Some 20% of the lunar regolith consists of micron sized dust particles (Park et al. 2008). Most are fine, angular and jagged grains composed of impact-generated glass, containing nano-sized metallic Fe (Lui & Taylor 2008). In the absence of an atmosphere, the solar wind and continuous chemical reduction can confer electrostatic charge levitating dust by the order of a metre.

The Lunar Dust and Environment Explorer (LADEE) Horányi et al. (2015), detected a permanent, asymmetric, dust cloud around the Moon, likely caused by impacts from high-speed cometary dust particles on the regolith. The density distribution is strongly enhanced close to the morning terminator and extends over tens of kilometres in elevation. A dynamic “fountain” model has been suggested (Stubbs et al., 2005) to explain this extended cloud in which charged dust grains follow ballistic trajectories, after acceleration through a narrow sheath region by a surface electric field.

The reflectivities of the lunar laser ranging corner cube reflectors left on the surface in the 1970s by Apollos 11, 14 and 15 as well as that on Lunokhod 2 (Murphy et al. 2010) have decreased by an order of magnitude over 40 years. While much of the loss likely comes from an accumulation of dust, additional loss at full moon (Murphy et al. 2014) suggest the array surfaces warp when the dust is warmed by sunlight.

Shackleton Crater, at the lunar south pole, has long been recognised (van Susante 2002) as a prime site for an infrared telescope. The crater walls act as a complete solar shield, while the crater floor provides passive cooling to <90 K and continuous 4 steradian sky coverage centred on the south ecliptic pole. But, while certain types of astronomical observations may ultimately be made regularly from the Moon, the risk of lunar dust settling on the optics renders siting any large optical telescope there debatable (Lowman & Lester 2006). Apart from loss of light and chemical damage to optical surfaces, dust seriously increases parasitic thermal emission.

The LADEE observations did not include the lunar poles, so one cannot quantify the impact on a telescope at the pole. A simple monitoring of the elevated dust density, its scale height and particle size distribution are key in planning for an exposed optical facility. A crucial contribution will be measurements of dust accumulated at several levels up to, say, some 10 metres. Care needs to be taken with timing of the observations to discriminate between dust generated naturally and as a result of robotic and astronaut activity.

While the Artimis III program is unlikely to explore a crater such as Shackleton, elevated dust measurements close to the pole would be invaluable both for telescope and other exposed optical surfaces. One might anticipate dust densities similar to a 1000 clean room with the simplest monitor a \`deploy and leave\` having several collection surfaces at different heights up ~10 metres. The surfaces would be exposed in the absence of astronauts or robots and later retrieved and returned to Earth for analysis. Naturally, a more dynamic monitoring facility would be preferable.

Horányi, M., Szalay, J. R., Kempf, S., Schmidt, J., Gruñ, E., Srama, R., & Sternovsky, Z., A permanent, asymmetric dust cloud around the Moon, 2015, Nature, 522, 324.

Yand Liu & Lawrence A. Taylor, Lunar dust: Chemistry and physical properties and implications for toxicity, NLSI Lunar Science Conference (2008)

Lowman, P. D, & Lester, D. F., Build astronomical observatories on the Moon?, 2006, Physics Today, 59, 11, 50.

Murphy Jr., T. W., Adelberger, E .G., Battat, J. B. R., Hoyle, C. D., McMillan, R. J., Michelsen, E. L., Samad, R. L., Stubbs, C. W., & Swanson H. E., Long-term degradation of optical devices on the Moon, 2010, Icarus, 208, 31.

Murphy Jr., T. W., McMillan, R. J., Johnson, N. H., & Goodrow, S. D., Lunar eclipse observations reveal anomalous thermal performance of Apollo reflectors, 2014, Icarus, 231, 183.

Jaesung Park, Yang Liu, Kenneth D. Kihm, and Lawrence A. Taylor, Characterization of Lunar Dust for Toxicological Studies.I: Particle Size Distribution, Journal of aerospace engineering, Oct 2008, 266.

Timothy J. Stubbs, Richard R. Vondrak, & William M. Farrell, A dynamic fountain model for lunar dust, Advances in Space Research, Vol 37 issue 1, 2006, 59.

van Susante, P., Scenario description of the construction of a Lunar South Pole Infrared Telescope (LSPIRT), 2002, Proc. 36th ESLAB Symposium, ESTEC, Noordwijk, (Eds.: B. Foing, B. Battrick), ESA SP-514, 283.