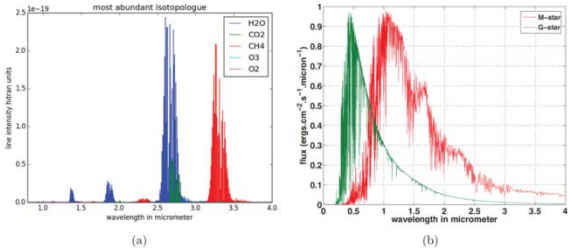
DETERMINING THE INNER EDGE OF THE HABITABLE ZONE AROUND M-DWARFS USING 3-D CLIMATE MODELS. R. K. Kopparapu[1,2,3], E. T. Wolf[4], J. Haqq-Misra[3,5], J. F. Kasting[1], S. Mahadevan[1], R. Terrien[1]. [1]Pennsylvania State University (ruk15@psu.edu), [2]Virtual Planetary Laboratory , [3]Blue Marble Space Institute of Science, [4]University of Colorado, Boulder (Eric.Wolf@colorado.edu), [5]jacob@bmsis.org

Introduction: The study of habitable zones (HZs) has received significant attention recently with the discoveries of terrestrial mass/size planets from both ground-based surveys and the Kepler mission. Specifically, terrestrial planets near the inner edge of HZs of M-stars have received more scrutiny because of their shorter orbital periods, which increases their chances of detection, and characterization, compared to G-stars. In this presentation, we will report our ongoing efforts to determine the inneredge of the HZ around late-K to late-M-dwarfs, using multiple 3-dimensional global circulation models (GCMs). We are updating the radiative transfer in these GCMs with new absorption coefficients for H_2O using the most recent line-by-line HITRAN2012 database, and with semi-empirical water-vapor continuum absorption, which will significantly affect the inner edge of the HZ. We will consider both water-rich and dry 'dune'-like planets, to identify the most accurate HZ limits around M-stars.



Caption: *Panel a*: Line intensity of water-vapor (blue) in the near-IR, compared to other molecules. The units of the vertical axis are $cm^{-1}/(molecule\ cm^{-2})$. *Panel b*: Spectrum of an M-dwarf star (red) which emits mostly in the near-IR, where water-vapor is a dominant absorber. H_2O line intensity from HITRAN2008 database, VPL (http://vplapps.astro.washington.edu/). M-star spectrum from BT-Settl grid of models (Allard et al., 2003, 2007).

References:

[1] Haqq-Misra, J., S. Lee, and D.M.W. Frierson. 2011. Tropopause structure and the role of eddies, J. Atmos. Sci., 68, 2930–2944.

[2] Haqq-Misra, J.,Kopparapu, R. 2015. Geothermal heating enhances atmospheric asymmetries on synchronously rotating planets, MNRAS, 446, 428

[3] Wolf, E., & Toon, O. B. 2014a. Controls on the Archean Climate System Investigated with a Global Climate Model. Astrobiology, 14, 241

[4] Wolf, E., & Toon, O. B. 2014b. Delayed onset of runaway and moist greenhouse climates for Earth. Geophysical Research Letters, 41, 167

Acknowledgments: R.K. gratefully acknowledges funding from the NASA Astrobiology Institute's Virtual Planetary Laboratory lead team, supported by NASA under cooperative agreement NNH05ZDA001C.