# DETECTING THE HYDROMETEORS BASED ON MULTI-FREQUENCY PASSIVE MONITORING OF MOBILE NETWORK STATIONS SIGNALS

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Intensive convective phenomena show strong variability in space and time, from tenths to hundreds of meters and from tenths of seconds to minutes. Atmospheric hydrometeors interfere electromagnetic signal in atmosphere. The magnitude of the interference is relative mainly to the intensity of precipitation. This fact enables us to detect the hydrometeors by monitoring the changes of electromagnetic signal either by active broadcasting of the signal and by detecting its part reflected by the hydrometeors or by passive receipt of the signal from different broadcasters.

Despite of the massive technical advancement in measurement of meteorological parameters and phenomenon in situ, for example by installing the automatic weather stations including the modern pluviographs, disdrometers, by completing optimal automated network and meteorological radars, there is relatively little effort in Europe being put into the use of data based on the evaluation of attenuation and signal drop-out on the telecommunication lines for hydrometeors detection.

The use of the methods of multi-frequency passive monitoring of the anthropogenic sources of electromagnetic energy around 1 GHz by means of which we can measure the parameters of attenuation and dropout of electromagnetic signal with the time resolution of 100m and space resolution a few seconds can enable to detect the hydrometeors in the peplosphere. Besides this fact the relation between the attenuation/signal drop-out and precipitation intensity shows lower sparsity and is closer to linear in contrast to highly non-linear relation between the precipitation intensity and reflected signal broadcasted by meteorological radar (Leijnse et al., 2007). It appears that the information derived by this method can not be obtained by other available methods and may supplement the information about precipitation field in concrete space.

Presented paper will discussed the possibilities of application of the method in the field of precipitation detection, fog and extraordinary phenomena.

Based on the utility model of the receiver system to measure parameters of multispectral electromagnetic smog there was measured and evaluated data about the time of occurrence, intensity and space distribution of hydrometeors in meso and micrometeorological space in the boundary layer of the troposphere. The processing and evaluation of the received signal disturbances is done on the original physical-mathematic aparatus for Kalman filters.

The frequencies used are below those used so far for the detection of hydrometeors. It is enabled by an innovative way of retrieving the data from the radio signals by modification of Kalman filter.

Electronic equipment uses synchronized receivers to receive signals from mobile base stations with directional antennas in GSM mobile downlink frequency range (920-960 MHz). The shift of signal received by the antenas refers the composition of the atmosphere in between the broadcaster and the antenas. The signal change reflects to different phenomenon differently and further to the precipitation or general hydrometeors there are detected more impacts on the signal (air pressure change, turbulence, air flow…). Nevertheless, the signal reacts mostly on the precipitation and also the intensity of the precipitation close to the ground can be derived from this data (see fig. 1).

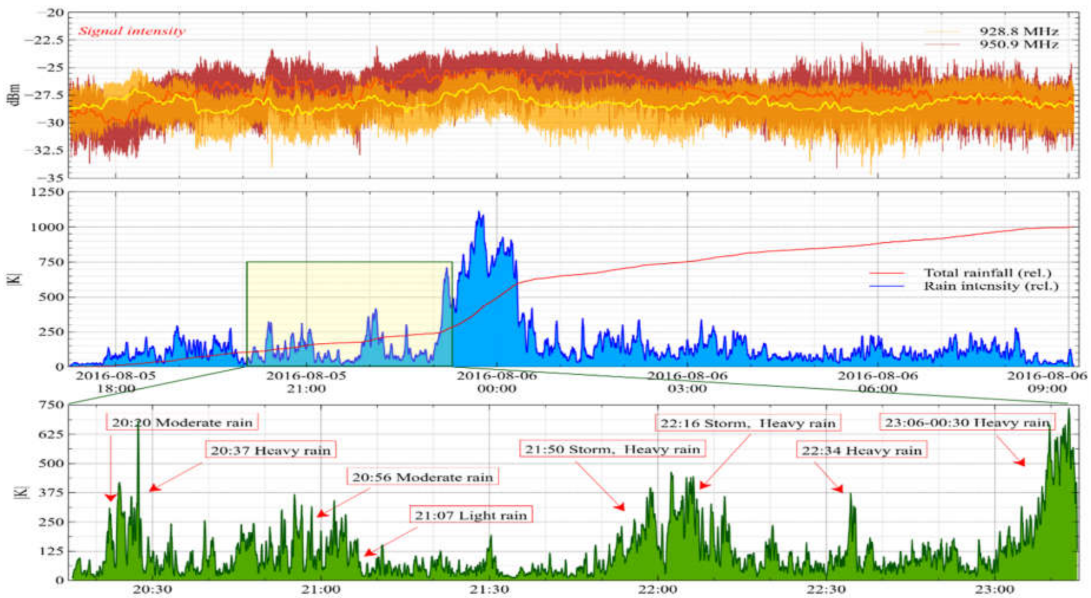


Fig. 1 The impact of atmospheric hydromemeteors (precipitation) on the electromagnetic signal.

The equipment for the detection of hydrometeors in the boundary layer close to the ground is under the development and was not calibrated towards the in situ measurements so far. Nevertheless, the measurements showed us the possibility to detect the presence of hydrometeors in the atmosphere with high space resolution in real time. This opens its use in many branches including the various types of ground transport as the space of transport lines in many countries is well covered by the respective signal.

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Reference:

Leijnse, H., Uijlenhoet, R., Stricke, J.N.M, 2007, Rainfall measurement using radio links from cellular communication networks. https://doi.org/10.1029/2006WR005631.