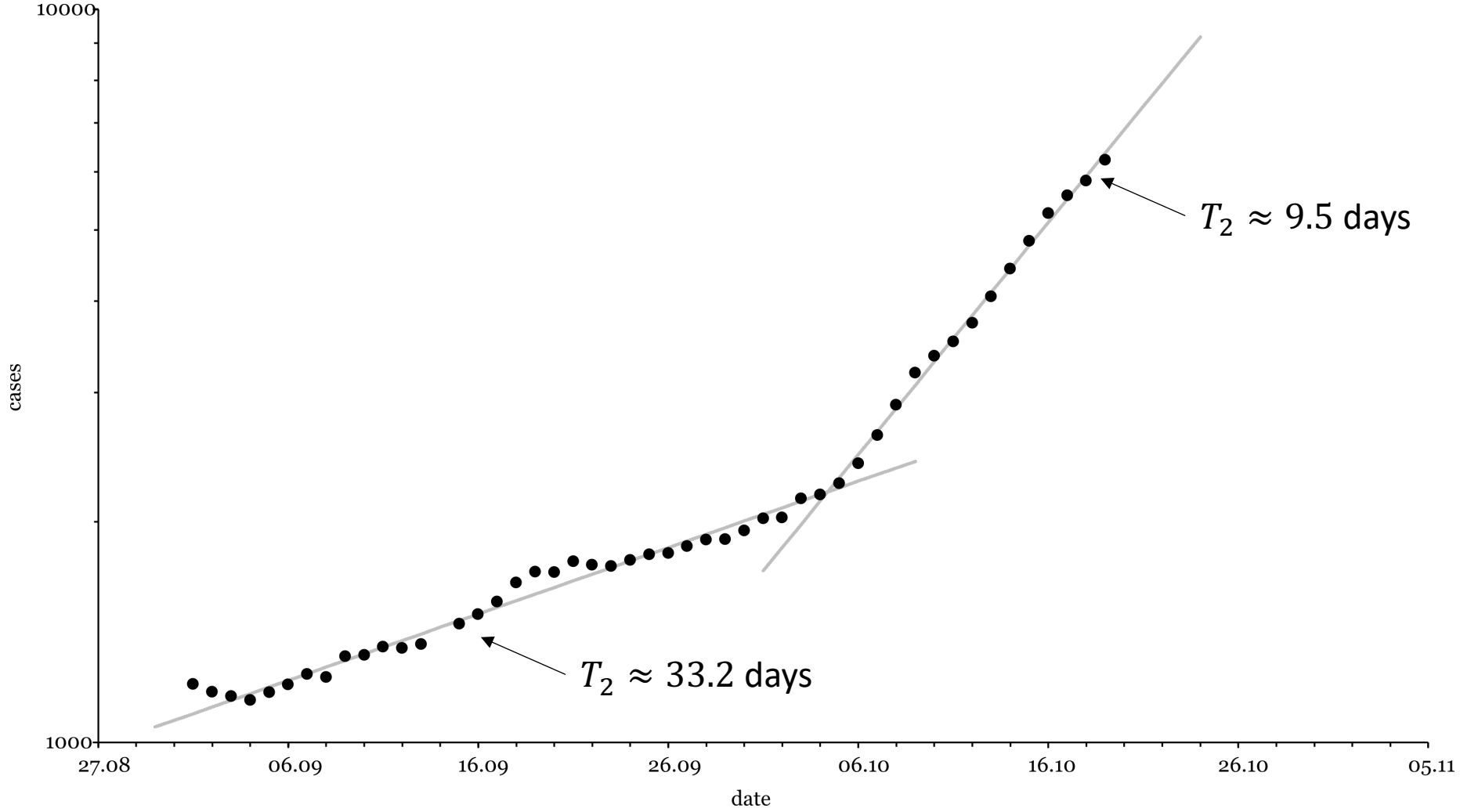
COVID & humidity

Can the rise of cases be related to lower humidity?

Olaf Dreyer | Frankfurt, 2020-10-26

Rising number of cases

In the beginning of October the number of cases in Germany rose rapidly



Reason

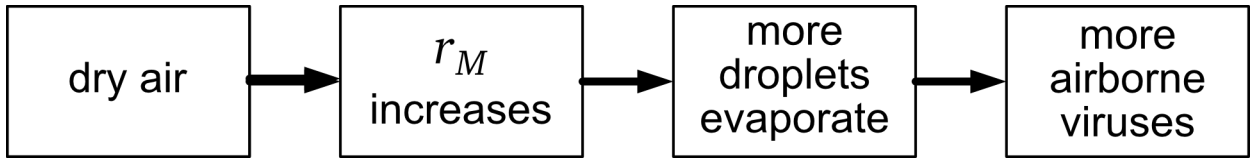
Conjecture: the increase is correlated with the increased use of indoor heating

Is this causal chain responsible for the increase?

That this chain is a possibility is related to the **coincidence of two length scales**:

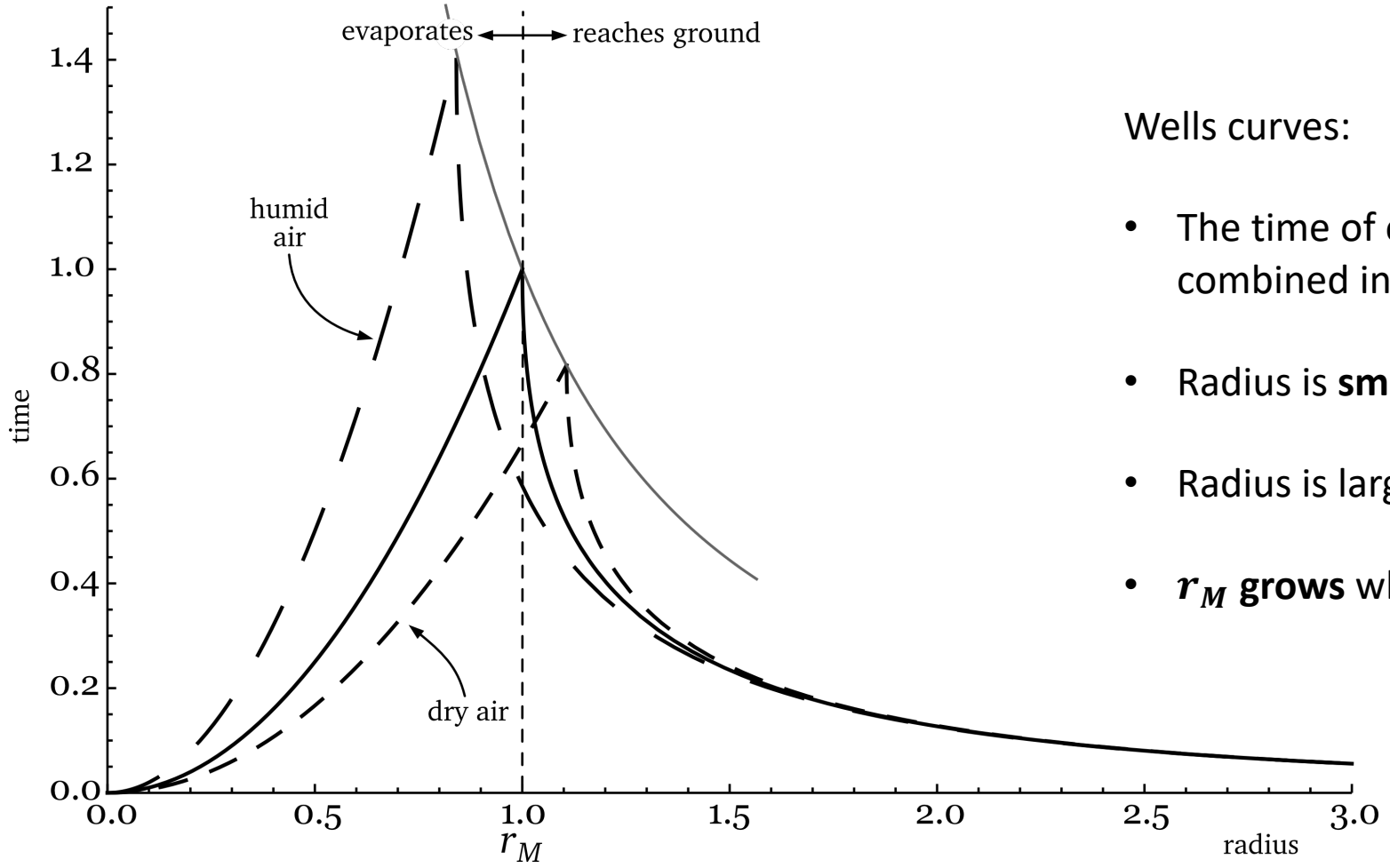
- The typical radius $\boldsymbol{r\_d}$ of a droplet exhaled by a human.
- The radius $\boldsymbol{r\_M}$ of a droplet that completely evaporates just as it hits the ground.

The radius $\boldsymbol{r\_M}$ depends on the humidity:



Falling droplets

Two outcomes: **Evaporation** or **fall to the ground**

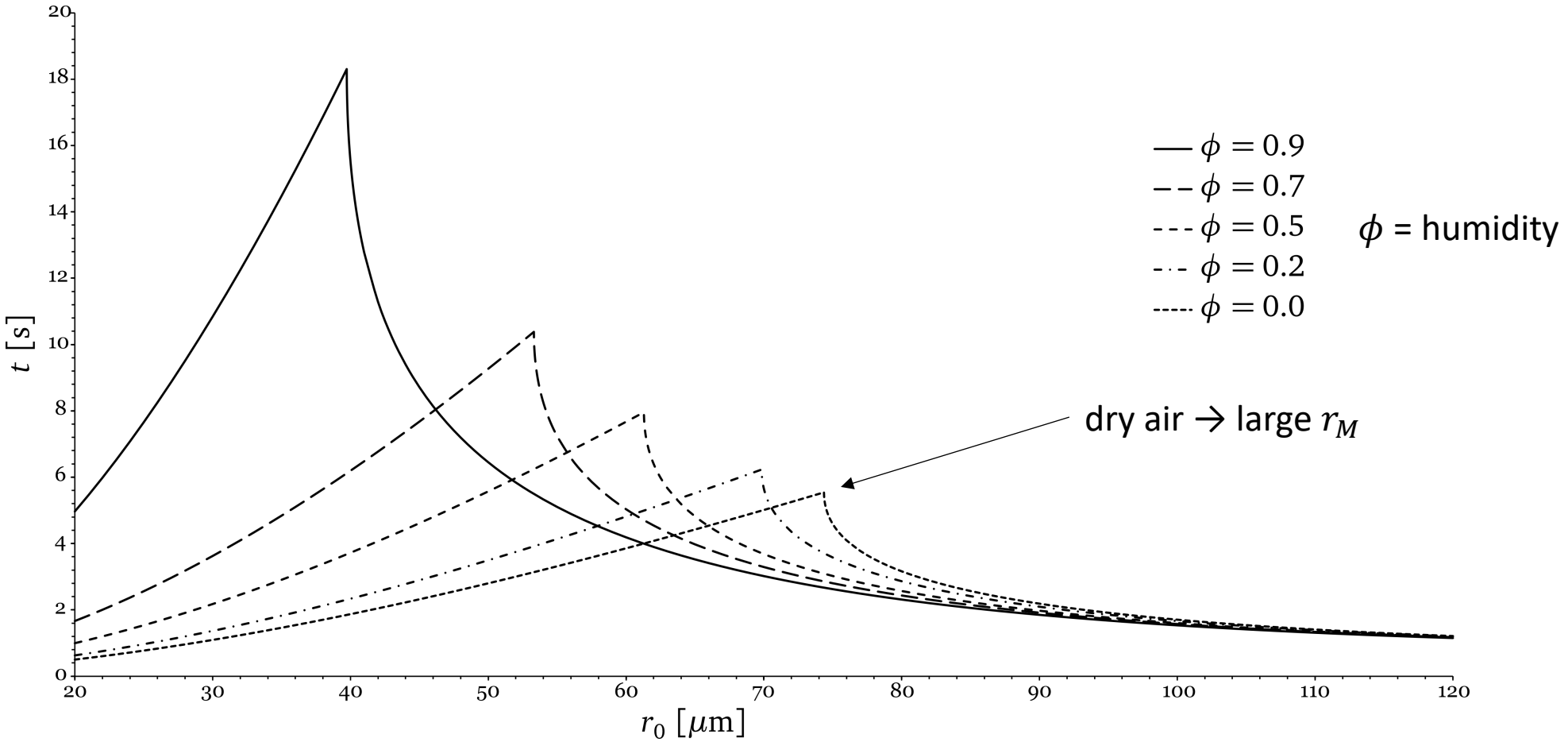


Wells curves:

- The time of **evaporation** and the **time of fall** combined in one figure.
- Radius is **smaller** than $\boldsymbol{r_M}$: **evaporation**.
- Radius is larger than $\boldsymbol{r_M}$: **fall to the ground.**
- $\boldsymbol{r_M}$ **grows** when the humidity **drops**.

Results of the calculation

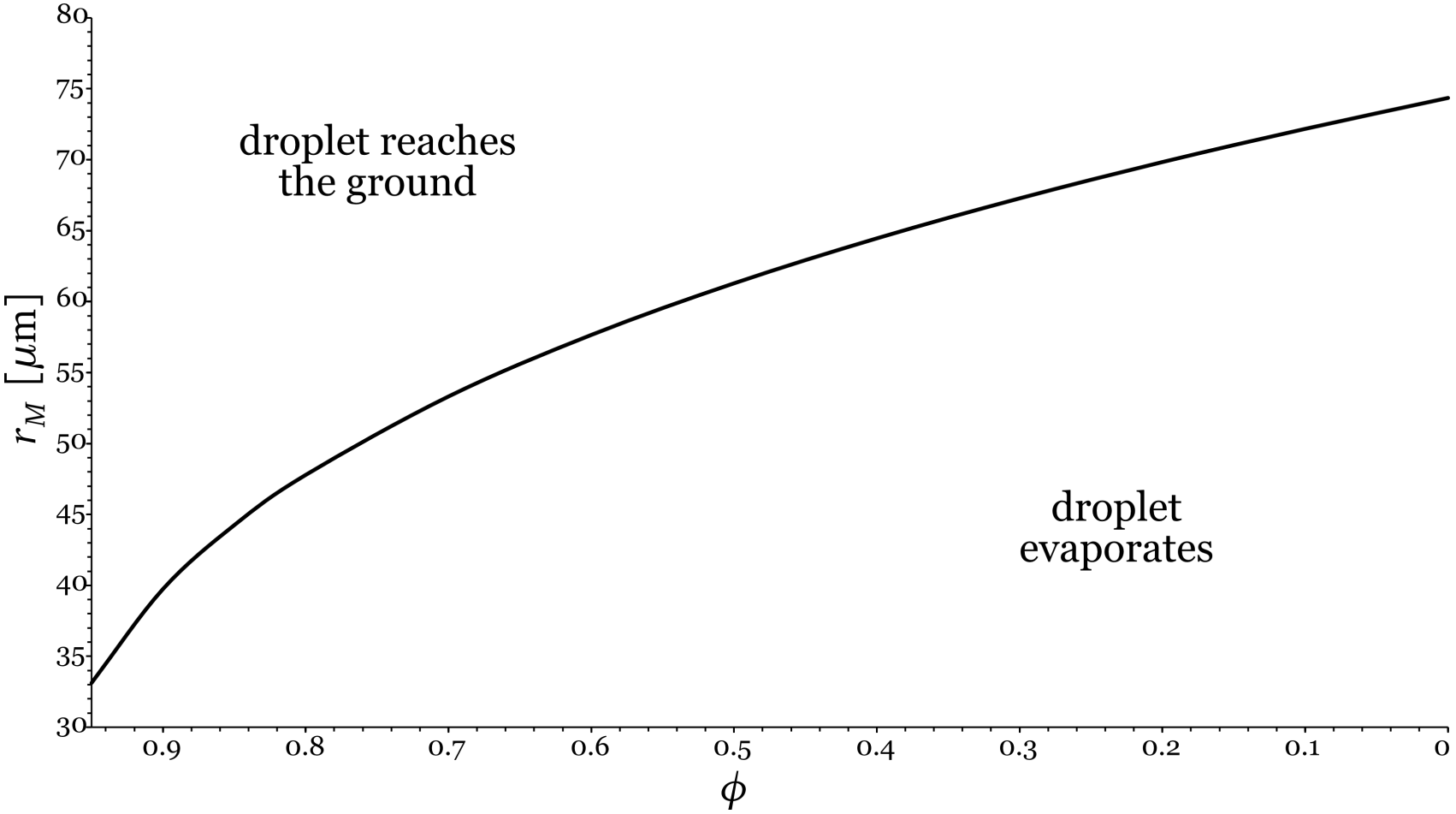
The calculation follows Kukkonen et al. (see note)



The JAVA code for this calculation is available at https://github.com/olafdreyer/covid

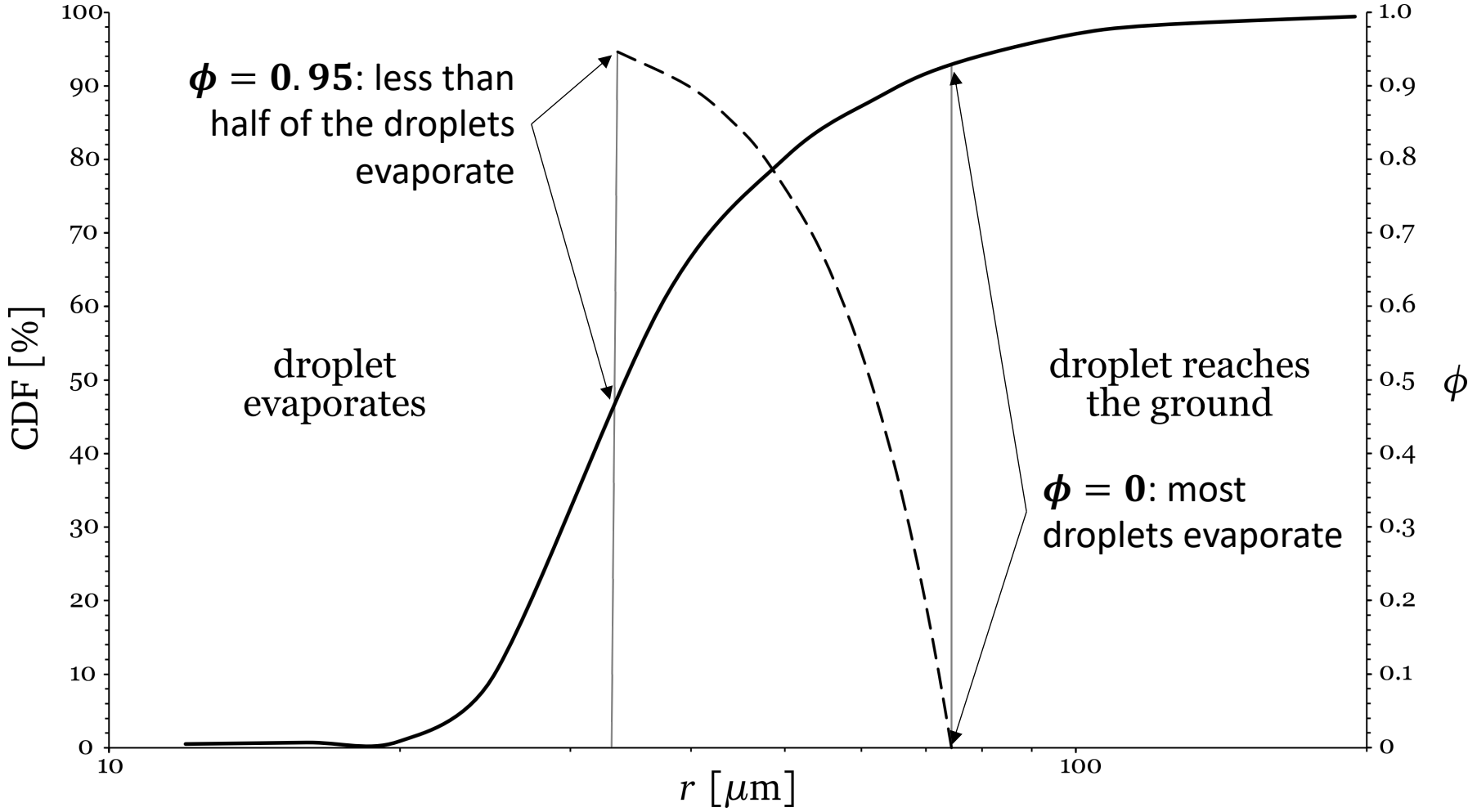
The radius r_M as a function of humidity

Lower humidity corresponds to more evaporation



Comparison with the size of droplets exhaled by humans

The values for r_M overlap strongly with the radii of droplets exhaled by humans



CDF = cumulative distribution function

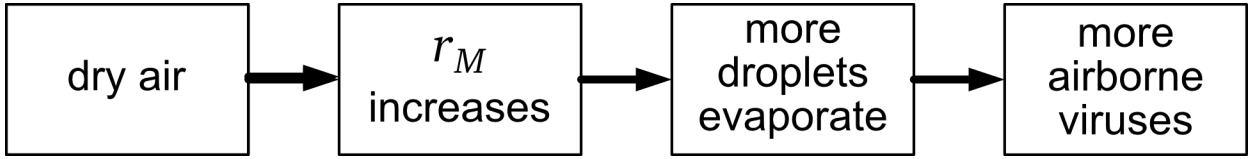
Results by Xie et al. (see note)

Conclusion

The arrival of fall might have changed the effectiveness of COVID countermeasures

We have argued that this causal chain is **plausible**:

The **simulation** of the evaporation process and the fall of a droplet shows:



This is possible because $\boldsymbol{r_M}$ and $\boldsymbol{r_d}$ are roughly equal.

What can be done?

- use of **humidifiers**
- Frequent **ventilation** of indoor spaces
- **avoidance** of indoor spaces (**2nd lockdown**)
- **masks**

Peronal information

I am a **physicist** and **mathematician**. I have a Ph.D. in theoretical physics from the Pennsylvania State University and have worked for many years as a postdoctoral fellow in **quantum gravity**.

For six years now I am working as a quantitative analyst in Frankfurt, Germany. I am advising banks on how to implement models of financial markets. My focus is on the risk management side of a bank.

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