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Studies of atmosphere radio-sounding for monitoring of radiation environments around nuclear power plants

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The nuclear power plants practically do not discharge to the atmosphere any products causing significant radioactive contaminations. However, during the years of the nuclear power industry, some large accidents occurred at the nuclear objects, and that caused enormous environmental contamination.
Among the most significant accidents are: thermal explosion of a reservoir with high-level wastes at the Mayak enterprise in the South Ural region, near the town of Kyshtym, in the end of September 1957; accident at the nuclear power plant in Windscale, UK, in October 1957; accident at the Three-Mile Island, USA, in 1979; accident at the Chernobyl power plant in April 1986. In March of 2011, a large earthquake and the following tsunami caused the largest nuclear catastrophe of XXI century, the accident at the Fucushima-1 power plant.
The last accident highlighted the need to review seriously the safety issues at the active power plants and to develop the new effective methods for remote detection and control over radioactive environmental contamination and over general geophysical situation in the areas.
The main influence of the fission products on the environment is its ionisation, and therefore various detectable biological and physical processes that are caused by ions. Presence of an ionisation source within the area under study may cause significant changes of absolute humidity and, that is especially important, changes of the chemical potential of atmosphere vapours indicating presence of charged condensation centres.
These effects may cause anomalies in the IR radiation emitted from the Earth surface and jumps in the chemical potentials of water vapours that may be observed by means of the satellite remote sensing by specialized equipment (works by Dimitar Ouzounov, Sergey Pulinets, e.a.).
In the current study, the theoretical description is presented from positions of the molecular-kinetic condensation theory that shows significant changes of the absolute and relative humidity values in the near-earth air layer. The detailed calculations of the water vapours in atmosphere were carried out with use of detailed non-stationary kinetic model of moist atmosphere air. The processes of condensation and evaporation were effectively considered with use of reactions of neutral water molecules' association under presence of a third particle, conversion of water molecules with an ion cluster to a more complicated cluster, and the relevant counter reactions' splits of neutral and ion clusters.