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# Modeling global surface dust deposition using physics-informed neural networks

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## Abstract

Paleoclimatic measurements serve to understand Earth System processes and evaluate climate model performances. However, their spatial coverage is generally sparse and unevenly distributed across the globe. Statistical interpolation methods are the prevalent techniques to grid such data, but these purely data-driven approaches sometimes produce results that are incoherent with our knowledge of the physical world. Physics-Informed Neural Networks follow an innovative approach to data analysis and physical modeling through machine learning, as they incorporate physical principles into the data-driven learning process. Here, we develop a machine-learning algorithm to reconstruct global maps of atmospheric dust surface deposition fluxes from paleoclimatic archives for the Holocene and Last Glacial Maximum periods. We design an advection-diffusion equation that prevents dust particles from flowing upwind. Our physics-informed neural network improves on kriging interpolation by allowing variable asymmetry around data points. The reconstructions display realistic dust plumes from continental sources towards ocean basins following prevailing winds.

**Keywords:** Paleoclimatology, Machine Learning, Differential Equations

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