6 months Master Internship 2020

Interaction bacteria – viruses in soil: Response to soil water content and consequences on soil organic carbon dynamic

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Summary (up to 300 words) :
Viral ecology in soil is still poorly documented while viruses are key entities regulating bacterial dynamics and soil biogeochemical cycles. Phages exert both top-down and bottom-up controls on soil bacteria through lysis of their host and release of dissolved organic matter that is available for the remaining microbial communities. Moreover, viruses constitute a reservoir of genetic information and are likely to participate in bacterial evolutionary trajectories through horizontal gene transfer.
In soils, phage - bacteria interactions take place within the pore spaces and are controlled by soil properties and especially soil water content that drives spatial isolation between phages and their hosts. The objective of this internship is to determine to what extent the viral-mediated bacterial loop controls the dynamic of soil organic matter and how it might be regulated by changes in soil water content. First, an existing protocol will be optimized in order to extract and quantify viruses from soil samples. Then, the effect of soil water content on virus – bacteria interactions and the consequences on soil organic matter dynamic will be studied using an experiment in controlled conditions. Sterile soil samples inoculated with either their bacterial or viral communities or both will be incubated at different water contents. At different times during the incubation, bacterial and viral abundances will be determined by flow cytometry simultaneously to soil organic matter content and composition, and carbon gases emissions (CO_2, CH_4 and VOCs). DNA and RNA will be coextracted from the same soil samples for further virome and bacterial-based molecular analyses. Finally, field work will be initiated on the Ploemeur site in Brittany, France (https://deims.org/731f3ced-148d-4eb5-aa46-870fa22be713) in order quantify bacteria and viruses from soil according to the water-table height simultaneously to dissolved organic matter contents and composition.

Publications on the field of research :

Ballaud, F., Dufresne, A., Francez, A.-J., Colombet, J., Sime-Ngando, T., Quaiser, A., 2016. Dynamics of viral abundance and diversity in a Sphagnum-dominated peatland: temporal fluctuations prevail over habitat. Front. Microbiol. 6, 1494.

Bonetti, G., Trevathan-Tackett, S.M., Carnell, P.E., Macreadie, P.I., 2019. Implication of Viral Infections for Greenhouse Gas Dynamics in Freshwater Wetlands: Challenges and Perspectives. Front. Microbiol. 10. doi:10.3389/fmicb.2019.01962

Kuzyakov, Y., Mason-Jones, K., 2018. Viruses in soil: Nano-scale undead drivers of microbial life, biogeochemical turnover and ecosystem functions. Soil Biol. Biochem. 127, 305–317.

Williamson, K.E., Fuhrmann, J.J., Wommack, K.E., Radosevich, M., 2017. Viruses in Soil Ecosystems: An Unknown Quantity Within an Unexplored Territory. Annu. Rev. Virol. 4, 201–219.