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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Resampling and ensemble techniques for improving ANN-based high streamflow forecast accuracy" *by* Everett Snieder et al.

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General: This paper explored the potential of data-driven models such as ANN for improving the accuracy of high flow estimation through integrating resampling and ensemble techniques. For this exercise, three resampling techniques: random undersampling (RUS), random oversampling (ROS), and SMOTER; and four ensemble techniques: randomized weights and biases, bagging, adaptive boosting (AdaBoost), least-squares boosting (LSBoost) were systematically combined to show the improvement in the forecast accuracy in terms of reducing the timing and amplitude error. This paper used the hourly river stage data along with other meteorological data collected

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Discussion paper

from Bow and Don River basins, Canada to demonstrate the proposed modelling approaches. While many previous papers have already reported the potential application of several ensembles and resampling methods to improve the forecast accuracy of data-driven models, this paper claims that the implementation of ROS, and new approaches for SMOTER, LSBoost, and SMOTER-AdaBoost are the new addition. The paper is well written and interesting to the researchers of hydrology. However, the paper needs some more clarity, which I have marked below. 1. Since the variation in the streamflow is evident, I do not know the usage of word imbalance is correct or not in this context. 2. You have selected the 80th percentile to segregate the peak flow data from the entire dataset. I agree that ANN models are completely dependent on the choice of data. Still, it would be interesting to see the effect of selecting any other values (70th and 90th percentile), at least for a few cases. 3. How to choose the model HF, TF for the unknown data for the future forecast? 4. How do you define highly imbalanced flow datasets? 5. Line 25: "One cause of low model accuracy on high flows is the scarcity of representative sample observations available with which to train such models." Add one or two references 6. Line 30: "As a result, studies that assess models using traditional performance metrics risk overlooking deficiencies in high flow performance." I agree with this point. However, separating high flow hydrograph from the dataset and evaluate the model performance using the traditional indices would still reveal the actual model performance. This should be mentioned. 7. Line 40: Improving the accuracy of high flow forecasts has been the focus of many studies. Several studies have examined the use of preprocessing techniques to improve model performance. Reference is required. I would suggest adding Kasiviswanathan et al. (2015). 8. Line 85: The Bow and Don River watersheds are the focus of this research. You may consider deleting this line. 9. Authors refer to the stage as flow. This should be corrected. 10. It would be interesting to see how the peak flow of Bow River in the years 2005 and 2013 forecasted by these models. Similarly, for Don River. 11. Why stage data, why not directly for the discharge data?

Reference Kasiviswanathan KS, He J, Sudheer KP, Tay J-H (2016) Potential applica-

tion of wavelet neural network ensemble to forecast streamflow for flood management. Journal of Hydrology, DOI: 10.1016/j.jhydrol.2016.02.04

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