UPDATED LEND HYDROGEN MAPPING IN THE LUNAR SOUTHERN POLAR REGION. A. B. Sanin[1], I. G. Mitrofanov[1] and M. L. Litvak[1], [1]Space Research Institute, Russian Academy of Sciences, Profsoyuznaya st. 84/32, 117997, Moscow, Russian Federation (sanin@np.cosmos.ru).

Introduction: Modern programs for the exploration of the Moon, developed by many space agencies, involve the creation of permanent habitable bases on its surface. The cost of creating and maintaining a habitable lunar base can be significantly reduced by using elements contained in the lunar soil, such as Fe, Al, Si, Mg, etc., and also volatiles, one of the most valuable of which is water, which can be used in many aspects - from the manufacture of rocket fuel to direct use by astronauts. One of the methods of remote sensing for hydrogen-bearing compounds in the upper 1–2 m subsurface soil layer of atmosphereless celestial bodies or planets with thin atmospheres is the spectroscopy of the neutron leakage flux from the surface [1]. To determine hydrogen concentration in the planetary soil one needs not only to measure neutron spectra but also to perform a set of numerical simulations of the neutron production by the Galactic Cosmic Rays (GCRs) in the soil, leakage of these neutrons from the surface, their transport to the instrument on the orbit and processes of neutron interactions with the instrument's detectors. These simulations make possible a model dependent deconvolution of the measured data to obtain the hydrogen concentration and/or other soil properties at a particular region of the planet. Such approaches were used to analyze neutron data gathered by a different neutron spectrometers on a number of missions to the Moon, Mars, Mercury, etc. One of them is the Lunar Exploration Neutron Detector (LEND) aboard the Lunar Reconnaissance Orbiter (LRO) [2, 3], operating almost continuously in orbit around the Moon from 2009 to the present.

Method: LEND is the collimated epithermal neutron telescope which uses the passive neutron collimator to collect most of neutron signal at a narrow field of view (FOV). Since the FOV is defined at the instrument reference frame, the instrument's spatial resolution along lunar surface depends on the spacecraft orbital altitude. From September 15, 2009 till December 11, 2011 the spacecraft operated on the circular orbit with about 50 km altitude. After December 11, 2011 it operates on an elliptical orbit with pericenter at South polar region with a mean altitude of about 50 km. This orbit allows continuous accumulation of the LEND data at South polar region with almost the same spatial resolution for about 11 years. Dataset gathered by LEND till April 1, 2015 was early used to estimate water equivalent hydrogen (WEH) and create its map [4]. After 5 years of additional data accumulation we would like to up-date the WEH map in the southern circumpolar region and provide estimation of hydrogen in the both large permanently shadow regions (PSRs) and in the neutron suppression regions (NSRs), which might be partially overlapping with PSRs and often lying on sunlit areas.

The map will be updated not only by the new larger dataset, but by an updated WEH estimation method also. This method uses precise estimation of the neutron flux at different altitudes of spacecraft orbits modelled with specially developed code based on the Geant4 toolkit with additional treatment of the neutron propagation in the lunar gravity field [5]. Also, the method precisely accounts the fact of the collimator partial transparency which leads to additional background counting rate in the collimated detectors dependent from WEH amount in the soil of regions located out of the instrument FOV. This allow to develop an iterative algorithm of estimation and removal of the background counting rate produced by neutrons escaped lunar soil far away of the instrument FOV and penetrate through the collimator.

Discussion: We will discuss the developed method to reprocess the data gathered by the collimated detectors of LEND during about 11 years of operations. As the result, we plan to present the new WEH map for the lunar Southern polar region and estimate WEH for the both permanently shadow and neutron suppression regions.

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