An improved chaos similarity model for hydrological forecasting

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The local approximation prediction model (LPM) is a forecasting approach based on chaos theory. It uses the Euclidean distance to evaluate the spatial proximity between two phase points, which is a measure of "quantity" similarity. This study improved LPM by proposing a coupled "quantity-pattern" similarity model (CQPSM). The "pattern" similarity is defined as the similarity of two phase points on internal structure, and measured by a cumulative unit-step function. The forbearing stratified sequencing method is employed to solve the double-objective optimization problem. The proposed model was tested using the data from the Danjiangkou reservoir basin for future 12-monthly precipitation forecasting with lead times from a month to a year. Four performance measures (R, RMSE, MARE and NSE) were computed and compared to those of LPM and autoregressive (AR) model. The results show a better performance of CQPSM and indicates the importance of considering "pattern" similarity between two phase points. Moreover, the weighted Euclidean distance based on partial information logic was discussed and applied to further improve the "quantity" similarity. Consequently, the proposed CQPSM could provide a new alternative for hydrological forecasting.

References

Liang Z., Xiao Z., Wang J., Sun L., Li B., Hu Y., Wu Y. (2019) An Improved Chaos Similarity Model for Hydrological Forecasting. *Journal of Hydrology*. **577**. 123953. doi:10.1016/j.jhydrol.2019.123953.