Evolution of the Global Terrestrial Habitability during the Last Century

Abel Méndez
Department of Physics and Chemistry
University of Puerto Rico at Arecibo
(abel.mendez@upr.edu)

Climate change will have an impact on life on Earth. The distribution, abundance and diversity of primary producers in land and ocean environments might be altered thus changing the biosphere's capacity to compensate for carbon emissions and recover from climate change. Estimates show that the primary productivity of terrestrial vegetation has increased in the last two decades. The potential for life or our biosphere, its habitability, has been changing as a result of climate change. However, there are no standard frameworks to quantify these habitability changes of our biosphere. Therefore, the main goal of this study is to evaluate the evolution of the global terrestrial habitability during the last century. Seasonal and annual habitability was calculated using the Quantitative Habitability Theory (QH Theory). Ground and satellite data was used to define a biophysical quantity, the Standard Primary Habitability (SPH), which describes the environmental requirements for primary productivity. The SPH was used to estimate the global spatial and temporal variation of terrestrial habitability and primary productivity. A Planetary Habitability Classification (PHC) was constructed to characterize planetary habitable zones and establish a terrestrial-based standard for future comparisons with other planetary bodies including extrasolar planets. Results show that terrestrial habitability has been generally increasing during the last century even long before the last decades of global warming. This represents a century change of 1.5 PgC, and 0.5 PgC in the last two decades. Global variations of temperature and humidity account for only 15% of the increase of terrestrial productivity in the last two decades. The current mean global terrestrial habitability is 0.39, which makes Earth a Class D planet and therefore not in its optimum potential for primary productivity. Further studies will analyze spatial and temporal variations of habitability at local scales of various regions including Puerto Rico. This study was supported by the UPR Arecibo and by the NASA Astrobiology Institute MIRS Program.