Vegetation and microtopography drive microbial necromass carbon sequestration in wetland soils

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Background

Floodplain wetlands are critical carbon sinks, yet drought-induced water level declines trigger mudflat-to-meadow transitions that alter soil organic carbon (SOC) stocks and stability. Microtopography shapes wetland hydrology and vegetation; however, its interaction with vegetation on microbial necromass carbon (MNC)—the main stable SOC component—remains unknown.

Methods

Soil sampling

- Dry season
- Meadow & mudflat from three microtopographic units (Fig.1)
- Depth: 0–30 cm

Soil analysis

- Soil properties
- Amino sugars
- Amplicon/metagenomic sequencing
- Exoenzymes

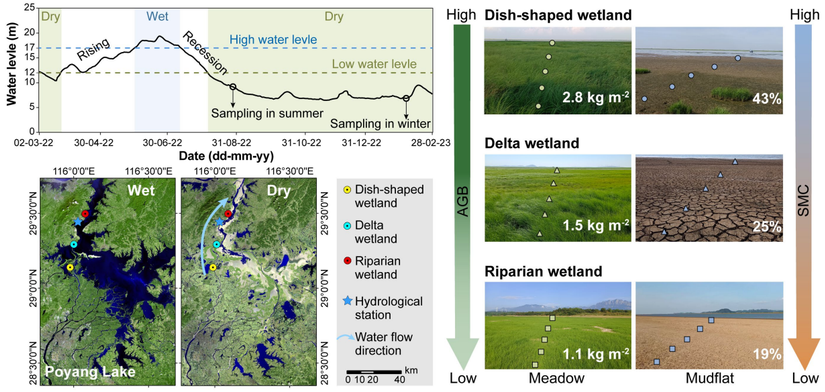

Fig. 1. Dry-season sampling, locations, and field photos of the three microtopographic units.

Results

Mudflat-to-meadow conversion shifted MNC dominance from bacterial (BNC) to fungal (FNC) and restructured microbial community in the top 10 cm (Figs. 2 and 3).

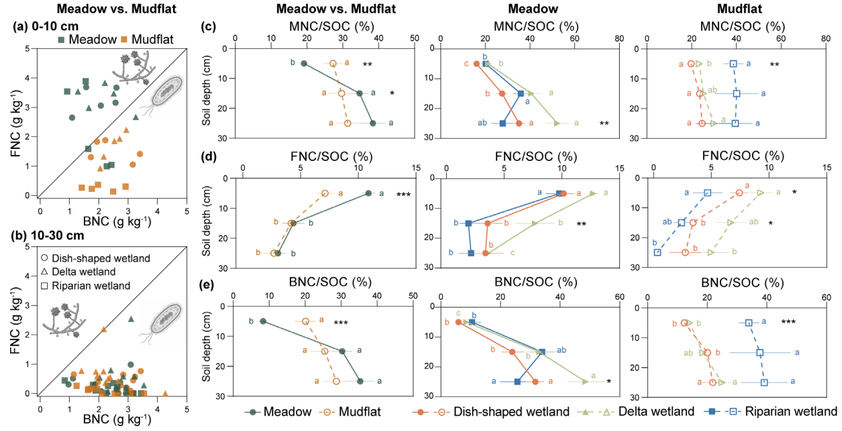

Fig. 2. Effects of vegetation and microtopography on MNC.

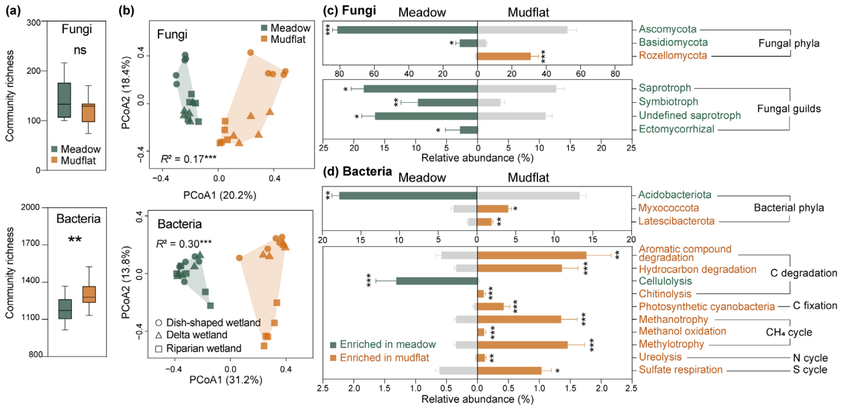

Fig. 3. Topsoil microbial niche differentiation in meadow and mudflat.

Slope wetlands (delta meadow & riparian mudflat) had higher MNC/SOC ratio than dish-shaped depressions across 0–30 cm. In the top 10 cm, microtopography affected MNC/SOC primarily via carbon substrate in meadows and nitrogen substrate in mudflats. Below 10 cm, clay–silt mineral protection was the key driver (Figs. 2 and 4).

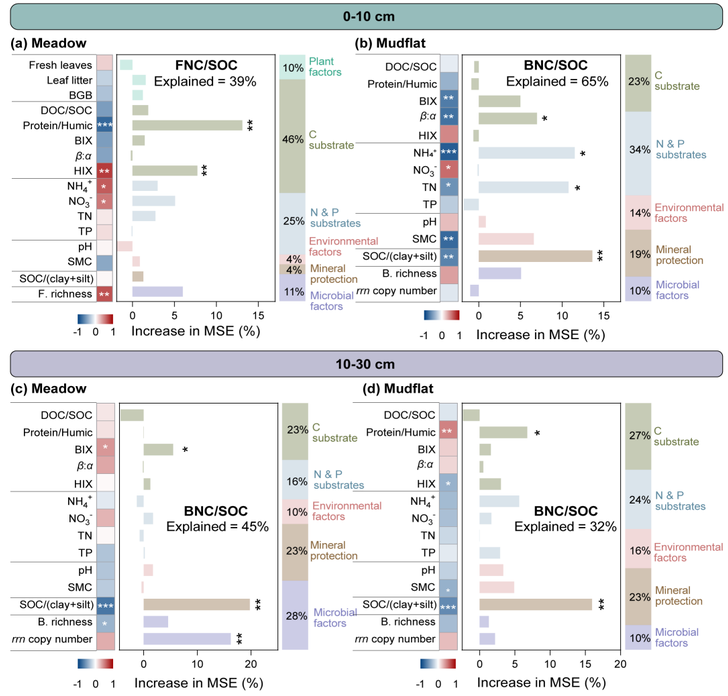

Fig. 4. Impact of microtopography on MNC/SOC.