AGU Abstract
For special session B11 - Environmental Assessment from the Width, Anatomy, and Chemical Composition of Tree Rings
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Tree-ring evidence for volcanic eruption effects on temperate and boreal tree net primary productivity

The 1991 Pinatubo eruption and the apparent increased terrestrial carbon uptake in 1992 and 1993 have motivated interest in understanding the impact on plant productivity of the climate and radiative change resulting from volcanic eruptions that generate large amounts of stratospheric aerosol. We used tree ring width series to look for anomalously high or low tree growth following 10 large eruptions since 1500 (not including Pinatubo) that resulted in stratospheric aerosol loadings comparable to Pinatubo's. We obtained crossdated ring width series from the International Tree Ring Data Bank, developed regional mean width indices, and used a Monte Carlo approach to test for significant departures in the indices following eruptions. Boreal zone trees (north of 50°N) showed significantly reduced (~5% below average) widths for several years centered around years 4-6 after eruptions. Temperate zone trees (35°-50°N) in eastern North America showed significantly increased widths (by ~6%) on years 0-2 after eruptions. Temperate zone trees in western North America showed a smaller increase, and trees in Europe showed no increase. We tentatively suggest that eruption-induced cooling causes the growth reduction in boreal trees, whereas the differing regional patterns found in temperate trees could be due to a combination of differences in eruption climate effects between regions, temperature versus moisture limited growth depending on ambient climate, and enhancement of tree light use efficiency in closed-canopy forest because of an increase in diffuse light fraction. Our findings invite additional research to clarify how regional climate and ecology modulate the effects of eruptions on tree growth and to assess the net effect of eruptions on global plant productivity. A series of annual tree carbon increment compiled from coring in plots of Harvard Forest, Massachusetts (42.5°N, 72.2°W), as well as other series for eastern North America do not show increased growth following the Pinatubo or the 1982 El Chichón eruptions. For this region, non-volcanic climate variation may be more important than any eruption effects in causing interannual variability in net primary productivity after any individual eruption.