**University of Leicester**

**Future 50 PhD Scholarship**

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| **Project Reference** | RI EF Williams |

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**Section 2 – *Project Information***

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| **Project Title** | A resilience index for Earth-type biospheres |
| **Project Highlights:** | 1. | Develop a habitability index for Earth’s biosphere |
| 2. | Interrogate models of deep time biotic change |
| 3. | Use your analysis to understand current impacts on the biosphere |
| **Project Summary**  |
| Planet Earth has been continuously habitable for at least 3.5 billion years. During that immense time the Earth has been subject to considerable environmental perturbation, resulting from both intrinsic and extrinsic forces. These range from the small-scale, such as solar radiation changes from orbital forcing mechanisms, to the very large scale, such as an asteroid strike. The biosphere has shown considerable resilience to perturbation and provides the only quantifiable measure of habitability available to us in the Cosmos. Here we seek to relate the ‘energetics’ of environmental change to the degree of change seen in the biosphere, thereby quantifying its likely response to different degrees of perturbation. How might this be quantified? We would focus on a range of key geological events with well-documented records, ranging from smaller-scale episodes of change, such as the Mid Miocene climate optimum (circa 15 million years ago), to much larger environmental perturbations, such as the Great Oxygenation episode (circa 2.4-2.0 billion years ago). Taking these endmembers, one fully reversible, the other irreversible, we would seek to quantify the relative position of a range of more minor to more major biotic events and examine the driving mechanisms of such change. Events of intermediate scale include the Palaeocene-Eocene thermal maximum (55 million years ago), which caused an irreversible change to several components of the biosphere (a minor extinction), and the Permian-Triassic extinction, with the loss of 95% of species diversity. Finally, we would ask the question, do events lie on a continuum from ‘no change’ to ‘wholesale change’, or show diagnostic groupings indicative of a system in various degrees of state shift? We would use this analysis to examine questions of biosphere resilience and establish an index of habitability according to different levels of perturbation. Notably, we would then apply our index to try and understand the likely level of biotic change resulting from current (considerable and human-induced) environmental change in the 21st century. |