HEAT TRANSFER IN DROP-LADEN TURBULENCE

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Exchanges of heat, mass and momentum are of key importance in many applications involving turbulent multiphase flows. These systems consist of a carrier phase and a dispersed phase, which can be found in many different forms, like solid particles, drops or bubbles. In this context, a case of particular interest is when the considered dispersed phase is composed by large and deformable drops and/or bubbles, as for instance in bubble-column reactors or oil-water flows.

We consider a two-phase flow system composed by large and deformable drops dispersed in a turbulent flow. The evolution of the system flow is described here employing a phase-field method while the energy equation describes the temperature field. For a fixed Reydnols number, we investigate the effect of the Pradntl number, ratio betweem momentum and thermal diffusivities.

After an initial transient, drops move along the streamwise direction advected by the flow (figure 1). While moving, drops deform under to the action of the turbulent flow breaking and coalescing. The temperature field also evolves over time. Starting from an initial uniform temperature in the two phases, the system moves towards an equilibrium state. At the same time, breakage and coalescence events produce modifications to the temperature field (figure 2).

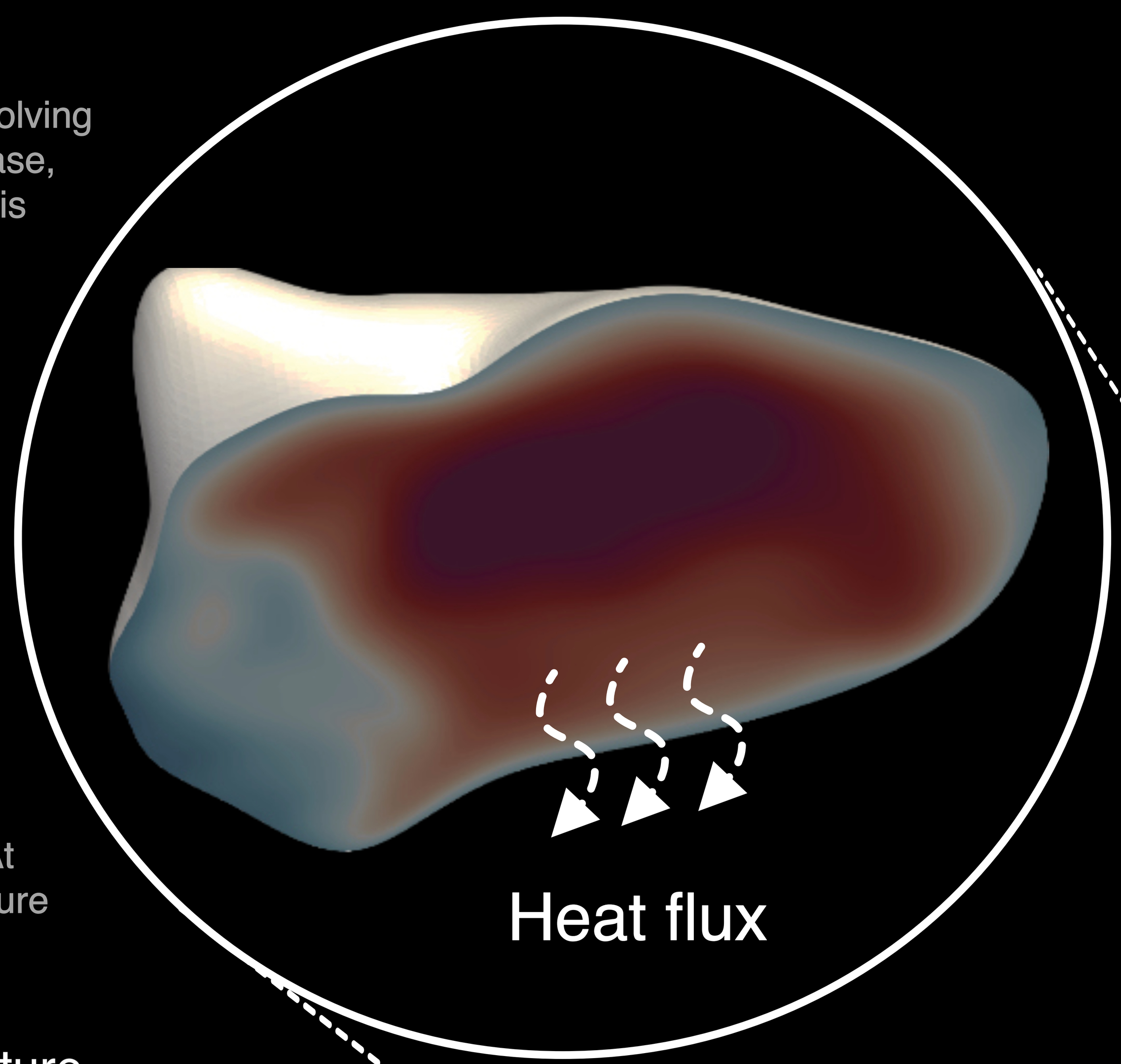

Figure 1: Rendering of the computational setup employed for the simulations. A swarm of large and deformable drops (hot) is released in a turbulent channel flow (cold).

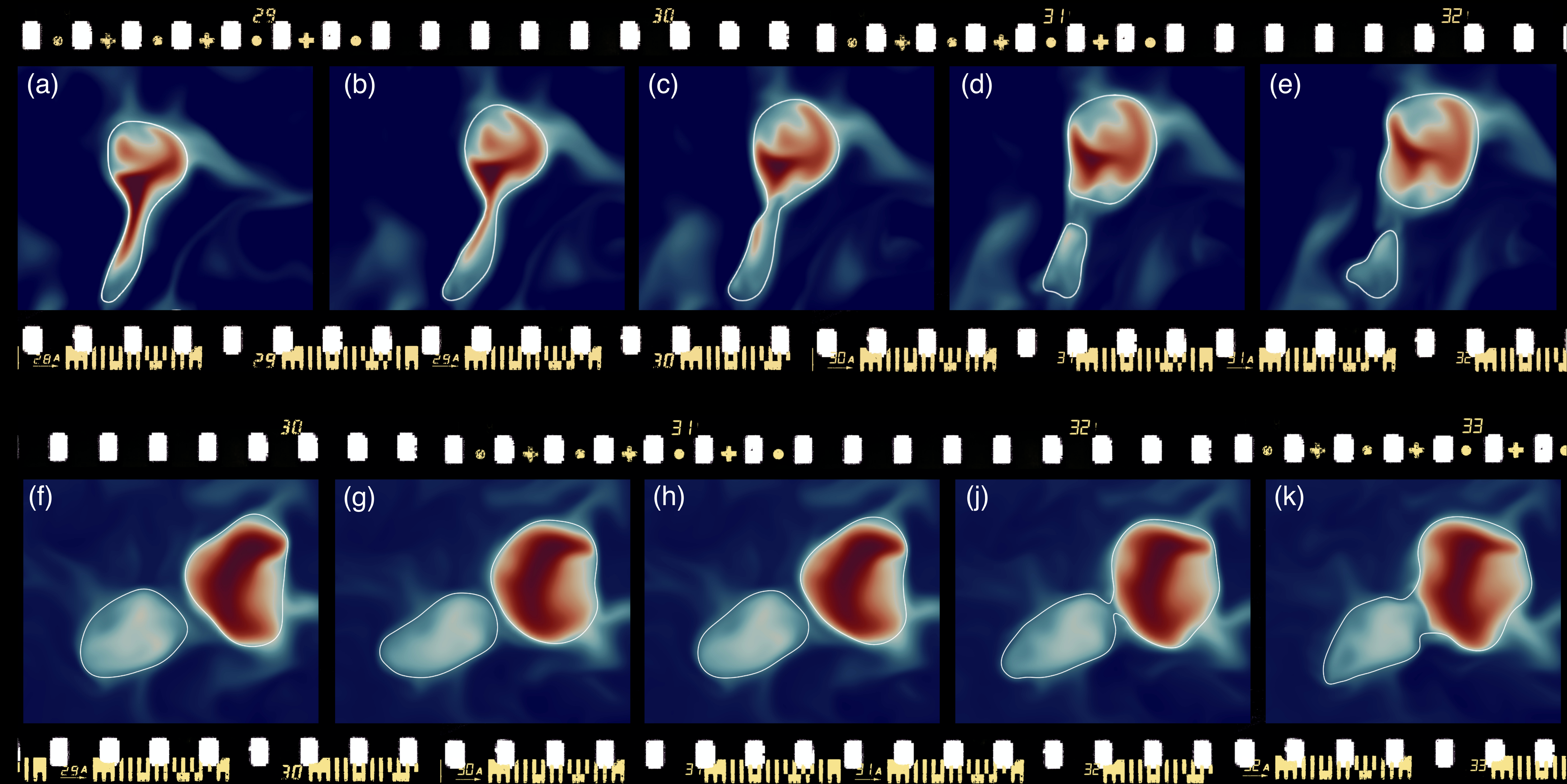

Figure 2: Time sequence of a breakage event (top row) and of a coalescence event (bottom row). The temperature field is rendered with a red-hot blue-cold colormap. As drops move along the streamwise direction advected by the flow; drops coalesce and break and simulateously the temperature field also evolves: heat is transfered from the dispersed phase to the carrier phase and breakage and coalescence events produce further mixing of the temperature field.

We acknowledge EURO-HPC JU for awarding us access to Discoverer@Sofiatech, Bulgaria (EHPC-REG-2022R01-048) and LUMI-C@LUMI, Finland (EHPC-EXT-2022E01-003) and ISCRA for awarding us access to Leonardo (HP10BUJEO5).

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