

INTERNATIONAL STANDARDS AND THE NASA LUNAR GEODESY AND CARTOGRAPHY WORKING GROUP. Lunar Geodesy and Cartography Working Group, including: B. Archinal¹ (chair), C. Acton, B. Bussey, B. Campbell, G. Chin, A. Colaprete, A. Cook, D. Despan, R. French, L. Gaddis, R. Kirk, W. Mendell, F. Lemoine, M. Nall, J. Oberst, J. Plescia, M. Robinson, D. Smith, K. Snook, T. Sweetser, R. Vondrak, M. Wargo, and J. Williams. ¹U. S. Geological Survey, Astrogeology Team, 2255 N. Gemini Drive, Flagstaff, AZ 86001, USA, barchinal@usgs.gov.

Introduction: Several of the session questions for this meeting address what types of standards and infrastructure are needed for lunar exploration. E.g. Question 2-2 essentially asks what international standards are needed for robotics development, habitats, and hazard prevention. The NASA Lunar Precursor Robotic Program (LPRP) has established a Lunar Geodesy and Cartography Working Group (LGCWG) with U. S. and international membership. This group is addressing precisely these sorts of questions in regard to standards for lunar mapping and map products, which are critical for use in lunar landing and surface operations.

The LGCWG has recognized that with the acquisition of large volumes of new imaging data for the Moon and the resurgence of lunar mapping programs worldwide, there is an urgent need for international adoption of lunar cartographic standards. Use of such standards facilitates and enhances both creation and use of lunar data products. Because such uniform products are coregistered into common reference frames and can more readily be analyzed and compared, they are essential for both efficient lunar mission operations and scientific investigation of the Moon.

WG Operation: Although primarily formed to ensure that products for the Constellation program [1] adhere to fundamental cartographic standards, the LGCWG also provides a forum for cooperation and coordination with the international lunar exploration community. The LGCWG accepts recommendations from lunar experts, and makes decisions by consensus of a core membership representing data providers and users as well as NASA management. LGCWG meetings are occurring primarily by teleconference, with some in-person meetings and regular e-mail communication. Presentations (such as this one) to the broader lunar community are also being made to increase awareness of our work.

The LGCWG will follow – or, as necessary, recommend changes to – the basic lunar standards of the International Astronomical Union / International Association of Geodesy Working Group on Cartographic Coordinates and Rotational Elements (WGCCRE, the international advisory group that sets high-level cartographic standards for all solar system bodies) [2]. Further, the LGCWG will define and extend geodetic and

cartographic requirements and recommendations to lower level standards than considered by the WGCCRE. The LGCWG thus provides the essential level of detail for development of new cartographic products from lunar data that is necessary to support ongoing and future lunar exploration.

Activities: Since its inception in late 2007, the LGCWG has addressed the following: a) Use (including further updating) of the white paper “A Standardized Lunar Coordinate System for the Lunar Reconnaissance Orbiter” [3]; b) Use of the mean Earth/polar axis (ME) coordinate system for the Moon for creation of cartographic products (per recommendation of the WGCCRE); c) Use of the new JPL DE 421 ephemeris [4] to specify the initial lunar body-fixed frame in the principal axes system, and associated Euler angles, to define a ME frame; d) Development of draft recommendations for a standard for creating lunar mosaics and global map products; and e) Development of draft recommendations for verifying and publishing lunar products such as digital elevation models. Teleconferences and meetings include presentations on mission and instrument teams’ data processing and product plans, as well as reports on newly available lunar cartographic products.

Future Plans: In the future, the LGCWG will: a) Continue to update the above recommendations, b) Recognize and make recommendations on the use of updated lunar reference frames; c) Define gravity field standards and updates as needed; d) Recommend a new model for the lunar reference shape when results from new missions are available; e) Develop recommendations for controlled, semi-controlled, uncontrolled, mosaicked, and/or projected image products; and f) Assist organizations such as the NASA Planetary Data System (PDS) and/or the International Planetary Data Alliance (IPDA) with data archiving requirements, including formats, mapping conventions, scales and projections for digital images and mosaics.

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References: [1] Cohen, et al. (2008), *Lunar Planet Sci.*, XXXIX, Abstract #1640. [2] Seidelmann, et al. (2007), *Cel. Mech. & Dyn. Ast.*, 98, 155. [3] LRO Project (2008), <http://lunar.gsfc.nasa.gov/library/451-SCI-000958.pdf>. [4] E.g. NAIF (2008), http://naif.jpl.nasa.gov/naif/lunar_kernels.txt.