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Long-term changes in climatic and hydrological systems: some questions

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A statistical long-memory process has a hyperbolically (slowly) decaying autocorrelation function (acf), a short-memory process has an exponentially (fast) decaying acf. In statistics, the definition of trend is wide and intentionally not precise: a systematically, deterministically, slowly changing component. Conventionally, climate processes are thought of as a combination of trend and a short-memory noise process. On the other hand, many hydrologists accept measured records (e.g., runoff) to be a realization of a long-memory process. If long-memory existed also in the climate system in its strict sense (atmosphere), this had profound consequences including: (1) a longer predictability not only of the mean state but also of clusters of weather extremes; (2) considerably larger error bars of estimated climate parameters like rates of change, equilibrium levels or positions of "tipping points." The motivation for setting up this session "Climatic and hydrological perspectives on long-term changes" came from a discussion on the blog realclimate.org, where in 2006 two interpretations (short-memory versus long memory) clashed together. It is believed by the session organizers that a public, scientific exchange of the two views on one single climate record (e.g., global-mean surface-air temperature over the past 1000 years) can contribute to the growth of climatological knowledge, see Popper or Kuhn. Some questions may guide this exchange.

First, do we have enough data points to obtain estimates of the long-memory parameter d with a sufficient accuracy? In particular, can d be shown to be significantly different from zero? Can the estimation technique be improved to yield a higher accuracy than with the present methods? Second, are statistical tests of model suitability (graphical,

numerical) indeed always performed when claiming the existence, or absence, of long memory? What is the potential for improving such tests? Third, is the statistical finding (pro or contra long-memory) supported by a climatological explanation rooted in the physics of the climate system? Can climate models reproduce long memory?