Continuous Particle Size Mapping of Alluvial Fan Material in Mojave Crater from HiRISE Imagery. P. E. Carbonneau[1] K. Goddard[2], S. Gupta[2]. [1] Durham University, Dept. Geography, Science Laboratories, DH1 3LE, UK. patrice.carbonneau@dur.ac.uk. [2]Dept. Earth Science & Engineering, Imperial College London, South Kensington Campus, SW7 2AZ, UK.

Introduction: In terrestertrial environments, the need to understand sediment size distributions across entire watersheds has prompted much research and progress in the field of fluvial remote sensing [1]. As a result, it is now possible to continuously map riverbed material grain sizes at submetric resolution with the use of high resolution airborne imagery [2]. In these fluvial environments, image texture is strongly correlated with the particle size of the exposed material. Once this relationship is calibrated, it is possible to measure grain sizes continuously over very large areas with the use of high resolution aerial photography. Calibration of these methods usually requires field measurements of grain size [2]. However, it has also been demonstrated that grain sizes can be continuously mapped without the need for such field-based calibration data [3]. Furthermore, the findings of [2] show that the minimal grain sizes that can be measured with this method approach half-pixel sizes. When applied to HiRISE imagery having a resolution of 25cm, these methods could potentially measure particles as small as large cobbles, continuously, for extended areas. To our knowledge, no comparable data exists for this size range. Such data could allow for significant advances in our understanding of alluvial fans on Mars where the full understanding of the dynamic processes responsible for the formation of these fans is currently hindered by the lack of data on particle size [4]. Consequently, this paper discusses the use of recent grain size mapping methods developed for terrestrial rivers in a Martian context. Specifically, we show that HiRISE images of Mojave crater are of sufficient spatial and radiometric resolution to allow for large scale, continuous, size measurements of coarse (cobble and above) sediments.

Methods: A method dubbed 'aerial photosiving' [3] was employed in order to collect a calibration data set. This involves direct, on-screen measurements of boulders in HiRISE images of Mojave Crater. A boot strapping approach, combined with a Monte Carlo parameter optimization, is then employed to find the optimal texture parameters. This then allows for the production of optimized grain size maps.

Preliminary Results: The initial results derived from a 250 point calibration dataset showed that texture was correlated with visible particle sizes with an r^2 of 0.32. This relationship is significant at the 99.99% confidence level. Whilst weaker than those observed [2,3], it clearly demonstrates that grain size information can be derived from HiRISE imagery. Figure 1 shows an example of an image and the associated grain size map. Future work, to be presented at the conference, will focus on improving the optimization with additional calibration points and on the estimation of reliable error bounds for the grain size estimates.

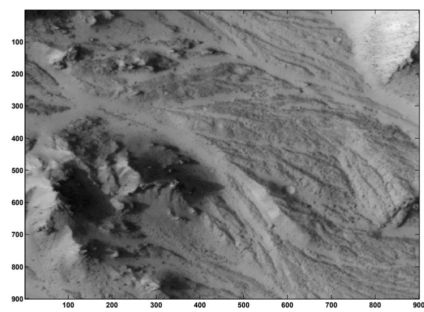

Figure 1A: Sub-image of Mojave Crater extracted from HiRISE tile PSP_002167_1880

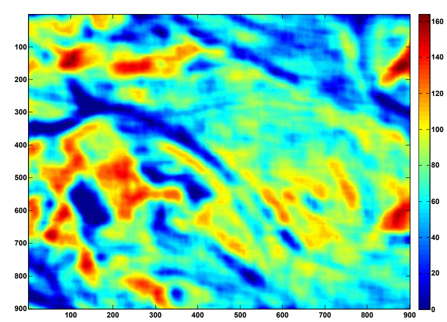

Figure 1B: Grain size map for the sub-image in 1A. The map gives median grain size for local areas of 45X45 pixels (11.25m). Fine grained channel patterns are identified as well as coarse boulders and crags.

Conclusion: This work demonstrates that cobble and boulder sized materials can be continuously measured from HiRISE imagery. Such information is highly valuable and will help to constrain the geomorphic processes which have created these alluvial fans.

References: [1] Marcus and Fonstad (2008), ESP&L vol 33. [2] Carbonneau et al. (2004) *Water Ressources Research,* vol 40. [3] Carbonneau et al. (2010) ESP&L doi: 0.1002/esp.1936 [4] Williams, R, Malin, M (2008) *Icarus*, 198.