Gradient of bioaerosol impaction/deposition defined by biomimetic passive sensors

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Keywords: sensor, deposition, bioaerosol, qPCR.
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Bioaerosols by their biological nature are potential vectors of pathogens, toxins and thus have a health impact on residents and workers. They also have an ecological and economic impact in the case, for example, of contamination of farm sites and production of fish, crustaceans, shellfish and microalgae.

Currently used bioaerosol sensors are volumetric sensors 'instantaneous' (short periods of time). These sensors cannot take into account the multiple settings that change the dispersion and determine the impacted area. These parameters are variations in the level of emissions, weather conditions (sunshine, temperature, humidity, etc.) and the topography of the site. In the absence of tools, the areas impacted and the level of impact by bioaerosol emission sources are not currently mappable and therefore mapped. To overcome these limitations, we developed the concept of passive sensors for the environmental monitoring of bioaerosols.

On a first trail, we used pine needles as collection surface of bioaerosols released by a composting plant located in the South of France. We quantified the microbial compost indicator *Saccharopolyspora rectivirgula* (LeGoff, 2010). Samples were collected at distances ranging from 100 m to 4000 m around the composting plant. 16S rDNA abundance from *S. rectivirgula* and the total bacteria were measured by qPCR to indicate the impact of composting plant bioaerosol. The abundance of 16S rDNA of *S. rectivirgula* varies from 10^2 to 10^4 copies by g of *P. halepensis* needles (Fig. 1).

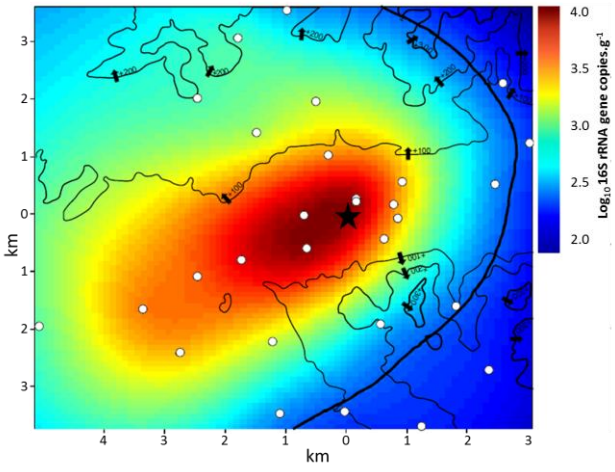

Figure 1: Map corresponding to predicted bioindicator concentration in 16S rRNA gene copies.g^{-1} of pine needles. White spots correspond to sampled trees. Narrow and thick black lines correspond to altitude and background level contour lines, respectively. The cross corresponds to the location of the composting plant.

The abundance of *S. rectivirgula* on *P. halepensis* needles were negatively correlated with distance to the point source. Topography and prevalent wind direction had an influence on the dispersion pattern. The abundance of indicator organism has reached the background level at distances ranging from 2 km to more than 5.4 km from the composting plant (Galès, 2014).

As the pines are not available everywhere, a second trail was performed using bottlebrushes to mimic pine needles. Bottlebrushes located close to a bioaerosol emission source (microalgae pond) collected over time showed an accumulation of bacteria and microalgae (Fig. 2). Accumulation level was similar between leave (indeterminate time) and bottlebrush (up to 20 days).

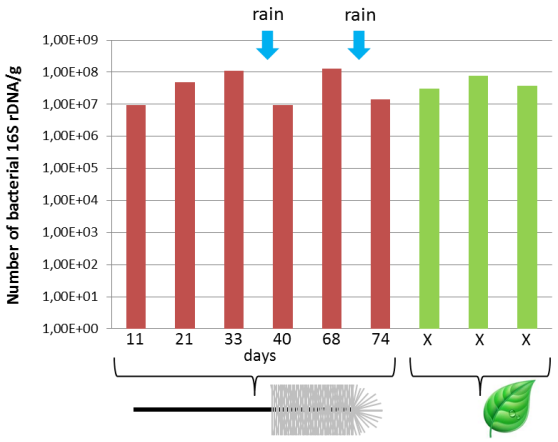

Figure 2: accumulation of bacteria over time on bottlebrushes and leaves around a microalgae pond.

Thus, nowadays we have the tools necessary to draw a map of the areas impacted by any source of bioaerosols. To do that we need (i) the analysis plan (relevant distance between the source and the sensor), (ii) a sensor (bottlebrushes), (iii) a specific microbial indicator (depending of the bioaerosol source), (iv) a qPCR measuring system (depending of the indicator).

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