

Modeling shelf sediment composition through glacial-interglacial time based on maps and machine learning

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The continental shelves cover relatively small areas of the globe, but show high productivity and sediment fluxes, leading to an unproportionally high contribution to global biogeochemical cycles. This contribution changes dramatically with sea level during glacial-interglacial transitions. At low sea level during glacial intervals, shelf sediments become exposed to air and freshwater and available for oxidation and terrestrial weathering, while high sea levels are expected to support productivity, carbon burial and deltaic processes. Shelf sediment distributions are essential to understand and model these processes. The composition of shelf sediments mainly depends on shelf setting, climatic variables, oceanic and terrestrial processes.

We combined regional geological map data of shelf sediments compiled from literature and a machine learning approach to model the carbonate, organic carbon and phosphorus content of shelf sediments. The model integrated data from a global database of chemical, physical, and mineralogical properties of ocean sediments, as well as ocean physical and biogeochemical parameters from Earth system models, and lithological map data from terrestrial watersheds that transport sediment fluxes to the river mouths. The model was built in python using a Random Forest Regression, while other work was conducted in ArcGISpro.

By leveraging the availability of modeled marine data for both the preindustrial and the Last Interglacial (LIG) periods, we generated sediment distribution maps for these timeframes. Particularly, the LIG sediment map will allow for the quantification of global weathering fluxes during the Last Glacial Maximum (LGM), because those sediments might have been exposed when sea levels were lowered during LGM.