EGU2020-5744
https://doi.org/10.5194/egusphere-egu2020-5744
EGU General Assembly 2020

Relic charcoal hearth geomorphology and hydrology across the northcentral Appalachians, USA

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Throughout the northeastern United States and Europe, relic charcoal hearths (RCHs) are more regularly being discovered in proximity to furnaces used for iron or quick-lime production; charcoal was used as a primary fuel source in the furnaces. RCHs have been found across parts of Europe and Connecticut, USA in different hillslope positions, on vary degrees of slope and aspect, all of which can be a factor affecting the shape of the RCH. Their usage for charcoal production varied with time period furnaces were in operation with some hearths being used once and older ones (such as in Europe) being used multiple times. RCHs across the northcentral Appalachians, USA have been minimally investigated, thus determining where they occur on the landscape, their shape, and their morphologic positions will be useful in discerning their effect on surface hydrology and soil development. Our study focuses on developing a repeatable process for: finding RCHs, classifying the different shapes or styles of the hearths in relation to their geomorphic positions and quantifying how RCHs may alter surface hydrology.

We used a combination of processed LiDAR to create hillshades of varying light angles and altitude, and slope gradient maps derived from the same LiDAR, to visually digitize > 6,100 hearths. A subset of the mapped hearths was ground-truthed for accuracy of the methodology. For our study, three areas in the mid-Appalachian region of Pennsylvania were chosen for study in order to reflect different historical time periods of construction and environments. A goal of our study is to determine the age of hearths. We hypothesize that using a calculated 3D distance to nearby furnaces, hearths closer to furnaces will be the oldest and have a higher likelihood of being used multiple times resulting in multiple layers of charcoal-enriched substrate. An initial analysis of RCHs indicates a relationship between slope gradient and hearth shape. Hearths constructed on flatter slope gradients are seemingly more circular in shape and have more equal axes whereas steep slopes have a more oval shape being elongated in one axis and shortened on the other. Likewise, there may be a relationship between hillslope position and the shape of the RCHs such as more circular hearths are on or near flatter hillslope positions (such as on summits or shoulders) whereas oval shaped hearths are on steeper hillslope positions (like backslopes). We also modeled the effect of RCHs on hydrology. Based on a combination of topographic wetness index data and geomorphology, hearths are not acting as sinks for surface flow but instead often cause water to flow around them leading to slightly drier conditions within RCHs. Future work will

address site-specific monitoring of hearth temperature and moisture, and hearth carbon decomposition dynamics in relation to temp and moisture conditions.