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Orbital pacing of large fluctuations in wildfire activity during the Pliensbachian

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At present Earth's climate is warming and the frequency of large wildfires appears to be increasing (Westerling and Bryant, 2008). Long term trends in climate and the effect on wildfire are understudied and examining the geological record can aid current understanding of natural variability of wildfire over longer time scales. The Early Jurassic is a period of overall global warmth, and therefore serves as a suitable modern-day analogue to understand changes in the Earth System. The Early Jurassic was characterized by major climatic and environmental perturbations which can be seen preserved at high resolution on orbital timescales. Recent research has indicated from Quaternary deposits that wildfires respond to orbital forcings (Daniau et al., 2013). This study tests whether wildfire activity corresponds to changes over Milankovitch timescales in the deep past.

A high-resolution astrochronology exists for the Upper Pliensbachian in the Llanbedr (Mochras Farm) borehole (NW Wales). Ruhl et al. (2016) show that elemental concentration recorded by hand-held X-ray fluorescence (XRF), changes mainly at periodicities of ~21,000 year, ~100,000 year and ~400,000 year, and which can be related to visually described sedimentary bundles.

We have quantified the abundance of fossil charcoal at a high resolution (10-15 cm) to test the hypothesis that these well-preserved climatic cycles influenced fire activity throughout this globally warm period. Our results suggest that variations in charcoal abundance are coupled to Milankovitch forcings over periods of ~21,000 and ~400,000 years. Supplementary to the charcoal record, a high-resolution clay minerology dataset has been generated, which indicates the presence of the 400ky cycle. Decreased hydrology on land, corresponds to increased charcoal production. We suggest that these changes in fire relate to changes in seasonality and monsoonal activity that drove changes in vegetation that are linked to variations in the orbital forcing.