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Mapping Solar Irradiance within Schrödinger Basin for Future Robotic Sample Return Missions.

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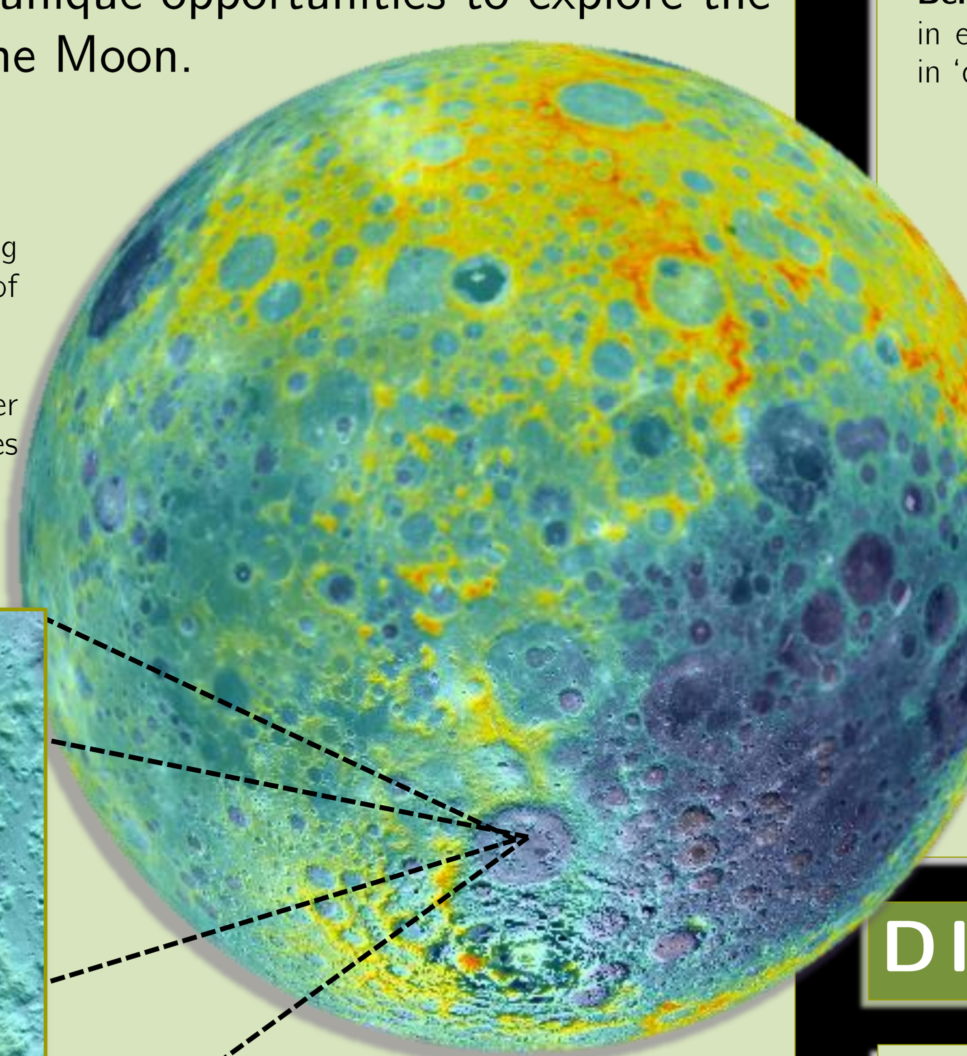
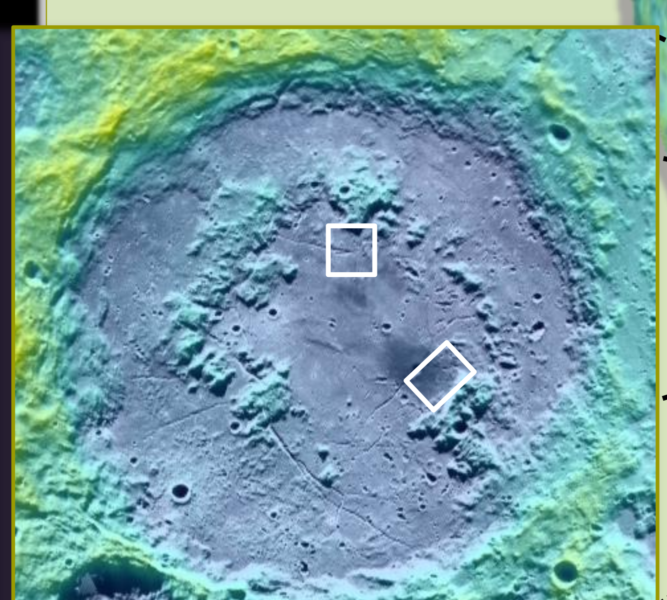
INTRODUCTION

The US NRC identified 8 scientific concepts to be addressed with continued lunar exploration [1]. The majority of these objectives require sample return from the Moon. Schrödinger basin has been highlighted as an attractive location to find suitable samples [3]. Schrödinger basin is the second youngest basin on the Moon and is located within the farside's South Pole-Aitken basin, the oldest and largest basin on the Moon. The Schrödinger basin-forming impact uplifted a peak ring of lunar crustal material that M^3 data [4] suggest contains diverse lithologies. Furthermore, mare basalt flows and a pyroclastic vent provide unique opportunities to explore the magmatic evolution of the Moon.





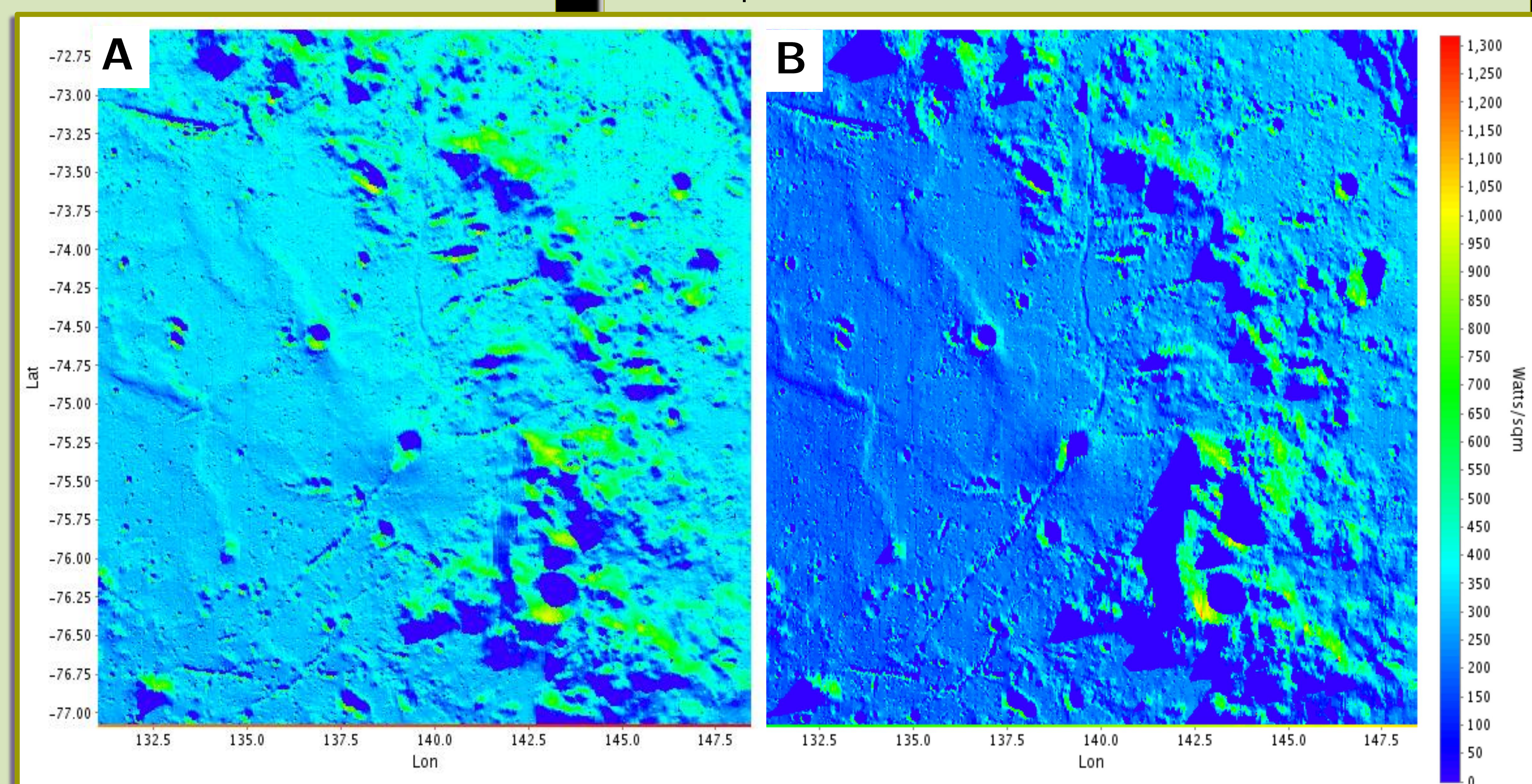
Left: Topographic image of Moon showing SPA (dark purple) and location of Schrödinger.
Below: Topographic image of Schrödinger basin (320 km diameter). White boxes correspond to sites of interest.

Two landing sites for the robotic missions which optimize sampling opportunities have been identified [7, 8]. Schrödinger impact material that could be used to determine the age of the basin is present at both sites. Samples at the northern landing site would consist of peak-ring material, mare basalts thought to be younger than those on the nearside, and potentially volatile-bearing lithologies in a deep fracture. The southeastern landing site provides unique exposures of both the peak ring and a pyroclastic vent.

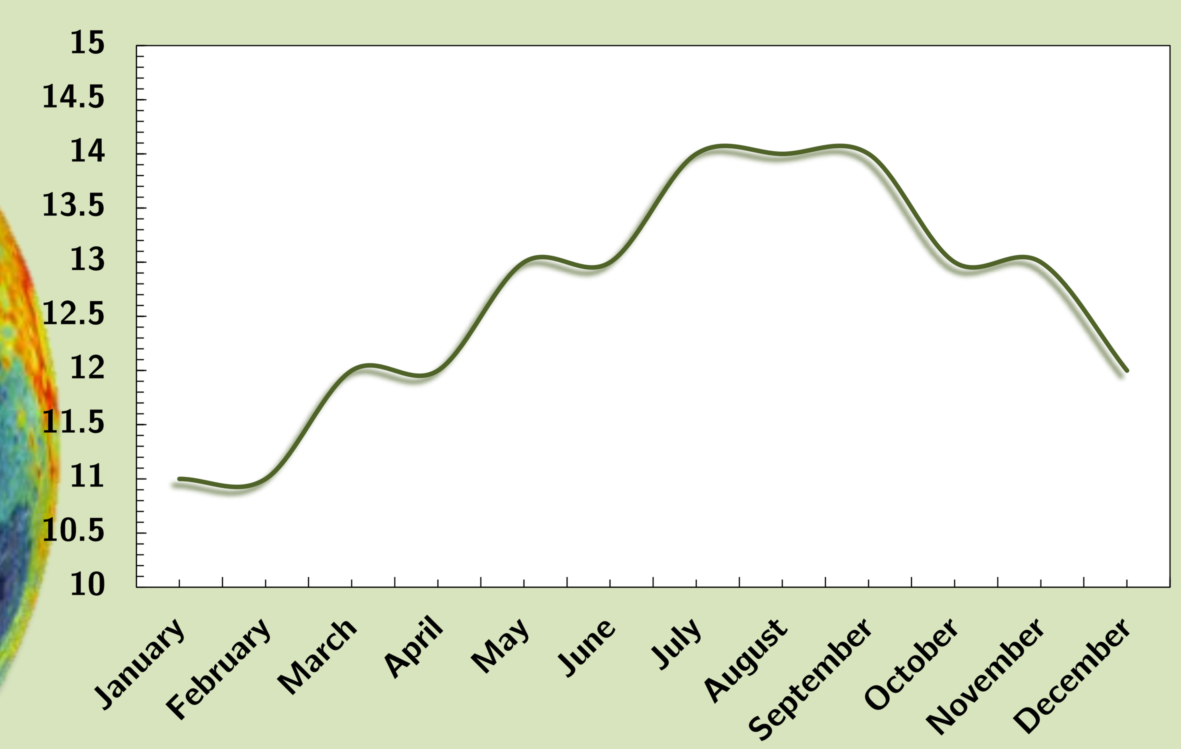
SOLAR IRRADIANCE

A short-duration solar-powered rover mission must coincide with a period of lunar illumination (~14 Earth days). Solar irradiance (sunlight power on surface) data from Lunar Mapping and Modeling Portal (LMMP) for the period January 2018 through December 2021 were analyzed. An area covering both localities (-72.5545N, 131.041E to -72.108N, 148.4384E) was selected. A mesh size of 1 m with 39% Earth shine and terrain reflection were used. Results are given in watts/sqm.

Left: Solar irradiance map covering both proposed mission localities with Schrödinger for comparative period of illumination for August 2018 (A) and January 2019 (B). The maps highlight the difference in solar power (watts/sqm) between the two periods, with the Eastern Inner-Basin floor averaging 450 watts/sqm in August 2018 compared to an average of 150 watts/sqm in January 2019.



Below: Chart of average amount of days (*y* axis) illuminate days in each month. Minimum watts/sqm of 250 used to define still in 'day' time.



DISCUSSION

Optimal periods of solar irradiance are the months July through September, which have a ~15% longer than average period of lunar illumination. Tracking variations in sun angle over a one year period indicate some areas within Schrödinger may be in complete shadow one year and have adequate solar power the next. This is particularly evident behind local topographic highs such as the peak ring at the northern landing site, which was not always illuminated during the period of interest. The base of the peak ring at the southeastern landing site did not have any areas that were shadowed during periods of lunar illumination. Traverse routes in that region are, therefore, less restricted in date than those at the northern landing site.

CONCLUSIONS

Solar irradiance within Schrodinger varies by a factor of 3, depending on the time of the year. Thus not every 14-day-long illumination period provides the same solar power on the surface. This does not preclude missions in the first half of the year, but they may require larger solar panels or a more power-efficient rover.

This illumination study can facilitate several mission trade studies involving the sizes of the rover, solar panels, and power storage; the number of instruments requiring power (whether they are limited to those needed for sample return or also include those for in situ analyses); and whether the capacity to survive a lunar night or not is necessary. The illumination results can also be used to select traverse routes and stations locations [7,8] that maximize access to solar recharging.

Movies

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