Development of a New GIS Database of Lunar Impact Craters. D. T. W. Buckingham , B. Salimkumar, and N. G. Barlow, Dept. Physics and Astronomy, Northern Arizona University, Flagstaff, AZ 86011-6010.
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Introduction: The lunar surface is scarred with impact craters. Morphological and morphometric measurements of these craters, compiled into datasets, facilitate the study of impact cratering and its effects on the lunar surface. Several datasets were compiled in the past but they do not cover the entire lunar surface and are limited in their utility. Thus, it is vital that a new global catalog of lunar impact craters is compiled to further aid in expanding our comprehension of these surface features. The aim of this project is to create a new GIS database of all lunar impact craters, ≥5-km-diameter. The current stage of this project is focusing on impact craters in the eastern equatorial region (±45° latitude zone) on the lunar nearside.

Outline of Project: The project consists of the following steps: (1) Existing databases derived originally from Lunar Orbiter IV photographs, Apollo images and Earth-based telescopic observations will be converted into digital format. The entries in these datasets will be cross-referenced in the new crater database being produced in this project. (2) Using the Clementine GIS map of the lunar surface, we will measure diameters and central coordinates of all craters ≥5-km-diameter across the entire lunar surface. (3) We will update the morphologic and morphometric characteristics of all impact craters using Lunar Reconnaissance Orbiter (LRO) image (LRO Camera (LROC)) and topography (Lunar Orbiter Laser Altimeter (LOLA)) data. (4) We will incorporate information on surface composition and soil maturity using data from Clementine, Lunar Prospector, and LRO. (5) We will conduct detailed analyses to look for correlations in crater characteristics as a function of latitude, longitude, geologic unit, surface composition, and soil maturity. (6) The updated database will be archived in the Planetary Data System (PDS) and through the USGS Planetary Interactive GIS on the Web Analyzable Database (PIGWAD) system for access by the planetary exploration community.

Existing Lunar Crater Databases: A number of lunar impact crater databases have been compiled over the years—see summary compiled by C. Wood at *themoon.wikispaces.com/Catalogs+of+Lunar+Craters*.
All of these existing databsets are limited in terms of completeness—some only list craters >20-km-diameter, others only include named craters, and others only include near-side craters. We are digitizing data contained in three of these datasets: *Arthur et al.* [1-4], *Pike* [5], and *Andersson and Whitaker* [6]. The *Arthur et al.* catalogs cover the entire near-side of the Moon and were derived from Earth-based telescopic data. The *Pike* dataset includes morphometric measurements of 339 impact craters derived from Apollo 15-17 orbital imagery and is the basis for most of the morphometric relationships for impact craters throughout the solar system. The *Andersson and Whitaker* catalog is a subset of a larger catalog of the morphologic and morphometric characteristics of near-side impact craters which was compiled by *Wood and Andersson* [7], but which has subsequently been lost. Details of these databases are provided in Table 1. We are converting these datasets from PDF to Excel format to facilitate data searches and sorting of the information contained within them. The craters in these datasets also will be cross-referenced in our new GIS crater database

Current Work: We have converted the first two quadrangles of the *Arthur et al.* catalog [1,2] and the *Pike* [5] morphometric dataset into Excel format. Latitudes, longitudes, and diameters of each impact crater in the *Arthur et al.* Quads 1 and 2 were compared with those in the *Andersson and Whitaker* database and crater names were updated as necessary.

We are utilizing the GIS-based Lunar Orbiter and Clementine (UVVIS 750 nm) image maps provided by the USGS to measure the diameters and determine the central coordinates of all lunar impact craters ≥5-km-diameter in the eastern hemisphere of the lunar nearside (0°E to 90°E and 45°N to 45°S) (Figures 1 and 2). Mapping of the polar regions is being conducted concurrently by Scott Mest [8]. To date, we have cataloged over 1550 craters (both named and unnamed) using ArcGIS. We have found that most of the craters in the Arthur et al., Pike, and Andersson and Whitaker catalogs are offset from their actual positions as determined from the 2009 Unified Lunar Control Network (ULCN 2009). [9]. Diameters measured for this catalog range from 5 to 460 km and are typically within 15% of the values cited in the previous lunar crater catalogs.

Future Work: Existing impact crater catalogs [e.g. 1-6] are incomplete in terms of their coverage and do not include the range of data now available. This project will utilize Lunar Reconnaissance Orbiter Camera (LROC) images to re-evaluate the morphology classifications for each crater in our new impact crater database. We will use LRO Lunar Orbiter Laser Altimeter (LOLA) data to determine morphometric characteristics such as crater depth, rim height, and central peak diameter and height—these values will be compared to crater diameter to determine if the existing

morphometric relationships remain valid. We also will utilize information from Clementine, Lunar Prospector, and LRO to include information about local and regional composition and optical soil maturity for each crater in our database. The end result will be a database that is easily accessible by the planetary exploration community for potential future studies in lunar-surface age and composition distribution.

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References: [1] Arthur D. W. G., et al. (1963) *Comm. LPL*, v. 2, #30. [2] Arthur D.W.G., et al., (1964), *Comm. LPL*, v. 3, #40. [3] Arthur D.W.G. , et al. (1965), *Comm. LPL*, v. 3, #50. [4] Arthur D.W.G., et al. (1966), *Comm. LPL*, v. 5, #70. [5] Pike R. J. (1980) *USGS Prof. Paper 1046-C*. [6] Andersson L. E. and Whitaker E. A. (1982) *NASA Ref. Pub. 1097*. [7] Wood C. and Andersson L. (1978) *Proc LPSC 9th*, 3669-3691. [8] Mest S.C. et al., (2010) LPSC XLI, Abstract #2363. [9] Archinal B. A., et al. (2006) *The Unified Lunar Control Network*, USGS Open-File, Report: 2006-1367.

Table 1: Additional information on existing lunar impact crater databases

Author	Data Source	Number of Craters	Comments
Arthur et al.	Earth-based telescope	~16,700	Size, location and interior morphology. Near-side only.
Pike	Apollo images	339	Morphometric measurements
Wood and Andersson	Lunar Orbiter IV photographs	11,462	Location, diameter, morphological type and preservation state. Near-side only. Lost
Andersson and Whitaker	Wood and Andersson subset	6,231	Named craters only

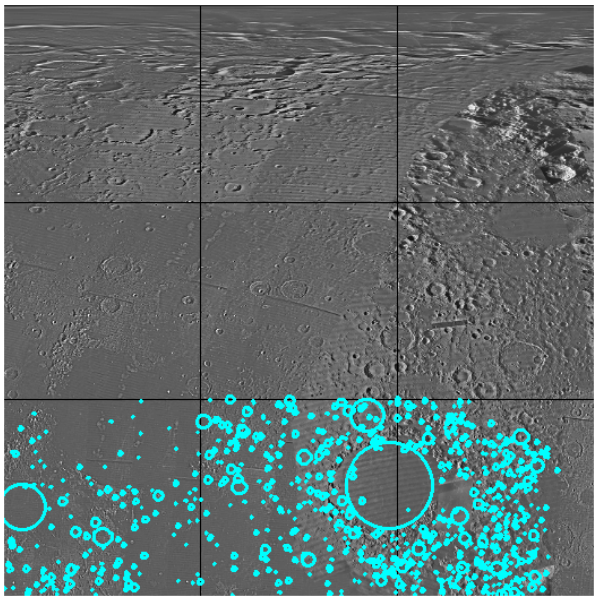

Figure 1: Distribution of cataloged impact craters with diameters ≥5 km in the northeast quadrant of the lunar near side.

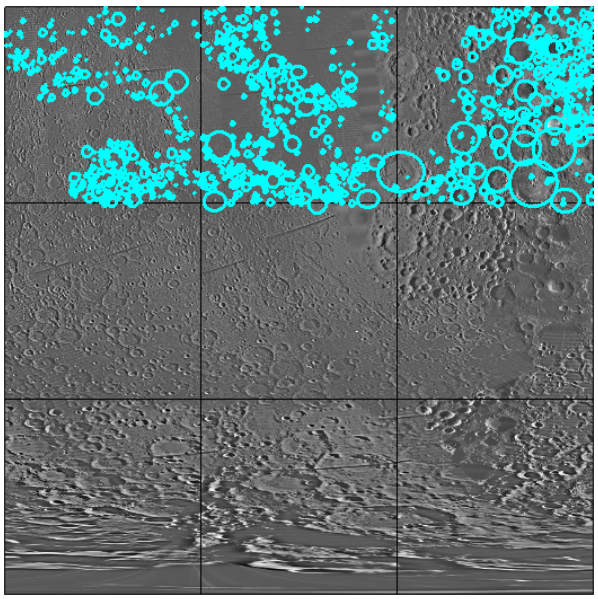

Figure 2: Distribution of cataloged impact craters with diameters of ≥5 km in the southeast quadrant of the lunar near side.