Geophysical Research Abstracts
Vol. 21, EGU2019-14563-1, 2019
EGU General Assembly 2019

Weather-type decomposition over the Grenoble valley using a convolutional neural network

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In order to study the impact of pollutants on health in an urban area, one must have the finest possible knowledge regarding their spatial distribution. This requires refined meteorological simulations over the area which are computationally very expensive. One workaround is to perform these simulations once and for all for representative weather types.

Hence our objective to determine – from synoptic data – weather types with a unique wind circulation at a local scale, for the Grenoble valley.

To do so, a multi-branch convolutional neural network is trained to do a supervised regression from the large scale meteorological data (Weather Research and Forecast outputs with 27 km horizontal resolution) to the local scale data (in-situ pollutant concentrations and winds). Secondly, this network is used as a feature extractor, allowing to perform a non linear dimensionality reduction with intrinsic consideration of local features. Unsupervised classification is then performed on this reduced dataset.

The regression step leads to the prediction of mean pollutant concentrations over the Grenoble valley with a Mean Absolute Error smaller than 2.5 $\mu g.m^{-3}$ (when annual mean should not exceed 25 $\mu g.m^{-3}$ according to the European regulations). Using this convolutional neural network to reduce the dimension of the large scale meteorological data, a classification is computed via a Kmeans algorithm. The results will be presented and discussed during the poster session.

This approach could also be valuable for other related scientific issues such as rain prediction.