GLOBAL WATER DISTRIBUTION MAPS IN THE UPPER MARTIAN SUBSURFACE BY FREND NEUTRON TELESCOPE ONBOARD EXOMARS TGO. A. V. Malakhov[1], I. G. Mitrofanov[1], A. B. Sanin[1], M. L. Litvak[1], D. V. Golovin[1], M. V. Djachkova[1], N. V. Lukyanov[1], S. Yu. Nikiforov[1], A. A. Anikin[1] and D. I. Lisov[1], [1]Space Research Institute of the Russian Academy of Sciences, Profsoyuznaya st. 84/32, 117997, Moscow, Russia, malakhov@np.cosmos.ru.

Introduction: FREND stands for Fine Resolution Epithermal Neutrons Detector and is a neutron telescope installed onboard the Russian-European ExoMars mission Trace Gas Orbiter. Neutron measurements from orbit are good characteristic of water content in the subsurface of Mars up to 1 meter in depth. The instrument's major characteristic is its neutron collimator that narrows significantly the field of view allowing for mapping with high spatial resolution of 60-200 km[1].

In this study we briefly present all major stages of data processing performed on the instrument measurements and the resulting global map of water equivalent hydrogen (WEH) distribution.

Neutron data processing: Neutron measurements are of statistical nature, and thus require many samples to be gathered from each location (pixel) of Mars and then these measurements need to be processed to achieve the final global water content map. First, raw data is corrected for any instrumental and other natural effects that influence the measurements but are not connected to variability of Martian neutron flux. These are temperature variations, background signal coming from the Galactic Cosmic Rays and the spacecraft itself. Secondly, the obtained signal measurements are mapped, binning the measurements into pixels of the Martian surface. At this stage, these measurements also contain background of Martian neutrons coming from outside the instrument field of view, due to its collimator partial transparency. We have devised a method that accounts for such background and subtracts it from the map, increasing the spatial resolution of our final product. Thirdly, we perform end-to-end numerical simulation to convert the neutron count rate of each pixel to WEH values in weight percent (wt%), accounting also for the thickness of the atmosphere in the current location. Applying this numerical model results in the final map of the FREND experiment.

Water content distribution maps: the resulting maps show hydrogen content, detected by FREND in the upper 1m of the Martian subsurface (see Figure). Currently, we present the equatorial region map, which is of most interest since water is known to be less abundant here. Due to statistical nature of measurements, we also present assessment of error of these maps in this study. Global analysis of the map shows water-rich locations where a more in-depth study can be carried out. Valles Marineris region is one such feature that we studied [2], along with several others [3]. In this study we conclude by presenting both, global and local features detected in the equatorial region of Mars.

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References: [1] I. Mitrofanov, A. Malakhov et al. (2018) SSR, 214, 86. [2] I. Mitrofanov, A. Malakhov et al. (2022) Icarus, 374, 114805. [3] A. Malakhov, I. Mitrofanov et al. (2020) Astronomy Letters, 46, 6, 407-421.