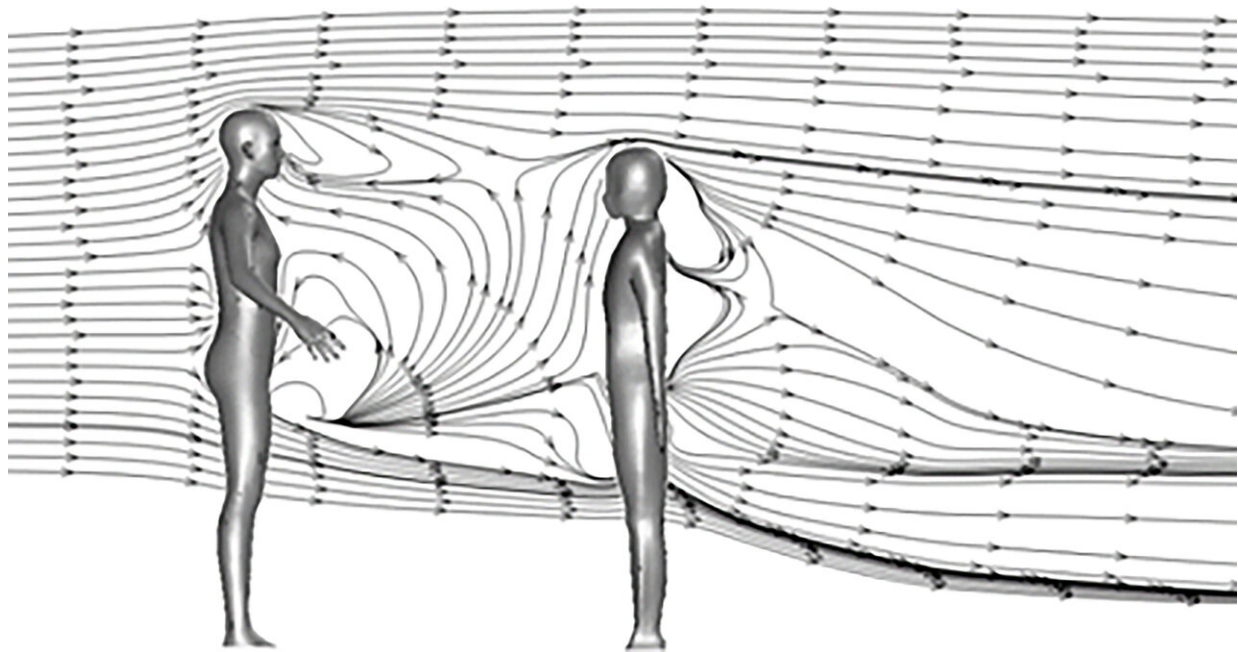# Tracking flight trajectory of evaporating cough droplets

November 3 2020

Recirculating flows, namely wakes, are observed both in the front of the cougher (left) and at the back of the listener (right). A droplet may be entrained and trapped in the wake, significantly altering its trajectory and fate. Credit: A*STAR Institute of High Performance Computing

The ongoing COVID-19 pandemic has led many researchers to study airborne droplet transmission in different conditions and environments. The latest studies are starting to incorporate important aspects of fluid

physics to deepen our understanding of viral transmission.

In a new paper in *Physics of Fluids*, researchers from A*STAR's Institute of High Performance Computing conducted a numerical study on droplet dispersion using high fidelity air flow simulation. The scientists found a single 100-micrometer cough droplet under [wind speed](#) of 2 meters per second can travel up to 6.6 meters and even further under dry air conditions due to droplet evaporation.

"In addition to wearing a mask, we found social distancing to be generally effective, as droplet deposition is shown to be reduced on a person who is at least 1 meter from the cough," said author Fong Yew Leong.

The researchers used computational tools to solve complex mathematical formulations representing air flow and the airborne cough droplets around [human bodies](#) at various wind speeds and when impacted by other environmental factors. They also assessed the deposition profile on a person at a certain proximity.

A typical cough emits thousands of droplets across a wide size range. The scientists found large droplets settled on the ground quickly due to gravity but could be projected 1 meter by the [cough](#) jet even without wind. Medium-sized droplets could evaporate into smaller droplets, which are lighter and more easily borne by the wind, and these traveled further.
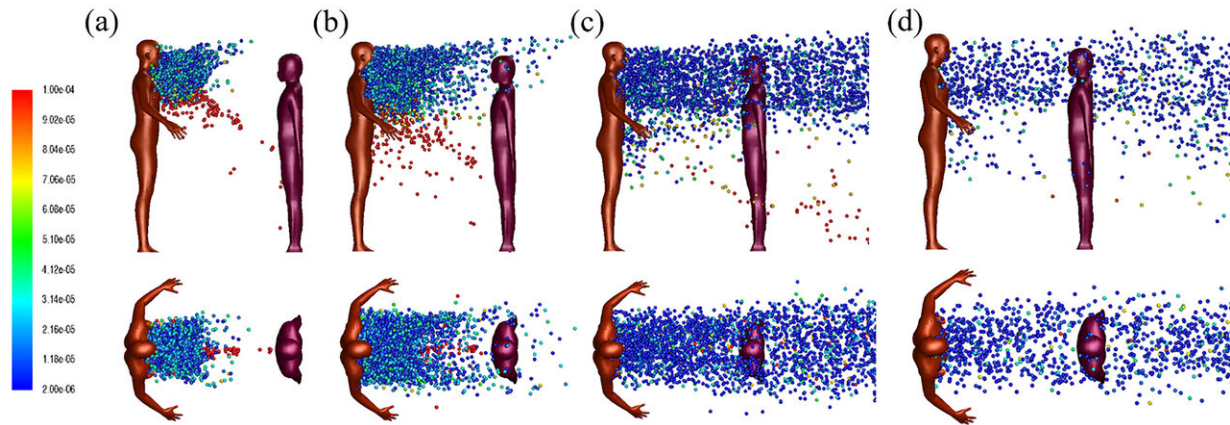
Droplet dispersion (side, top-down views) from a single cough for two people spaced 1 m apart at (a) t = 0.52s, (b) t = 1s, (c) t = 3s and (d) t = 5s. Credit: A*STAR Institute of High Performance Computing

The researchers offer a more detailed picture of droplet dispersion as they incorporated the biological considerations of the virus, such as the nonvolatile content in droplet evaporation, into the modelling of the airborne dispersion of droplets.

"An evaporating droplet retains the nonvolatile viral content, so the viral loading is effectively increased," said author Hongying Li. "This means that evaporated droplets that become aerosols are more susceptible to be inhaled deep into the lung, which causes infection lower down the respiratory tract, than larger unevaporated droplets."

These findings are also greatly dependent on the environmental conditions, such as wind speed, humidity levels, and ambient air temperature, and based on assumptions made from existing scientific literature on the viability of the COVID-19 virus.

While this research focused on outdoor airborne transmission in a

tropical context, the scientists plan to apply their findings to assess risk in indoor and outdoor settings where crowds gather, such as conference halls or amphitheaters. The research could also be applied to designing environments that optimize comfort and safety, such as hospital rooms that account for indoor airflow and airborne pathogen transmission.

  More information: "Dispersion of evaporating cough droplets in tropical outdoor environment," *Physics of Fluids* (2020). aip.scitation.org/doi/10.1063/5.0026360

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