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Comparison of atmospheric profile from ceilometer and UAV in the fog forest in central Taiwan.

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Xitou region, as the epitome of mid-elevation fog forest ecosystem in Taiwan, possesses a rich diversity of flora and fauna and is a famous forest recreation area. Long-term microclimate are monitoring more than 80 years by the Experimental Forest, National Taiwan University. Preliminarily study indicated the mean temperature was 17.05 ^{o}C in Xitou region from June 2005 to May 2013 which was 0.7 ^{o}C warmer than the 1980s. The warming rate was about 0.29 ^{o}C/Decade for the above-mentioned period while from the 1940s to the 1980s it was about 0.1 ^{o}C/Decade. It was nearly three times the warming accelerates. Moreover, literature reviews showed the frequency of foggy days was 87.7% in 2005 and decreased to 75.6% in 2011 (Liang et al., 2009; Wey et al., 2011). These situation may be accompanied with a very rapid development of local tourist industry in Xitou region driven by tourists number increased from 1 million/year in 1999 to 1.8 million/year in 2014. The global warming and the landscape changes could also be the most likely factors causing the dramatic warming accelerates and also decreasing the foggy frequency.

For the purpose of understanding the characteristics of fog layer, atmospheric profile observations from ceilometer and unmanned aerial vehicle (UAV) carrying self-developed measurements were compared from October to December in 2014. The results showed UAV can observe up to 1200m height above ground level and it is more economical than traditional radiosonde instruments. The height of atmospheric boundary layer of Xitou valley was close to the around mountain ridges (˜2000m a.s.l.) which was similar to the previous radiosonde observations (Wang, 2011). The ceilometer could provide water vapor profile under high temporal resolution; however it might underestimate the thickness of heavy fog due to the inability of clearly identifying the top height of the fog from the limit of laser power. A total solution of integrating ceilometer, UAV and remote sensing technology for monitoring/understanding the characteristics of Xitou microclimate change are on-going.

Keywords: microclimate, fog characteristics, ceilometer, unmanned aerial vehicle, global warming, landscape changes