An empirical model of the black-body temperature of a planet

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Abstract

In this paper, I describe an empirical model of the black-body temperature of a planet.

Introduction

In this paper, I describe an empirical model of the black-body temperature of a planet. This empirical model has both a high R^2 and a high adjusted R^2.

Data

The following data was obtained from NASA for the model.

Planet	Black-body Temperature (K)	Mean Temperature (K)	Bond Albedo	Perihelion (m)	Aphelion (m)
Mercury	439.6	440.15	0.068	4.60E+10	6.98E+10
Venus	226.6	737.15	0.770	1.08E+11	1.09E+11
Earth	254.0	288.15	0.294	1.47E+11	1.52E+11
Mars	209.8	208.15	0.250	2.07E+11	2.49E+11
Jupiter	109.9	163.15	0.343	7.41E+11	8.16E+11
Saturn	81.0	133.15	0.342	1.36E+12	1.51E+12
Uranus	58.1	78.15	0.300	2.73E+12	3.00E+12
Neptune	46.6	73.15	0.290	4.47E+12	4.56E+12
Pluto	37.5	48.15	0.720	4.44E+12	7.38E+12

Transformed data

The data was transformed to obtain the following dataset:

θ_{BB}	$ln(P)$	$ln(A)$	A_B	θ_μ
439.6	24.55	24.97	0.07	440.15
226.6	25.40	25.41	0.77	737.15
254.0	25.71	25.75	0.29	288.15
209.8	26.05	26.24	0.25	208.15
109.9	27.33	27.43	0.34	163.15
81.0	27.94	28.04	0.34	133.15
58.1	28.64	28.73	0.30	78.15
46.6	29.13	29.15	0.29	73.15
37.5	29.12	29.63	0.72	48.15

The model

An empirical model of the black-body temperature of a planet with the specification

$$\theta_{BB} = \alpha_1 ln(P) + \alpha_2 ln(A) + \alpha_3 A_B + \alpha_4 \theta_\mu + \epsilon$$

where
θ_{BB} is the black-body temperature (in Kelvin) of the planet
$ln(P)$ is the natural logarithm of the perihelion (in meters) of the planet
$ln(A)$ is the natural logarithm of the aphelion (in meters) of the planet
A_B is the bond albedo (from 0 to 1) of the planet
θ_μ is the mean temperature (in Kelvin) of the planet
ϵ is the residual

is available here.

The End