Making waves: Turbulent airflow enhances evaporation from undulating soil surfaces

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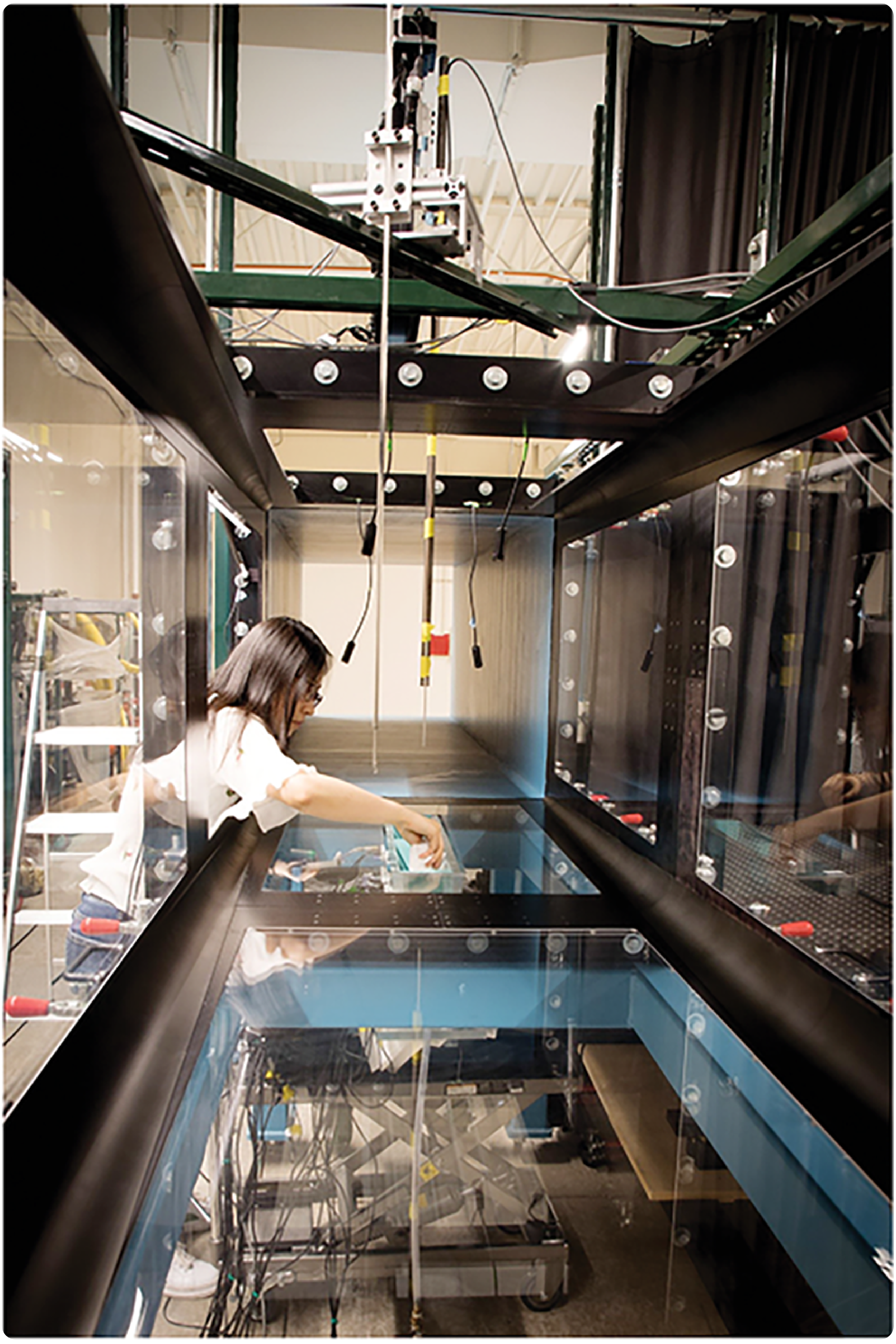

Graduate student and primary author Bo Gao installs sensors within the soil tank and wind tunnel experimental apparatus. Photo by Kathleen Smits.

Undulating or wavy soil surfaces occur naturally in both dry and wet environments like wind-blown sandy deserts or wet buggy boglands. They are also formed by human activity, such as in the distinct furrows formed in a ploughed field. What is unique to an undulating soil surface compared with a flat surface is that the location within the soil undulation drastically affects the hydrological conditions. However, our current understanding of the exchange processes between the soil and the atmosphere in the presence of undulations is limited.

In an article recently published in *Vadose Zone Journal*, soil and aerospace researchers teamed up to investigate evaporation from wavy soil surfaces using a unique experimental and modeling approach. They addressed questions about the influence of turbulence on the different stages of evaporation. Using an experimental technique called “hot-wire anemometry” to measure the velocity of the wind, along with a new mathematical model that fully describes the interactive behavior of the soil and the air, the team found that turbulent airflow greatly enhances the early high-rate stage of evaporation often seen after a heavy rainfall.

Wavy surface geometry significantly impacts the local evaporation rate by influencing both water vapor distribution and water availability at the soil surface. Using hot-wire anemometry, the researchers were able to capture recirculation flow forming in the surface valleys, demonstrating how it locally suppresses evaporation and affects the overall evaporation rate of the system. As a joint result of turbulence and surface undulations, the influence of wind speed on both the local and system-level evaporation rate is restricted.

Given the distinct evaporation rates along undulating soil surfaces, considering the soil surface configuration is important to a host of topics in climate, agricultural research, and a wide range of ecosystem processes.

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Gao, B., Farnsworth, J., & Smits, K.M. (2020). Evaporation from undulating soil surfaces under turbulent airflow through numerical and experimental approaches. *Vadose Zone Journal*, *19*, e20038. **https://doi.org/10.1002/vzj2.20038**

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