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On the multiple breakpoint problem and the number of significant breaks in homogenisation of climate records

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Changes in instrumentation and relocations of climate stations may insert inhomogeneities into meteorological time series, dividing them into rather homogeneous subperiods interrupted by sudden breaks. Such inhomogeneities can be distinguished from true variability by considering the differences compared to neighbouring stations. The most probable positions for a given number of break points are determinable by dynamic programming, where the maximum external variance between the segment averages is used as decision criterion. However, the external variance is growing with any additionally assumed break, so that a stop criterion is needed. This is defined by using the characteristics of a random time series as reference. The external variance is shown to be beta-distributed, so that the maximum is found by solving the incomplete beta function. In this way, an analytical function for the maximum external variance is derived. In its differential form our solution shows much formal similarities to the penalty function used in Caussinus and Mestre (2004), but differs numerically and exhibits more details.