Lac d'Annecy, continued from page 15

degree growing days for Montmin shows no significant climatic restrictions on summer crop yields since AD 1525. The weight of evidence gained so far suggests that fluctuations in the subsistence population and agricultural fortunes were determined by non-climatic factors, including outward migration and disease. There is the strong possibility that the most recent rise in human population during the late 18th century was coincidental with the timing of the shift towards more continental climatic conditions. The more open landscape at that time caused the natural climate-controlled processes of flooding to become accentuated in terms of higher magnitude and more frequent flood events that continued into the early 20th century even while the upland agricultural community declined.

The Record Back to 5000 BP

Sparse accounts of settlement before AD 1400, and pollen evidence, suggest that the structure of the present vegetation-agricultural landscape has its roots in Cistercian clearances around 1000 cal. yr. BP. Although the human impact on flooding and erosion probably started earlier, in Roman times, the long lake sediment records (Fig. 1d) show that high magnitude-low frequency flooding, which transported lowland and mid-altitude surface soil (Dearing *et al.* 2000; Noel *et al.*, 2000), reached a maximum at this time. Other evidence for major soil destabilisation comes from charcoal fragments dated to 960 cal. yr. BP found deep within a colluvial soil section in the Montmin valley, and from the Eau Morte floodplain stratigraphy where >2 m of silty overbank sediment has been deposited since ~2000 BP. Prior to 2000 BP, the evidence from floodplain sections and lake sediments is for a hydrological regime typical of stable wooded slopes, delivering clay-sized material from the montane zone except in extremely high energy events. Following the dramatic erosional response to forest clearance at ~1000 cal. yr. BP, the magnetic signatures for low-mid altitude surface soil and montane soil show divergent trends (Dearing *et al.* 2000) with the latter gradually increasing up to the present day (Fig. 1d). This may simply reflect the enhanced storage of surface soil in the floodplain after 2000–1000 BP. Alternatively, it may imply that while the lowland and mid-altitude soil-vegetation systems showed some sense of stabilisation over subsequent centuries, the montane zone progressively deteriorated. We may certainly hypothesise that early deterioration of the montane zone cultivation may have conditioned and, in the present situation, amplified the later hydrological responses to the agricultural changes documented since AD 1500.

Thus the findings are beginning to show that soil-vegetation-hydrological systems in diverse altitudinal zones, within the same catchment, appear to have significantly different degrees of resilience to climate and human activities. Some hydrological responses are clearly direct, broadly linear and exhibit negligible time-lags; other less obvious forcing-response relationships probably involve long term and threshold-dependent nonlinear change. Synergistic interactions between climate, human activities and hydrology in the Annecy catchment are therefore complex and require the present methodological framework in which all relevant spatial and temporal scales are included and integrated.

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For full references please consult *www.pages-igbp.org/products/newsletters/ref2003.html*

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The Murrumbidgee River Catchment, Australia

European settlement in Australia, the USA, and New Zealand had dramatic impacts on the fluvial system, many of which are still working their way through river catchments. These trends, punctuated by episodic floods, produce a complex set of changes that have been documented in the SE Australian catchment of the Murrumbidgee River.

The history of the sedimentary system since 1820 AD, when European settlers arrived, has been reconstructed from a sediment budget for a 130km^2 subcatchment (Jerrabomberra Ck), from analysis of cores taken from Burrinjuck Reservoir (13,000km^2), from flood deposits in the mouth of Tuggeranong Ck (~5,000km^2), from documented large floods that have caused major channel changes and therefore sediment transport, and from major lateral migrations and sediment transport in the downstream river at Mundowey and Narranderra (~80,000km^2).

The Figure opposite shows a trend in sediment yield from Jerrabomberra Creek generated by the growth of gullies the yield from which dominates the budget. Declining yield since 1890 AD occurred as gullies stabilized, a trend reflected in Burrinjuck Reservoir. While erosion of subsoils, via gullies and channels, dominates the sediment transport, periods of high topsoil erosion (estimated from the tracers ^{210}Pb excess and ^{137}Cs) were produced by high runoff and floods.

Records of nutrient deposition and algal response in Burrinjuck Reservoir are also available, and are being compiled with the sediment records.

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