SPATIAL DISTRIBUTION OF SUITABLE LANDING SITES BASED ON WATER-ICE STABILITY MODELS AND ENGINEERING CONSTRAINTS IN THE LUNAR SOUTH POLAR REGION. C. Orgel[1], E. Sefton-Nash[1], T. Warren[2], S. J. Boazman[1], O. King[2], N. Bowles[2]. [1]European Space Research and Technology Centre (ESTEC), European Space Agency, Noordwijk, NL (csilla.orgel@esa.int), [2]Dept. of Atmospheric, Oceanic and Planetary Physics, University of Oxford, UK.

Landing site assessment: The South Pole of the Moon and its potential for cold-trapped volatiles to persist [1, 2, 3, 4, 5] became the focus for future landed missions. Landing site selection for any surface mission typically involves optimizing a balance between quantities or criteria that indicate the extent to which the mission's objectives can be met or exceeded.

In this study we show results quantifying the probability of being able to target areas where thermal conditions permit the long-term stability of cold-trapped water-ice in the shallow subsurface using thermophysical model results [2, 6]. We also consider factors related to mission operations, namely: Earth visibility for direct-to-Earth communication and solar illumination for power [7].

Data and Methods: We combine datasets sampled at a spatial resolution of 120 m/pix, spatial coverage extending from the pole to 80°S at the cardinal meridians, and include metrics of volatile stability [2, 6] as indicators of science potential, as well as LOLA derived slope [8], average solar illumination, and Earth visibility [7] maps, following the work from [9]. We prepared boolean rasters that are true where terrain is compliant with scientific and engineering constraints in Table 1. We used the Conditional Tool in ArcGIS 10.7 software and MATLAB to derive the maps and histograms.

Dataset	Least constrained scenario	Most constrained scenario
LOLA derived slope, °	≤ 15°	≤ 7°
Earth visibility (%)	25%	50%
Solar illumination (%)	15%	35%
Volatile stability	True	True

Table 1: *Scenarios defined by thresholds on datasets.*

Scenarios: We define two scenarios, one more constrained, and one less constrained, to explore the distribution of compliant terrain, both spatially and in selected parameter spaces of the constraining criteria (Figure 1). Thresholds in slope, solar illumination, and Earth visibility (Table 1) were selected regarding the general case of a solar powered lunar polar lander using direct-to-Earth communications.

Landing probability: We investigate the likelihood of landing in a preferable location based on the landing precision of a landing system [10]. We assume circular landing ellipses with radii ranging in steps of 120m between 120–10080m.

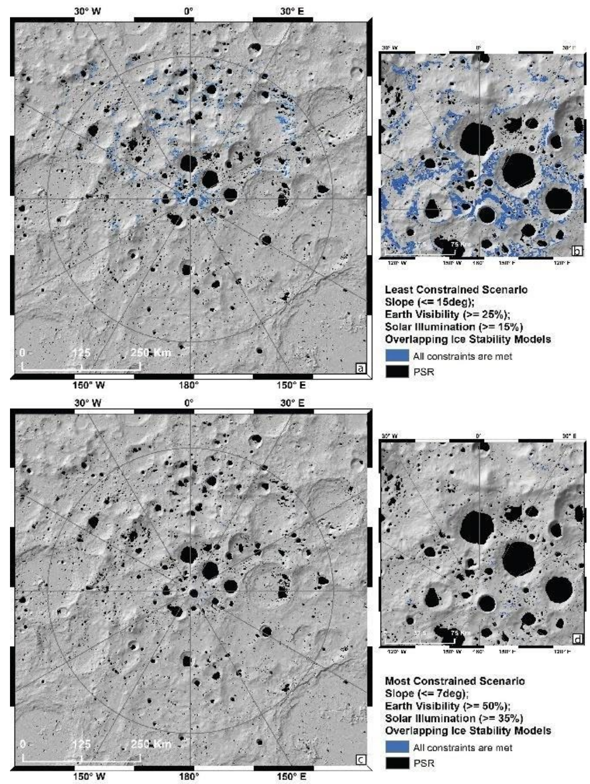

Figure 1: *Mask of terrain with compliant slope, Earth visibility, solar illumination and ice stability criteria. Note that data are cropped to the spatial extent of where ice stability is predicted by models of both [2] and [6].*

Conclusion: Sub-km landing precision (<1km radius) is required to confidently target places with potentially stable subsurface water ice that, on average, receive enough sunlight to power a spacecraft and communicate directly to Earth.

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