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EFFECTS OF PLANETARY ALBEDO AND GREENHOUSE GASES ON THE HABITABLE ZONE – SEEKING FOR HABITABLE PLANETS

Abstract

Big questions in astrobiology are whether our solar system is very unusual and weird and how many terrestrial planets there are in orbits around other stars. The habitability of these planets and the spread of habitable zones around stars are also key questions. Sophisticated planetary missions during the last 50 years gave us an impression how strange and different planetary worlds can be. Venus is a very good example to demonstrate two important properties: the albedo and the atmosphere. The presentation describes that due to high albedo and atmospheric greenhouse gases in exoplanets atmospheres the habitable zone around stars may be greater by the factor five than generally considered. The possible surface temperature of planets and moons is first given by the star insolation decreasing with distance. Additionally the albedo, the pressure and the amount of special greenhouse gases in the atmosphere are the most striking features which gives for Earth- with the law of Stefan-Boltzmann - a radiative equilibrium temperature (Te) of 255 K. A planet with the same albedo could orbit our sun in a distance of only 0.59 AU to result in a surface temperature of 288 K like on Earth. The second feature which increases the surface temperature by a factor of 3.1 on Venus is the greenhouse effect. In a distance of 4.5 AU Venus would have a temperature of 288 K. With an earth like albedo of 0.3 a planet could be as far as 7.8 AU away from our sun to have a likeable temperature of 288 K. Knowing that planetary bodies in the universe have wide range of properties, calculations of surface temperature give us a rough perception what we could expect in studying exoplanet properties. The presentation outlines that the resulting real surface temperature of exoplanets is finally given by a complex combination of many additionally planetary parameters like orbit eccentricity and axis tilt, as well as diameter and tectonic activity. Important properties are also the amount and distribution of liquid water. To get a habitable planet comparable with Earth it should put into account that many parameters may change with time. From Earth we learn that climate stability in a certain temperature range is an additionally requirement for habitability. All requirements lead to the disputable presumption that planets like Earth may be rare in the Galaxy.