ATMOSPHERIC DYNAMICS AS A DRIVER OF HABITABILITY FOR M-DWARF SYSTEMS. J. Haqq-Misra[1,2], R. K. Kopparapu[1,2,3], E. T. Wolf[4], [1]Blue Marble Space Institute of Science (1200 Westlake Ave N Suite 1006, Seattle WA 98109; jacob@bmsis.org), [2]Virtual Planetary Laboratory, [3]Pennsylvania State University (ruk15@psu.edu), [4]University of Colorado (eric.wolf@colorado.edu).

M-dwarf stars are the most numerous stellar type in the Galaxy, and upcoming missions, such as the Transiting Exoplanet Survey Satellite (TESS) and James Webb Space Telescope (JWST), will be capable of observing the atmospheric composition of terrestrial planets around these nearby stars. The initial targets for these missions will likely be at the inner edge of the habitable zone (HZ) due to the increased signal to noise ratio that results from a planet's close orbit to their host star. However, Earth-like planets within the HZ of M-type stars fall within the tidal locking radius of their parent star and may evolve into synchronous rotators. On these planets, the substellar hemisphere experiences perpetual daylight while the opposing antistellar hemisphere experiences perpetual darkness. Because the night-side hemisphere has no direct source of energy, the air over this side of the planet is prone to freeze out and deposit on the surface, which could result in atmospheric collapse. However, general circulation models (GCMs) have shown that atmospheric dynamics can counteract this problem and provide sufficient energy transport to the antistellar side [1, 2].

Here, we discuss how idealized GCM studies of atmospheric dynamics can be applied to constrain the potential habitability of extrasolar planets orbiting M-dwarfs. Idealized dynamical models illustrate that the effects of geothermal heating provide additional habitable surface area and may help to induce melting of ice on the antistellar hemisphere, while a cross-polar circulation provides an additional mechanism of mass and energy transport from the substellar to antistellar point that contrasts with the general circulation observed on Earth and increases the resilience of such climates against collapse [3]. We also examine the role of moisture in maintaining dynamical structures and examine fundamental differences between the equilibrium climate states of moist Earth-like planets and dry "Dune-like" planets in close orbit around M-dwarfs.

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