Improving Pollen-Based Paleoclimate Reconstructions

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The fossil record of pollen and spores is a natural archive that serves as one of the primary paleobiological sources for recon-structing terrestrial paleoclimate, as the bioclimatic preferences of the parent plant can be used to estimate paleotemperatures and paleopreciptation. However, because of the morphological similarities among pollen and spores within a single genus, and among many genera within certain families, the identificat-ions of pollen material are of variable taxon-omic rank. This means that characterizations of fossil assemblages for paleoclimatic reconstructions are primarily at the biome level. However, the biome approach fails when faced with plant assemblages that are not analogous to any modern biome.

I present an alternate approach for inter-preting palynological data, which rests on three modifications its collection and analysis. First, improvements in microscopy provide additional morphological data and allow improved discrimination of morphotypes. I present work demonstrating advanced optical microscopic techniques such as super-resolution structured illumination microscopy (SR-SIM) and confocal high resolution differential interference contrast microscopy (C-HR-DIC). Second, quantitative analyses of morphology provide finer and more consistent taxonomic classifications. I present collab-orative work demonstrating the power of numerical and machine-based methods in providing species-level classifications for two model datasets: black and white spruce and grasses. Third, paleoclimate reconstructions can be based on the probabilistic bioclimatic distributions of individual taxa, combined using maximum likelihood. I present the results of collaborative work estimating subtropical Holocene precipitation records.

The combination of these approaches will lead to more accurate and more dynamic reconstructions of paleoclimate.