SPIS-Dust Validation Cases

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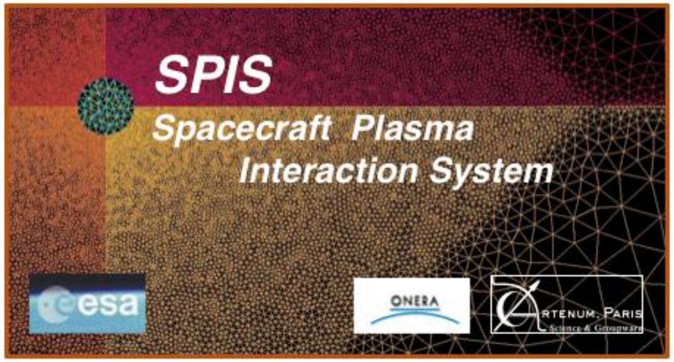
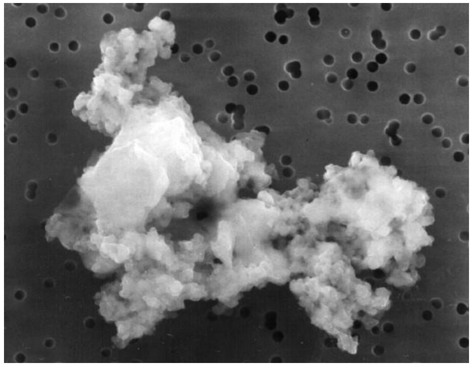
SPIS-Dust Validation Tests

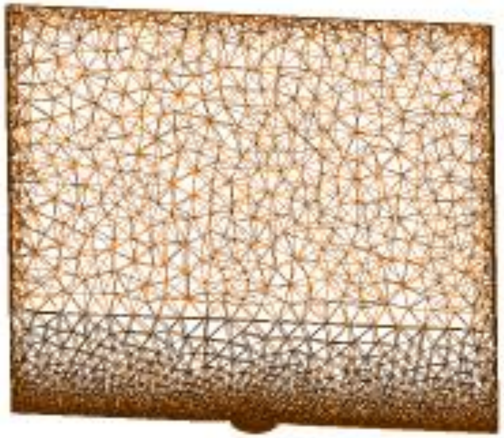




2D and 3D simulation cases

2D simulation Domain

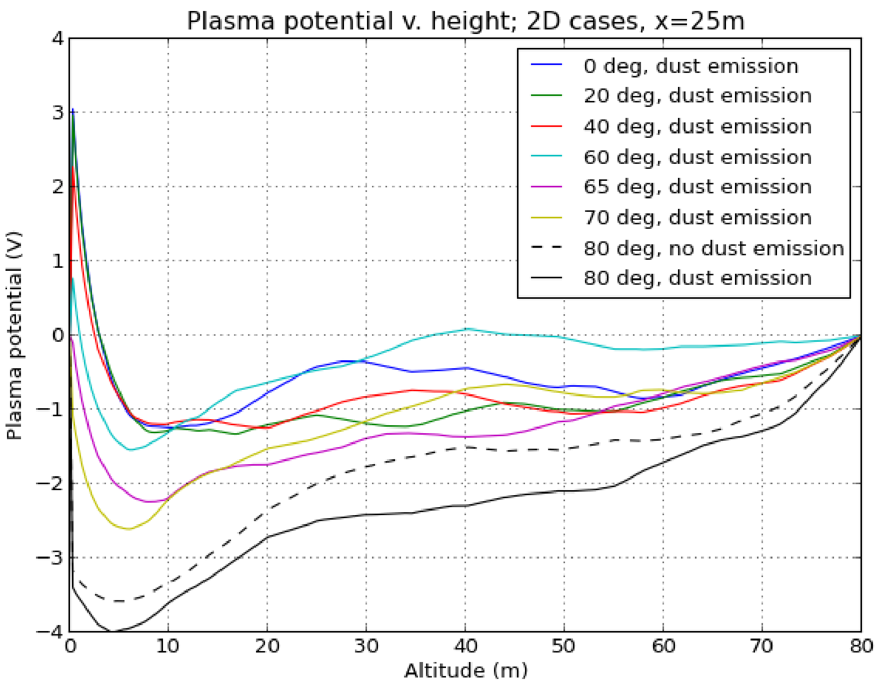
X=-50 to 50m
Y=0 to 2m
Z=-2 to 80m

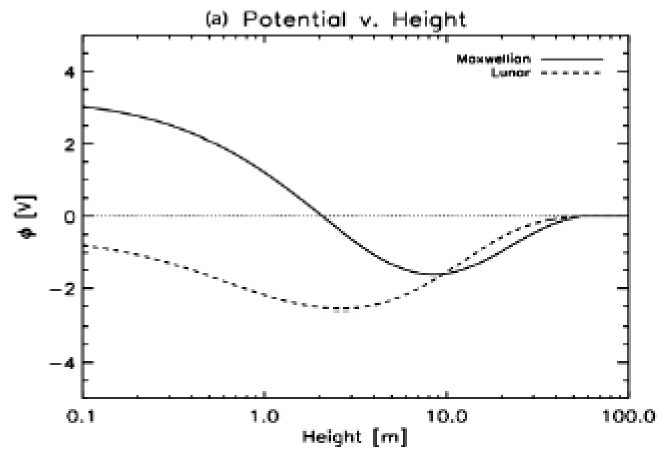


Top, open
boundary, 0V
5m mesh

Crater, non-conductive
(dielectric) lunar dust
10m diameter
2m deep, 0.5m rim

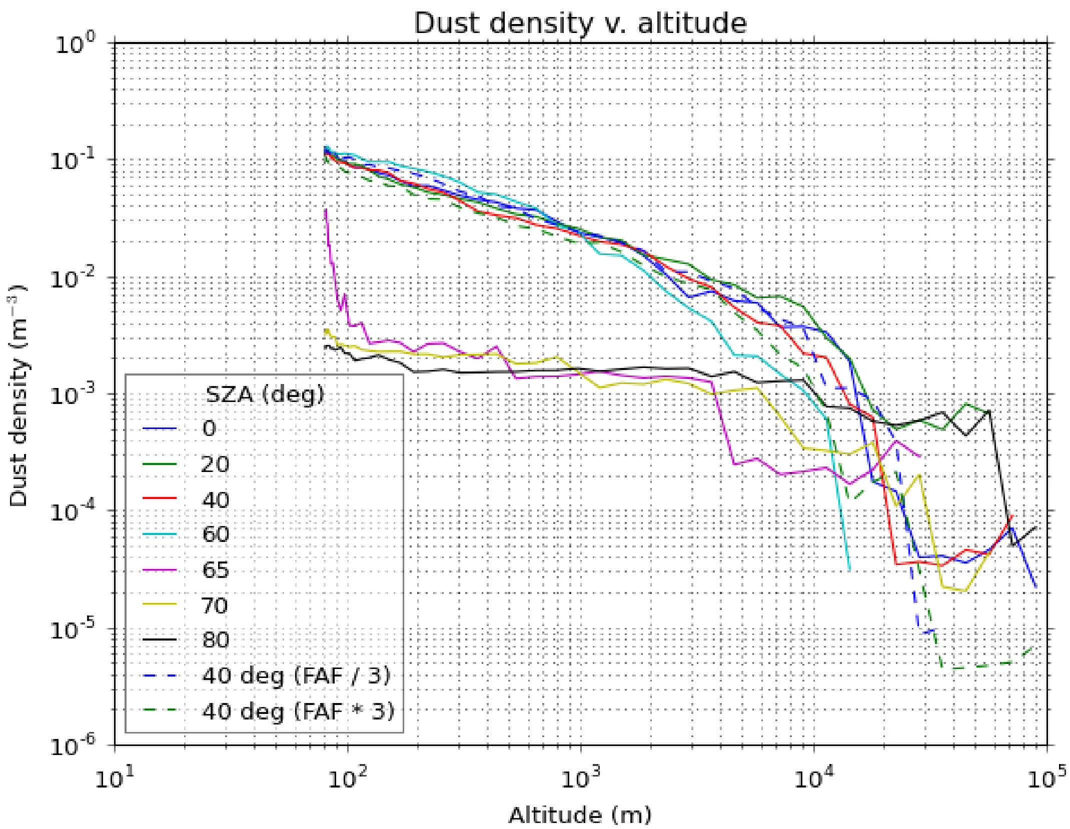
Plasma Potential



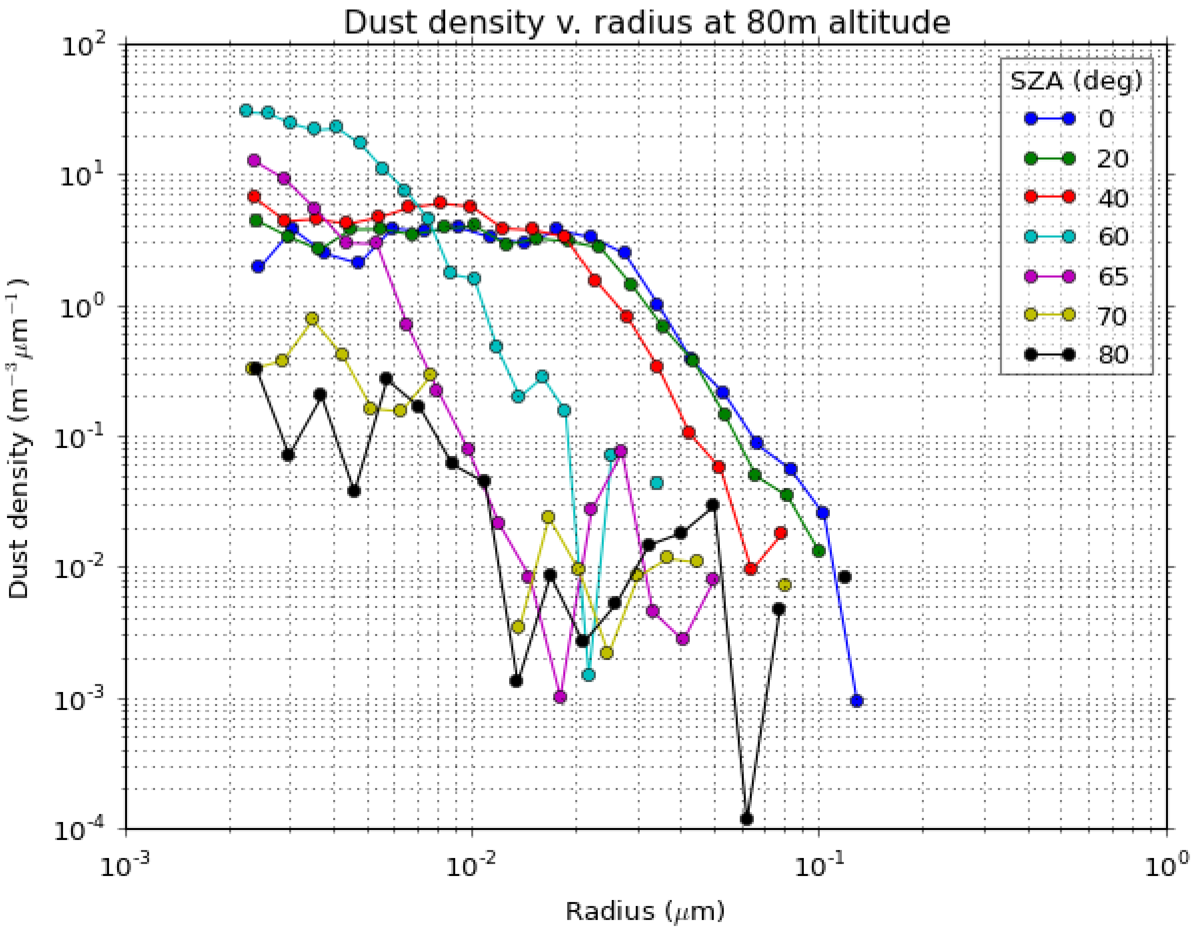


Poppe and Horanyi 2010

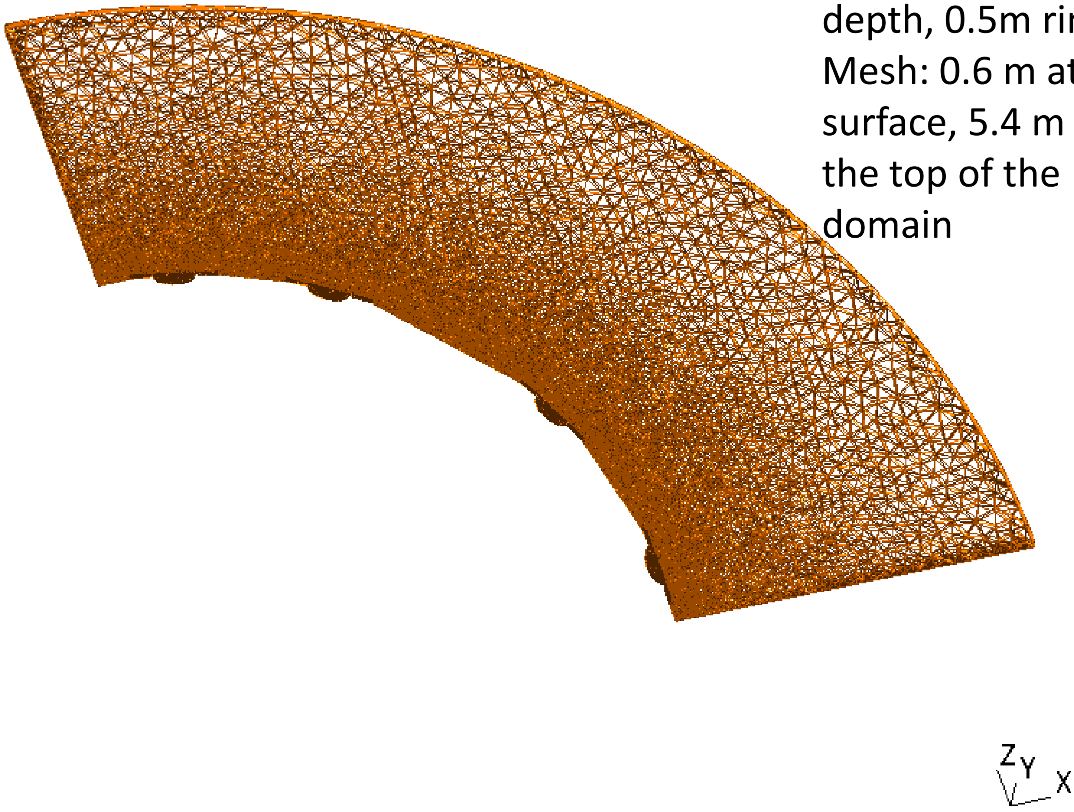
Dust Density for different SZA
2D simulation



Dust density as a function of radius



Simulation Domain for Asteroid



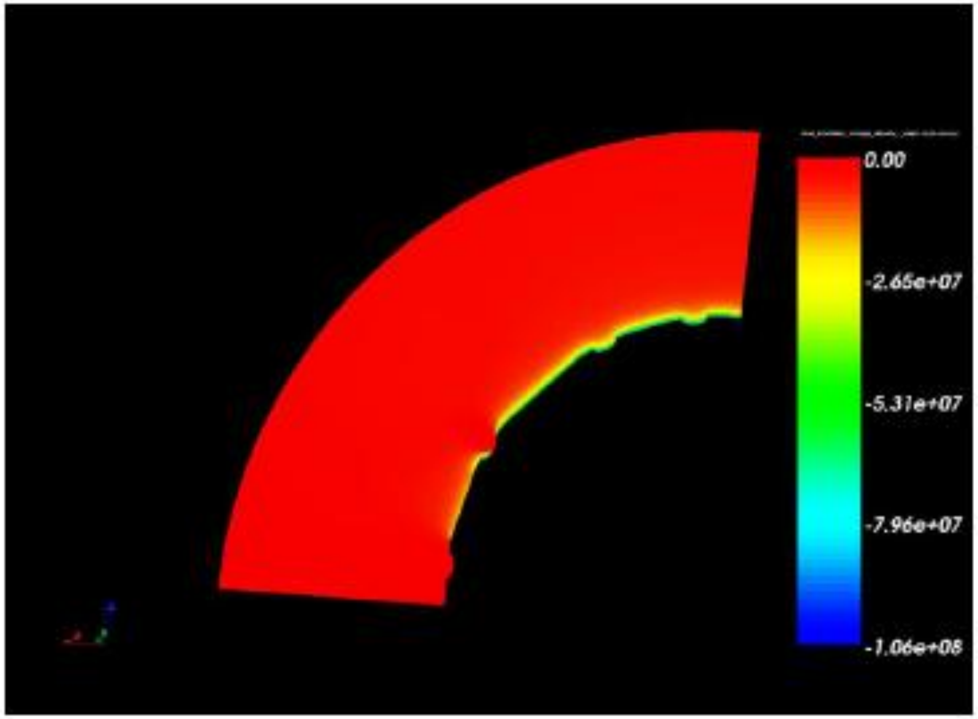
Craters: 10m Diameter, 2m depth, 0.5m rim

Mesh: 0.6 m at the surface, 5.4 m at the top of the domain

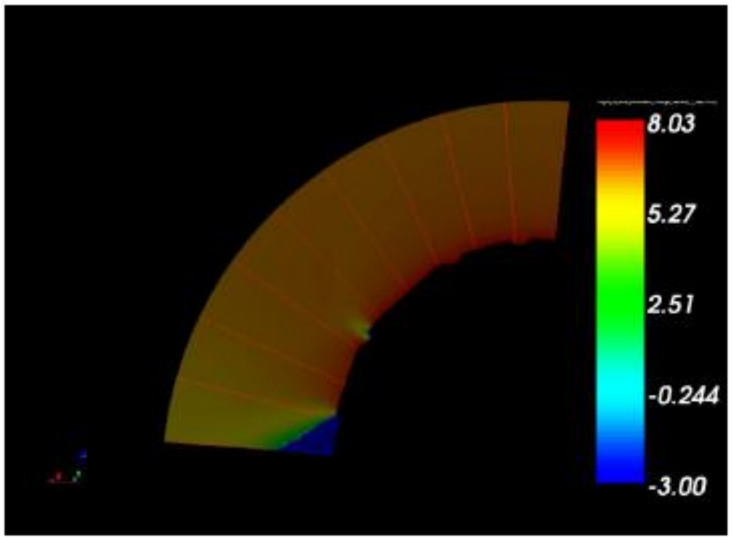
Simulation Parameters

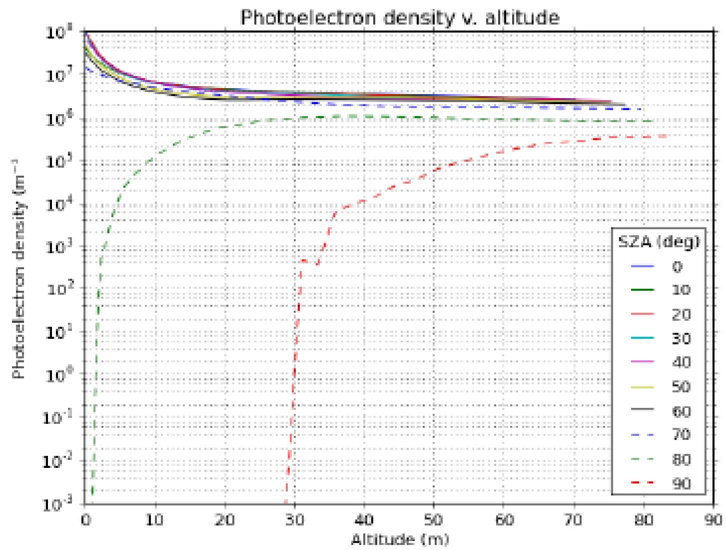
Parameters	Values
Semi-minor radius (x axis)	100m. Simulation domain extends 85m above asteroid surface along X axis.
Semi-major radius (Z axis)	115m. Simulation domain extends 70m above asteroid surface along Z axis.
Y	-1 to 1 m

Photoelectron Sheath



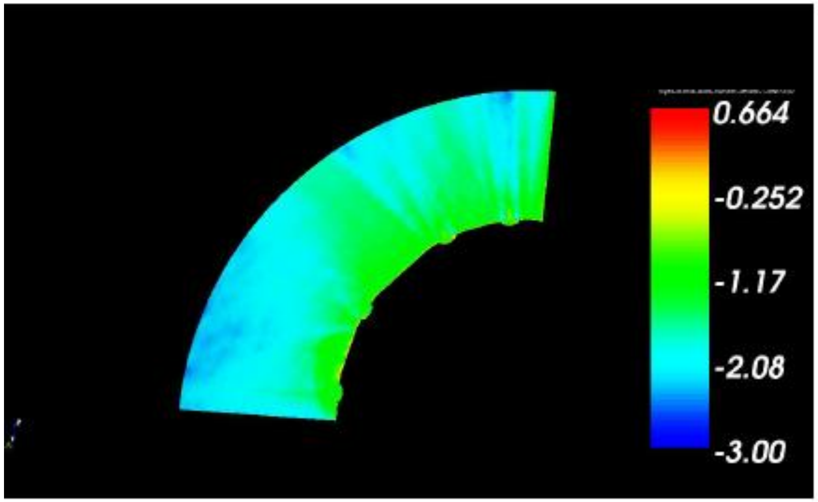
Photoelectron density as a function of altitude



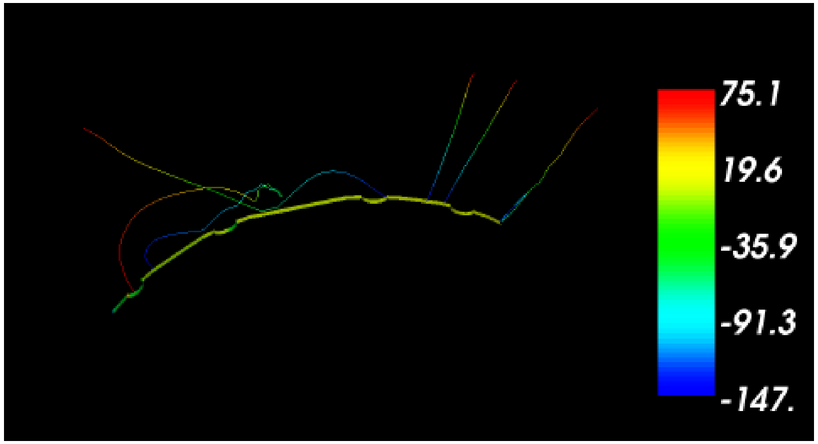


$\log_{10}$ of photoelectron charge density (m^{-3} ecu) with reduced transparency to highlight the probing lines; SZA = 90° at 9 o'clock, 0° at 12 o'clock.

Dust Density and trajectory



Log10 of dust density

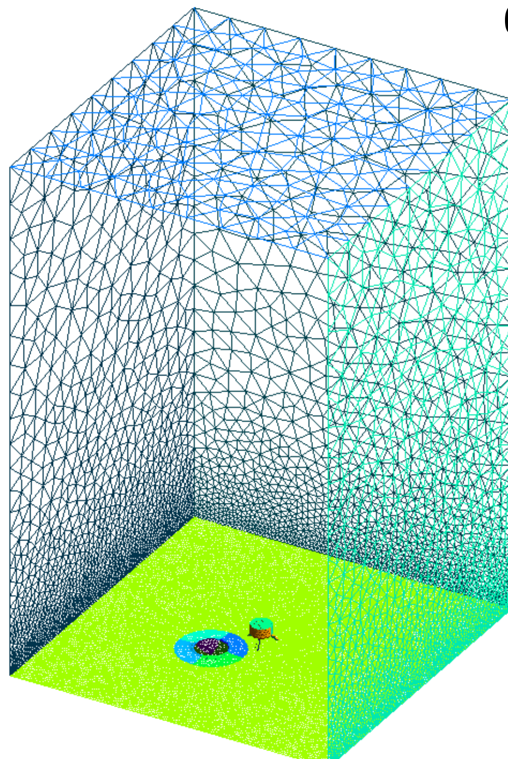


3D Simulation Domain

Lancaster University

Top, open boundary, 0V
6m mesh

Sides, periodic boundary
80m high



Crater, non-conductive
(dielectric) lunar dust
5m diameter
1m deep

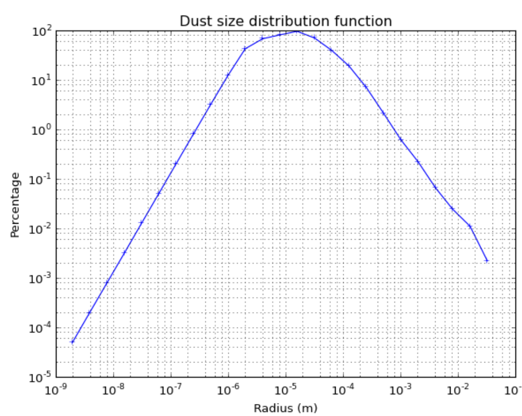
Lander 3m diameter
Solar cells on upper part

Lander underside and legs
aluminum

Bottom surface, conductive
lunar dust
50 x 50m; 0.6m mesh

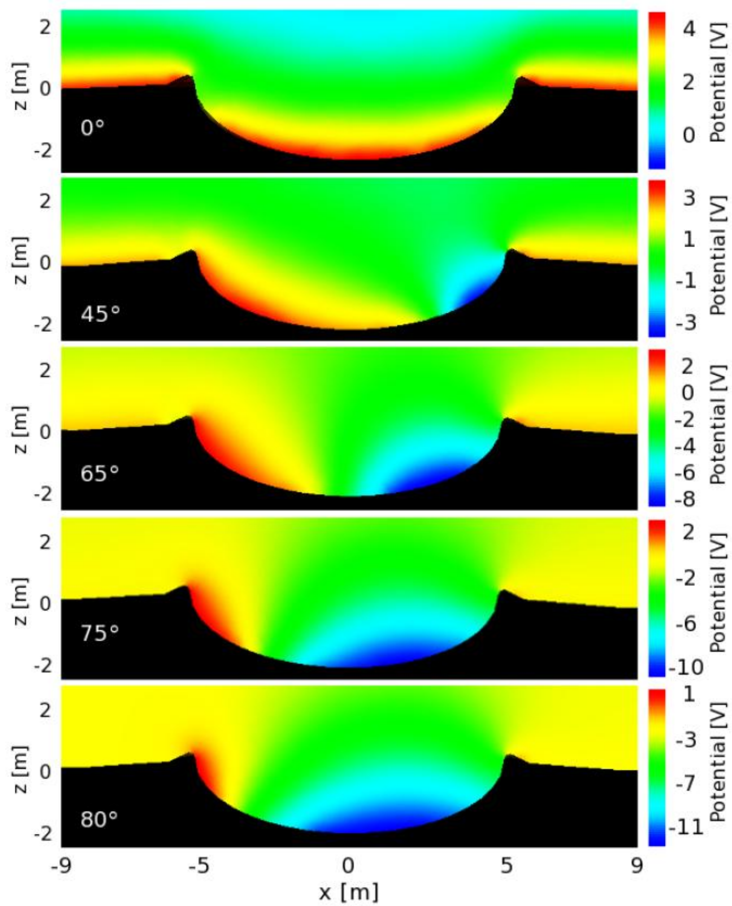
Simulation Parameters

Parameter	Value
Solar wind speed	400km/s
Electron and ion densities	1×10^7 m^{-3}
Electron and Ion temperatures	10 eV
Photoelectron distribution function	Maxwellian



Dust Distribution: taken from Lunar source book 1991, extrapolated for dust particles <1 μm

Electric Potential for different SZA

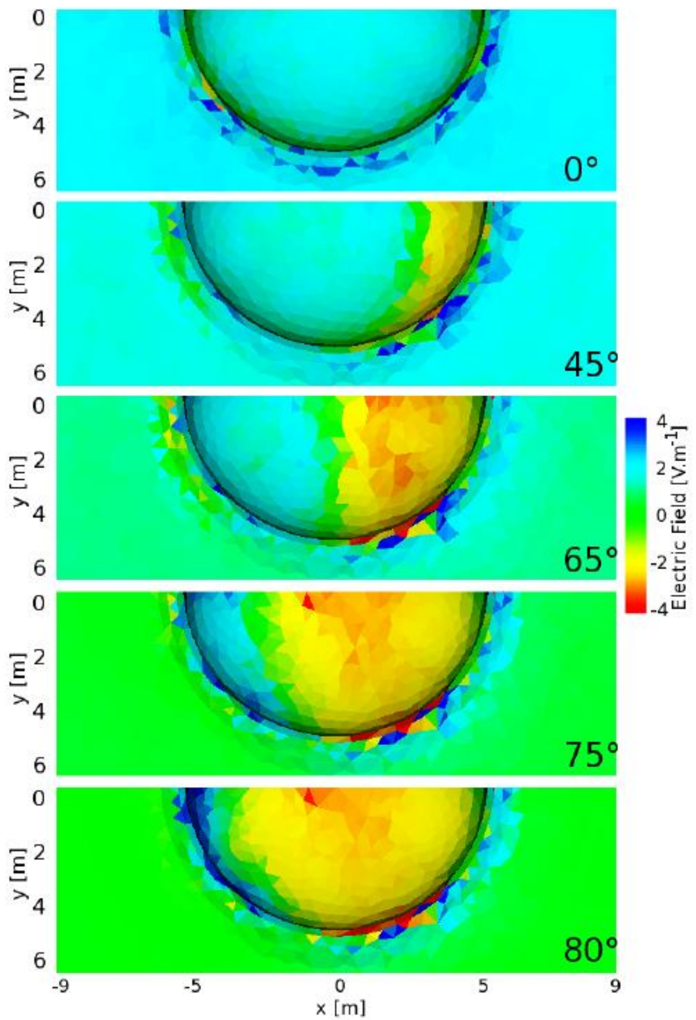


Because of both the sunlight and solar wind ion shadowing by the crater rim, the inside of the crater becomes very negative, down to potential of -15V in for SZA=82

The sunlit edge of the crater stays at a nearly constant potential of 1 - 2 Volts.

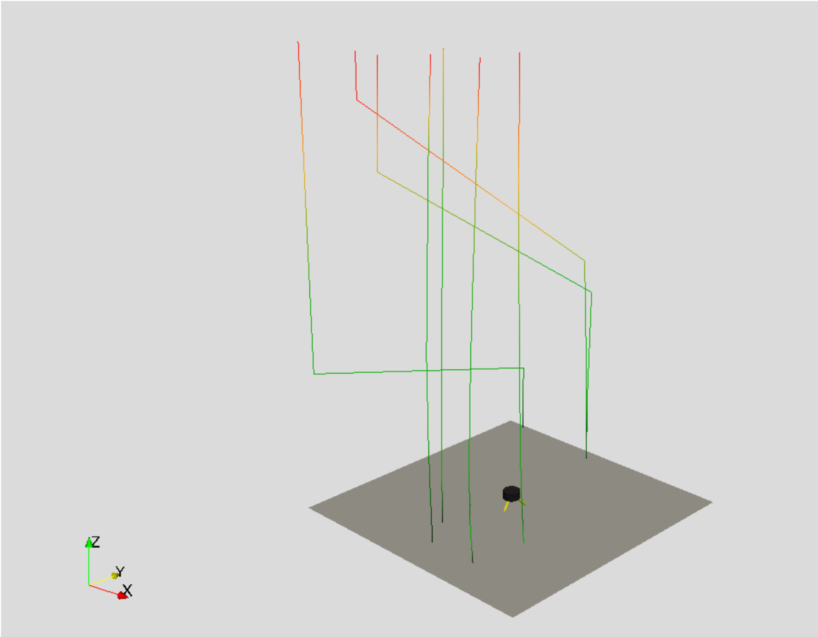
The flat surfaces out of the crater are positively charged for SZA<70 and negative for larger SZA.

Electric field normal to the surface

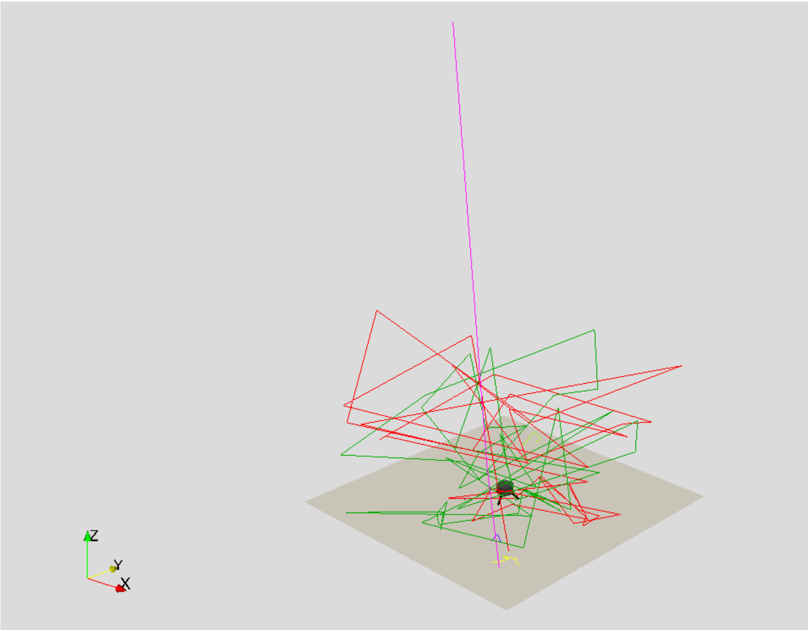


At low SZA, the electric field is mostly positive on the whole surface, leading to a positive charging of the surface dusts, whereas for large SZA the electric field is nearly
zero for at surfaces, and mostly negative in the crater, leading to the negative charging of the dusts.
Since the dust charge positively once emitted due to photoemission, the low SZA case seems more suitable to generate dust levitation, contrary to usual expectations.

Dust trajectory

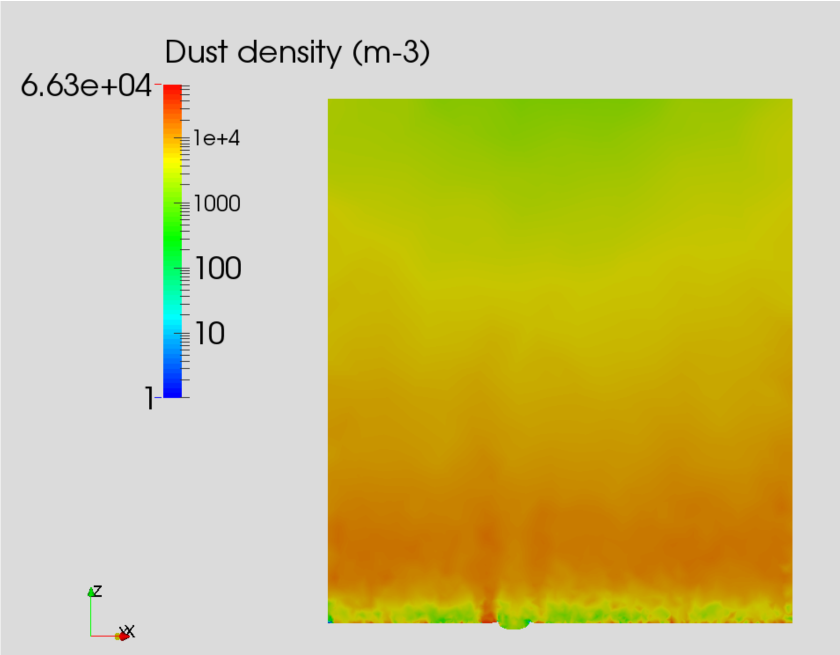


SZA=0, Lander

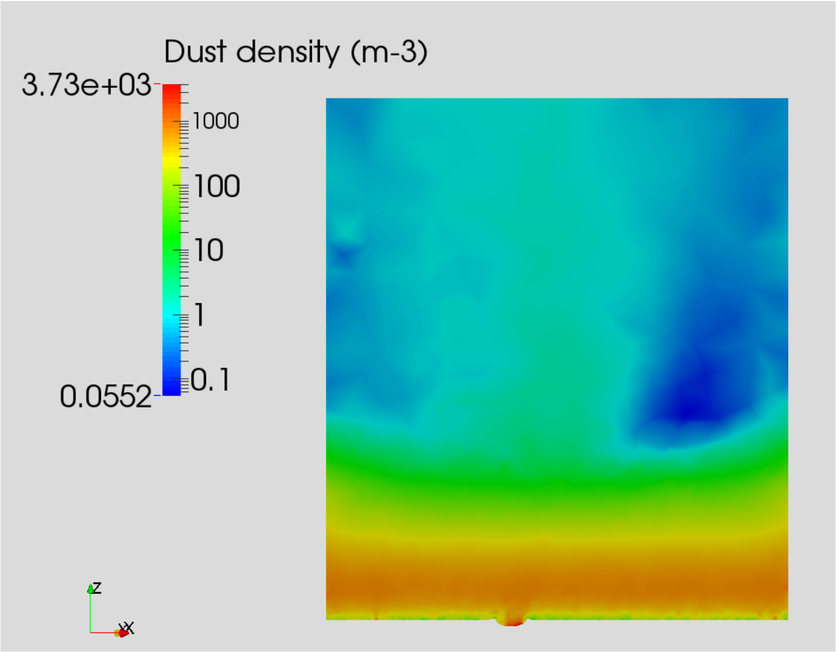


SZA=80, Lander

Dust Density in the vicinity of Crater

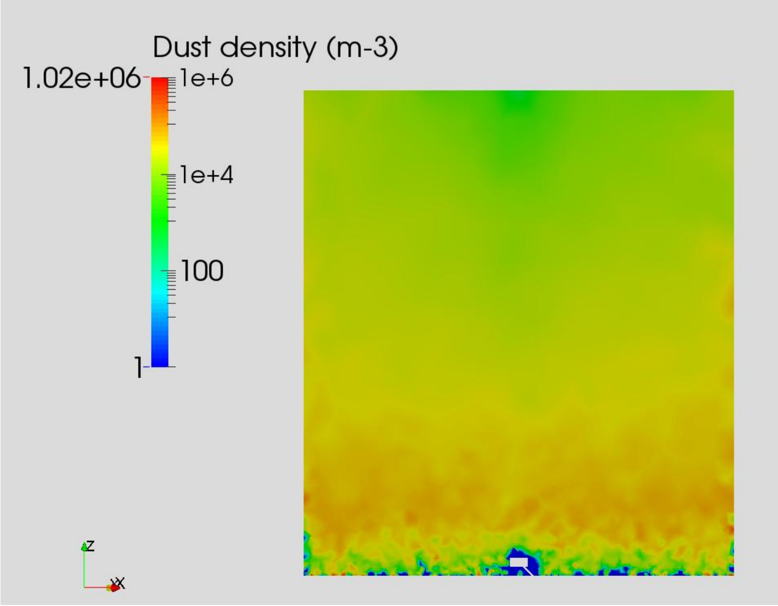


SZA=0, Crater

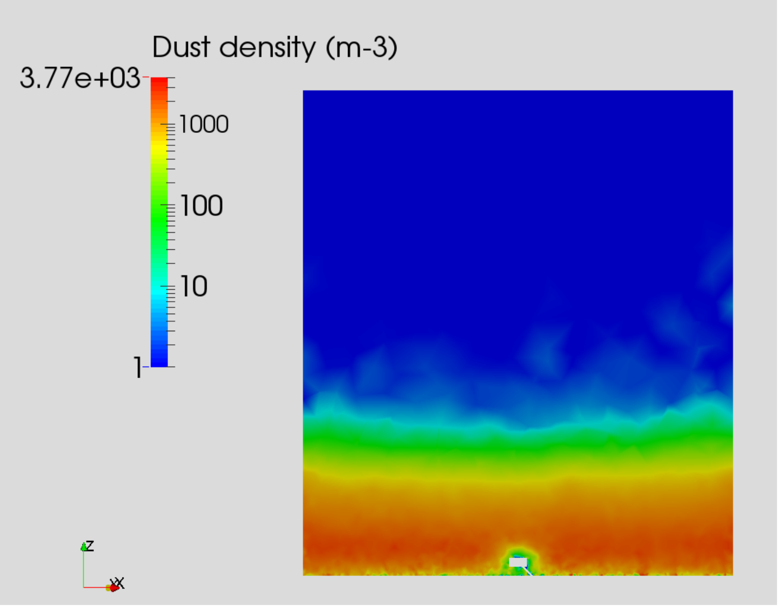


SZA=80, Crater

Dust Density in the vicinity of Lander

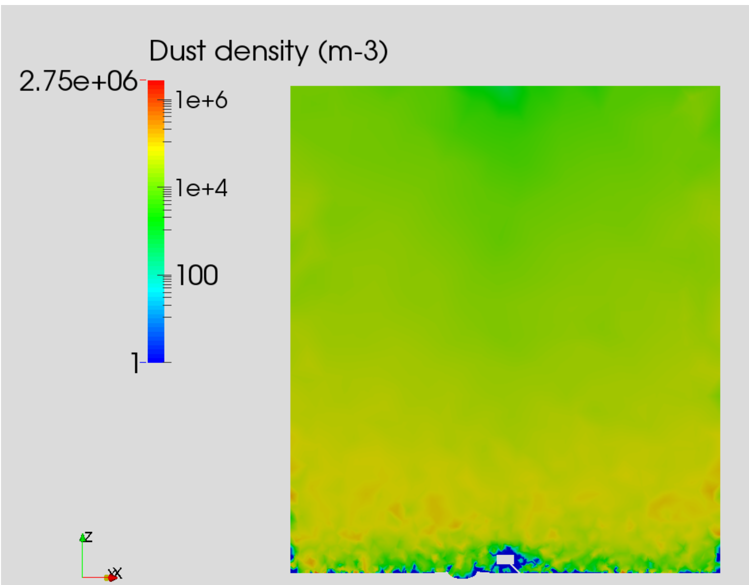


SZA=0, Lander

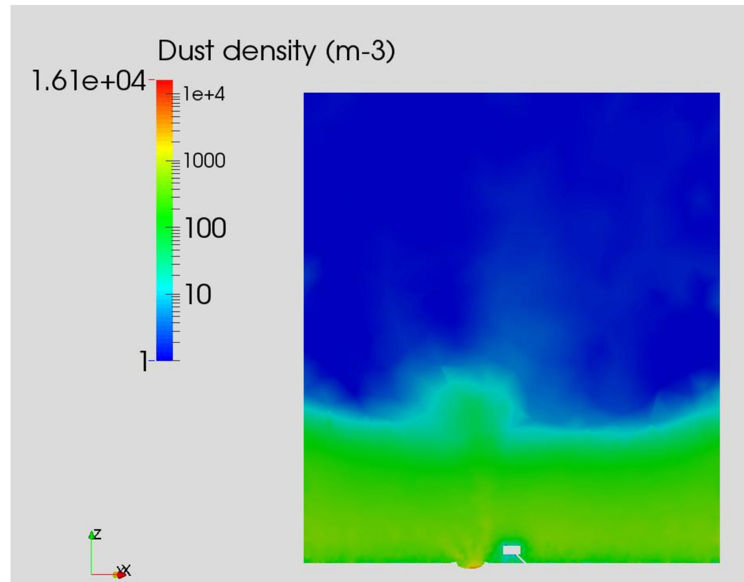


SZA=80, Lander

Dust Density in the vicinity of Crater and Lander



SZA=0, Lander and Crater



SZA=80, Lander and Crater

Thank you for listening