Lunar Surface Science Workshop – Abstract

Wolfgang Finsterle, Margit Haberreiter, Louise Harra

The Earth Energy Imbalance (EEI) is driving climate change. Continual monitoring of the EEI is a fundamental diagnostic for analyzing climate variability and anticipating future changes. The closure of the Earth Energy Budget (EEB) is seen by the climate science community as a key step in improving our understanding of global climate change.
The major components of the EEB are solar irradiance, reflected and emitted radiation from the Earth's surface and atmosphere. Other components, such as radioactive decays, primordial heat, and tidal friction, are several orders of magnitude smaller than the radiative exchange with the planetary environment.
The Earth facing side of the lunar surface offers a unique vantage point to continuously measure the Earth's outgoing radiation integrated over the visible hemisphere ("Earth as a star"). We will present requirement studies regarding accuracy and precision to successfully measure the Earth's outgoing radiation from the lunar south polar area and discuss the technical challenges to achieve this with an absolute radiometer.
Over the course of a month the radiometer will provide the daily totals of the Earth's outgoing radiation (reflected and emitted) at all local times. Combining these data with the Total Solar Irradiance (TSI) measurements from other space missions (e.g. TSIS-x) will form a unique long-term record of the EEI. Additionally, the synoptic measurements from the lunar surface can be used to complement and calibrate high-resolution EEI measurements from low-earth orbiting satellites.

The radiometer needs to be accurately installed by the crew in the direction of the mean position of Earth above the lunar horizon. The Earth's apparent motion due to lunar libration will be fully within the field of view of the radiometer, such that no active tracking or crew interaction will be required after set up is completed. The radiometer mount will be motorized to periodically point the radiometer to deep space and the lunar surface in order to calibrate the readings and to compensate for foreground radiation. The site should be chosen such that the angular distance between the lunar horizon and the Earth is greater than 10°.

Resource estimates	
Dimensions	~200x200x300 mm^3, mounted on a tripod
Mass	~10 kg incl. motor (excluding tripod)
Power consumption	<10 W
Development cost	< $10M
Operating cost	low (autonomous operation)