**Visual Analysis of Correlation Patterns in Meteorological Multi-parameter Datasets using Feature Relevance Methods on Neural Variable Transfer Models**

**ABSTRACT**

Climate is a complex system consisting of many variables that constantly shift. To understand it, first, the relationship between the variables must be explored. Recently, data-driven approaches, namely neural networks, have been utilized for this purpose. However, these models are often treated as black boxes. Finding and visualizing patterns that explain their decision process could encourage experts to adopt these models. In this work, we examine the correlation patterns in meteorological multi-parameter datasets and visualize them using various up-to-date methods. Our work also involves an approach to analyze higher-order correlations more efficiently. First, we utilize a Variable transfer model with a U-Net architecture to extract parameter features. Later in the training process, we apply dropout with multiplicative Gaussian noise to the inputs. In the evaluation stage, the dropout rate p of each parameter can be tuned to change their noise level. This limits the model’s information on certain inputs allowing us to observe the prediction strength of different input-output combinations. Additionally, we investigate the sensitivity(gradient) of the predictions with respect to the p-values of each input parameter. We found strong correlations between physically related variables, consistent with compared analyses. We observed groups of temperature-related and wind-related variables. We also remarked on differences in prediction performance analysis and sensitivity analysis results. To explore spatial patterns, we extended the gradient analysis to examine the sensitivity of the prediction with respect to the p-value of individual pixels of the world map. As an alternative, we also applied the layer-wise relevance propagation method to visualize the contribution of each pixel to the prediction performance. Both methods revealed visible patterns that were relevant to geological conditions such as landmass and ocean distinction, as well as global wind patterns. This work shows promise in exploring spatial correlation patterns in meteorological data. There remains a potential for further temporal pattern analysis. The consistency of the results with physical phenomena is to be further evaluated by climate scientists. If convinced of the model’s use, experts can use it to discover new spatial patterns that might be overlooked otherwise.

Mehmet Emre Özyurt, Matr. Nr: 03723524