

## ***Interactive comment on “PM2.5 / PM10 Ratio Prediction Based on a Long Short-term Memory Neural Network in Wuhan, China” by Xueling Wu et al.***

### **Anonymous Referee #2**

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This paper is addressing an important research question. It is generally well written. However, some important points need clarifying before publication.

In particular, the authors should clarify the way they split their data. They state on line 271, “80% of the data were used as the training sample for modelling, and 20% of the data were used as the verification sample.” It is important to specify how the hyper-parameters of their model were chosen. If they were chosen by optimising the performance against the verification dataset then it is possible that the algorithm has over-fit the hyper-parameters. Lines 272-274 seem to imply there was at least some hyper-parameter tuning performed. Ideally, the data should be split three ways, into

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a training, verification, and test, so that the hyper-parameters are tuned against the verification data, and the algorithm scored against the test data. The authors should reassure the reader that they have taken measures to ensure they have not overfit the hyper-parameters - for instance, perhaps they further split their training set.

In addition, they state on line 279 that for Section 5.1 that there were 570 samples in the training data, and what I infer is 20 samples in the verification data (two days multiplied by ten sites, as per the training data). This appears not to be an 80%/20% split. In any case, the verification data are from one period in the season (end of December) - the algorithm may simply be good at predicting air quality in December but not the rest of the year. A more convincing approach would be to test against multiple cases from throughout the year. This is similar for the spatial prediction, which appears to only be tested at one site.

As such, the authors must reassure us that their approach to validation guards against overfitting in order for this to be suitable for publication.

A series of specific comments and questions now follows:

\* Could you discuss why you have focussed on the PM2.5/PM10 ratio as opposed to considering them separately?

\* line 75: “random precision”, and Section 5.3 “random pattern prediction”. Please could you clarify what this is - it was unclear to me. Are you randomly selecting a subset of points in space and then predicting them with the remaining, contemporaneous points? If so, how is this significantly different from the spatial prediction in Section 5.2? Please better explain this task near the beginning of the manuscript.

\* line 112,113: I found this sentence confusing. Are “monitoring station” and “monitoring site” different things? I’m unclear what the definition is on an “inspection standard”? Does this mean the “truth” data you are using for the verification. I’m unclear what “correlation factors” means.

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\* line 132: You verify your data processing against NASA data. Is NASA has a product, why not just use that?

\* line 175: “higher trend” and “lower trend”. The word “trend” changes the meaning. I presume this should read “average temperature is higher in summer and lower in winter”, as expected. Otherwise, I don’t understand what it means.

\* line 185: Is this standard published. If so, please cite. In my opinion, this can be a technical paper as opposed to a peer review paper (but the editor may feel differently).

\* line 230: Could you clarify the optical subset approach? Was the R<sup>2</sup> score performed on the output of the LSTM as compared with the observations. If so, it may be better to put this section after the description of the LSTM and make that clear.

\* Table 4: I presume this table shows only the top 10 scoring selections? Presumably you scored all combinations of predictors. Please explain.

\* Line 258: Normally the first gate is expressed at deciding what to forget, rather than what to remember (I appreciate they are equivalent). Figure 7 shows a “Forget gate” so it would be helpful to standardise the terminology.

\* “and the third switch controls whether c is the current output of the LSTM model” I’m not sure about this - correct me if I’m wrong, but isn’t c<sub>t</sub> combined with h<sub>t-1</sub>, and x<sub>t</sub> to create h<sub>t</sub>, which is the output?

\* Section 4: I see the link to your code, that you used Keras and their LSTM implementation, which is great. If possible, could you cite Keras directly in the manuscript, and state that you used their implementation of LSTMs.

\* line 273: “with the first three layers being the LSTM layer and the last layer being the dense layer”. I presume this means that you have three LSTM units follows by a dense layer. However, each LSTM unit can be thought of of comprising multiple layers, so this terminology is confusing. In addition, could you explain to the reader the purpose of the final dense layer.

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\* line 282: I don’t understand the difference between a “multilayer perceptron” and a “artificial neural network”. In addition, I would have thought the LSTM, multilayer perceptron and artificial neural network, all rely on back propagation, so I don’t understand the terminology “back propagation artificial neural network”. Please clarify.

\* Section 5.3: as mentioned above, I don’t understand what is being done in this section.

Typographic and language errors:

\* line 24: “Aerosols are a general term” -> “Aerosol is a general term”

\*Please define all your acronyms on first use, for instance RH, DVV etc

\* line 74: “intelligent models”, please clarify what this means

\* line 89: “classic” -> “classical”

\* line 108: -> “Our environmental monitoring station only monitors data in real-time”. I’m also not sure what this sentence is meant to mean. Are you saying that the instrument doesn’t provide information about the future? Please clarify.

\* line 110: “which have”, is ambiguous - is this referring to the AOD or the atmospheric aerosols? It seems redundant to say that PM is linked to atmospheric aerosols. Please clarify this sentence.

\* line 140: “The shortest distance between points exceeds 3 km, and the average distance exceeds 10 km.” I don’t know what the word “exceeds” means in this context. Can we replace it with “is” instead?

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Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2019-180>, 2019.

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