Multi-fidelity Gaussian process for infilling daily rain gauge data gaps with satellite estimates case of Burkina Faso

Abstract: A Precipitation data is widely used in the planning and management of several projects in different fields such as hydrology, climatology, civil engineering, etc. However, missing precipitation data is frequently found at many rainfall gauge. In Africa, the main causes of this missing data are socio-political, economic (low density of stations due to lack of resources), and human origin such as the lack of qualified personnel. This work aims to analyze the performance of multi-fidelity Gaussian process (MFGP) regression in filling in missing daily precipitation data. The performance of the MFGP is compared to well-known machine learning approaches used to fill missing data as the mean, the k-Nearest Neighbours (kNN), multiple imputation method(mice), and Last observation carried forward (LOCF). In all methods, the satellite estimation is combined with the in situ rain gauge. However in MFGP the in situ rain gauge is considered as the high fidelity and the satellite estimation as the low fidelity model. The first step of proposed methodology consist of removing the missing data in the time series dataset. After training, the predicted value is used to replace the missing data. The performance of the approach is evaluated considering daily precipitation from three in situ gauges and satellites named rfe, tamsat, arc2, and chirps located in different climatic regions of Burkina Faso. In order to evaluate each model, we create an artificial gap of 5 %, 10 %, and 15 % in the rainfall data values. The performances of the different methods are evaluated by calculating the root mean square(RMSE), the False Alarm Ratio (FAR) and Probability of Detection (POD) , and the Critical Success Index (CSI). According to the results, MFGP provides better performance. This Gaussian multi-fidelity offers other advantages that the traditional method used for data imputation does not, such as uncertainty in forecasting and can be easily used to complete and forecast spatial-temporal daily precipitation data.

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Short Bio: Professor na escola Politécnica de Ouagadougou (EPO), Burkina Faso e ocupa atualmente cargo de diretor de relações exteriores e parcerias com empresas. Atuando principalmente na área de engenharia mecânica computacional. Possui Mestrado, Doutorado e pós-Doutorado (2009, 2017) na Universidade Federal do Rio de Janeiro no departamento Eng Mecânica e pós-doutorado (2017-2019) na Universidade Central Supelec (França). Tem experiencia na área de simulação numérica, quantificação de incertezas, machine learning e analyse de dados.