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Linkage between instrumental, documentary and dendrochronological data in the last millennium for long-time climate and flood dynamic reconstructions

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Dendrochronological data from alluvial forests had long been regarded as unsuitable for climatologically reconstructions because of the doctrine that dendrochronological data shows the best climate signal if obtained near to climatologically boundaries. Enhanced preparation techniques in combination with high resolution optical scanning allow for precise wood-anatomical analyses, which offer new insight from dendrochronologies hitherto regarded as not to be ideal. This abstract presents a new approach of interpreting climate data derived from dendrochronological proxies from alluvial forests and presents the potential of a time series covering the past 10k years with seasonal resolution for the climate signal, as well as information about flood events within the floodplains.

The region of the Main valley in south western Germany offers a large number of written climate proxies, which had been researched and catalogued by the work of Glaser (2008). The available information extends back to the beginning of the last millennium and contains detailed information with high temporal and spatial resolution about climate extremes and flood dynamics. Another unique archive for climate proxies presents the ultra-long Holocene Oak Chronology (HOC) from Hohenheim University, which mainly consists of sub-fossil oak trees originating from the floodplains from river Main. These chronology counts back from the present day to the year 8400 B.C. providing seasonal accuracy for a continuous, high resolution climate signal, which can be used as a proxy for temperature and precipitation reconstruction. Additionally a dis-continuous signal, which exactly dates high-magnitude flood events, can be derived from wood anatomical anomalies.

The combination of these two unique climate archives improves insight into postglacial climate variability in the Main area by allowing for the reconstruction of the climate characteristics for the past 10k years in seasonal resolution. The growth anomalies, which indicate a strong flood event, represent a climate proxy which - for the first time - offers insight into the climatologically character of the winter season if the event can bee understood as a result of the melting snow in spring. Additional information about river discharge during spring can be derived from vessel sizes within the growth-rings.

In order to establish a climate model, which is based on the proxy data provided by the HOC Hohenheim, the growth response of living oak trees in riverine forests of the Main valley has been analyzed for the period of instrument measurement data (1880 - today). The tree-ring behaviour of several tree-ring variables relating to climate and flood dynamics were measured and statistically compared to high resolution climate and environmental data (e.g. temperature, precipitation, sea surface pressure, groundwater level, river discharge or floods). High significant correlations were found for the latewood width (LWW), mean area of the five largest vessels (MVA5), conductive earlywood area (CEA) and the total mean vessel area (TMVA). These tree-ring variables contain high resolution climate signals of river discharge in June to August (LWW), air temperature in February and April (MVA5) and river discharge in April to May (CEA, TMVA). Wood anatomical anomalies ('flood markers'), preserving high-magnitude flood signals (spring/summer), are used to verify severe precipitation anomalies.

The climate dataset derived from documentary data allows for testing the found seasonal grow-to-climate-relations to a longer period of time (1400 – 1800 A.D.). The high temporal resolution in combination with the fact, that (growth-sensitive) climate extremes are best covered in documentary data, makes the joining of these two climate archives promising. First tests of selected growth parameters show highly significant, however moderate statisti-

cally relation.

The descriptions of climatologically relevant concomitants laid down in the documentary data, often give additional insight into circulation characteristics, which caused the researched phenomena and is therefore a valuable add on while using historical data.

Further goals of the presented project ('HoloFlood') is studying the amplitudes of natural climate variability, interactions of climate and pre-industrial man as well as spatial and temporal climate variability and flood dynamics in Central Europe, based on dendrochronological data. This will be done in two interesting time periods about 2700 and 6200 B.C., where severe changes in tree-growth behaviour of the HOC Hohenheim can be detected.

Besides the possibility to contribute to the reconstruction of European climate the combination of the two presented climate archives allow for a better understanding of the flood characteristics by adding information about past events with annual precision for the past ten millennia.