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The lifetime of evaporating dense sprays ALOIS DE RIVAS, EMMANUEL VILLERMAUX, Aix-Marseille University — We study the processes by which a set of nearby liquid droplets (a spray) evaporates in a gas phase whose relative humidity (vapor concentration) is controlled at will. A dense spray of micron-sized water droplets is formed in air by a pneumatic atomizer and conveyed through a nozzle in a closed chamber whose vapor concentration has been pre-set to a controlled value. The resulting plume extension depends on the relative humidity of the diluting medium. When the spray plume is straight and laminar, droplets evaporate at its edge where the vapor is saturated, and diffuses through a boundary layer developing around the plume. We quantify the shape and length of the plume as a function of the injecting, vapor diffusion, thermodynamic and environment parameters. For higher injection Reynolds numbers, standard shear instabilities distort the plume into stretched lamellae, thus enhancing the diffusion of vapor from their boundary towards the diluting medium. These lamellae vanish in a finite time depending on the intensity of the stretching, and relative humidity of the environment, with a lifetime diverging close to the equilibrium limit, when the plume develops in an medium saturated in vapor. The dependences are described quantitatively.

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