different GPP datasets and different drought metrics across land biomes. The conclusions drawn here may also be helpful to evaluate the terrestrial carbon cycle models for their response to climate variability. However, to further improve our knowledge of the resistance and resilience of vegetation to climate change, more studies need to be conducted exploring the different physiological mechanisms behind the different drought recovery patterns across land biomes.