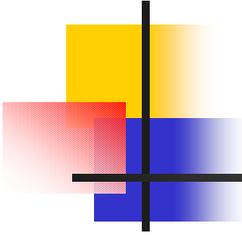


The Roughness of the Martian Surface: What we Know.

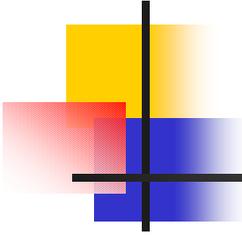
- Michael K. Shepard, Bloomsburg Univ.
- Frank P. Seelos IV, Washington Univ.
- Raymond E. Arvidson, Washington Univ.
- Albert Haldemann, JPL



Goals of This Work

- **Characterize** known landing sites at all possible spatial scales
- Use to **calibrate** other remote sensing techniques for estimating surface roughness.

Examples: Photoclinometry, MOC stereo, MOLA pulse-width, Radar



Data from Prior Landing Sites

- **Pathfinder**

- USGS DEM
- Rover Wheel Slopes
- MOLA Point-to-Point (PtP) Slopes

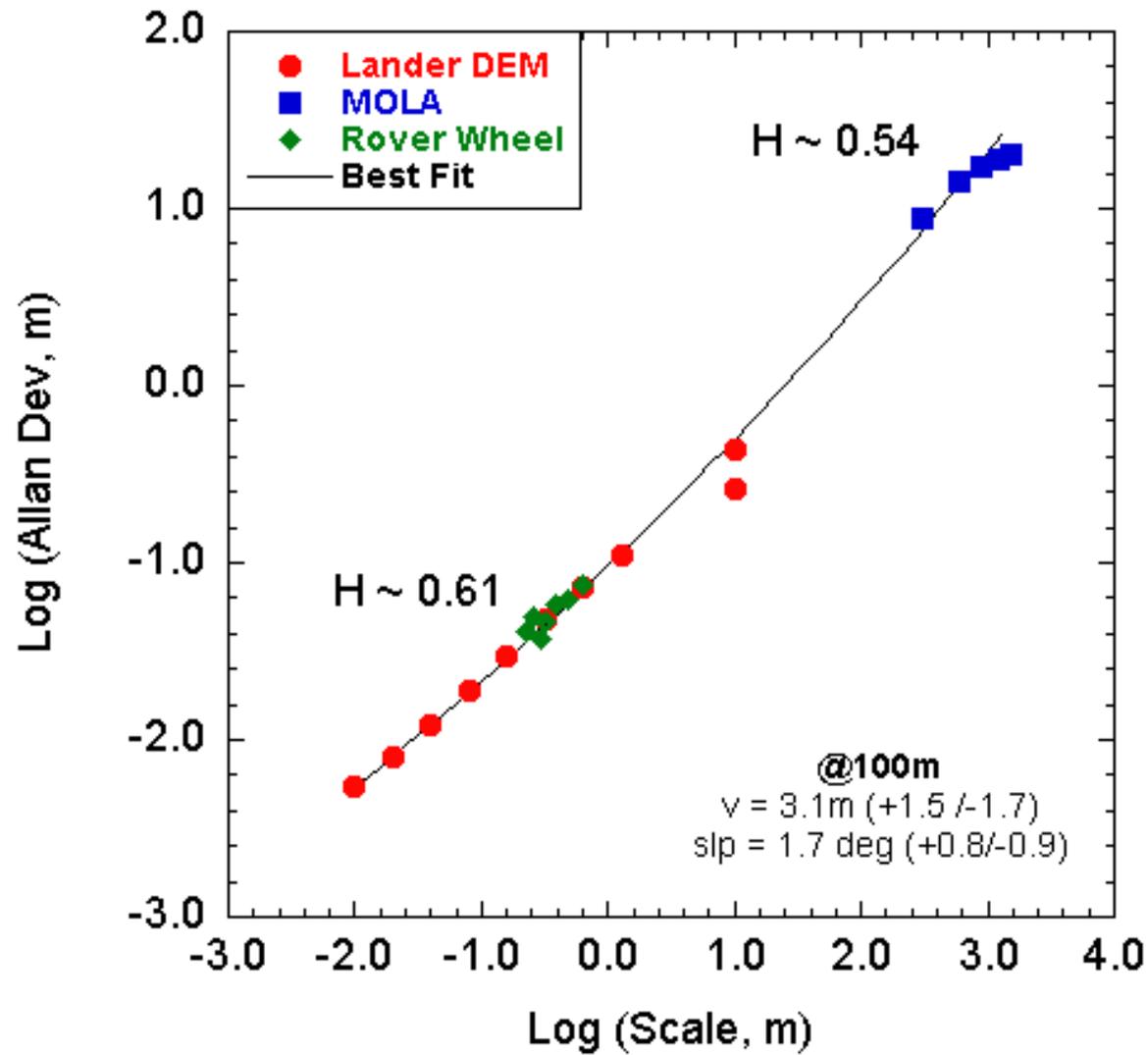
- **Viking Lander 1**

- New Stereo DEM
- MOLA PtP Slopes

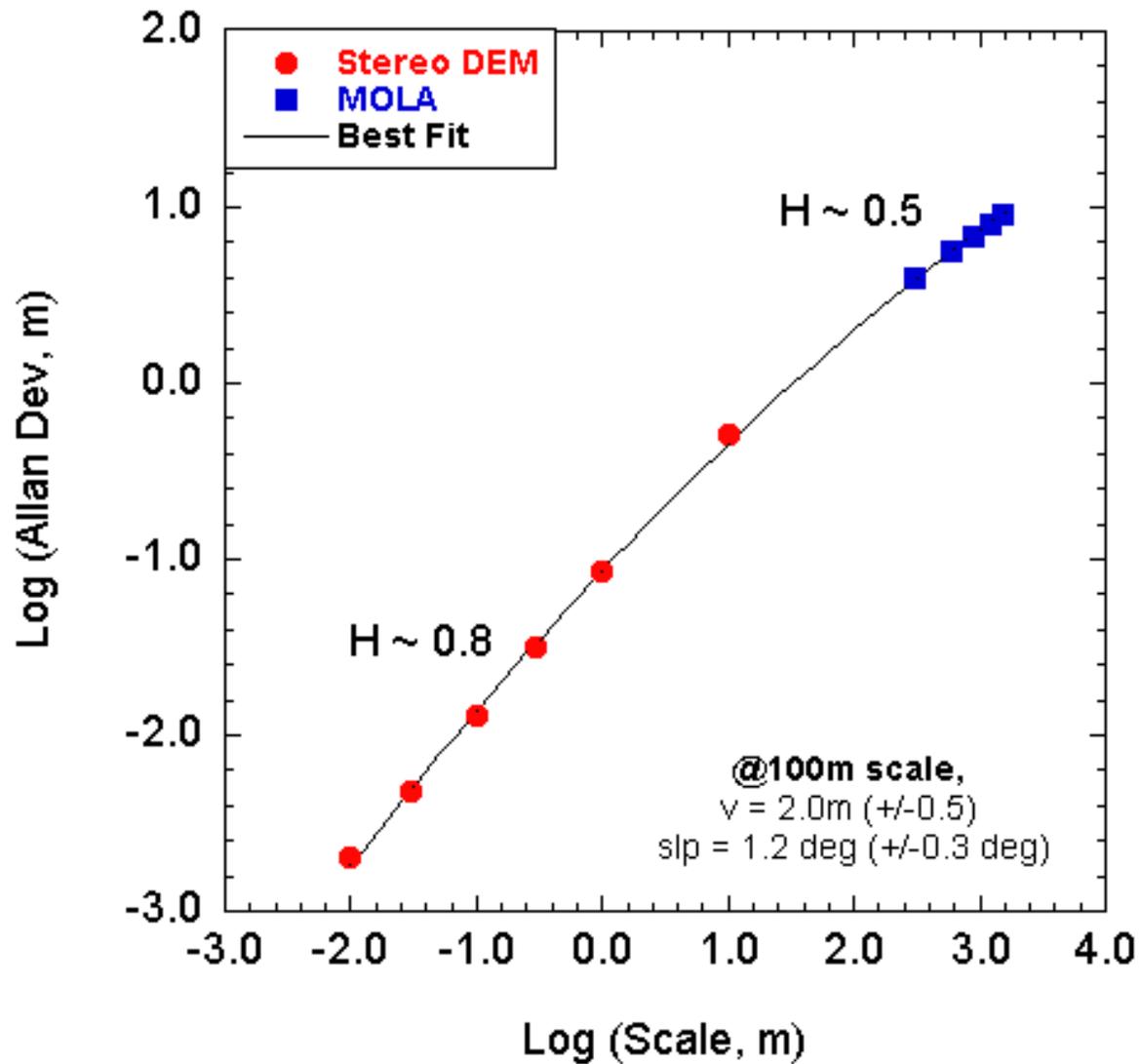
- **Viking Lander 2**

- Some New Stereo DEM
- MOLA PtP Slopes

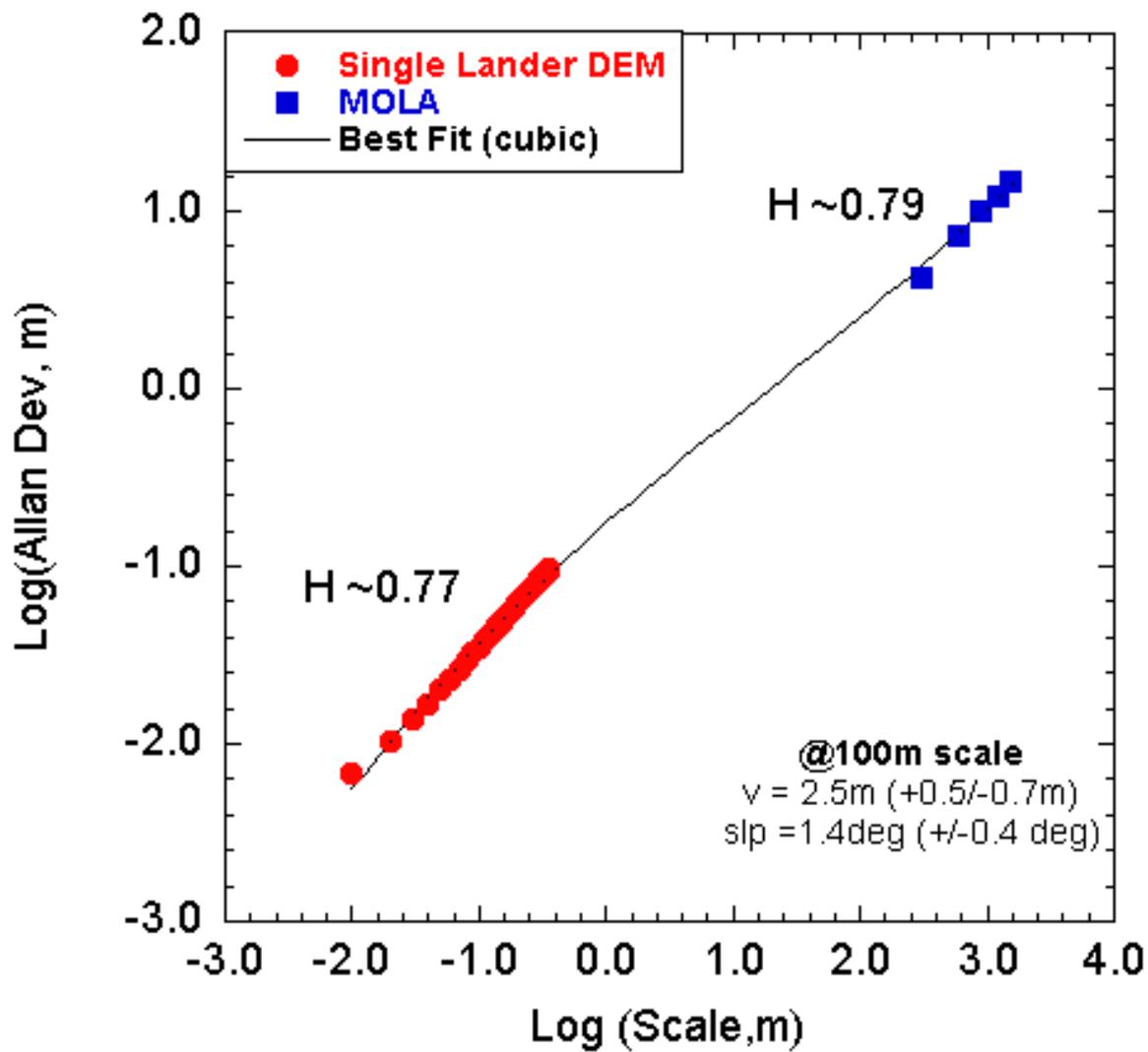
Pathfinder Topography



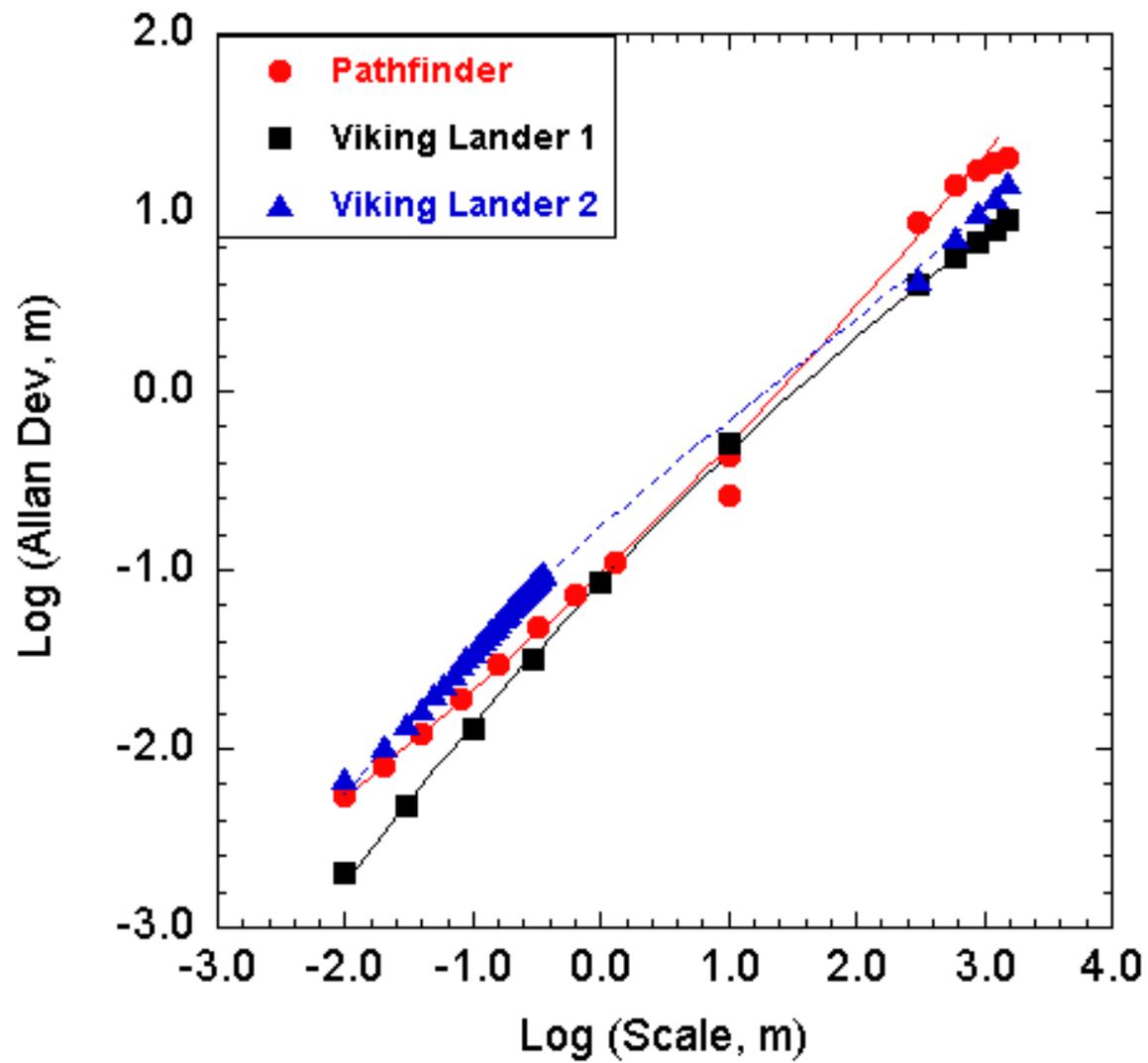
Viking Lander 1 Topography

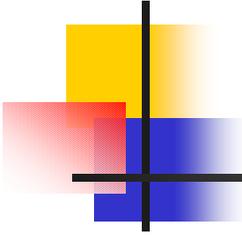


Viking Lander 2 Topography



Comparison





Some Numbers...

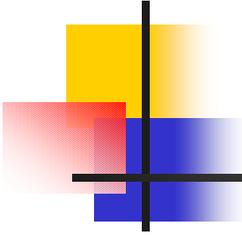
■ Pathfinder

- Hurst exponent 0.54 - 0.61
- RMS slope
 - @ 100m $1.7^\circ \pm 0.9^\circ$
 - @ 10m $2.5^\circ \pm 1.0^\circ$
 - @ 1m $5.4^\circ \pm 1.0^\circ$

Best fit to all data (x and v in meters)

$$\log(v) = -1.018 + 0.685 \log(x) + 0.032 \log^2(x)$$

All three data sources are reasonably consistent.



More Numbers...

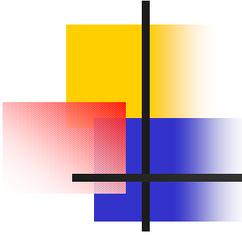
■ Viking Lander 1

- 83 new profiles from stereo
- Hurst exponent 0.5 - 0.8
- RMS slopes
 - @ 100m $1.2^\circ \pm 0.3^\circ$
 - @ 10m $3.0^\circ \pm 1.0^\circ$
 - @ 1m $4.8^\circ \pm 1.0^\circ$

Best fit to data (x and v in meters)

$$\log(v) = -1.063 + 0.760 \log(x) - 0.038 \log^2(x)$$

Data from profiles and MOLA are consistent but roll over.



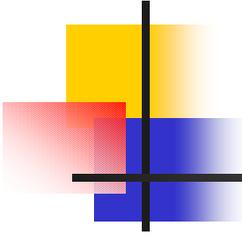
Still More Numbers...

■ Viking Lander 2

- Only 1 usable new profile *so far* (6m long)
- Hurst exponent ~ 0.8
- RMS slopes
 - @ 100m $1.4^\circ \pm 0.4^\circ$
 - @ 10m $3.8^\circ \pm 2.0^\circ$
 - @ 1m $8.8^\circ \pm 3.0^\circ$

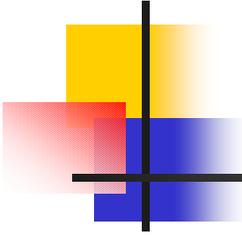
Best fit $\log(v) = -0.76 + 0.63 \log(x) -$
 $0.04 \log^2(x) + 0.011 \log^3(x).$

Hurst exponents at all scales are consistent. Meter-scale roughness is poorly characterized from a single profile.



Results

- All sites have comparable roughness at 10m-50m scales.
- VL2 is one of smoothest at large scales, but roughest at small scales.
- VL2 site may be misleading since it's based on only one 6m profile. However, it is generally consistent with rock abundance data from Golombek and Rapp [1997].



Application for MER03

- Use as “calibration” sites for remote sensing techniques at lander (~1m-100m) scales.
- Calibrated techniques can then be applied more confidently to prospective landing sites for MER.