INSOLATION EFFECTS ON LUNAR HYDROGEN: OBSERVATIONS FROM THE LRO LEND AND LOLA INSTRUMENTS. T.P. McClanahan[1] , I.G. Mitrofanov[2], W.V. Boynton[3], G. Chin[1], G. Droege[3], L.G. Evans[1,6], J. Garvin[1], K. Harshman[3], M.L. Litvak[2], A. Malakhov[2], G.M. Milikh[4], M. Namkung[1], G. Nandikotkur[5], G. Neumann[1], D. Smith[1,7], R. Sagdeev[6], A. G. Sanin[2], R.D. Starr[1,4], J.I. Trombka[1,5], M.T. Zuber[1,7], [1]Space Exploration Division, NASA Goddard Space Flight Center, Greenbelt, MD, USA., [2]Inst. for Space Research, Moscow, Russia, [3]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ, USA, [4]Catholic Univ., Washington , DC, USA. [5]Space Physics Dept., Univ. of Maryland, College Park, MD, [6]Computer Sciences Corp., Glenn Dale, MD, USA, [7]Dept. of Earth, Atmos., and Planet. Sci., MIT, Cambridge, MA, USA.

Introduction: The Moon's polar permanent shadow regions (PSR) have long been considered the unique repository for volatile Hydrogen (H) [1,2]. Largely, this was due to the extreme and persistently cold environment that has been maintained over eons of lunar history. However, recent discoveries indicate that the H picture may be more complex than the PSR hypothesis suggests. Observations by the Lunar Exploration Neutron Detect (LEND) onboard the Lunar Reconnaissance Orbiter (LRO) indicate some H concentrations lie outside PSR [3]. Similarly, observations from Chandraayan-1's M^3 and Deep Impact's EPOXI near infra-red observations indicate diurnal cycling of volatile H in lower latitudes [4,5]. These results suggest other geophysical phenomena may also play a role in the Lunar Hydrogen budget.

Clearly epithermal neutron evidence from [2,7] indicates correlated suppression of epithermal neutron rates and higher inferred H concentrations at the poles. Both instrument systems also indicate higher equatorial epithermal rates and lower H concentrations at the equator. These bulk observations are consistent with an insolation effects process where the effective solar irradiance and near surface thermal environment is highest at the equator and decreases as a cosine function of increasing latitude.

However, insolation contrast can also be evaluated locally, in the context of pole vs equator facing slopes. In terrestrial polar environments this effect is readily observed both above and below the surface as the lower insolation poleward slopes maintain lower thermal conditions and stay wetter longer than commensurate equator facing slopes establishing the concept of a **local insolation contrast**. This effect similarly extends into the sub-surface as the thickness of insulating layers above permafrost are similarly dependent on local insolation conditions. We isolate localized insolation contrast and correlate this process with LEND epitheral mapping data and evaluate the potential for thermally induced loss / redistribution processes influencing the Moon's near-surface < 1m volatile H budget.

To implement this physical process we correlate mapping data sets collected from the ongoing, 1.5 year long mapping mission of the Lunar Reconnaissance Orbiter (LRO) [6]. Epithermal neutron mapping data from the Lunar Exploration Neutron Detector (LEND) is registered and analyzed in the context of slope derivations from Lunar digital elvation models maps produced by the Lunar Observing Laser Altimeter (LOLA) [7][8]. Slope derivations provide a continuum of slope orientation between pole facing and equator facing slopes, range 0 to 180°. Insolation effects seen on the topography increase as a function of orientation. LEND map pixels are aggregated and averaged from sparsely distributed map pixels in the context of the defined insolation continuum.

High latitude results >+/-60° reported in [9] indicated that both North and South Polar cases epithermal rates were consistently lower (wetter) in pole facing slopes vs equivalent equator facing (dryer) slopes ~0.01 to 0.02 cps. Results suggested epithermal rates were positively correlated with insolation effects and Further, insolation is a factor influencing H spatial distributions on the Moon.

In this presentation we review the techniques and results from the recent high latitude analysis and apply similar techniques to equatorial regions. Results from our low latitude analysis will be reported. We discuss interpretations and implications for Lunar Hydrogen studies

References: [1] Arnold (1979) *JGR*, #84, 5659-5668 [2] Feldman et al.,(2001) *JGR*, 106-E10, 23231-23251 [3] Mitrofanov et al.(2010) *Science*, 330-6003, 483-486 [4] Pieters et al.(2009) *Science*, 326(5952), 568-572 [5] Sunshine et al., (2009), *Science*, 326(5952) [6] Chin et al. (2007) *Sp. Sci. Rev.,* 150(1-4), 125-160 [7] Mitrofanov et al.(2010) *Sp. Sci. Rev., 150(1-4),* 183-207. [8] Smith et al.(2010) *Sp. Sci. Rev., 150(1-4)*. [9] McClanahan et al., (2011), *Lunar and Plan. Sci Conf. , #1970*