Study on the meso scale water vapor disturbance by using GPS

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1. Introduction

It is a new observation method of meteorology to investigate the water vapor disturbance at the meso scale by using GPS. Especially, it requires much detail analysis to obtain the relationship between meteorological disturbance and the water vapor of the meso beta to gamma scale since the water vapor disturbance is difficult to measure. Moreover, to investigate the disturbance of water vapor is important to understand the mechanism of meso scale meteorological disturbance.

In this study, we investigate the relationship between meteorological phenomena and water vapor disturbance of the meso gamma scale by using the data of experiences. These experiences are X-BAIU98, X-BAIU99 and GPS Tsukuba Experience 2000. We also investigate the relationship between water vapor and meteorological phenomena in the meso beta scale as well as meso gamma scale by using the routine radar data of the MLIT and GPS data of GSI from July to August, 1998.

2. Relationship in the meso beta scale.

First, we discuss the relationship between the meteorological phenomena and water vapor disturbance in the meso beta scale. The area around the lake BIWA is selected for the investigation. The objectives of this investigation are to research the relationship between advection of rainfall cells and water vapor under condition of no disturbance of large scale.

To investigate the relationship between advection of rainfall cells and water vapor, we calculate the two dimensional convergence and divergence of precipitable water vapor. This calculation uses the precipitable water vapor of GPS network of GSI and wind field obtained by AMeDAS. As a result of investigation, we distinguish the effect as two types; 1) rainfall cells move to the leeward without relation of convergence of precipitable water vapor under condition of relatively humid; 2) rainfall cells move towards the convergence of precipitable water vapor under condition of relatively dry.

For verification of the effect, we made the numerical simulation by using Advanced Regional Prediction System (ARPS). This simulation used the GPV data of RSM for initial and boundary condition. As a result of the simulation, we obtain the same result as observation.

3. Relationship in the meso gamma scale.

Second, we discuss the relationship between the meteorological phenomena and water vapor disturbance in the meso gamma scale. We use the experience data of Radio sonde and GPS. Moreover, we made the simulation by using a cloud resolvable numerical model. In this investigation we did not use the precipitable water vapor but use the one way residuals of GPS atmospheric delay. The one way residual data is used very carefully to avoid the noise. The data represented clearly the decreasing period (about ten minutes) of atmospheric delay. The amplitude of the decreasing is 5 to 10 mm of atmospheric delay. This decreasing exists at the same time of the rainfall cells passing across the GPS radio wave. Therefore, the water vapor disturbance is affected by the cloud.

For verification of the mechanism, we made the simulation data of cloud by cloud resolvable model. We investigate the water vapor disturbance in the numerical data. As a result of the simulation, water vapor decreasing is simulated by numerical model. After investigation of the numerical data, we understand that the water vapor is decreased by down draft. The down draft is generated by falling of rain drop. The down draft pull down the upper air which contains the smaller amount of water vapor than lower air. On the other hand, simulated data obtained by ARPS cannot show the decreasing of precipitable water vapor. It suggests that the drag force of down draft might be evaluated smaller in ARPS.

4. Conclusion

Currently, we are now in process of investigation the relationship between size distribution of rain drop and small scale water vapor disturbance. The result of the investigation is talked in the presentation.