Lageard, Jonathan G.A., and Ian B. Drew
Manchester Metropolitan University, Crewe, England

[P] An investigation of salt subsidence and industrial pollution using oak ring-widths

Cheshire has a long history of salt extraction. Archaeological evidence for this dates from the Roman Period (1st to 5th centuries A.D.) with discoveries of lead salt pans (for brine evaporation) and more recently significant salt processing sites at Middlewich (Roman Salinae, 'Saltworks') and at Nantwich. Early extraction probably centred on natural springs, but nineteenth century pumping technology enabled human-assisted solution of underground salt strata. This unregulated 'Bastard' and 'Wild' brine pumping continued into the late twentieth century and resulted in un-supported underground cavities. Subsidence associated with these large caverns in the Cheshire Saltfield has been significant, with sudden collapses in towns such as Northwich and in the study area for this research, subsidence rates were as high as 11 cm per annum between 1950 and 1975. This research focuses on the Elton area between Crewe and Sandbach where large lakes 'flashes' have developed, particularly in the late twentieth century. Tree ring-width data (*Quercus robur*) from Elton and from a control site are compared with brine pumping records, historical records of the surrounding brine-utilising industry and meteorological data in order to test the suitability of tree ring-widths for reconstructing the timing and scale of environmental impacts of the salt industry in Cheshire.

Lavier, Catherine
CNRS : UMR 6565 and University of Franche-Comté, Besançon, France

[P] Technical evolution of wooden craft during the last millennium in Western Europe

Making of wooden objects are mainly subdued to cultural, economical, political and religious wills of the human societies. It is also constrained by mechanical aspects and due to materials. 4 examples will illustrate these relationships in space and in time: painting panels, brabantine altar pieces, wooden covers of manuscripts and medieval furniture. They show that evolutions are visible, that the rhythms are definable, that processes can continue longer than historical dates tell and that know-how can sometimes stop and appear again later.

Leal[1], Sofia, Thomas M. Melvin[2], Michael Grabner[1], Rupert Wimmer[1] and Keith R. Briffa[2]
[1]*Department of Material Sciences and Process Engineering, BOKU - University of Natural Resources and Applied Life Sciences, Vienna, Austria*
[2]*Climatic Research Unit, University of East Anglia, Norwich, England*

[P] Tree-ring width variability in the Austrian Alps and its relation with climate

The annual variations in radial growth rate of several tree species, across altitudinal gradients in the Austrian part of the Eastern Alps and the relationship between tree growth rates and climate over more than one century were studied. Series of mean ring-width measures were created for 1206 trees of five conifer species. Samples were taken from living trees of *Abies alba* Mill., *Picea abies* (L.) Karst., *Larix decidua* Mill., *Pinus cembra* L. and *Pinus nigra* Arn. Measured ring-width data were crossdated using standard dendrochronological methods. Mean series of ring indices were produced by taking residuals from a 30-year low-pass smoothing spline fitted through the raw measured data. The tree indices for each species from a site were averaged to create species-specific site chronologies. In total 100 chronologies were created. Mean monthly temperature and monthly precipitation measurements from several climatic stations were used to create long series representing regional and seasonal climate variability. The relations between ring and climate variables were analysed using Pearson correlations. Principal component analysis (PCA) was applied to all chronologies and the first principal component, which accounts for most of the variability, is strongly associated with site altitude ($r=0.88$, $p<0.01$, period from 1906 to 1995). A hierarchical cluster analysis was performed in order to group the sites using the first four eigenvectors obtained in the PCA. The chosen solution creates five groups of sites:

- BPine: all the black pine chronologies, located in the submontane zone.
- Sfir: all the fir chronologies, located in the sub- and montane zones.
- MonS: montane spruce (<1400 m) and submontane larch (500 m) chronologies.
- SubAlp: all high altitude (>1400 m) sites, of mixed species mainly from the subalpine zone.
- MonL: montane (900-1300 m) larch chronologies.

The strongest relationship with temperature is obtained for SubAlp sites, when monthly means for June and July of the current year are averaged ($r^2=0.48$, $p<0.05$, period from 1886 to 2003). BPine and SFir are mainly influenced by current year winter temperature. MonS and SubAlp are influenced by summer temperatures from current and previous years. MonL shows weak associations with October temperatures from current and previous years. All chronologies show the influence of March or April precipitation, which in the case of BPine extends from April through July and is stronger ($r^2=0.36$, $p<0.05$, period from 1840 to 1996). The chronologies showing the highest correlations with precipitation and temperature will be used in the future to study the relationship between climate and tree growth.

Leuschner[1], Hanns Hubert, Thomas Riemer[2], Mike G.L. Baillie[3] and Tomasz Ważny[4]

[1] *Laboratory for Dendrochronology and Dendroclimatology, University of Göttingen, Germany*

[2] *Systematika GmbH, Czernyring 22/10, Heidelberg, Germany*

[3] *Palaeoecology Centre, Queens University Belfast, North Ireland*

[4] *Institute for the Study, Conservation and Restoration of Cultural Heritage, Nicholaus Copernicus University, Torun, Poland*

[L] Long term ring-width variations in European oak chronologies between 900 and 2000 AD

Tree-ring series of European oak trees contain a considerable amount of low-frequency variation. These decadal to centennial variations in the tree-ring series are reflecting both, the internal age trend and the influence of external environmental factors like climate and site-specific factors such as settlement history and changes in forest management. It is difficult to distinguish between these factors and apply a detrending method to eliminate undesired internal and external non-climatic low-frequency variation from the tree-ring series (Briffa et al, 1996).

Riemer (see this volume) developed a new mixed-model approach based on the evaluation of long-term internal growth trends in trees of different cambial age. This model has been applied on tree ring series of European oak spanning the period from 900 to 2000 AD. We have chosen material from five European areas which represent a transect through the main climatic zones from atlantic in Northern Ireland/Scotland to continental in Poland. In between these two extremes three sites from Lower Saxonian (North German) are located: one

Tree ring-width variability in the Austrian Alps and its relationship to climate

S Leal[1], TM Melvin[2], M Grabner[1], R Wimmer[1], KR Briffa[2]

[1]Universität für Bodenkultur, Department für Materialwissenschaften und Prozesstechnik, Gregor Mendel Strasse 33 A-1180 Wien, Austria

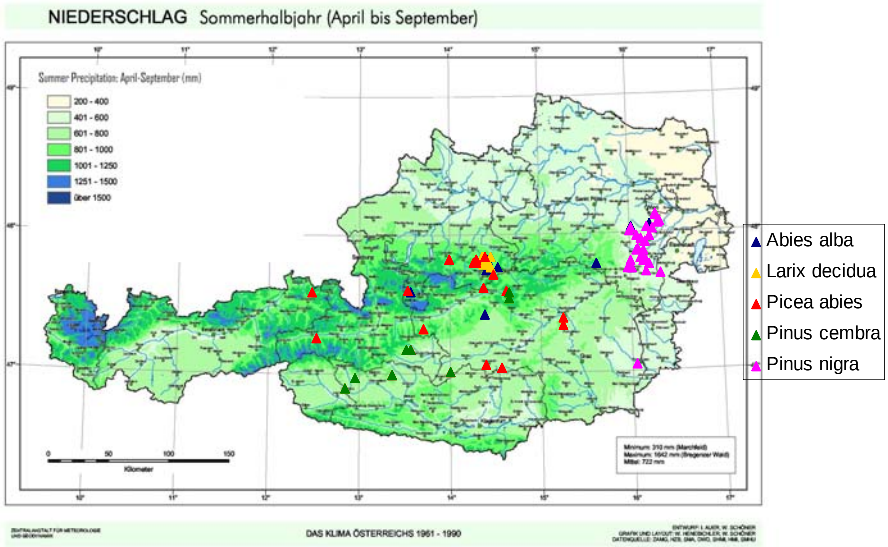
[2]Climatic Research Unit, University of East Anglia, Norwich NR4 7TJ, UK

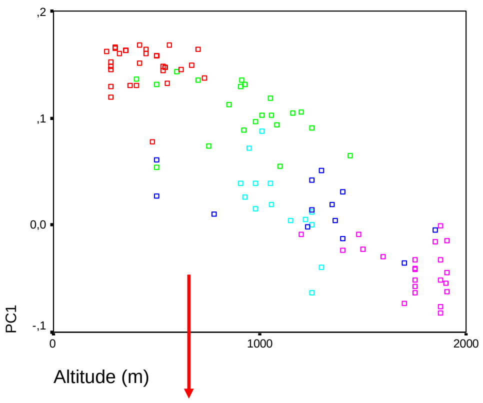
Universität für Bodenkultur Wien
Department für Materialwissenschaften und Prozesstechnik

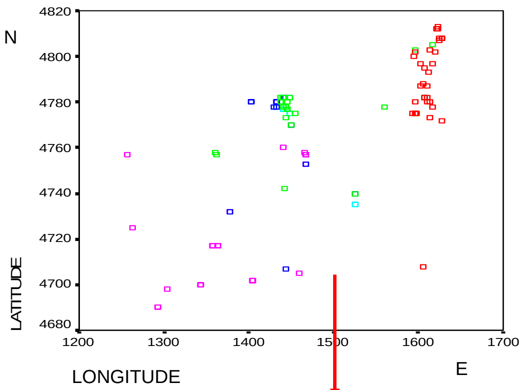
Material and Methods:

Tree-ring samples were collected from five species of conifers (1206 trees), across altitudinal gradients in the Austrian Alps, and measured according to standard dendrochronological procedures. Mean series of ring indices were produced by taking residuals from a 30-year low-pass smoothing spline fitted through the raw measured data. The tree indices were averaged to create species specific site chronologies. In total 100 chronologies were created (see map).

Principal component analysis (PCA) was applied to all chronologies and a hierarchical cluster analysis was performed in order to group the sites using the first four eigenvectors obtained in the PCA.







PC1 is strongly related with site altitude (r=0.88, p<0.01).

Clustering does not seem to be influenced by site location.

CLUSTERS:

MonL: montane (900-1300 m) larch;

SubAlp: all high altitude (>1400 m) sites, mixed species;

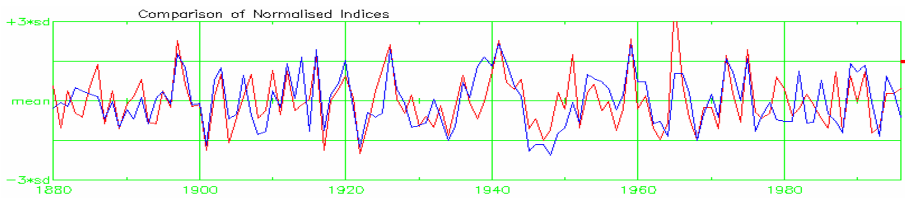
MonS: montane spruce (<1400 m) and submontane larch (500 m);

Sfir: sub- and montane fir;

BPine: submontane black pine.

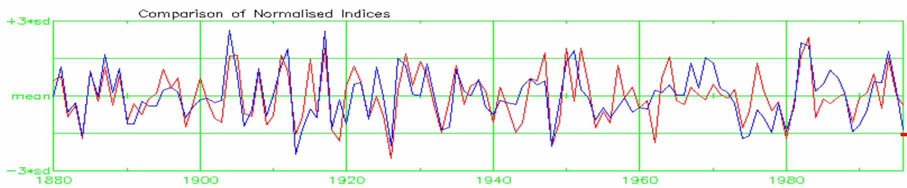
Main differences in growth appear to be due to site altitude and tree species.

In the subalpine zone no major differences in growth were found between the species (all grouped in the same cluster).



STRONGEST RELATION WITH TEMPERATURE:

SubAlp / June-July (r^2=0.48, p<0.05, 1886 to 2003)



STRONGEST RELATION WITH PRECIPITATION:

BPine / April-July (r^2=0.36, p<0.05, 1840 to 1996)

Upper graph: ----- Bpine; ----- Precip April-July   Lower graph: ----- SubAlp; ----- Temp June-July

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