Reply to the comments

Anonymous Referee #1:

Major issues:

Question (1): P6 L19 '…and can be regarded to be the error-free data.' Weather radar data could have significant errors. Your study is about radar data error propagation. If you assume the radar data are error free, explain how this assumption will affect your study results. P7 L20 'Consequently, all the model errors are assumed to be free', again, this assumption is quite wrong. Again, explain how this assumption will affect your study results.

Reply:

The aim of this work is to analyse the error propagation of radar rainfall in the context of hydrological models. And the analysed error in this study was assumed to be derived from the proposed error model only, instead of the errors contained in the raw radar rainfall and hydrological models. In order to achieve that, the raw radar rainfall data in this study was extracted from Nimrod data, which can be considered to be error-free with the state-of-the-art processes by Met Office, while the hydrological models were assume to be error-free as the surrogate of the study catchment, after the selected criteria for model calibration and validation have been met.

The reason for those assumptions is to set up a conditional environment to trace the error in the rainfall through the hydrological models, without the interference of internal error from the raw radar rainfall data and hydrological models.

Question (2): P6 L25, 'Due to the data availability of radar rainfall, the period from July 2006 to December 2007(18 months in total) was

selected for radar-based rainfall error propagation analysis.' However, P9 L15 'This process were performed for a 6 months period (from September 2003 to February 2004), using the first 2 months as a warm-up period, and the remaining 4 months were used to evaluate model outputs.' You mentioned the availability of 18 month data. Why only 6 months here?

Reply:

The process from September 2003 to February 2004 was used for model calibration, instead of the error propagation analysis.

Question (3): P11 L1, It is not clear the simulated flow in Eq(4) and (5) are in the calibration data or validation data. Please clarify.

Reply:

As mentioned before the Eq (4) and (5), the simulated flow is the model simulation result using the perturbed radar rainfall data, while the observed flow is simulated using the raw radar rainfall data. The two equations were not used for model calibration and validation.

Question (4): P11 L1, Eq (4) expression is not correct (what is the average of the sum of the absolute error?). The numerator should sum (|Qo-Qs|)/n. Ditto, the same problem also occurs with Eq(5).

Reply:

Yes, the expression was a bit not clear. The Eq (4) and (5) should be described as:

$$\sigma = \frac{\overline{\sum |Q_o - Q_s|}}{\overline{\sum Q_o}}$$

$$\phi = \frac{\overline{\sum (Q_o - Q_s)}}{\overline{\sum Q_o}}$$

Question (5): P11 L6, the error model is problematic: the bias PHI should be additive, not multiplicative. For example, if there is no bias, Phi would be zero, Rp would zero, which is not realistic because there are still random errors. In addition, the random error should be a function of a random number with a certain probabilistic distribution. However, Eq(6) uses a fixed positive number to represent the random error, which is not correct. Also, if bias is to be considered, Eq(4) is incorrect in representing the random noise because the bias should be removed in the calculation. Please clarify those points.

Reply:

Two sources of noise were taken into account in the error model, normalised error and normalised bias, which were represented in Eq (4) and (5) respectively. When there is no normalised bias, the PHI is 1 instead of zero in this study, which means all the noise will come from normalised errors solely.

The error model Eq (6) is a function of a random number with a certain probabilistic distribution, which is Gaussian distribution in this study. It should be rewritten as:

$Rp = \phi R\ (1 + \sigma E_{Radn})$

where $E_{Radn}$is the random error generated from Gaussian distribution.

Therefore, the error model is set to generate a Gaussian distribution error with the mean value and standard deviation are rounded to 0 and 1 respectively, then apply different combinations of manually assigned errors (from 0 to 1) and bias (-0.3, 1, 0.3) to generate the perturbed radar rainfall data. The related contents have been rewritten, please refer to revised manuscript.

Question (6): P11 L11 The Gaussian distribution is used as the random noise. Since Eq (4) is about absolute error, not variance, how is the variance (or SD) in the Gaussian distribution derived?

Reply:

The Eq (4) and (5) are used to evaluate the results of perturbed rainfall and simulated ensemble flows. The SD value is explained in the previous question.

Minor issues (mainly grammatical errors or typos):

P2 L22 'There is a wide range of studies have focused on using weather radars for quantitative…' P5 L7, 'to define and quantitative the…' -> 'to define and quantify the' P5 L25 'potential evapotranspiration is around 729mm and 663mm,'-> 'potential evapotranspiration are around 729mm and 663mm,' P6 L15 'Therefore, this high-resolution radar composite rainfall estimates incorporates…'->' Therefore, the high-resolution radar composite rainfall estimates incorporate…'

P7L7 PRTF should use the publically available paper at: 'Derivation of unit hydrograph using a transfer function approach', Yang, Z., and D. Han, Water Resources Research, 42, W01501, DOI:10.1029/2005WR004227 , (2006)

Reply:

The grammatical errors and typos are corrected, please refer to revised manuscript.