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Observational implications on the presence of selected bioaerosols in exoplanetary atmospheres

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On Earth, atmospheric instabilities drive the aerosolization of distinct microorganisms directly from the biosphere. Particle diameters of these (bio)aerosols typically range from □1nm to □100μm, and their residence times in the atmosphere have been suggested to range from a few days to weeks or even months. Found even beyond the troposphere, they have been shown to, in some cases, be metabolically active as well as involved in cloud processing mechanisms, depending on their surface properties, by acting as cloud condensation nuclei (CCN) or ice nuclei (IN), and thus effectively changing cloud life time and optical properties via a change in the droplet size distribution within the cloud.

Even though the immediate sample we can observe from the Solar System already suggests a wide variety of planetary climates and that any particular planetary atmosphere exhibits a high degree of complexity, it is reasonable to assume that a finite set of physical and chemical processes are the major agents governing the climate. One of these processes is the phase change of volatiles in the atmosphere and its inhomogeneous impact on the radiation budget of the planet, altering the radiatively-induced temperature gradients and thus the general circulation of the atmosphere.

With the help of a Global Climate Model (GCM), we will study the radiative forcing caused by selected bioaerosols, under different hypothesized behaviours, in a simplified model atmosphere representing a plausible exoplanetary environment. In the end, a synthetic spectrum will be generated and compared to a “bioaerosol-free” sample in search for discrepancies that might, or not, be regarded as biosignatures. Furthermore, with the launch of the James Webb space telescope towards L2 we shall have access to new empirical data of exoplanetary atmospheres that constitute the ideal playground for this way of hypothesis testing.