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Microwave Remote Sensing of Rainy and Non-rainy Clouds: A Technique to Predict Rain

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Abstract: The need to efficiently predict rain has lead to the development of many sensors. Microwave remote sensing is one of the emergent fields in this area. In this study, a method for the detection of water content by means of a radiometer has been described. The output of the radiometer, which is in the form of voltage, has been used to detect the water content in the cloud. The results can be used to form an algorithm for the prediction of rain.

Key words: Radiometer, rain, remote sensing

INTRODUCTION

Recent trends show a tremendous interest in the field of sensors used for cloud remote sensing[1]. Microwave radiometer can be successfully used for sensing cloud characteristics. A microwave radiometer acts as a thermal detector. It detects the thermal radiation from the sky in form of sky noise and provides the output in form of voltage. Clouds comprise of water drops ice crystals having radii of the order of 10 μm. In the microwave region of the spectrum, the absorption due to clouds is negligibly small. The transmittance of a non-rainy cloud is 90% and scattering is negligibly small. Raindrops however interact strongly with the microwave radiation[2]. Therefore non-rainy clouds are nearly transparent in the microwave region while rainy clouds are not, forming the basis for detection of rainy clouds.

MATERIALS AND METHODS

The experimental setup comprised of a 30 GHz radiometer (Fig. 2) housed in an air-conditioned Lab (Fig. 1). A radiometer is an instrument to detect sky noise temperature and it provides the output in the form of equivalent volts. This output voltage is directly converted to the temperature by using a calibration chart. The specifications of 30 GHz radiometer used (Table 1). A zenith looking metallic reflector sheet at an angle of 45 degree, Plate 2 was used to incident radiation from the sky on the radiometer, which gives the output in volts. The data was collected using Agilent Data Acquisition System Unit and logged into the computer using the Agilent Data Logger software.

Table 1: Radiometer specifications

Frequency (GHz)	29.9
IF (MHZ)	2.0
Detectable temperature range (°K)	30-500.0
Sensitivity (°K/V)	50.0

Fig. 1: Experimental laboratory

Fig. 2: 30 GHz radiometer

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Fig. 3: Snapshot of data logger software showing radiometer output voltage for clear sky (1.214 v)

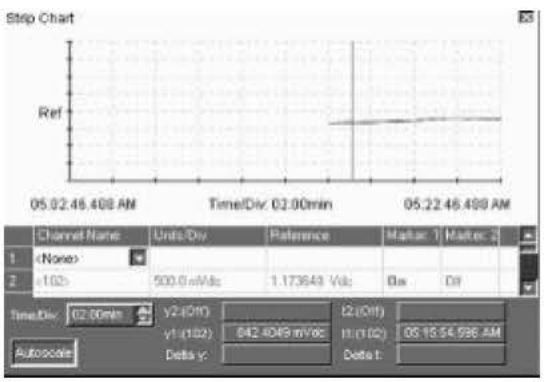

Fig. 4: Snapshot of data logger software showing radiometer output voltage for non-rainy clouds (0.842 v)

Fig. 5: Snapshot of data logger software showing radiometer output voltage for rainy clouds (0.432 v)

RESULTS AND DISCUSSION

The data, in the form of voltage was collected for various events of clear sky, non-rainy and rainy sky conditions. The snapshots of data logger software are as shown in Fig. 3-5 for three different sky conditions namely clear sky, non-rainy and rainy clouds.

As evident, the difference between the voltage levels of clear sky and that of non rainy cloud is 0.367 V and the difference between voltage levels of clear sky and rainy clouds is 0.786 V i.e. difference of 18.35 and 39.30°K respectively. From the difference in the output voltage levels, non-rainy and rainy clouds can easily be distinguished[3]. This forms the basis for the formulation of an algorithm for the prediction of rain using a radiometer.

CONCLUSIONS

The sky noise temperature from the rainy and the non-rainy clouds has been successfully measured. Long-term data would help to develop an algorithm for the prediction of rain by remote sensing of clouds using radiometer.

REFERENCES

1. Ware, R., D. Cimini, P. Horzegh, F. Marzono, J. Viveknandan and E. Westwater, 2004. Ground based microwave radiometer measurements during precipitation. 8th Specialist Meeting on Microwave Radiometry, Rome, Italy, pp: 1-3.
2. Stanly, Q.K. and T.H. Vonder Haar, 1995. Satellite Meteorology: An Introduction. Academic Press Limited, pp: 95.
3. Bossio, A.V. and C. Capsoni, 1995. Effectiveness of Brightness Temperature Ratios as Indicators of Atmospheric Path Conditions. Microwave Radiometry and Remote Sensing of Environment. (Ed. Solimini, D.), pp: 129-138.