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Infilling Spatial Precipitation Recordings with a Memory-Assisted CNN

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Missing climate data is a widespread problem in climate science and leads to uncertainty of prediction models that rely on these data resources. So far, existing approaches for infilling missing precipitation data are mostly numerical or statistical techniques that require considerable computational resources and are not suitable for large regions with missing data. Most recently, there have been several approaches to infill missing climate data with machine learning methods such as convolutional neural networks or generative adversarial networks. They have proven to perform well on infilling missing temperature or satellite data. However, these techniques consider only spatial variability in the data whereas precipitation data is much more variable in both space and time. Rainfall extremes with high amplitudes play an important role. We propose a convolutional inpainting network that additionally considers a memory module. One approach investigates the temporal variability in the missing data regions using a long-short term memory. An attention-based module has also been added to the technology to consider further atmospheric variables provided by reanalysis data. The model was trained and evaluated on the RADOLAN data set which is based on radar precipitation recordings and weather station measurements. With the method we are able to complete gaps in this high quality, highly resolved spatial precipitation data set over Germany. In conclusion, we compare our approach to statistical techniques for infilling precipitation data as well as other state-of-the-art machine learning techniques. This well-combined technology of computer and atmospheric research components will be presented as a dedicated climate service component and data set.