Limits On Lunar Reorientation From Small(er) Craters

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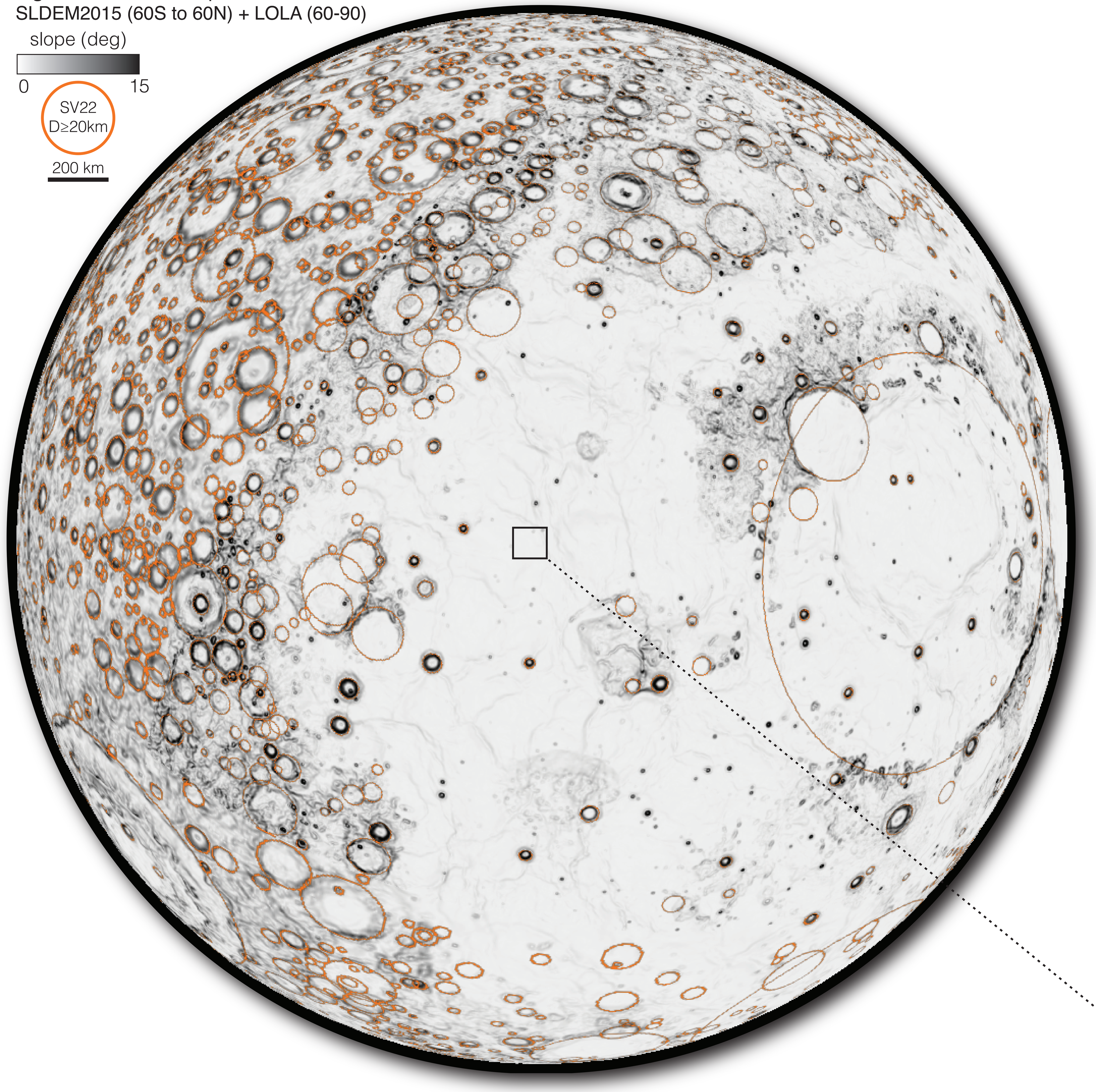
Fig A: Lunar terrain slope based on:
SLDEM2015 (60S to 60N) + LOLA (60-90)



Craters between 20 to 1200 km in diameter (D) are a significant contributor to the Moon's True Polar Wander (*Smith, Viswanathan et al. 2022/PSJ*).

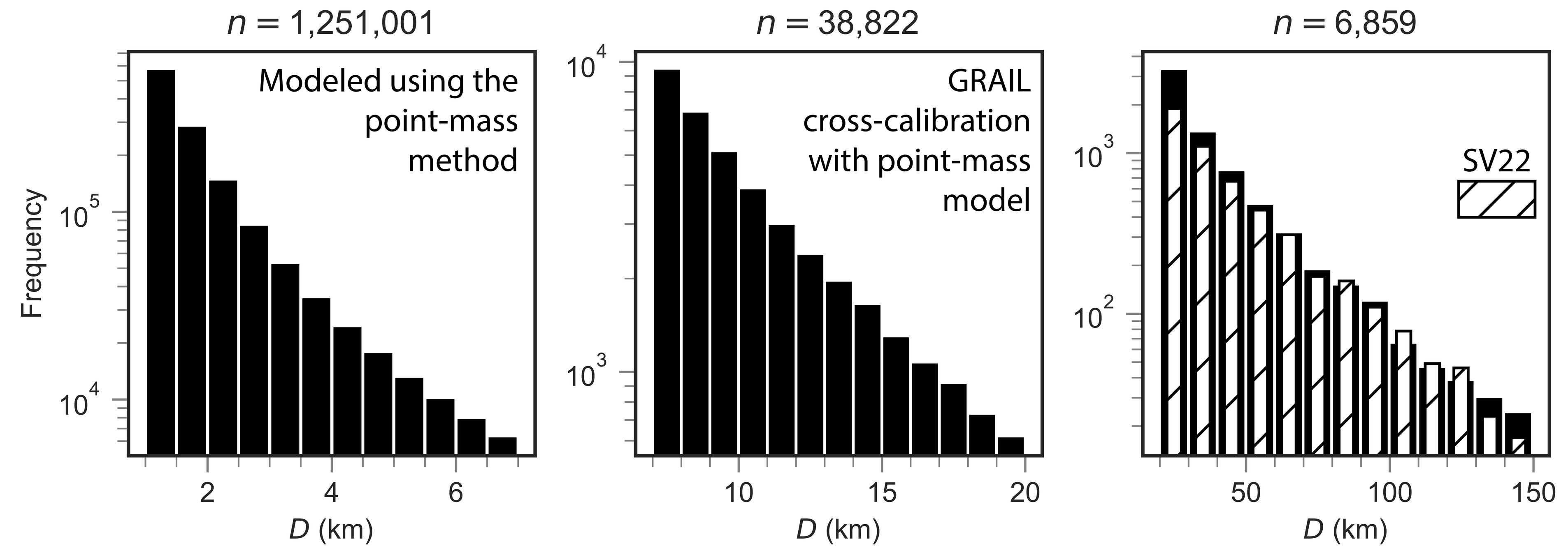


Fig B: Size frequency distribution of lunar craters. Larger craters are modeled directly from a GRAIL gravity map (using the SV22 method), while the smaller craters are forward modeled using a digital elevation model, surface density, porosity, a geometrical shape approximating the crater and a cross-calibration with the SV22 method.

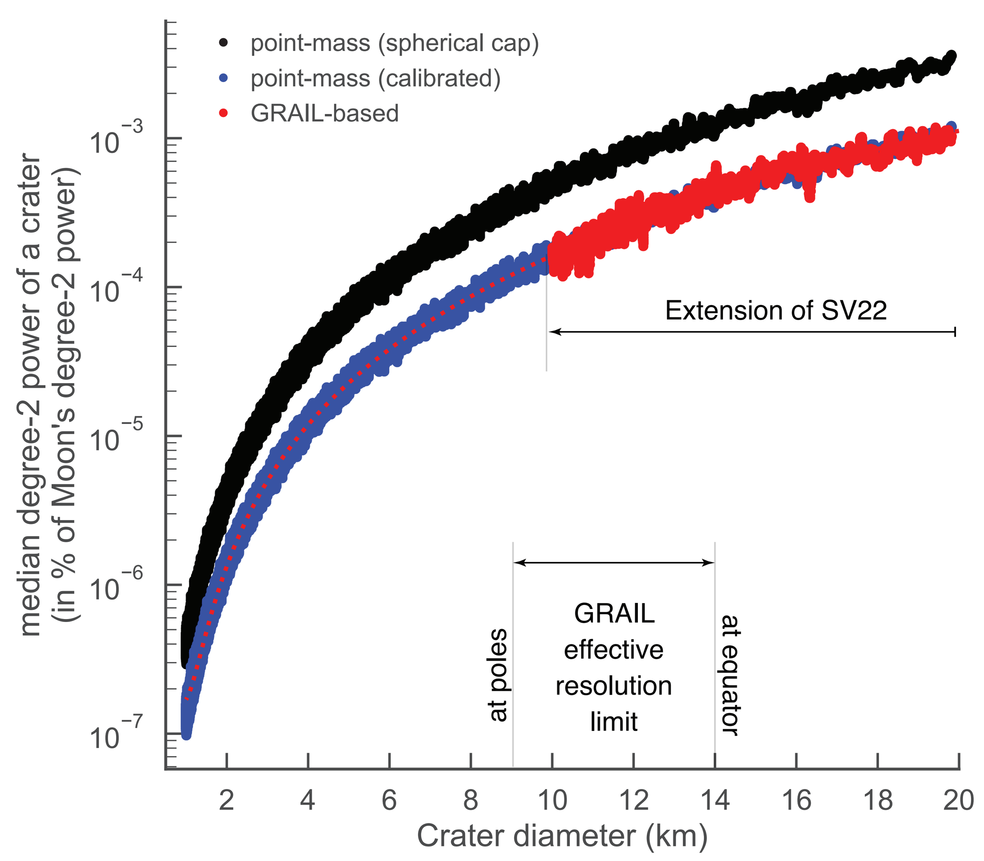
Fig C: Spatial distribution of 1.29M craters in $1 < D < 20$ km from Robbins (2019); darker means denser crater distribution.

QUESTION **Are craters with D<20km significant for the Moon's True Polar Wander?**

APPROACH
a. Extend the method from SV22 to limits of GRAIL effective resolution.
b. Forward model craters with point-mass approximation & calibrate.

RESULTS **The maximum net influence of ~1.3M craters between 20 > D ≥ 1 km on the pole position is between ~1.29-2.15° in latitude.**

TAKE AWAY **Cratering reoriented the Moon, changed the illumination conditions of its polar regions, and therefore the time-history of polar volatiles.**



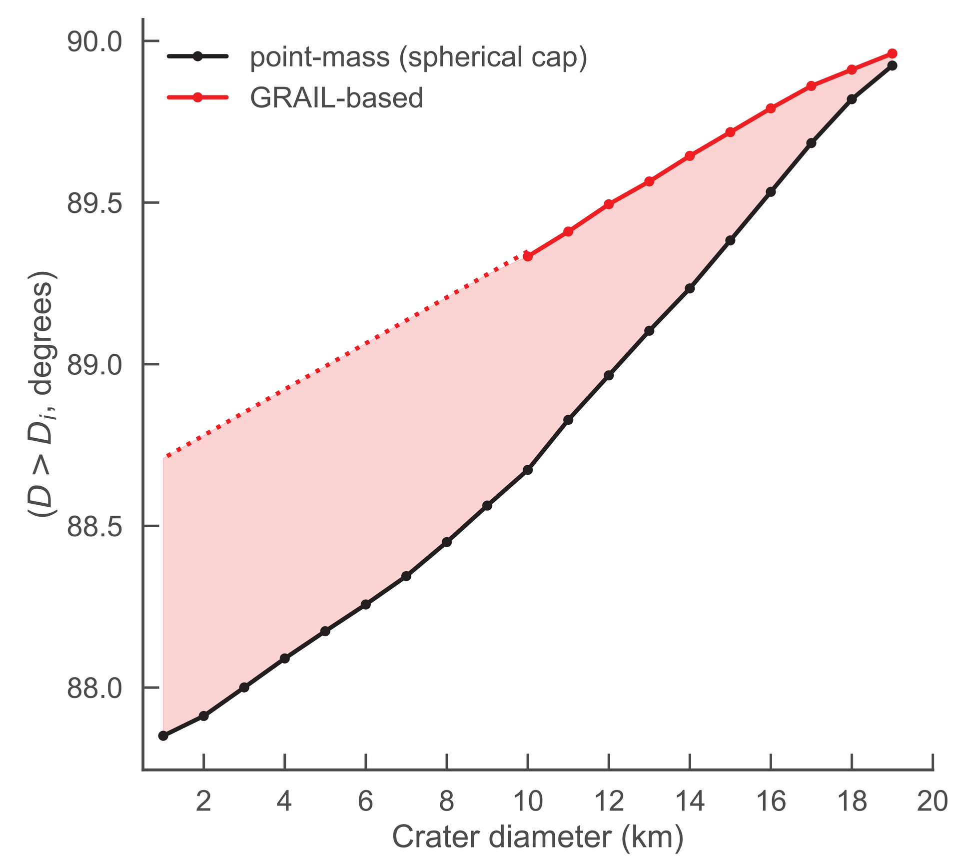
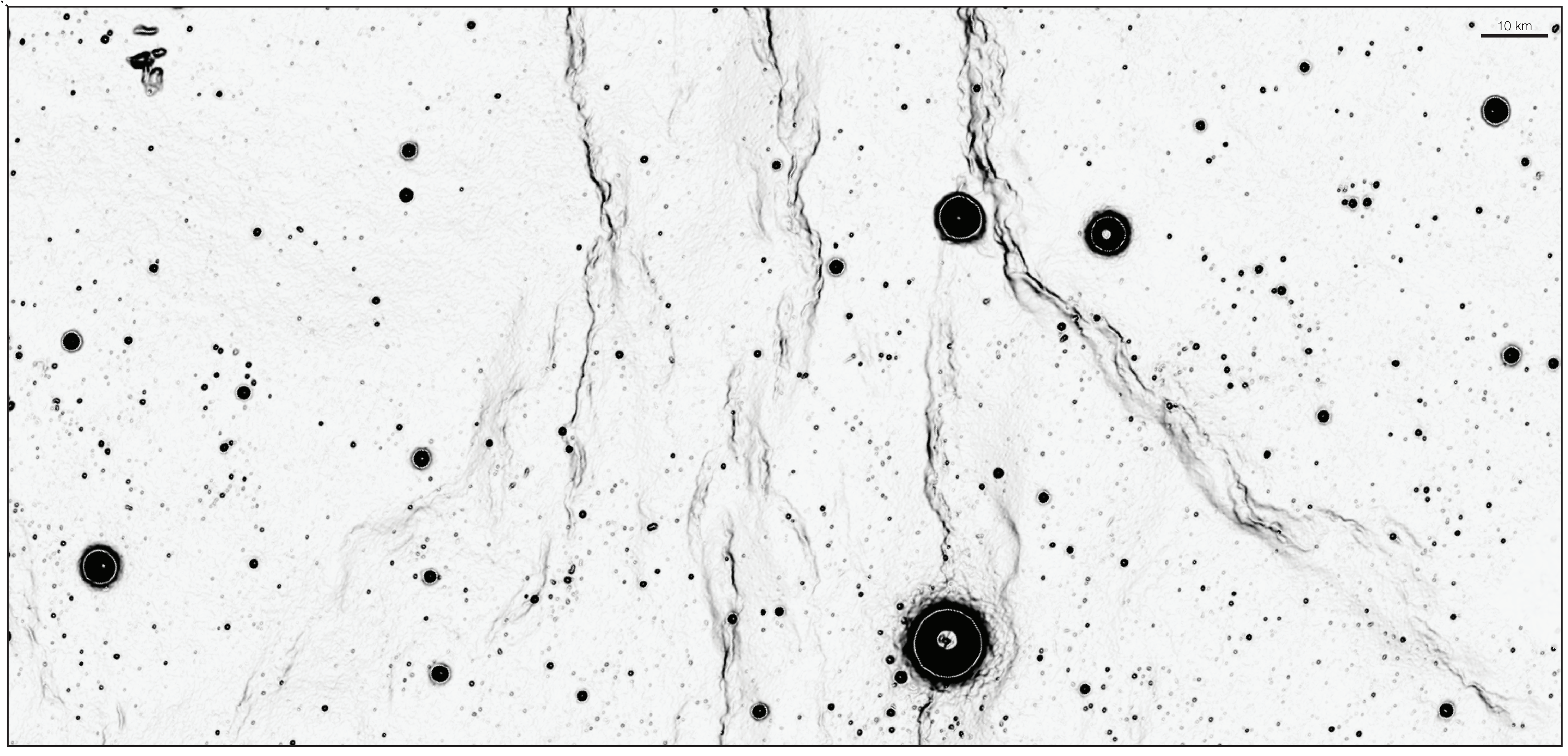


Fig D: Degree-2 power of each crater sorted by size. A calibration is needed to approximate the point-mass (spherical cap) method to GRAIL-based modeling.

Fig E: Pole movement accumulated by crater size; from diameter 20 km to 1 km. The influence of craters not considered in the SV22 study contribute to <2.2° degrees.



Craters with D<20 km exist in areas showing no crater in SV22.

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