# Coupled abrupt climate-dust events driven by ice sheet dynamics: Combined source and age analysis of last glacial loess in NW Europe

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Abrupt climate change events during the last glacial represent some of the most dramatic environmental transitions in the recent geological past. These $10^{1-3}$ yr shifts in climate are closely linked to ice sheet fluctuations, meltwater pulses and their influence on North Atlantic ocean circulation. Significantly, dust archives around the globe show that these events are also coupled to abrupt changes in atmospheric dust activity. Yet, the mechanism behind this climate-dust coupling and the role of dust in rapid climate change remains unclear. Wind-blown mineral dust deposits (loess) in Europe serve as source-proximal archive of past dust activity and a potential means to address this gap. However, uncertainties over the depositional age and sources of this material essentially limit constraint of the drivers of last glacial dust deposition variability in Europe, and prevent any analysis of their role in abrupt climate events. Here, we address this question through combined multi-technique provenance analysis and high sampling resolution luminescence dating of last glacial loess along a W-E transect across the English Channel region in NW Europe. During the last glacial, the English Channel basin was exposed due to global sea level lowering and acted as drainage route for sediment-rich meltwater derived from the Eurasian Ice Sheet (EIS) into the North Atlantic. Zircon U-Pb age spectra, heavy mineral assemblages, and quartz grain morphology of loess from areas adjoining the English Channel demonstrate that these ice sheet derived sediments acted as source for atmospheric dust deposited along the meltwater drainage route. Moreover, new published and unpublished detailed chronologies of last glacial dust deposition across this region (e.g., Stevens et al., 2020) indicate phases of greatly enhanced dust activity that match the timing of EIS decay phases and associated meltwater pulses. Based on these findings, we propose that EIS dynamics not only affected North Atlantic ocean circulation via meltwater pulses but also caused abrupt and substantial changes in atmospheric dust loading over NW Europe. The combined ocean-atmospheric effects of these meltwater and dust pulses drove and reinforced abrupt climate events of the last glacial. This mechanism would provide the first coherent explanation for the close coupling of dust and climate on millennial timescales during the Quaternary.

## References

Stevens, T., Sechi, D., Bradák, B., Orbe, R., Baykal, Y., Cossu, G., Tziavaras, C., Andreucci, S., Pascucci, V., 2020. Abrupt last glacial dust fall over southeast England associated with dynamics of the British-Irish ice sheet. *Quaternary Science Reviews 250*. doi:10.1016/j.quascirev.2020.106641