Geophysical Research Abstracts
Vol. 20, EGU2018-9643-1, 2018
EGU General Assembly 2018

The influence of sub-surface flow on microbial horizontal gene transfer

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The soil-bacteria interaction is fundamental for many terrestrial ecosystems processes such as denitrification, weathering and antimicrobial resistance. Indeed, the physical structure of soil changes across distances of a few micrometers creating a multitude of microenvironments where abundant bacterial species thrive under fluctuating conditions. Some of these bacteria, called competent bacteria, have the ability to uptake free DNA from their environment and to express it, a mechanism of gene transfer known as natural transformation. This is a form of horizontal gene transfer in opposition to vertical gene transfer which is the transmission of genes between a bacteria and its descendants. Thus in certain case they may acquire new genetic traits that can help them to adapt to changing environmental conditions. In the environment, this evolutionary process is usually observed in the long term.

Here we investigate the influence played on these transformation rates by flow heterogeneity as the latter is a critical component for most of the soils and may contribute to the dispersion of free DNA. We combined microfluidic devices with fluorescent optical microscopy to observe the events of transformation. Then numerical treatment of images was applied to render the efficiency of the transformation under different flow conditions. This method is very promising to study this critical process source of biodiversity with naturally competent bacteria species involved in soil key processes.