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The evaporation of dense sprays as a mixing process ALOIS DE RIVAS, EMMANUEL VILLERMAUX, Aix-Marseille Université, France — A dense spray of micron-sized droplets (water or ethanol) is formed in air by a pneumatic atomizer in a closed chamber, and is then conveyed through a nozzle in ambient air, forming a plume whose extension depends on the relative humidity of the diluting medium. We focus on the dry ambient medium, and large plume Reynolds number limit. Standard shear instabilities develop at the plume edge, forming the stretched lamellar structures familiar with passive scalars, except that these vanish in a finite time, because individual droplets evaporate at their border. Experiments also demonstrate that the lifetime of an individual droplet embedded in a lamellae is much larger than expected from the usual d-square law for an isolated droplet. By analogy with the way mixing times are understood from the convection-diffusion equation for passive scalars, we show that the lifetime of a lamellae stretched at a rate γ is $t_v = \frac{1}{\gamma} \ln\left(\frac{1+\phi}{\phi}\right)$ where ϕ is a parameter which incorporates the thermodynamic and diffusional properties of the vapor in the diluting phase. The droplets field thus behaves as a -non conserved- passive scalar.

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