A prospective project of the Chang'E program: Engaging the Moon in the study of terrestrial climate change

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The 20th century global warming is well documented in the world-wide meteorological record. Still under heated debate are the influences of natural forcing such as fluctuation in solar irradiance and anthropogenic forcing such as greenhouse effect. Both solar irradiance and greenhouse effect affect the energy budget of the climate system of Earth. Of fundamental importance to our ability to predict future climate change is to separate the contributions of these two factors. However, it has not been an easy task because experiments and observations on the Earth's surface are also influenced by both factors.

Accurate measurement of solar and terrestrial radiations was not possible until high precision and self-calibrating solar probes were lofted into orbit by spacecraft a quarter century ago. But man-made satellites have very limited life spans and Earth-observing angles. Reliable detection of the change in the energy budget of the terrestrial climate system requires the construction of composite records utilizing overlapping data for cross calibration of measurements from different radiometers. The lack of long term continuous monitoring from a permanent observatory has made the task difficult and sometimes controversial.

The Moon is a unique platform for the detection and study of the radiation budget variation of the terrestrial climate system. There is no complication of human activities or atmosphere in the lunar climate system. Indeed, important hint may already exist in the lunar surface temperature from the Apollo 15 landing site. As a bonus of the Apollo Heat Flow Experiment three decades ago, *in situ* lunar surface temperature was recorded over a 41-month period at the landing site of Apollo 15. The Apollo data show distinct patterns in the daytime and nighttime lunar surface temperatures.

The daytime and nighttime temperatures at a given site on the near-side of the Moon are controlled by the radiations it received from the Sun and Earth, respectively. The difference in the Apollo 15 daytime and nighttime temperatures illustrates that both

the solar and terrestrial signals are detectable from Moon-based observations. Here we outline the scientific base for the prospective lunar surface temperature and radiation project for the Chinese Chang'E lunar program. We call for international efforts to establish permanent high precision temperature and radiation observatories on the Moon for new insights into the global climate change this most profound social, economical, and scientific issue of our time.