Geophysical Research Abstracts
Vol. 17, EGU2015-369, 2015
EGU General Assembly 2015

Spatial and Temporal Reconstruction of Scottish Summer Temperatures for the Last 300 Years

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It is important to place recent anthropogenic climate change into a longer term context. Despite a good understanding of past climate variation for much of the Scandinavian region, little is known about Scottish climate over recent centuries. In order to fill this current gap in our understanding of northwest European climate dynamics and thus provide the context necessary to assess likely future changes of climate in this climatically important region, the limited spatial and temporal coverage of instrumental data must be extended using proxy data. Tree-rings provide one of the best proxy data sources for such an exercise. Until recently, the development of dendrochronological records in Scotland for climatological purposes has been limited. To help develop insight into the patterns of temperature variability in this region, multiple tree-ring parameters including ring-width (RW), maximum latewood density (MXD) and blue intensity (BI) from a network of 42 living Scots pine (Pinus sylvestris L.) sites distributed throughout the Scottish Highlands were utilized to reconstruct mean summer temperature with a grid resolution of 0.5°. Due to considerable anthropogenic disturbance from past logging events at some locations, RW data were assessed and corrected for disturbance-related growth releases using a Combined Step and Trend Intervention Detection methodology prior to their utilization in reconstruction development. Although the BI parameter offers a cheaper alternative to MXD while providing similar information, some limitations have been noted related to heartwood-sapwood colour differences in some species that may induce low frequency chronology biases. To avoid such BI limitations, in addition to the use of individual parameter site chronologies, corrected RW series were also combined with BI data to develop filtered high-frequency-BI / low-frequency-RW composite band-pass chronologies. Utilizing the TR network, a point-by-point principal component regression nested analysis was used to derive spatially independent reconstructions of (0.5°) gridded summer temperatures. The reconstruction results identified the timing, scale and duration of warmer and colder periods in the recent past, revealing the spatial patterns of temperature variability in this region over the past few centuries. The spatial reconstruction results agree well with a 600-yr composite BI / RW reconstruction from central Scotland using independent Scots pine chronologies extended into the past with samples preserved in Highland lakes.