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Geoscientific Model Development Discussions

Interactive comment on "ClimateLearn: A machine-learning approach for climate prediction using network measures" *by* Q. Y. Feng et al.

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This paper presents a toolbox for applying a range of machine learning techniques to climate data, and illustrates the approach by describing a case study in which a network representation of spatial and temporal correlations in surface temperature data is used to generate data models, which are then shown to have some skill in predicting existence of El Nino events up to one year in advance, and predicting values of the NINO3.4 index up to 3 months in advance.

The paper offers a good, readable introduction to network representations of spatially correlated climate data ("climate networks") and machine learning approaches (sections 2 and 3), which would be useful to audiences not familiar with these techniques. But otherwise the paper is very disappointing. The abstract and conclusion claim that the paper describes a toolbox, ClimateLearn, but the paper tells us almost nothing about this toolbox, other than some brief details of implementation and functionality in

the final paragraph of the paper. It's not clear then what this toolbox offers to other researchers interested in applying ML to climate data, how this toolbox compares to existing libraries of ML algorithms, and what set of applications it might be applicable to. For this journal, Geoscientific Model Development, it's a very poor fit, as there is no "development" described anywhere in this paper.

So if the paper does not describe the development nor the functionality of the toolbox, I'm left wondering what the value of the paper is. The case studies presented in section 4 seem to be fairly elementary applications of ML algorithms to the ENSO dataset, repeating the existing work of Ludesher and colleagues. There is, of course, value in replication of existing results, but the description in this paper falls far short of a useful replication, as it does not compare in any detail either the methods or the results with previous work. Most of the choices made in applying the techniques are presented with no rationale, and no analysis of the impact on the results. For example, why a 3x3 ANN in the first study and a 2x1 in the second? What difference do these choices make? Why a prediction lead time of 12 months (On this point, the paper says "similar to Ludescher et al". What does "similar" mean? Is it an exact replication, and if not, what changes were introduced and why?). How was the data filtering done, and how does it impact the results?

Furthermore, the paper suffers from a common failing of a lot of work in applied machine learning. The paper places way too much emphasis on the algorithms and the training procedure, as if these alone were responsible for useful results, and largely neglects the role of prior knowledge in pre-processing the data, selecting candidate variables to include in the models, and expert interpretation of the results. The role of domain expertise is hinted at throughout the description of the method, as the authors draw on existing work to select candidate variables (e.g. skewness and wind stress residuals, as analyzed by Feng and Dijkstra). Surely if there is value in this work it is in the investigation of why these variables are good candidates for model finding, rather than the generation of yet another predictive model from them via a machine learning algorithm?

Overall, I do not recommend this paper for publication. There is some value in the introductory sections for audiences not familiar with the basics of ML, but such introductions are already widely available elsewhere. The case studies do not offer enough critical analysis, nor comparison with the literature, to represent a useful contribution applied machine learning for climate data, and the paper does not describe the toolbox promised in the abstract.

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