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Exhalations and evaporation EMMANUEL VILLERMAUX, Aix-Marseille University, LYDIA BOUROUIBA, MIT — Exhalations are impulsive emissions of a gas phase - air from the lungs - laden with a payload of liquid that originates from the respiratory tract. This mixture is emitted in the form of a turbulent droplet-laden puff cloud. Here we consider emissions in a quiescent environment, in which the expansion rate of the cloud is known, associated with entrainment of ambient air. It is commonly assumed that the evaporation physics of such respiratory droplets is governed by the *d-squared* law describing the fate of a single drop evaporating in a quiescent environment, rooted in the assumption of homogeneity of the multiphase cloud. Yet, our direct experimental observations and in situ measurements of such clouds, show that this law does not in fact govern the evaporation of the droplets in exhaled multiphase clouds. Combining these observations with analog experiments and theory, we derive insights and predictions of the lifetime of the droplets and discuss how the coupling between the saturated vapor field and its heterogeneity in the turbulent cloud has substantial implications for the lifetime of the droplets within it. We discuss the implications in the context of respiratory disease transmission relevant to human exhalations like breathing, sneezing or coughing.

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