

The presented thesis deals with detections of natural emissions by the MAR-SIS instrument on the Mars Express spacecraft. Frequency and time delay data of the radar intensities measured by this instrument (“ionograms”) are analysed. We identify specific regions of these ionograms that do not correspond to any intensity increases related to the radar sounding of the Martian ionosphere. Within these intervals we select ionograms with a possible detection of lightning emissions based on a predefined threshold criterion. These ionograms are then juxtaposed with relevant information on dust storms in the Martian atmosphere. We further perform a detailed analysis of the dependence of mean ionogram intensities from all ionograms on relevant parameters. After the elimination of the principal dependence on the spacecraft altitude, we study long-term effects, such as the dependence on the solar longitude L_s , the solar zenith angle, the magnitude of crustal magnetic fields, and the $F10.7$ parameter.