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Sporulation and Germination patterns – hedging a bet on long term microbial survivability in dry soil

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Soil hosts unparalleled diversity of microbial life that is constantly challenged by the vagaries of fluctuating ambient conditions. Desiccation stresses play a key role not only by directly affecting individual bacterial cells, but also by shaping diffusion pathways and cell dispersion. The gradual thinning and fragmentation of the aqueous environment during drying have led to different survival mechanisms including dormancy and sporulation, resulting in a highly resistive state capable of surviving extreme and prolonged environmental stresses until conditions improve in the future. Our aim is to investigate how temporal changes in hydration status shape microbial communities over time, based on simple survival strategy rules for each individual bacterium. The two survival strategies considered are dormancy and sporulation. Dormancy is the state in which bacterial cells significantly reduce their metabolism with minor morphological adaptations. The required energy and time for attaining this state are low relative to sporulation costs. Sporulation involves several morphological and biochemical changes that result in a resistive capsule that endures extreme stresses over long periods of time. The working hypothesis is that different micro-ecological conditions and community compositions would result from temporal patterns and magnitude of desiccation stresses. An Individual Based Model (IBM) considering habitats on rough soil surfaces and local effects of micro-hydrological conditions on dispersion and nutrient diffusion would enable systematic study of emerging communities over extended periods. Different population compositions are expected to emerge based on low and high frequency, duration and amplitudes of wetting-drying cycles reflecting relative success or failure of survival strategy.