1. INTRODUCTION

In recent years, global warming and extreme weather are of great interest to researchers and society for not only Japan but also all over the world. Especially, rapid weather changes such as localized heavy rainfall, torrential rain, downburst, tornado and so on are of great concern as they threaten human life and property. Comprehension of the reasons for these localized extreme weather changes is significant for the aspect of not only for meteorology but also for disaster prevention. However, these weather events are said to be meso-γ scale and the size is defined as from 2 to 20 km. Because the installation resolution of the Japan Meteorological Agency’s (JMA) Automated Meteorological Data Acquisition System (AMeDAS) is approximately 17 km, it is very difficult to examine these weather changes in detail. Therefore, we have developed a compact weather station (POTEKA). Moreover, we have realized many high density ground surface meteorological observation networks with a resolution of approximately 2 ~ 4 km composed of these compact weather stations all over Japan. These networks would be widely utilized in order to calibrate and validate the observation data of not only the ground surface radars such as phased array but also the space-borne radars such as GPM satellite.

2. POTEKA WEATHER STATION

POTEKA weather station was developed according to the concept that it should be compact, light and capable of being installed anywhere. This compact weather station can observe 7 variables including temperature, pressure, humidity, wind speed, wind direction, sunshine and rain. By utilizing the spare channels, this station can observe other variables such as precipitation, lightning, snowfall, water level, soil index, PM 2.5 and so on. Moreover, temperature, pressure, humidity, wind speed and precipitation passed the JMA’s variable verification test.
4. EXTREME TRANSITION OF OBSERVATION VARIABLES ON THE GROUND SURFACE JUST BELOW A DOWNBURST

Because the existing ground surface observation system such as AMeDAS has the low resolution compared with POTEKA network, it has been relatively difficult that we observe and analyze the extreme transitions of meteorological observation variables in detail just below the localized weather change. But, about these three severe events, POTEKA network could observe the extreme transitions of meteorological variables just below a downburst such as the steep temperature drop and the steep pressure jump. Figure 3, Figure 4 and Figure 5 indicate the POTEKA observation data just below the particularly severe downbursts on August 11, 2013, June 15, 2015 and July 14, 2016 respectively.

5. CLARIFIED ADVANCING CHARACTERISTICS OF CUMULONIMBUS WHICH CAUSED A SEVERE DOWNBURST

Even if some observation point could observe the localized weather change coincidentally in the existing ground surface observation system such as AMeDAS, it had been difficult to clarify the characteristics of the phenomenon causing the localized weather change such as the advancing speed and direction. But, POTEKA network could obtain the detailed observation data although it was a very localized extreme weather change such as a downburst. The contour plot data of Fig.6, Fig.7 and Fig.8 are associated with the particularly severe downbursts on August 11, 2013, June 15, 2015 and July 14, 2016 respectively. For example, in the case of Fig.7 of June 15, 2015, POTEKA network has clarified that the advancing speed and direction are 0.58 km per a minute and the southeast respectively about the cumulonimbus which caused the severe downburst.
Fig. 6-1 18:02 JST
Fig. 6-2 18:07 JST
Fig. 6-3 18:18 JST
Fig. 6 Contour plot of the advancing characteristics about the downburst on August 11, 2013

Fig. 7-1 15:34 JST
Fig. 7-2 15:55 JST
Fig. 7-3 16:03 JST
Fig. 7 Contour plot of the advancing characteristics about the downburst on June 15, 2015

Fig. 8-1 13:32 JST
Fig. 8-2 14:06 JST
Fig. 8-3 14:18 JST
Fig. 8 Contour plot of the advancing characteristics about the downburst on July 14, 2016

6. ESTIMATED RESULT OF A DOWNBURST SCALE BY THE GROUND SURFACE OBSERVATION DATA

Figure 9 and Figure 10 indicate the pressure contour line at the just damaged time (16:03 and 14:06 JST respectively) about the particularly severe downbursts on June 15, 2015 and July
14, 2016 respectively. The localized high pressure area of more than 1007 hPa and 996 hPa respectively have the scale of approximately 5 km. Therefore, the downburst scale could be estimated to be a radius of approximately 5 km. POTEKA network have revealed the detail situation on the ground surface just below the localized extreme weather change.

7. CONCLUSION

A high density ground surface meteorological observation network is considered to have indicated the actual truth data on the ground surface for the aspect of meteorology development. In a fact, these actual truth data have been utilized in order to supplement the ground surface radar observation such as phased array and contribute to solve the riddle of the localized extreme weather changes such as downbursts and so on.

We hope that a high density ground surface meteorological observation network will be widely utilized in order to calibrate and validate the observation data for many aspects such as phased array radars and space-borne radars.

References

