In this talk, we will present two projects that pertain to the dynamics of fluid-fluid interfaces. In the first part of the talk, we experimentally and theoretically demonstrate the effect of air flow that is applied to an initially stagnant water droplet on a solid surface. Reminiscent of the drying process in printing, the droplet exhibits complex behaviors — splitting and depinning, depending on the strength and configuration of the applied wind. A mathematical model qualitatively captures the evolution of the 2D thin drop and the splitting transition, by combining the potential flow and Prandtl boundary layer theory. In the second part, we present particle-induced viscous fingering when a particle/oil mixture displaces air inside a radial Hele-Shaw cell. Our theoretical and experimental results reveal the key mechanism of this unexpected instability is the shear-induced migration of particles. This work demonstrates the complex coupling between suspensions and fluid-fluid interfaces, as a function of the particle volume fraction and the ratio of the particle diameter to gap size.

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