Abstract Submitted
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Drop Spreading with Random Viscosity[1] FENG XU, OLIVER JENSEN, The University of Manchester — Airway mucus acts as a barrier to protect the lung. However as a biological material, its physical properties are known imperfectly and can be spatially heterogeneous. In this study we assess the impact of these uncertainties on the rate of spreading of a drop (representing an inhaled aerosol) over a mucus film. We model the film as Newtonian, having a viscosity that depends linearly on the concentration of a passive solute (a crude proxy for mucin proteins). Given an initial random solute (and hence viscosity) distribution, described as a Gaussian random field with a given correlation structure, we seek to quantify the uncertainties in outcomes as the drop spreads. Using lubrication theory, we describe the spreading of the drop in terms of a system of coupled nonlinear PDEs governing the evolution of film height and the vertically-averaged solute concentration. We perform Monte Carlo simulations to predict the variability in the drop centre location and width (1D) or area (2D). We show how simulation results are well described (at much lower computational cost) by a low-order model using a weak disorder expansion. Our results show for example how variability in the drop location is a non-monotonic function of the solute correlation length increases.

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