On the possibility of deriving historical Total Solar Irradiance (TSI) from the lunar heat flow measurements

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A promising measurement that can significantly reduce the large uncertainty in the external forcing of earth's climate by the Sun, and thus improve the confidence in estimates of the relative impacts of human-induced greenhouse gas forcing, is the temperature profile in a lunar borehole. Temperature variations in a lunar borehole, unlike those in a terrestrial borehole, are dominated by variations in the solar intensity at the Moon's surface. The lunar regolith is directly heated from above by the variable sun, so temperature profile in the upper regolith is attributed to variations in solar irradiance. Downward propagation of these variations is controlled by the thermal diffusivity, measured in the upper 2.7 m by Apollo 15 and 17 to be two orders of magnitude smaller than terrestrial values. Thus, relevant temperature variations in the Moon's surface layers are much closer to the surface than on Earth, and are free of non-solar influences. The terrestrial borehole heat flow measurements have been successfully operated and the thermal history of the atmosphere has been obtained for the last 500 years. We applied commonly assumed scenarios of TSI variations in the recent centuries (Lean, 2000; Wang et al., 2005) as input to a numerical model of heat flow in the lunar regolith, and examined the feasibility of resolving the history of TSI by the heat flow measurements of the lunar regolith in the near future. We demonstrate that the difference of 2W/mˆ2 in the TSI scenarios can be distinguished by detectable differences in temperature within 10 m of the Moon's surface. This qualitatively confirms and updates earlier results of Huang et al (2000), and clarifies the dependence of heat flow in the regolith on the variations in the background TSI, and on the choice of latitude of the lunar site.