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Gravitational Interactions of Two Small Evaporating Drops
MICHAEL ROTHER, University of Minnesota Duluth — Relative trajectories are calculated for two sedimenting spherical drops with exact methods for determining the hydrodynamic forces at finite Stokes number and low Reynolds number. The drops are losing mass by isothermal evaporation controlled by diffusion, and bispherical coordinates are used to solve for the vapor concentration between the two liquid spheres. When the Reynolds number is small, fluid inertia is negligible, and the hydrodynamic forces are linear functions of the translational velocities of the drops. However, at nonzero Stokes numbers, drop inertia must be taken into account, and the hydrodynamic forces do not balance the applied forces. For drops in close approach, lubrication forces and attractive molecular forces are considered. The effect of evaporation is studied by comparison with trajectories for two drops of constant mass. The effect of the second drop on mass loss is analyzed by comparing trajectory results with those for two interacting drops, each evaporating at the isolated drop rate. An important application is to raindrop growth. For water droplets in the atmosphere, at drop radii between 10 and 30 μm, drop inertia is important while the Reynolds based on the surrounding air is still small.

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