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Artificial intelligence reconstructs missing climate information

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Historical temperature measurements are the basis of global climate datasets like HadCRUT4. This dataset contains many missing values, particularly for periods before the mid-twentieth century, although recent years are also incomplete. Here we demonstrate that artificial intelligence can skilfully fill these observational gaps when combined with numerical climate model data. We show that recently developed image inpainting techniques perform accurate monthly reconstructions via transfer learning using either 20CR (Twentieth-Century Reanalysis) or the CMIP5 (Coupled Model Intercomparison Project Phase 5) experiments. The resulting global annual mean temperature time series exhibit high Pearson correlation coefficients (≥0.9941) and low root mean squared errors (≤0.0547 °C) as compared with the original data. These techniques also provide advantages relative to state-of-the-art kriging interpolation and principal component analysis-based infilling. When applied to HadCRUT4, our method restores a missing spatial pattern of the documented El Niño from July 1877. With respect to the global mean temperature time series, a HadCRUT4 reconstruction by our method points to a cooler nineteenth century, a less apparent hiatus in the twenty-first century, an even warmer 2016 being the warmest year on record and a stronger global trend between 1850 and 2018 relative to previous estimates. We propose image inpainting as an approach to reconstruct missing climate information and thereby reduce uncertainties and biases in climate records.

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The presentation will tell from the journey of changing an image AI to a climate research application.