

## Accepted Manuscript

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PII: S1568-4946(18)30418-6  
DOI: <https://doi.org/10.1016/j.asoc.2018.07.030>  
Reference: ASOC 4998

To appear in: *Applied Soft Computing*

Received date: 20-12-2017  
Revised date: 5-6-2018  
Accepted date: 8-7-2018



Please cite this article as: Wang J, Li H, Lu H, Application of a novel early warning system based on fuzzy time series in urban air quality forecasting in China, *Applied Soft Computing Journal* (2018), <https://doi.org/10.1016/j.asoc.2018.07.030>

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# Application of a novel early warning system based on fuzzy time series in urban air quality forecasting in China

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## Highlights

- An early warning system based on fuzzy time series is developed for air quality.
- A novel hybrid model is proposed to forecast major air pollutant concentrations.
- Interval analysis is applied to mine uncertainties involved in air pollutants.
- Comprehensive and reliable evaluation of the proposed model is generated.
- The system's effectiveness and stability are verified in monitoring air quality.

## Abstract

With atmospheric environmental pollution becoming increasingly serious, developing an early warning system for air quality forecasting is vital to monitoring and controlling air quality. However, considering the large fluctuations in the concentration of pollutants, most previous studies have focused on enhancing accuracy, while few have addressed the stability and uncertainty analysis, which may lead to insufficient results. Therefore, a novel early warning system based on fuzzy time series was successfully developed that includes three modules: deterministic prediction module, uncertainty analysis module, and assessment module. In this system, a hybrid model combining the fuzzy time series forecasting technique and data reprocessing approaches was constructed to forecast the major air pollutants. Moreover, an uncertainty analysis was generated to further analyze and explore the uncertainties involved in future air quality forecasting. Finally, an assessment module proved the effectiveness of the developed model. The experimental results reveal that the proposed model outperforms the comparison models and baselines, and both the accuracy and the stability of the developed system are remarkable. Therefore, fuzzy logic is a better option in air quality forecasting and the developed system will be a useful tool for analyzing and monitoring air pollution.

**Key words:** Hybrid pollutants forecasting model; Fuzzy time series; Interval analysis; Data preprocessing; Forecasting accuracy

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