

EGU21-4455, updated on 26 May 2022

<https://doi.org/10.5194/egusphere-egu21-4455>

EGU General Assembly 2021

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## **Influence of snow cover and air temperature on variations of ground freezing depth in Moscow and the Moscow region**

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According to considered influence of snow cover thickness and air temperature on variations of ground freezing depth at the site of meteorological observatory of Moscow State University and also according to the data of observatories in the Moscow region it is expected to make conclusions about the impact of the urban heat island to a ground freezing depth in Moscow region. For this purpose, the values of the maximum ground freezing depth were analyzed for MSU meteorological observatory and for the weather stations of the Moscow region: Kolomna, Mozhaisk and Sukhinichi. And since not always the data of actual observations are available, for these weather stations the calculated values of the maximum ground freezing depth were obtained. The calculations were performed according to the previously developed calculation scheme, based on the problem of thermal conductivity of a three-layer medium (snow, frozen and thawed ground) with a phase transition at the boundary. The heat balance equation included the energy of the phase transition, the inflow of heat from the thawed ground and the outflow to the frozen ground and, in the presence of snow cover, through it to the atmosphere. The heat flow was calculated according to Fourier's law as the product of the thermal conductivity and the temperature gradient. It was assumed that the temperature in each medium varies linearly. For snow cover and frozen ground, the formula of thermal conductivity of a two-layer medium was used. The obtained calculated values were compared with the actual values of the ground freezing depth. The coefficients  $R^2$  of the reliability of the linear trend line approximation when comparing the calculated and actual values for Moscow and the Moscow region were at the level of 0.6-0.7. The maximum ground freezing depth in Moscow and in the Moscow region in the same years may differ by an average of 10 cm. This confirms that the designed scheme well describes ground freezing depth based on data on air temperature and snow cover thickness and can be used to model the underground heat island of the Moscow region. In report it is also supposed to present the results of the recent years observations of snow cover and freezing depth variations in Moscow and the Moscow region. The past 2020 year is considered as the warmest in the entire history of observations according to the MSU Meteorological Observatory for Moscow, according to the Hydrometeorological Center of Russia for the whole of Russia and according to the Copernicus Climate Change Service (C3S) for the entire Globe. So the winter season of 2019/20 in Moscow region was also unusually warm, and therefore in the winter season of 2019/20 there was very little snow in the Moscow region. However, the warm summer of 2020 resulted in one of the lowest summer values of sea ice extent in the Arctic and, as a result, abnormally strong minimum temperatures and heavy snowfall in the winter of 2020/21 in Eurasia and Moscow. The work was

done in a frame of state topic AAAA-A16-116032810093-2.