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Hydrology and Earth System Sciences Discussions

Interactive comment on "Technical Note: Analytical sensitivity analysis of a two parameter recursive digital baseflow separation filter" *by* K. Eckhardt

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I thank Referee #1 for his constructive comment!

There is a close connection between the two-parameter filter I have presented

bk = [(1 - BFImax) * a * bk-1 + (1 - a) * BFImax * yk] / (1 - a * BFImax)

(Eq. 1) and the Boughton-filter

bk = a / (1 + C) * bk-1 + C / (1 + C) * yk

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The Boughton-filter is equal to Eq. 1 if one sets

C = (1 - a) * BFImax / (1 - BFImax)

(Eckhardt, 2005).

Furey and Gupta (2001) mention that a simplified version of their filter, which can be written as

bk = (1 - gamma) / (1 + gamma * c3/c1) * bk-1 + gamma * c3/c1 / (1 + gamma * c3/c1) * yk

(Eq. 28 in their paper) is equivalent to the Boughton-filter if one sets a = 1 - gamma and C = gamma * c3/c1.

Equivalence of the simplified Furey-Gupta-filter and the Boughton-filter on the one hand and equivalence of the Boughton-filter and Eq. 1 on the other hand means that there is also an equivalence between the simplified Furey-Gupta-filter and Eq. 1, namely for

a = 1 - gamma

BFImax = c3 / (c1 + c3)

Thus, one may argue that there also exist analytical expressions for the two parameters in Eq. 1, and that the values of these parameters do not need to be estimated or to be determined by calibration.

However, this would only be true if correct values of gamma, c1, and c3 were known. The parameter gamma is one minus the recession constant a, which can be found by a recession analysis (Furey and Gupta, 2001; Eckhardt, 2008). c1 is the ratio of overland flow to precipitation, and c3 is the ratio of groundwater recharge to precipitation. All these parameters are subject to uncertainties. Furey and Gupta (2001) point themselves to problems in deriving c1 from measured precipitation and to the sensitivity of their filter to this parameter. To this end, they carry out an empirical sensitivity analysis.

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Conclusions: (1) The filters of Boughton (1993) and Eckhardt (2005) are equivalent. They are linked to the filter of Furey and Gupta (2001) in a very similar way. (2) The filter of Furey and Gupta (2001) is derived from physical principles, but not without simplifying assumptions. Its parameters are subject to uncertainties, and so is the calculated baseflow. In this regard, it is not better than other filters. (3) The filter of Furey and Gupta (2001) has four parameters and requires observed time series of streamflow and precipitation. The filter of Eckhardt (2005) has only two parameters and requires only streamflow data. Therefore, it is much easier to apply.

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