# Modelling Cosmic Radiation Events in the Tree Ring Radiocarbon Record

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Annually-resolved measurements of the radiocarbon content in tree-rings have revealed rare sharp rises in carbon-14 production. These so-called 'Miyake events' are likely produced by rare ($\sim$ thousand year) increases in cosmic radiation from the Sun or other energetic astrophysical sources. The leading hypothesis is that these are extreme solar flares orders of magnitude larger than the largest ever recorded in the instrumental era; if so, a modern occurrence would seriously threaten space- and Earth-based infrastructure. These events are observed in radiocarbon in tree-rings, and in chlorine and beryllium in ice cores. Interpreting the high-resolution tree-ring measurements necessitates modelling the entire global carbon cycle: the radiocarbon produced in these events is not only circulated through the Earth's atmosphere and oceans, but also absorbed by the biosphere and locked in the annual growth rings of trees. In this presentation and the accompanying papers (under review at the time of submission), we introduce 'ticktack', the first open-source Python package that connects box models of the carbon cycle with modern Bayesian inference tools. We use this to analyse all public annual $^{14}C$ tree data, and infer posterior parameters for all six known Miyake events. They do not show a consistent relationship to the solar cycle, and several display extended durations that challenge either astrophysical or geophysical models: either the carbon cycle or tree growth are more variable than predicted, or the events arise from prolonged outbursts. We also show that several recently-published candidate events are likely false positives, and connect our findings to complementary radionuclide data from ice cores.