Applying Machine Learning Methods to predict rain using GNSS products and meteorological parameters

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Nowadays, weather forecast is an important factor of everyday life that we should be well prepared for. Especially the amount of rainfall can positively or negatively influence our lifestyle. While a moderate rainfall is supportive for agriculture or provision of potable water, too much rainfall can cause disasters like floods. Therefore, accessing the rain information in near-real-time is beneficial in all aspects. In recent years, GNSS meteorology has been widely utilized as a valuable tool to better interact with the weather conditions in the now-casting and forecasting applications. Nevertheless, rainfall cannot be estimated directly from the GNSS measurements, and therefore some other methods like Artificial Intelligence (AI) are employed to do so. One of the well-known methods in AI is Machine Learning (ML) which focuses on data in order to model or classify various cases such as anomaly detection, earthquake prediction, and rainfall classification. The main objective of this research is to develop a predictive model for accumulated rain every 3 hours for an area populated with 21 GNSS stations of the EUREF Permanent GNSS Network (EPN). For this purpose, we applied different ML methods. The period of interest ranges from 2017 January to 2021 October. The years 2017 to 2020 are used for training, and 2021 is utilized to evaluate the rain model. The temperature, atmospheric pressure, wind speed, wind direction, relative humidity, Zenith Wet Delay (ZWD), Gradients (GN-S, GE-W), Total Electron Contents (TEC) are selected as input parameters in ML. Besides, the rain product from Global Satellite Mapping of Precipitation (GSMaP) is considered as the reference of the model. Finally, the accumulated rain prediction models are derived every 3 hours over the area of interest.