Estimating the Distribution of Habitable Real Estate in the Milky Way

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Our Galaxy may contain several different types of habitable worlds. One certain type is a rocky planet in the habitable zone of a G-type star. However, in principle other types of stars can have habitable planets in their habitable zones, perhaps including even tidally locked planets around M-dwarfs. Jovians can also have habitable moons either in the habitable zone or tidally heated ones beyond the ice line like Europa. All of this provides a potentially rich variety and diversity of habitable planets. However, the total number and relative importance of all of these types of planets remains relatively unexplored.

In this paper, we attempt to estimate the total habitable surface area of each kind of potentially habitable planet and moon in our Galaxy. Specifically, for each type of world, we estimate the mean habitable surface area per body, the mean number of bodies per spectral type of the star, and integrate over spectral type. For each case we start with the relevant number from the solar system, and then add detail from the literature, in particular accounting for the mass-luminosity relationship of stars and the initial mass function. Finally, we study the evolution of the habitable area in our galaxy in time for different planet types and star populations.