Towards the Exploration of the Exoplanets: Studying Key Physical Parameters for the Habitability of Primitive Earth Using Climate Models

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The question of the existence of extraterrestrial life has been a long-standing aspiration of humanity. Studying the physical, geological, and chemical conditions of exoplanets will advance our understanding of their potential to host life. Our concept of life is based on the life found on Earth. Primitive Earth was an aqua planet, received energy from a fainter Sun, had thousands of times more atmospheric CO2, and had no oxygen. Our planet was quite alien at the early times of her evolution, yet she hosted life. One of the most important quantities to consider for habitability is temperature. In this project, I used simulations based on an Earth-like planet Surface Temperature Model to study the habitability of primitive Earth. Sun luminosity and the Earth rotational period between 2.5 and 4 billion years ago were used as input parameters. Two other key parameters were varied: ocean fraction and atmospheric content of CO2. I found that too much CO2 resulted in a blistering hot planet even in the conditions of a faint Sun. Ocean fraction was essential for habitability since our simulations demonstrated that a very dry planet and a moderate amount of CO2, would turn the planet into a snowball. But if there is an abundance of CO2, even a small amount of water would be sufficient to make an Earth-like planet habitable. Like many other studies, my simulations of present-day Earth's current atmospheric content of O2 and CO2 show that global warming will continue its increase as the CO2 concentration increases.

Awards Won:
Arizona State University: Arizona State University ISEF Scholarship (valued at up to $52,000 each)