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Image Inpainting for Missing Values in Observational Climate Datasets Using Partial Convolutions in a cuDNN

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Nowadays climate change research relies on climate information of the past. Historic climate records of temperature observations form global gridded datasets like HadCRUT4, which is investigated e.g. in the IPCC reports. However, record combining data-sets are sparse in the past. Even today they contain missing values. Here we show that machine learning technology can be applied to refill these missing climate values in observational datasets. We found that the technology of image inpainting using partial convolutions in a CUDA accelerated deep neural network can be trained by large Earth system model experiments from NOAA reanalysis (20CR) and the Coupled Model Intercomparison Project phase 5 (CMIP5). The derived deep neural networks are capable to independently refill added missing values of these experiments. The analysis shows a very high degree of reconstruction even in the cross-reconstruction of the trained networks on the other dataset. The network reconstruction reaches a better evaluation than other typical methods in climate science. In the end we will show the new reconstructed observational dataset HadCRUT4 and discuss further investigations.