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Fog-observed performance of low-cost atmospheric particulate matter sensors

Yen-Jen Lai (1) and Po-Hsiung Lin (2)

(1) Experimental Forest, National Taiwan University, JuShan, Taiwan (alanlai@ntu.edu.tw), (2) Department of Atmospheric Sciences, National Taiwan University , Taipei, Taiwan

The visibility sensor is one of the most commonly used instruments to detect fog evolution. However, the expensive costs of visibility sensors limit the number of deployment for monitoring the spatial and temporal distributive characteristics of fog evolution. In recent years, accomplishment with the technology of Internet of Things (IoT), 3D printer and low-cost sensors, development of the cost-reasonable instruments for specific approaches by individual researchers has become easier.

Air pollution is a big issue in Taiwan and many researchers make their own instruments for monitoring the air quality using the low-cost atmospheric particulate matter. This kind of sensor can detect any matter of 2.5 and 10 micrometers or less in size and outputs the values of PM2.5 and PM10 concentration respectively. The fog droplet size is usually distributed from 1 to 35 um. It is worthy to understand the ability of these low-cost sensors for detecting fog droplets.

This study cooperated with “Maker” to develop an atmospheric particulate matter observation system suitable for Taiwan’s high-humidity forest environment. This study set up two models (PMS3003 and PMS5005, Plantower) of low-cost atmospheric particulate matter sensors beside the EPA observed station to compare the performance of detecting PM2.5. The results showed R2 can reach 0.70 or more. The linear regression showed the PM2.5 values were overestimated by about 2% since these sensors detect both air pollution matter and atmospheric water vapor. Another comparison of the PMS5005 with visibility sensor (MIRA visibility sensor 3544, AANDERAA INSTRUMENTS) at the Xitou Flow Tower inside the cloud forest of central Taiwan showed the observed PM2.5 values would rise dramatically with fog formatting. The preliminary results indicated the low-cost sensor is sensitive to the fog droplet. How to further quantify the volume of fog/cloud water and covert the PM2.5 values to the visibility are on-going topics.