Observations of Lightning on Earth from the Lunar Surface. S. J. Goodman,[1] D. E. Buechler,[2] H. J. Christian, Jr.,[2] and P. Stahl[1], [1]NASA George C. Marshall Space Flight Center, NSSTC, 320 Sparkman Dr., Huntsville, AL 35805, [2] The University of Alabama in Huntsville, NSSTC, 320 Sparkman Dr., Huntsville, AL 35805.

Introduction: The NASA Optical Transient Detector (OTD) launched in April 1995 and the Lightning Imaging Sensor (LIS) launched in 1997 (and still operating today) have produced the most comprehensive global observations of lightning activity on Earth [1, 2]. The OTD collected data for 5-yr from an altitude of 740 km while the LIS, in its 10th year of operations, is still collecting data from its current altitude of 402 km. Figures 1 and 2 show the combined LIS/OTD distribution of lightning for day and night during the Northern Hemisphere warm season as might be observed from the lunar surface (12-h daylight and 12-h nighttime observations).

The Next Generation: The next generation NOAA Geostationary Operational Environmental Satellite (GOES-R) series with a planned launch in 2014 will carry a Geostationary Lightning Mapper (GLM) that will provide day and night observations of lightning from the west coast of Africa (GOES-E) to New Zealand when the full constellation is fully operational (Figure 3). However, global coverage cannot be provided by only the two GOES-E and W satellites. The northern boreal forests of Asia and the central Africa lightning "hotspot" in the Democratic Republic of Congo will not be observed. Predictions and indicators of climate change suggest noticeable impacts at high latitudes as well as increasing storm intensity. The thunderstorm (and fire) season at high latitudes in the northern hemisphere will begin ealier in the year.

Conclusion: A lunar-based Lightning Transient Imager with a 1-m aperture will be capable of mapping lightning on Earth with the same resolution as the GLM. Such an instrument would provide a global climatology of lightning activity with more extensive observations throughout the diurnal cycle than is possible today or even ten years from now. In addition, electric field perturbations associated with the lightning discharge process also can produce gamma ray bursts [3], x-rays, sprites, jets, and other middle atmosphere phenomena. Integrated multi-platform observations of these phenomena would be possible using the vantage points of LEO, GEO, and the moon.

References:

[1] Christian, Hugh J., et al. (2003): Global frequency and distribution of lightning as observed from space by the Optical Transient Detector, JGR, 108(D1), 4004, doi:10.1029/2002JD002347, [2] Goodman, S., D. Buechler, and E. McCaul. (2007): "Lightning," chapter in *Our Changing Planet*, M. King, ed., Cambridge University Press, in press, [3] Fishman, J., et al. (1994): Discovery of intense gamma-ray flashes of atmospheric origin, Science, 1313-1316.

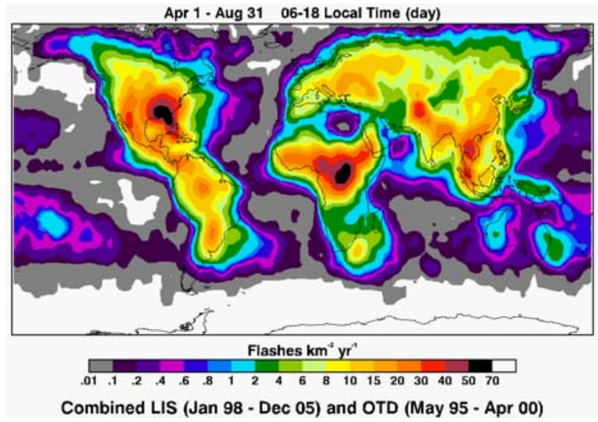

Figure 1. Mean annualized lightning flash density for the 12-hr period centered on local noon from the combined observations of LIS/OTD for April 1- August 31.

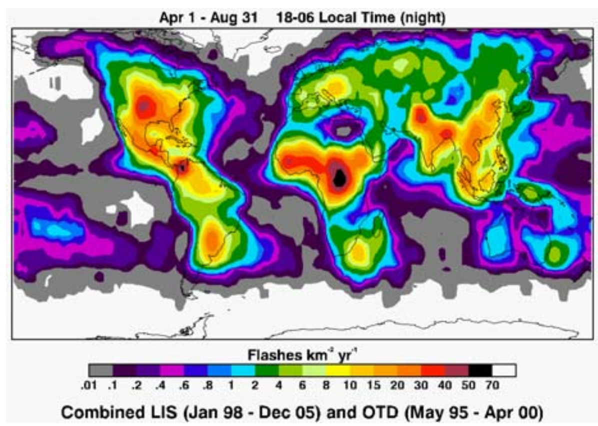

Figure 2. Mean annualized lightning flash density for the 12-hr period centered on local midnight from the combined observations of LIS/OTD for April 1- August 31.

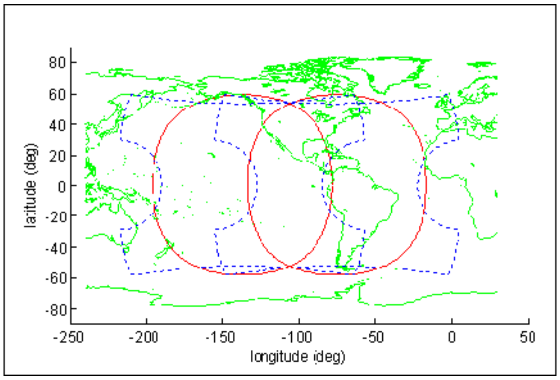

Figure 3. The GLM full-disk is defined as the intersection of circular and square Earth-centered fields-of-view having minimum diameter 16.0° and minimum length 15.1° respectively.