8.22 WATER VAPOR ESTIMATION USING REFLECTED WAVE OF DIGITAL TERRESTRIAL BROADCASTING WAVE

T. KOUKETSU[1], S. KAWAMURA[1], H. HANADO[1], H. OHTA[1]

[1] National Institute of Information and Communications Technology, Koganei, Tokyo, Japan

kouketsu@nict.go.jp

The number of flood disasters brought by rapid-diveloping cumulonimbi in urban areas is increasing. For disaster prevention, it is necessary to detect such cumulonimbi, which rapidly develop in localized area, as soon as possible. Weather radar can detect them only after hydrometeors are formed from water vapor. For early detection of sign of cumulonimbus generation from the stage of water vapor, it is important to measure the spatial distribution of water vapor.

It has become well-known that precise information of spatial distribution of water vapor is necessary for the precise quantitative precipitation forecast (QPF) using high resolution numerical model. However, the measurements of water vapor are still sparse and lacking for precise QPF, although estimation of precipitable water vapor (PWV) with Global Navigation Satellite System (GNSS) have been realized.

The authors have been developing a method of water vapor measurements near the surface with propagation delay of digital terrestrial broadcasting wave due to water vapor (Kawamura et al., 2017). The basic idea of using propagation delay is the same as that of retrieving PWV using GNSS. We estimate water vapor amount near the surface from the horizontal propagation delay of digital terrestrial broadcasting waves.

The propagation delay is quite small and masked by phase fluctuations of local oscillators of transmitter and receiver of broadcasting waves. To cancel these phase fluctuations, we used the phase difference of direct wave from a broadcasting tower and reflected wave from some reflector(s), such as building or transmission line tower, opposite direction of the broadcasting tower. This gives us a pure propagation delay and the information of pass integrated water vapor amount between the receiving point and the reflector(s).

For the utilization of the integrated water vapor amount for the input of numerical model, it is necessary to identify the reflector with its range and direction, which determine the pass of propagation delay by water vapor. For this purpose, we have tried estimation of angle of arrival (AOA) of reflected wave. For the measurement of water vapor in this study, we used commercially available antennas for receiving digital terrestrial broadcasting wave. Such antennas have large beam width (several tens degrees for half-value width) and not enough for AOA.

To overcome this problem, we used plural receiving antennas to detect the path length differences and calculate the AOA geometrically.

In the presentation, we will introduce our results of water vapor measurements.

References

Kawamura, S., et al. (2017), Water vapor estimation using digital terrestrial broadcasting waves, Radio Sci., 52, 367377, doi:10.1002/2016RS006191.