

**THE SCALE OF EXPLORATION: PLANETARY MISSIONS SET IN THE CONTEXT OF TOURIST DESTINATIONS ON EARTH.** W.B. Garry<sup>1</sup>, L.V. Bleacher<sup>2</sup>, J.E. Bleacher<sup>2</sup>, N.E. Petro<sup>2</sup>, S.C. Mest<sup>1,2</sup>, S.H. Williams<sup>3</sup>, <sup>1</sup>Planetary Science Institute, Tucson, AZ, (wbgarry@psi.edu), <sup>2</sup>NASA Goddard Space Flight Center, Greenbelt, MD, <sup>3</sup>NASA Headquarters, Washington, DC.

**Introduction:** Apollo Astronauts landed at six different locations on the Moon between 1969 and 1972. While the public is familiar with this fact and have seen photographs and video footage of the Astronauts walking and driving the lunar rovers, the scale of these missions can be deceiving. More recently, the Mars Exploration Rovers have explored the surface of the red planet since 2004, but how much of their surroundings have they actually explored? While traverse maps show the routes the Astronauts and rovers have taken on the surface of the Moon and Mars, without the context of familiar landmarks, it is difficult to grasp just exactly how much ground each mission has covered. Comparing Apollo and MER traverse routes to cities and tourist sites here on Earth provides that context in a digestible manner.

**Mission Statistics:** Comparing the statistics for Apollo missions 11, 14, and 17 illustrate the increase in extra-vehicular activities (EVAs) (A11:1, A14: 2, A17: 3), total EVA duration (A11: 2:31, A14: 9:22, A17: 22:04 hours:minutes), maximum distance from the Lunar Module (LM) (A11: 100 m, A14: 1.4 km, A17: 7.4 km), and total distance traveled (A11: 100s m, A14: 3.5 km, A17: 36 km) from the first to the last mission [1,2]. On Mars, the rovers have traveled: Spirit (7.73 km) and Opportunity (34.3 km) (as of 12/2011).

**Apollo in Washington, D.C.:** In the context of Washington, D.C., the Apollo 11 crew would not leave the grounds of the National Mall (Fig. 1). Mission options can be illustrated using the Apollo 14 traverse. For example, if the crew traveled east, they could visit several museums and make it to the U.S. Capitol. If they traveled west, they could visit the Washington Monument, but would not reach the Lincoln Memorial (Fig. 1). Using the lunar rover, the Apollo 17 crew could cross the Potomac River into Virginia (Fig. 1).

**MER Rovers in Florida:** Walt Disney World and NASA Kennedy Space Center are popular tourist destinations and provide excellent context for comparisons. If MER Spirit explored Disney (Fig. 2), the rover would have spent several years at Space Mountain, instead of Home Plate. If MER Opportunity explored NASA KSC, the rover could visit several launch pads; Spirit would explore only Launch Pad 39-B (Fig. 3).

**Education:** Classroom or public activities that involve these missions can combine map reading, scale, unit conversion, geography, problem solving, and decision making skills. Example questions that could be asked to students: 1) *If you could create your own EVA*

*in Washington DC, but you only had 6 hours on the surface, where would you go, and why? 2) If you had to plan a MER-style Mission in your hometown, where would you send the rovers and why? Sharing these maps to the public at these destinations helps to put the missions in context.*

#### Apollo 11



#### Apollo 14 – East Traverse Option



#### Apollo 14 – West Traverse Option



#### Apollo 17



**Figure 1.** Traverse routes for Apollo 11, 14, and 17 overlain on satellite images of Washington, D.C. The LM is set near the Smithsonian Metro exit on the Mall. Apollo 11 would not travel beyond the grassy area on the Mall. Two options are provided for Apollo 14: east to the Capitol or west to the Lincoln Memorial. Apollo 17 would explore northern DC and cross into Virginia.

**Summary:** These comparisons show the significant progress made with each mission, the importance of choosing a landing site, the importance of mobility enabled by technology, and differences in exploring with humans and robots. These maps have been presented at International Observe the Moon Night in

2010 and were also presented to the public at NASA KSC for the GRAIL and MSL launches in 2011.

**References:** [1] Orloff R. W. (2001) *Apollo by the Numbers: A Statistical Reference*, pp. 348. [2] Lunar and Planetary Institute (2010) Lunar Mission Summaries website, <http://www.lpi.usra.edu/lunar/missions/>.



**Figure 2. What if MER Spirit explored Walt Disney World?** The traverse for MER Spirit is overlain on satellite imagery of Walt Disney World. The rover would pass by the Disney Speedway, through the lagoon, and into the park. Home Plate on Mars covers about the same area as the Space Mountain rollercoaster.

**Figure 3. What if the MER Rovers and Apollo 17 explored NASA KSC?** MER Opportunity has covered approximately the same distance as Apollo 17, but the traverse routes are really different. Apollo 17 had to return to their landing site each day, but MER could keep going to explore the majority of the launch pads at KSC and the Shuttle landing site. MER Spirit would traverse the route to Launch Complex 39-B.

