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Discussions

Interactive comment on "A Comparison of the Discrete Cosine and Wavelet Transforms for Hydrologic Model Input Data Reduction" *by* Ashley Wright et al.

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The authors would like to thank the reviewer for their comments and questions. Please note that all updates to the manuscript will be made once all of the reviews are received. The remarks made by the Reviewer are written in italics, and the replies in normal font.

Thank you for the chance to review this manuscript. The manuscript is generally well written. However, there are a number of issues that need to be resolved before this manuscript can be accepted for publication. 1. Innovation and contribution of the paper needs to be better defined.

Thank you for your review of our manuscript. A statement addressing why the study is important is included in the abstract on page 1 Lines 1-4. In short this study is a novel

step towards estimating errors associated with input uncertainty and model structure.

The authors compared two methods commonly used in signal processing (i.e. DCT and DWT) for reconstructing rainfall information. But why is this study important? Further motivation and reasoning why the study is important is addressed in lines 11-23 page 1 and lines 1 -24 on page 2. In summary the use of model input data reduction allows modern parameter estimation algorithms to more efficiently estimate errors associated with input uncertainty and model structure.

And why these two methods were selected? Are these two methods better than currently used methods?

A brief reasoning for choosing these two of the many possible transforms is that they are the two most commonly used transforms for model input data reduction techniques in other fields. A more comprehensive reasoning for selecting these two methods is addressed on page 2 lines 23-35 and page 3 lines 1-4. Model Input Data Reduction is currently not performed in hydrology, however the techniques are the most current in other fields.

What about other methods used in signal processing, such as short-time Fourier transform (STFT)?

The Discrete Cosine Transform is a version of the STFT. In the manuscript on line 9 page 3 we have stated that the Windowed Fourier Transform is sometimes referred to as the short time Fourier transform. We also mention on line 11 page 5 that the DCT is a version of the WFT.

2. Description of experiment design is not very clear. [1] Can you please use a flow chart to illustrate the steps taken during the experiment? If space is of concern, this reviewer recommends to remove current Figure 1, which is not described in detail and does not have much value.

In order to avoid doubling up on presenting the experiment design the authors would prefer not to include a flow chart. However, if it would be deemed necessary, we are certainly willing to provide this. If possible could you please in detail outline which areas of the experiment design are not clear? We are certainly willing to provide more explanation. The caption of Figure 1 has been expanded upon to provide more detail. This is discussed further in a later comment.

[2] What is the role of stream flow in this study? In the last paragraph on page 7, PE (peak error) is defined as "the peak streamflow error over the 10 year period". Can the authors explain how this error is calculated? How is this error linked to reconstructed rainfall and the performance of the two methods? Are rainfall-runoff models used? If so, these rainfall-runoff models need to be described in the experiment design section. All these information can be included in the flow chart mentioned above, it will help the readers to understand the experiment process.

The mention of streamflow is a typographical error. Thank you for pointing out this error. In the manuscript Peak error in fact refers to peak rainfall error.

âĂČ *[3] The two methods were not validated – please refer to comment 3.3. 3. Results analysis [1] It is obvious that DWT performs better than DCT from the results obtained. But why is this the case? Is this because the nature of cosine functions oscillating at different frequencies makes DCT unsuitable for rainfall signals that is not cosine in nature? If this is the case, it comes back to my comment 1 above, why is DCT selected for this study at the first place?*

It was clear prior to the study that the DCT would not perform as well as the DWT in reconstructing hydrologic data which are generated by transient mechanisms. This was discussed on page 3 line 15. Yet the use of Fourier transforms remains prevalent in hydrologic studies. Consequently some of the reasons for the selection of the DCT are as follows:

1. To demonstrate that the DCT and Fourier based transforms are not the best transform to use for transformations involving hydrologic rain gauge data,
2. As a baseline from which to compare the DWT to,
3. In the literature it is a commonly used transform for model input data reduction.

[2] Figure 4 is a scatter plot of RSR generated using the two methods. It is obvious that they are linearly correlated and the RSR from DWT is always lower than that from DCT. However, what evidence included in this figure show that "DWT is able to reconstruct the input rainfall signal" (line 23 page 8)?

It was never intended for Figure 4 to demonstrate that the DWT is able to reconstruct the input rainfall signal. This information is outlined in Section 2.3. The RSR that is mentioned throughout the text is the RMSE/standard deviation of the reconstructed signal when compared to the observed signal.

[3] The authors claimed that in this study the two methods were "validated" "using several simulation performance summary metrics". Line 24, page 3. This reviewer disagrees. In this study, the performance of the two methods was evaluated using a number of different metrics; however, no independent validation was conducted.

Thank you for pointing this out, the wording has been corrected to evaluated.

Minor comments: 1) There a few typos throughout the manuscript. For example, Line 7, page 2: "prediction uncertainty" should be "prediction of uncertainty"; Line 22, page 8 "is always able reconstruct" should be "is always able to construct".

The typos in 1) have been corrected.

2) Line 12 page 1: The sentence does not really make sense here. "Unfortunately, errors in rainfall time series data may lead to hydrological model parameter estimates that produce adequate streamflow simulations during calibration".

This sentence begins with an explanation of why it is important to address errors in rainfall time series. It is unfortunate that the combination of errors in the input data and parameters often lead to adequate streamflow in the calibration period and poor streamflow in the validation period.

3) Figure 1 has only symbols, which is rather confusing. Please add descriptions in both the figure and caption so the figure stands alone and makes sense.

The Figure 1 caption has been updated to provide a stand-alone explanation. And is included below "A schematic showing the pyramid algorithm used to decompose and down sample $(\downarrow 2)$ an input signal $(\widehat{\mathbf{R}})$ into high and low frequency components. The input signal is filtered using the high and low pass filters described in Equations 7 & 8 before being down sampled to produce the level one high and low pass parameters. The low pass parameters are now used as input for the high and low pass filters. This process of filtering and down sampling is repeated until the desired level of decomposition is met."

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