Planetary Protection: Identifying Microbes with potential for Contamination using Data Science

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Introduction: Sterlizing spacecraft completely is nearly impossible. Any hitchhiking microbes that will not survive the harsh conditions of space flight are not of much concern. But if there are species that could potentially survive, and ultimately reproduce at the destination, that poses two issues: (1) we have contaminated an alien, possibly pristine surface, and (2) if there is alien life, we may have no way of separating it from the one we carried there ourselves. In fact, one of NASA's prime objectives is the minimization of forward contamination of spacecraft surfaces by Earth organisms. To address that we have created *checkContamination*, a prototype tool that can determining the presence of potentially contaminating microbes. A scaled version of the tool would likely become a necessary component of all future space missions.

Section-1: We have created a database of a small set of microbes with varied potential of survival and hence contamination, with special reference to planetary protection-relevant microbes like anaerobes, thermophiles, psychrophiles, and radiation-resistant organisms capable of surviving space flight missions. We then created a software tool we call *checkContamination* to determine if input data contain any of the listed species, and what their contamination potential is. Users can provide a threshold of contamination, number of reads etc. as arguments. The tool is currently for terrestrial (laboratory) use and has been tested on data from SAF, ISS etc. The footprint of the tool is small and could easily be incorporated onboard future missions if new samples are to be taken and processed before being passed on to *checkContamination*.

Section-2: We further describe plans to extend this set to a much larger one by creating methods that allow scaling the dataset with the use of machine learning methods. For gappy data similarity measures will be used and appropriate error margins provided for both conservative and aggressive determinations of contamination potential.

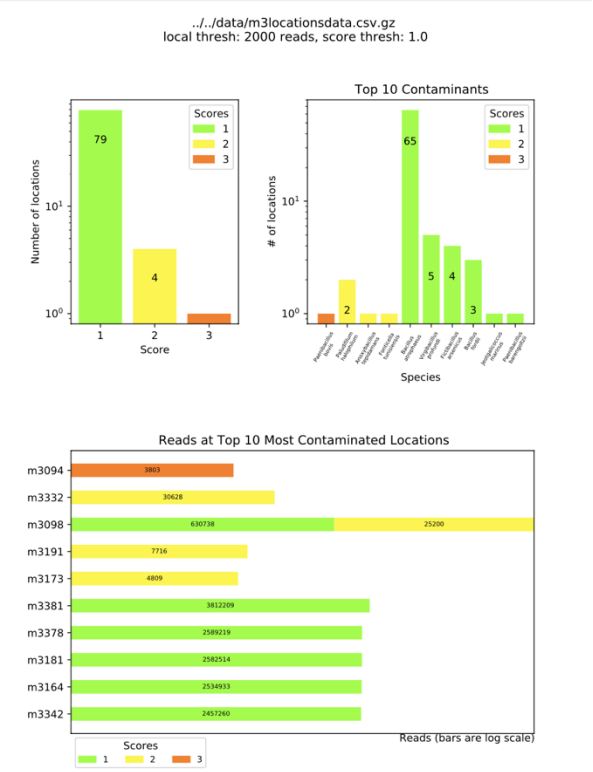

Fig 1: Graphical output from *checkContamination*

Conclusion: Forward contamination of spacecraft by Earth microbes can be mitigated using a scaled version of *checkContamination*.

References:

[1] GitHub will be public before conference

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