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Vegetation and Carbon Storage Changes Following >200 Years of Drainage in a Temperate Peat Swamp

Globally, peatlands have acted as a significant carbon sink over the Holocene, resulting in net cooling of the Earth's surface. However, land-use change (ditching and draining) has transformed many peatlands from carbon sinks to sources. We studied the Great Dismal Swamp (GDS), a ~500 km² temperate peat swamp on the mid-Atlantic Coastal Plain, USA, to determine how >200 years of drainage altered vegetation, fire regimes, and carbon storage. We present new records of pollen, plant macrofossils, macroscopic charcoal, and carbon accumulation rates (CAR) and loss from four GDS wetland types. Results show that while wetland sediments began accumulating >14 kilo annum (ka), peat began accumulating ~10 ka closest to drainages before spreading across the landscape by 4 ka. Marsh vegetation persisted until ~4-3 ka, when GDS transitioned to a forested swamp, likely driven by a moister climate and stabilization of sea level and water table position. CAR was higher during the marsh phase, despite a higher fire frequency than the late-Holocene swamp phase. Recent fires are consistent with drying from anthropogenic drainage and drought and are anomalous compared to the previous 4 ka. Modern post-fire reversion to marsh suggests frequent fires maintained early Holocene marshes. Preliminary results suggest that centuries of swamp drainage led to a loss of ~2 Tg of carbon from surface peats within the existing swamp area, which is one-quarter to one-half of its original extent. These results imply that higher water tables could preserve existing forested swamp, prevent peat oxidation, and reduce the frequency and severity of fires.