Thermal Conductivity and Thermal Emission Inverse Problems

K.P.Gaikovich

Radiophysical Research Institute, B.Pecherskaya, 25, Nizhny Novgorod, Russia, 603600
Phone: (8312)367294, Fax: (8312)369902, E-mail: gai@nirfi.nnov.su

Methods of subsurface radiometry monitoring of the temperature and heat flux dynamics are presented. They are based on simultaneous solution of equations of radiation transfer and thermal conductivity [1,2]. The expressions connecting the temperature distribution and heat flux dynamics with the brightness temperature of its thermal radio emission are obtained for half-space and for space outside of sphere. The approach developed is used for noninvasive radiometry investigations using measurements at wavelengths 0.5, 0.8, 3, 9 and 13 cm. On the base of radiobrightness dynamics measurements of soils the subsurface temperature profile and heat flux evolution has been retrieved.

The investigation of heat and mass exchange through the air-water interface have been carried out both in laboratory and natural conditions. Using the laboratory measurements of evolution of water radiobrightness at wavelength 0,5 cm in the process of air turbulization (using fan) the dynamics of temperature profile in the water and in the air viscosity sublayer as well as the evaporation rate through water-air interface have been determined. The viscosity sublayer depth in this process has been also determined from measurements data (about 0.2 cm). The strong dependence of radiobrightness dynamics on water turbulization gave a simple method to estimate the depth of water cold thermal film.

The investigations of thermal film formation and heat flux variations related with the wind variations in natural conditions (in open water pool) have been carried out using measurements of radiobrightness dynamics at wavelength 0.5 cm.

Thermal history inverse problems are also discussed. The solution of the new inverse problem for retrieval the temperature profile evolution of half-space by thermal emission dynamics including time interval in the past before measurements is presented.

This work was supported by RFBR, grant No. 96-02-16514.

References

1. K.P.Gaikovich, A.N.Reznik and R.V.Troitskii, "Microwave subsurface profile thermometry," Dig. IGARSS'91, 1991, Univ. Technol., Espoo, Finland, vol.3, pp.1195-1198.
2. K.P.Gaikovich, "Simultaneous solution of emission transfer and thermal conductivity equations in the problems of atmosphere and subsurface radiothermometry," IEEE Trans.Geosci.Remote Sens., 1994, vol.32, pp.885-889.