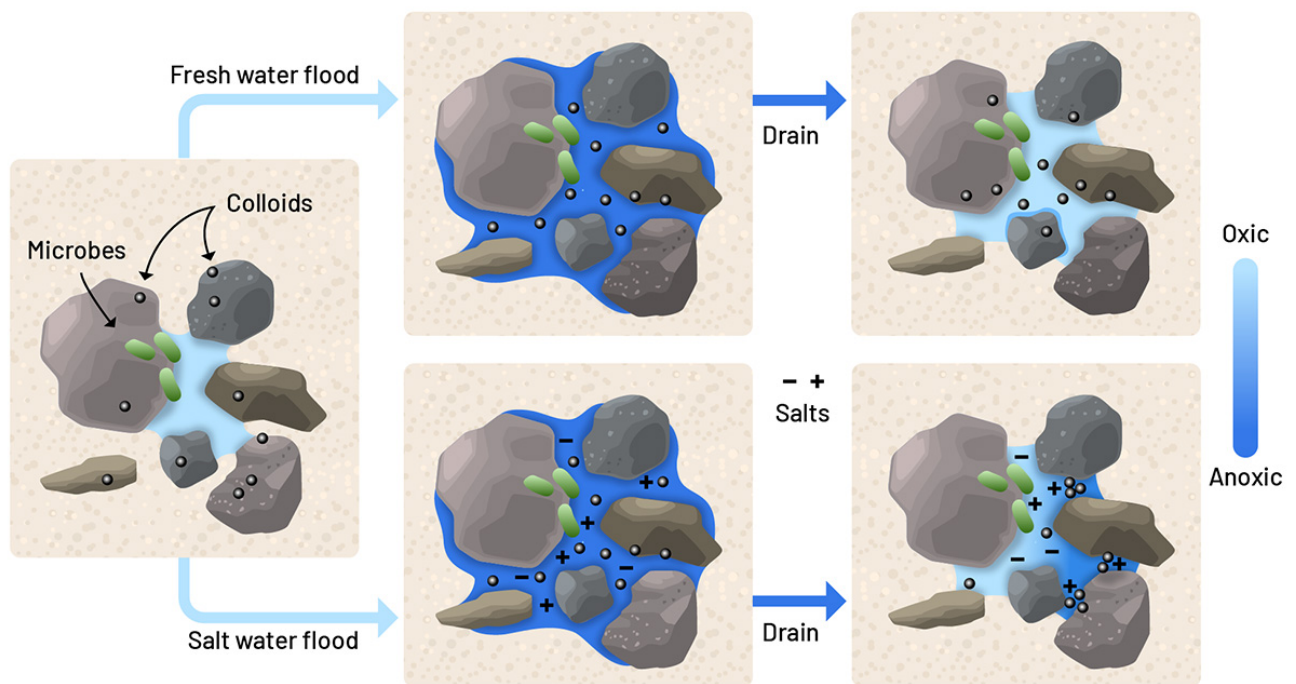




Coastal floods affect soil pores and oxygen flow

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Graphical abstract depicting how saltwater and freshwater differently affect oxygen levels in soil pores. Image courtesy of Nathan Johnson, science illustrator at Pacific Northwest National Laboratory.

Saltwater intrusion from rising seas and storm-driven flooding events are increasingly affecting coastal forests. These short-term salt pulses are often followed by freshwater from rainfall or runoff, creating alternating flood conditions that reshape soil pore structure and function.

Researchers at Pacific Northwest National Laboratory used intact soil cores from the TEMPEST field scale manipulation experiment—part of the Department of Energy’s COMPASS project—to simulate the field in the laboratory. They tested how simulated flooding conditions affected air movement in the soil. Over six flood and drain cycles, they compared freshwater only flooding to alternating saltwater and freshwater treatments. The saltwater treatments resulted in mobilized colloids (small soil particles evenly dispersed in water) that migrated and clogged fine pores, altering the pore size distribution.

These structural changes reduced oxygen diffusion back into the soil during drainage, particularly in the topsoil where tree roots are most active. Just three saltwater pulses were enough to elevate exchangeable sodium to levels consistent with long-term structural breakdown. These results suggest a fast-acting physical mechanism linking storm surge exposure to reduced oxygen availability for roots. The findings offer a new explanation for the rapid onset of coastal forest dieback and demonstrate that even brief saltwater intrusions can trigger lasting changes in soil function.

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Rod, K. A., Doro, K. O., Patel, K. F., Kemner, K. M., Wilson, S. J., Megonigal, J. P., Ward, N. D., Weintraub, M. N., & Bailey, V. L. (2026). Alternating salt and freshwater floods of

coastal soils impact soil structure, hydraulic properties, and oxygen dynamics.

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