Paper ID: 35516
student

IAA/IAF SPACE LIFE SCIENCES SYMPOSIUM (A1)
Astrobiology and Exploration (5)

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LIVABILITY ZONE: EXPANDING THE BOUNDARIES OF THE HABITABLE ZONE

Abstract

The quest for extraterrestrial life and its origins is a topic that has captivated the fascination of humankind for eons. A concept closely associated with this quest is that of a Habitability Zone (HZ). One common definition of it on the part of NASA is" ... the distance from star where liquid water can exist on a planet's surface". This definition, however, is very limiting, and does not consider a variety of factors which influence the habitability potential of certain astrophysical bodies. These factors include, for example, the initial mass and evolutionary status of a star, planetary albedo, atmospheric composition and pressure, potential subsurface life, tidal influence of natural satellites, etc. in addition, the scientific data substantiating the presence of liquid water and energy sources available on Mars, Europa and Ganymede, and Titan further reinforces the limited value of the classic HZ definition. This paper attempts to expands the concept of a HZ by making it more relevant to a contemporary search for extraterrestrial life. We analyze the conditions, which are most relevant to the emergence and sustenance of life. We have also approached our investigation in an interdisciplinary fashion with respect to key factors influencing habitability. These include star system classification and luminosity, planetary formation as well as planetary physics and chemistry such as the presence of a 'bio-friendly' atmosphere, and a magnetosphere. Our proposed model categorizes additional factors often overlooked in the classic HZ model. These factors include the hierarchical structures for physical science characteristics, and classification of life forms on Earth, including evolutionary processes. We have divided them into three 'layers' of importance based on a weighting system devised by us. Finally, we constructed a general summary table which attempts to consolidate and characterize all habitability variables we considered.