TERRESTRIAL VALIDATION OF A HABITAT SUITABILITY MODEL FOR BRINE ENVIRONMENTS ON MARS. K. L. Lynch[1], E. G. Rivera-Valentín[1], A. Soto[2], V. F. Chevrier[3], A. Méndez[4]; [1]Lunar and Planetary Institute (USRA), [2]Planetary Habitability Laboratory, [2]Southwest Research Institute, [3]Arkansas Center for Space and Planetary Sciences, University of Arkansas, [4]University of Puerto Rico at Arecibo.

Introduction: Habitat Suitability Index (HSI) Models have recently been presented as quantitative methods for assessing and resolving the habitability potential of extraterrestrial environments in a consistent manner [1]. In terrestrial ecology, HSI models apply known environment-species relationships, such as temperature tolerances, to predict survival, reproduction, and development. HSIs allow for a consistent way of comparing environments in space, as well as over time. Given the level of environmental data available from both orbiters, landers, and general circulation models (GCMs), HSIs can now be used to assess the present-day habitability of the Martian surface and shallow subsurface. Furthermore, Mars may presently support (meta)stable liquids, specifically brines [2,3]. We have developed an HSI model based on species-environment relationships dependent on temperature and water activity [4], these parameters also strongly control brine stability. Furthermore, because when a brine is at equilibrium with the local atmosphere, water activity is related to relative humidity with respect to liquid (RH_l) by $a_w = (RH_l/100)$, then the HSI metric is based on two measurable environmental parameters, temperature and relative humidity.

The goal of the developed quantitative metric is to identify where and when Mars would be, relatively speaking, the most habitable. Because liquid water is important for life as we know it, the models are particularly applied to potential brine environments [4].

To evaluate the HSI model in an astrobiological context, we have also applied the metric defined by [4] to two often used terrestrial analogs for Mars, the Atacama Desert, and the Antarctic Dry Valleys. We then validated the model against recorded biomass and metabolic activity from terrestrial studies in these analog environments as a function of season over the course of a standard Earth year.

Validation Data: The biomass measurements used to validate the HSI metric were obtained from biological data documented in peer reviewed studies within regions of both the Atacama Desert and the Antarctic Dry Valleys. To utilize the data as a qualitative metric, only studies that presented biomass/metabolic data (e.g., DNA, viable cell counts, ATP, etc.) both spatially and temporally were used.

We defined a qualitative metric for each individual study and then normalized to three simple validation metrics of High (Dark Blue), Medium (Cyan), and Low (light blue) levels of "bioactivity". For example, [5] published data on DNA copy numbers (biomass) from natural samples at different sites, during different sampling campaigns and at two depth intervals. They also collected in situ ATP data (metabolic activity) from the same sample suite. A "High" bioactivity designation was assigned if a sample had a credible value for both DNA and ATP at *both* depth intervals, a "Medium" designation was assigned if a sample had a credible value of DNA and ATP at *either* depth interval, and a "Low" designation was assigned if there was *only* a DNA *or* an ATP result at either depth interval (note: both depth intervals could have a result, but it would be only DNA or ATP, but not both).

Results: In Figure 1, we plot the calculated HSI metric from [4] for the Atacama Desert and supporting validation data identified. The HSI metric for the Atacama Desert was calculated using data from the NCEP Reanalysis-2 data assimilation analysis, which integrates in situ observation from weather research stations, remote sensing observations, and atmospheric model to reconstruct atmospheric and weather properties as a function of time and place [6].

The current validation data shown was collected from recent studies between 2015 and 2018 [5, 7]. In general, the validation data corroborates the times when the habitability metric identified periods of high suitability. However, it should be noted that the current data was collected after unusual periods of significant rainfall in the Atacama region, and we are currently working to add more validation data from "drier" periods of time.

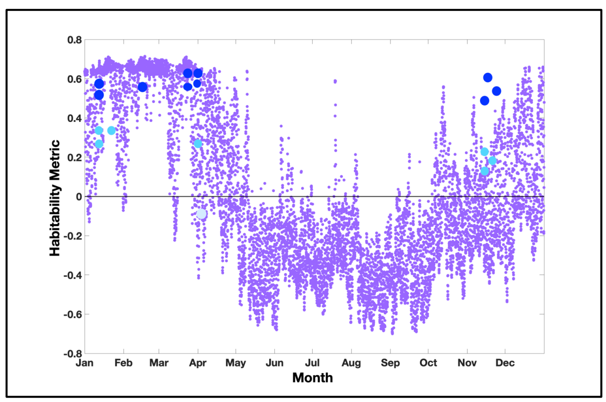

Figure 1. Calculated HSI metric for the Atacama Desert (purple) overlayed with the qualitative validation data (circles). The color scale of blue (Dark, Cyan, Light Blue) represents the qualitative level of biomass and/or

metabolic activity recorded within the defined Atacama region.

Conclusions: Here we present terrestrial validation for HSI metric developed for Mars. Although we concentrated on validating the model using data from the Atacama Desert, we aim to also present work using the Antarctic Dry Valleys during the conference. Our current results show that the HSI metric can simulate the observed seasonality of bioactivity in the Atacama Desert.

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