Geophysical Research Abstracts,
Vol. 10, EGU2008-A-12223, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-12223
EGU General Assembly 2008

Estimating Unconditional Uncertainty of Streamflows of Athabasca and Fraser rivers of western Canada using Multifractal Analysis

Ernst Kerkhoven and Thian Yew Gan
Department of Civil & Environmental Engineering, University of Alberta, AB T6G 2W2, Canada (tgan@ualberta.ca)

The multifractal properties of observed and simulated hydrographs in the Athabasca and Fraser River Basins were calculated using multifractal detrended fluctuation analysis (MFDFA). Although there were some significant differences in the multifractal properties, the simulated and observed hydrographs' strengths of multifractal behaviour and featured properties could both be closely modelled by the generalized multifractal cascade model in both river basins. For each basin, the multifractal properties of 54 simulated hydrographs based on the predictions of seven general circulation models, for four SRES climate scenarios, over three 30-year periods in the 21st century were evaluated and used to generate extended artificial time series based on the randomized generalized multifractal cascade model. These artificial time series had the same periodic, statistical, and fractal properties as the simulated hydrographs over a much longer time span than could be reasonably modelled by conventional simulation techniques. These time series could therefore provide a basis to estimate the 95% confidence intervals for mean river flows over short-term (single year) or climatological (30 year) time scales while avoiding some of the difficulties associated with other uncertainty techniques, such as the influence of long-term trends in the original data and the assumption of normally distributed variance. The multifractal hydrographs featured significant departures from the behaviour of long-term statistical independence with extended periods of low and high flows resulting in a wider range flows over a 30-year time scale than other methods predict as well as significant skew in the distribution of long-term flows. Indeed, there is evidence that the multi-

fractal model is too skewed, since the greatly extended time series could not reproduce the lowest flow season in the historical record for either basin. The artificial time series appear to be biased towards extended periods of relatively mild droughts at the expense of short, severe droughts. This suggests that it would be beneficial to further modify the multifractal cascade model, or develop new multifractal models that can better reproduce the characteristics of droughts. The two basins' multifractal properties responded differently to climate change. In the Fraser River Basin, the multifractal strength of river flows tended to increase along with temperature as the snow fed character of the basin began to weaken, and in extreme scenarios, almost disappear. In the colder the Athabasca Basin, only the most extreme scenarios hinted at this behaviour. Instead, increased temperatures were associated with decreased flows over the entire annual cycle as snow packs declined without a compensating increase in winter flows. This resulted in a decreased multifractal strength in the Athabasca Basin under rising temperatures.