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# Radiative Convective Transfer Calculations for Effective Stellar Fluxes of Habitable and Life Supporting Zones

Wolfgang Ludwig (1), Siegfried Eggl (2), David Neubauer (3), Johannes Leitner (1,4), Maria Firneis (1,4), Regina Hitzenberger (1,5)

(1) Research Platform ExoLife, University of Vienna, Boltzmanngasse 5, 1090 Vienna, Austria, (2) IMCCE - Observatoire de Paris 77 Avenue Denfert-Rochereau F-75014 PARIS France, (3) ETH Zürich Institute for Atmospheric and Climate Science Universitätstrasse 16 8092 Zürich, (4) Institute of Astronomy, University of Vienna, Türkenschanzstraße 17, 1180 Vienna, Austria, (5) Faculty of Physics -Aerosolphysics and Environmental Physics Boltzmanngasse 5 A-1090 Vienna Austria

Recent fields of interest in exoplanetary research include studies of potentially habitable planets orbiting stars outside of our Solar System. Habitable Zones (HZs) are currently defined by calculating the inner and the outer limits of the mean distance between exoplanets and their central stars based on effective solar fluxes that allow for maintaining liquid water on the planet's surface. Kasting et al. (1993), Selsis et al. (2007), and recently Kopparapu et al. (2013) provided stellar flux limits for such scenarios. We compute effective solar fluxes for Earth-like planets using Earth-like and other atmospheric scenarios including atmospheres with high level and low level clouds. Furthermore we provide habitability limits for solvents other than water, i.e. limits for the so called Life Supporting Zone, introduced by Leitner et al. (2010). The Life Supporting Zone (LSZ) encompasses many habitable zones based on a variety of liquid solvents. Solvents like ammonia and sulfuric acid have been identified for instance by Leitner et al (2012) as possibly life supporting. Assuming planets on circular orbits, the extent of the individual HZ is then calculated via the following equation,
d(i,o) = [L/Lsun*1/S(i,o)]**0.5 au, where L is the star's luminosity, and d(i,o) and S(i,o) are the distances to the central star for the inner and the outer edge and effective insolation for inner and the outer edge of the HZ, respectively. After generating S(i,o) values for a selection of solvents, we provide the means to determine LSZ boundaries for main sequence stars. Effective flux calculations are done using a one dimensional radiative convective model (Neubauer et al. 2011) based on a modified version of the open source radiative transfer software Streamer (Key and Schweiger, 1998). Modifications include convective adjustments, additional gases for absorption and the use of an offline cloud model, which allow us to observe the influence of clouds on effective stellar fluxes.

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