

Ecosystem Responses to the 2024 Total Solar Eclipse: Insights from Eddy Covariance Towers

Abstract

On April 8, 2024, a total solar eclipse traversed North America, providing a unique opportunity to study terrestrial ecosystems' responses to sudden changes in solar radiation. A network of 54 eddy covariance towers along or near the path of totality was established to collect high-resolution data to investigate these dynamic responses. The totality lasted approximately 3.5 to 4 minutes depending on the location, with the maximum duration of 4 minutes and 28 seconds in Mexico. The field sites spanned a diverse range of land cover types, including forests, grasslands, wetlands, urban sites, and agricultural fields.

This natural experiment allowed us to observe and measure sudden environmental changes. Our hypothesis posits that the rapid decrease and eventual interruption of solar radiation during the eclipse alter ecosystem processes both during the event and as ecosystems transition back to their usual daytime behavior. We examine spatiotemporal variations in temperature, humidity, and other abiotic factors, alongside plant behavior, hypothesizing that these changes disrupt typical diurnal patterns. During the eclipse, we observe a notable decrease in temperature and changes in light quality, culminating in complete darkness before gradually returning to usual conditions. The eclipse occurs at different local times along the path of totality, such as 9:51 AM MT in Mazatlan, Mexico; 1:27 PM CT in Dallas, Texas; 3:13 PM EDT in Cleveland, Ohio; and 5:16 PM NDT in Gander, Newfoundland and Labrador, Canada. This variation allows us to observe alterations in atmospheric conditions and their effects on ecosystem processes at different times during the day. Building on findings from prior eclipse studies, such as those conducted during the 2017 eclipse, the 2024 eclipse presents an unprecedented opportunity to deepen our understanding of how ecosystems adapt to sudden changes in solar radiation.

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