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## Comment on hess-2021-566

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Community comment on "Hydrological concept formation inside long short-term memory (LSTM) networks" by Thomas Lees et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-566-CC1>, 2021

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### S-hydrograph vs. the unit hydrograph

The LSTM uses a hyperbolic tangent ( $\tanh$ ) as an activation function for the cell input  $g[t]$  and the recurrent input  $h[t]$ , though not discussed in the manuscript, but elsewhere (e.g., Frame et al., 2021, Fig. A1.). This is similar in shape to a summation or S-curve hydrograph in unit hydrograph theory, e.g., Chow (1964, Fig. 14-5(a)).

To map some hydrologic realism onto the LSTM, I suggest the authors consider, as an alternative, using a kernel, i.e. a unit hydrograph model, my work (Ding, 1974, Figs. 1 & 4) being but one. Since a kernel has typically a unimodal distribution, a new LSTM-kernel variant will have to track whether the discharge is rising, falling, or remains steady.

### References

Chow, V. T. , 1964. Handbook of applied hydrology, Section 14 - Runoff, McGraw-Hill, New York, ISBN 07-010774-2.

Ding, J. Y., 1974. Variable unit hydrograph. J. Hydrol., 22: 53-69.