

Microbiological Influence on Atmospheric Dynamics



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Biocomplexity

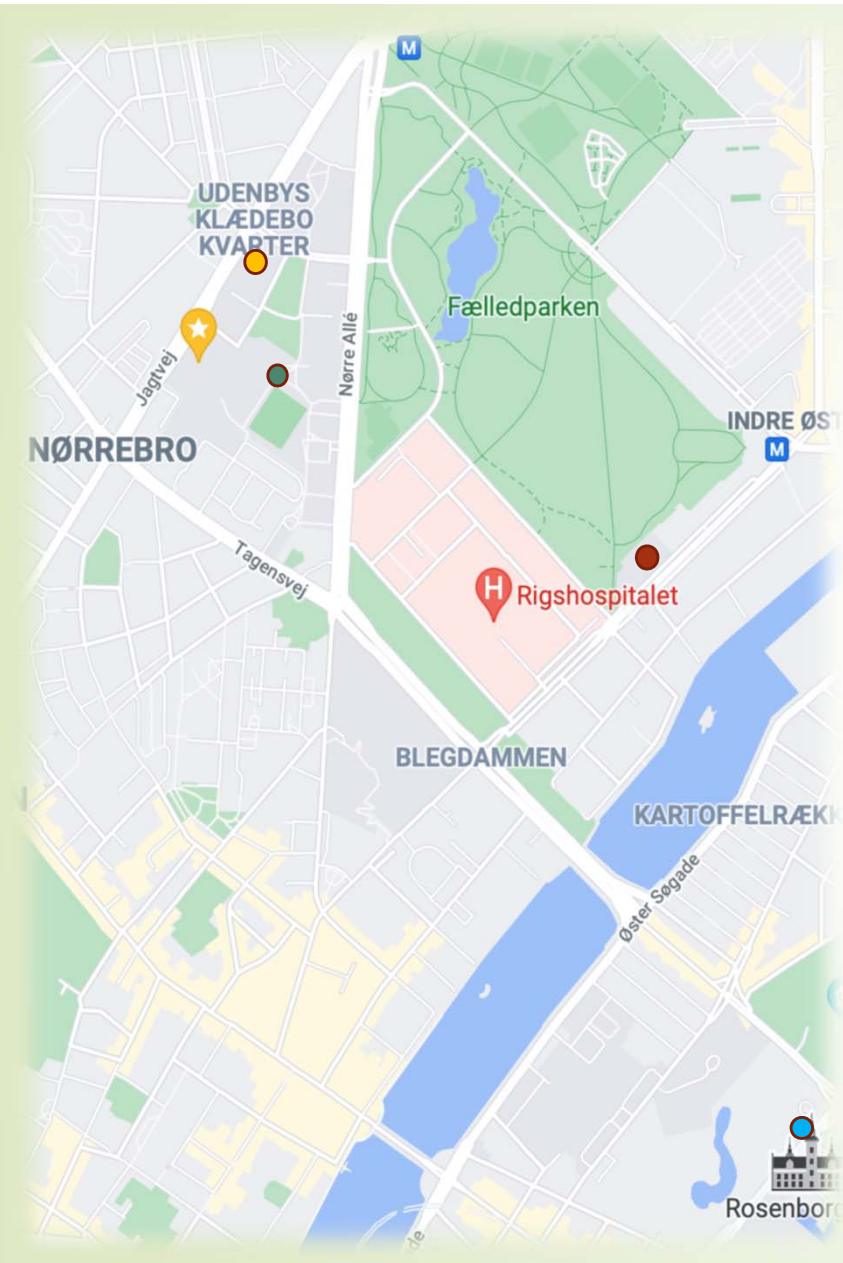
Niels Bohr Institute, Blegdamsvej 17



Background

- ▶ Bachelor's degree in Physics – Barcelona (Spain)
- ▶ Master's degree in Physics, Biophysics – Copenhagen (Denmark)

... just diving into astrobiology



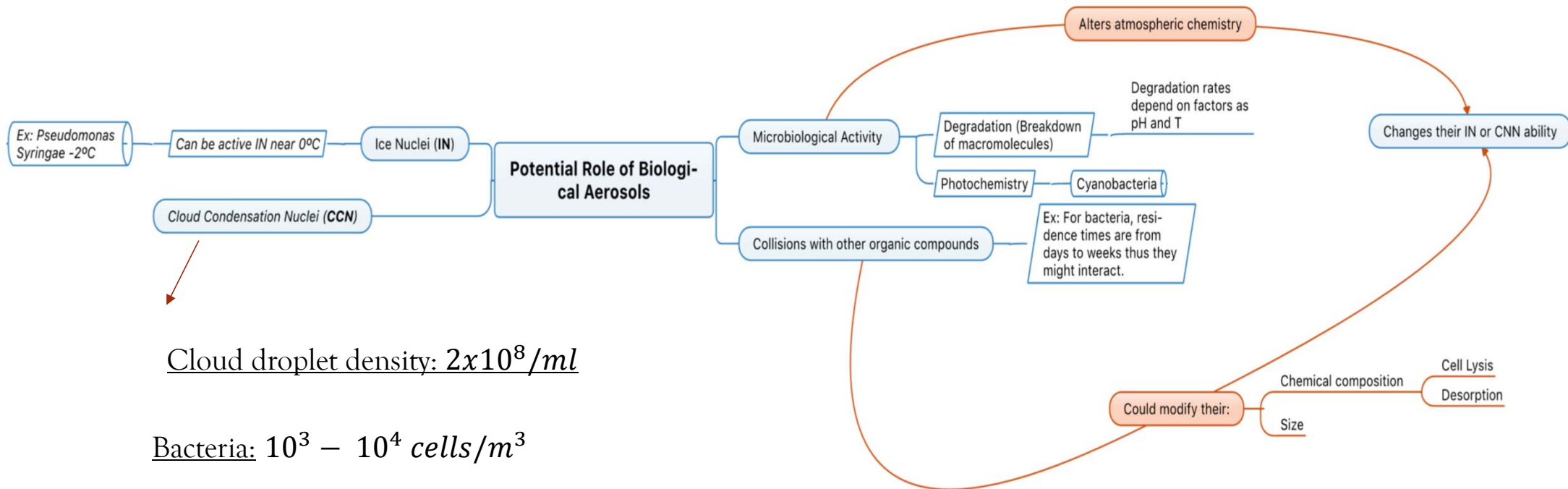
Where are we (Biocomplexity)

- Microbiology
- Biocomplexity
- Chemistry
- Astrophysics and Planetary Science



“PhD 4” - “Micro-biological influence on atmospheric dynamics”

Some ideas - Roles of Biological Aerosols



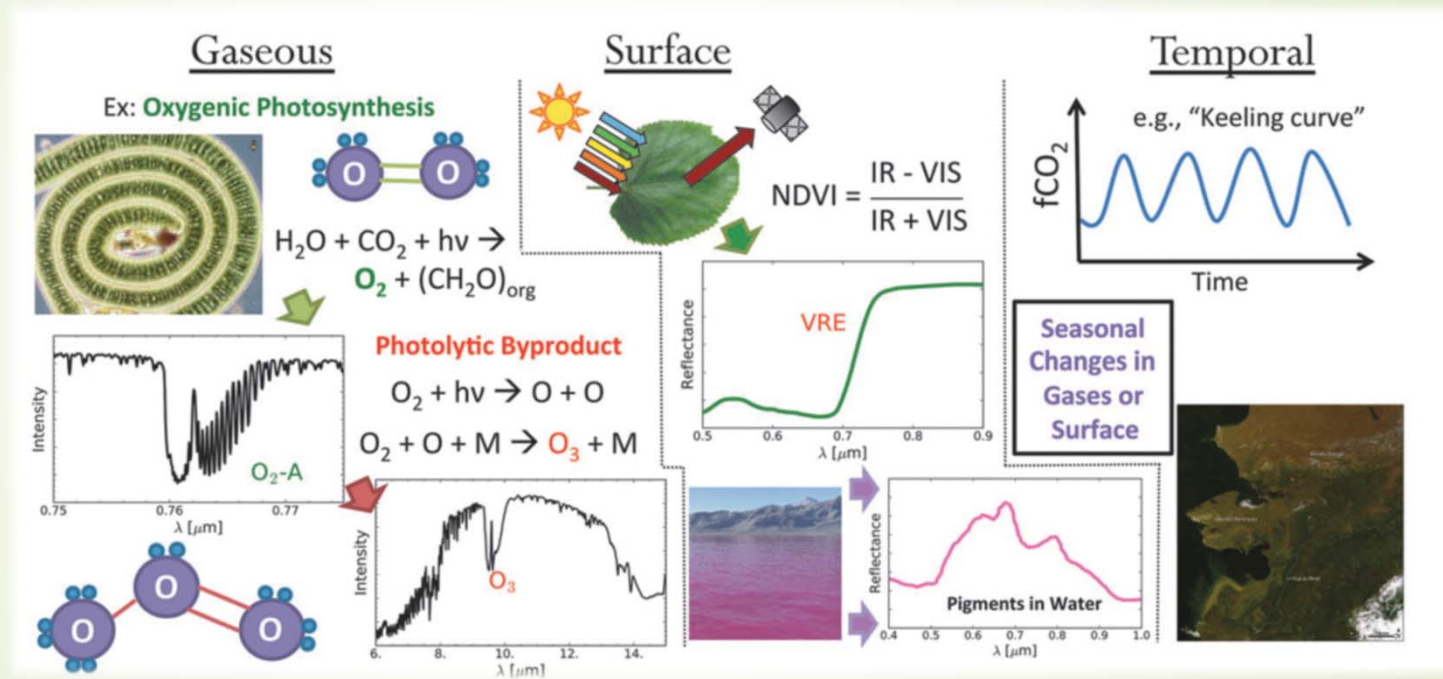
Cloud droplet density: $2 \times 10^8 / \text{ml}$

Bacteria: $10^3 - 10^4 \text{ cells}/\text{m}^3$

Every branch yields different cloud formation scenarios / potentially influences cloud dynamics.

- Dead, dormant or actively reproducing
- Model atmosphere as playground
- Ideally → Narrow down phenomenology and translate it into biosignatures

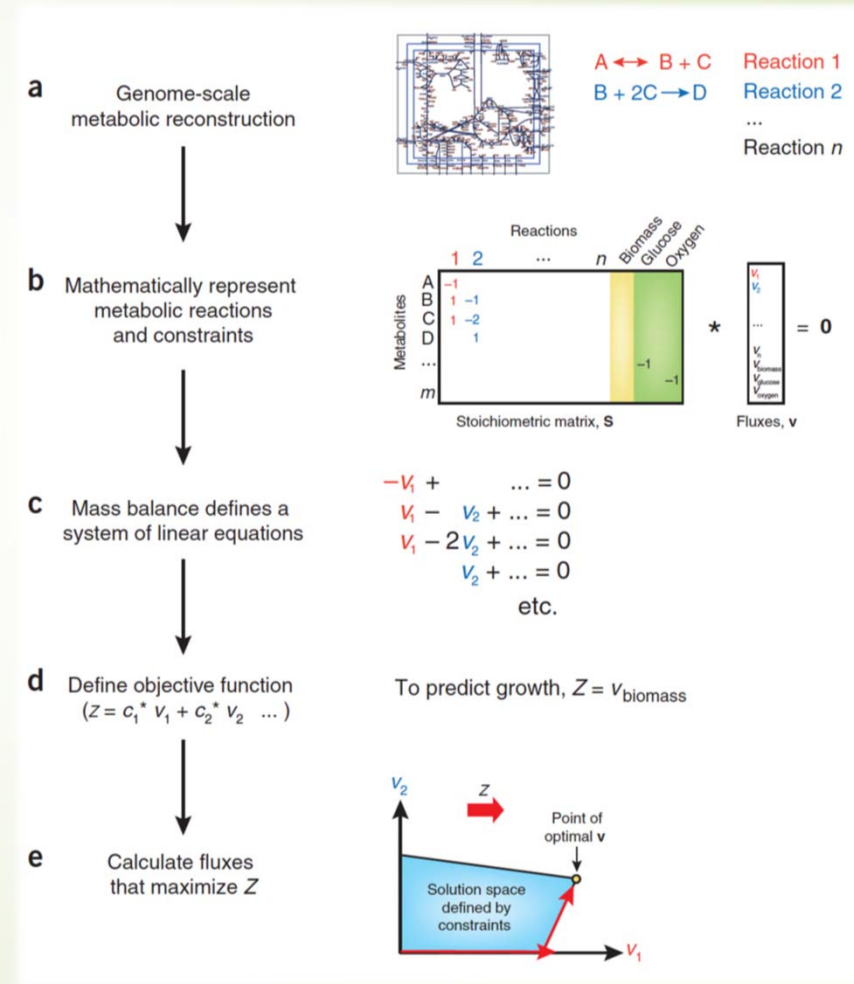
Ex:




Some ideas - Flux Balance Analysis - Metabolic network reconstruction

- Simulate Microorganism Metabolism
- Implement in a dynamical model → See what comes out in simple scenarios

Could use it to predict the growth rate as a function of some boundary conditions.





However ... bacteria are unlikely to encounter “good” growth conditions outside batch cultures found in laboratories. This becomes evident by noticing that a single E.coli cell, if growing in the exponential phase, would grow to a population equivalent to the mass of the Earth within 2 days, a statement that obviously disagrees with both common sense, and the estimated $(4-6) \times 10^{30}$ prokaryotes on Earth.

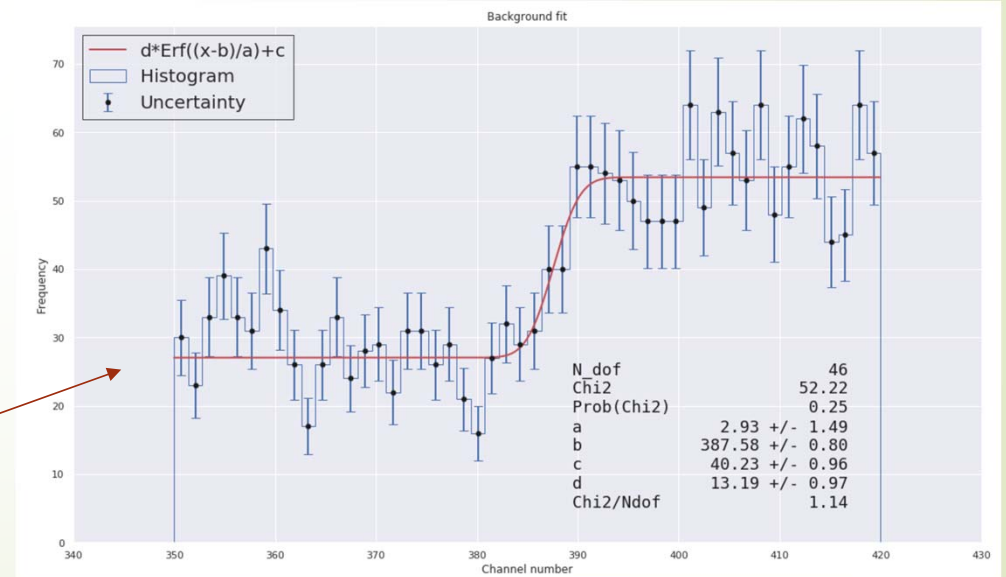
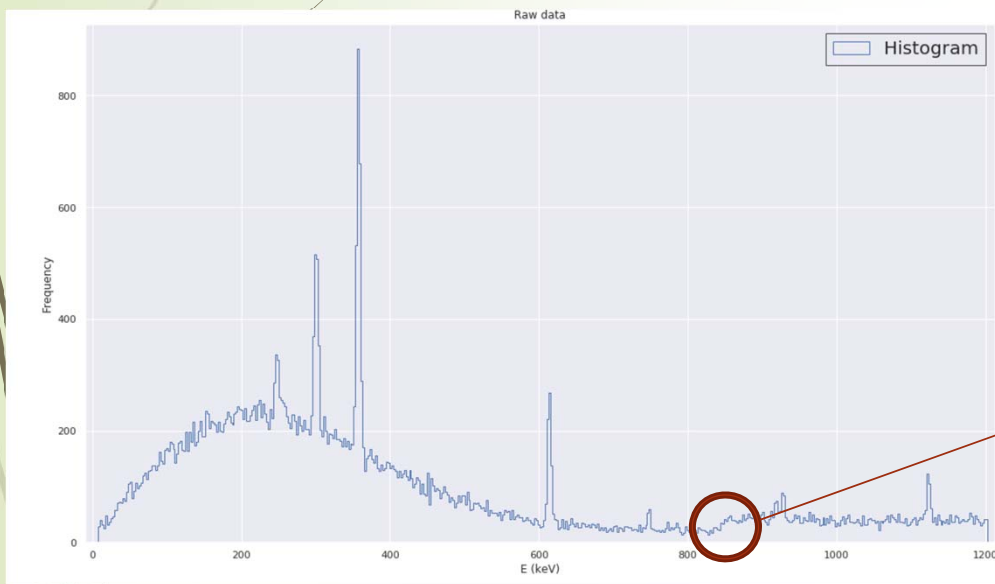
► **On Earth:**

- Viral abundance correlates with microbial presence – 5-10 VLPS per bacteria.
- Estimated to kill 4-50% of the bacteria produced every day.

Does it make sense to
study bacteria alone?

Some ideas – Significance of peaks – Simulate Experimental Noise

- Simulate James Webb Telescope experimental noise
- Establish some lower limit for the significance of peaks





Thanks!

