Etablissement d'un modèle théorique pour la collecte des aérosols par les gouttes de pluie : modélisation explicite du flux de Stefan et de la contribution de la diffusiophorèse

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Abstract

The current understanding of droplet-particle interactions is studied in two ways, through experiments and through numerical simulations. In the case of the latter, there are currently limitations to study drop sizes where perfectly sphericity is maintained, and drops that present deformations are studied through experiences, however these results may present uncertainties in the measurements. Therefore, there is a need for new methods that can accurately capture the complex behavior of deformable droplets and their interactions with particles. In this study, we aim to contribute to this effort by investigating the dynamics of water droplets under different Reynolds numbers and analyzing their interaction with aerosol particles. To do so, an Eulerian approach to simulate the internal and external flows of the drop is coupled with a Lagrangian approach to simulate the transport of aerosols. The flows are simulated with Direct Numerical Simulation (DNS), by numerically solving the incompressible Navier-Stokes equations. The dynamics of the liquid/gas interface is tracked with a coupling of the Volume of Fluid (VOF) and Level Set methods (Vaudor et al. 2017). Aerosol transport is simulated by applying Newton's second law, considering drag force and Brownian motion (Mohaupt et al. 2011). We show that this approach, applied to drops presenting no oscillation, allows retrieving collection efficiencies published in the literature. The approach is then applied to drops presenting oscillations, and corresponding collection efficiency are obtained, which are then compared to the experimental findings of Quérel et al (2014).