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An evaluation of compact weather sensors

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Some of the extreme weather events such as torrential rain, tornado, microburst, and heat wave are smaller spatial and temporal scale to observe by ground-based measurements. It is very important to monitor and forecast these phenomena for the social impacts of the hazards to the large cities with a population of several million people. Remotely-sensed data by meteorological satellites and radars are extremely useful for the purpose. But improvement of spatial resolution of ground-based observation is also important. In that case, compact weather sensor (CWS), which is composed of several of sensors in the small dimensions to measure meteorological elements, is quite helpful to observe meso/micro-scale weather phenomena with low cost.

Recently, CWSs become commonly available. However we have little knowledge about the data quality of CWSs, especially the effect of the integrated design of sensors which are different from those of conventional meteorological instruments. To evaluate five CWSs (by different manufacturers), we made wind tunnel experiments and field observations for two months at Disaster Prevention Research Institute, Kyoto University. Mean value of wind direction and wind speed are compared with reference values which are measured by pitot tube anemometer in the wind tunnel. The data by some CWSs shows flow distortion by the pillars near the receiver-transmitters of sonic anemometer. During the field observation from July 2011 to September 2011 at Shionomisaki Wind Effect Laboratory, barometric pressure, wind direction, wind speed, atmospheric temperature, and relative humidity are measured by five CWSs. Mean values of each meteorological element by CWSs are compared with reference values which are observed by the conventional meteorological instruments. The difference of the mean values falls within the specification errors of CWS. The fluctuations and gusts of natural wind measured by CWSs are also comparable to those derived by a standard sonic anemometer. Two CWSs observed rain precipitation. The rainfall records in each 10-minute periods by CWSs are not corresponding with the reference value by rain gauge, especially during the heavy rain periods of typhoon No. 15. It is considered that some inconsistencies are caused by the difference of the principle of measurement.

Keywords: compact weather sensor, CWS, ground-based meteorological measurements, meteorological instrument