

Table 1. The specifications of Type-4 MPL.

Transmitter	
Laser wavelength	532 nm
Laser Pulse Frequency	2500 Hz
Laser Pulse Energy	6–8 μJ
Receiver	
Telescope Type	Maksutov Cassegrain
Focal Length	2400 mm
Diameter	178 mm
Field of View	100 μrad
Data System	
Detector	Avalanche APD, photon counting mode
Range resolution	5/15/30/75 m (programmable)
Temporal resolution	Minimum: 1 s (programmable)
Maximum range	45 km

Table 2. The PBLH retrievals and differences between each retrieval method and UAV-derived result at each flight times on August 29.

	Time (LT)						
	06:00	08:00	10:00	12:00	14:00	15:30	17:30
Methods (Difference)	PBLH (meter)						
UAV	606	636	1226	1445	1379	983	830
Combination	554 (–52)	824 (188)	861 (–365)	388 (–1057)	774 (–605)	680 (–303)	375 (–455)
Haar wavelet transform	295 (–311)	596 (–40)	1054 (–172)	1328 (–117)	1028 (–351)	1143 (–160)	459 (–371)
Hybrid image processing	300 (–306)	635 (1)	1225 (–1)	1575 (130)	1340 (–39)	995 (12)	840 (10)

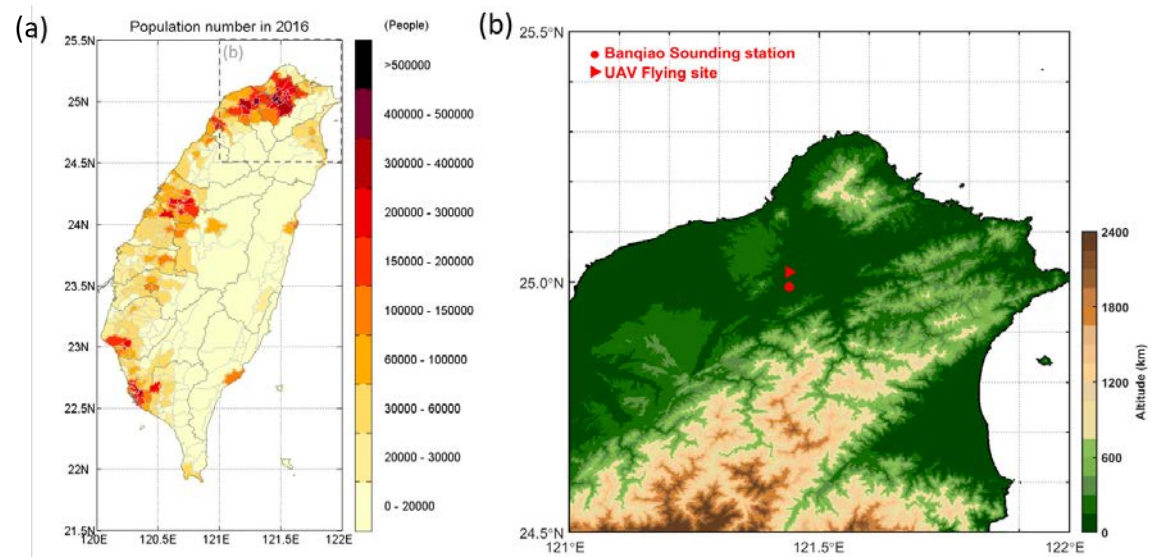


Fig. 1. (a) Population map of Taiwan; (b) locations of Banqiao sounding/MPL station (24.99°N , 121.44°E) and UAV flight site (25.02°N , 121.44°E) in the Taipei basin.

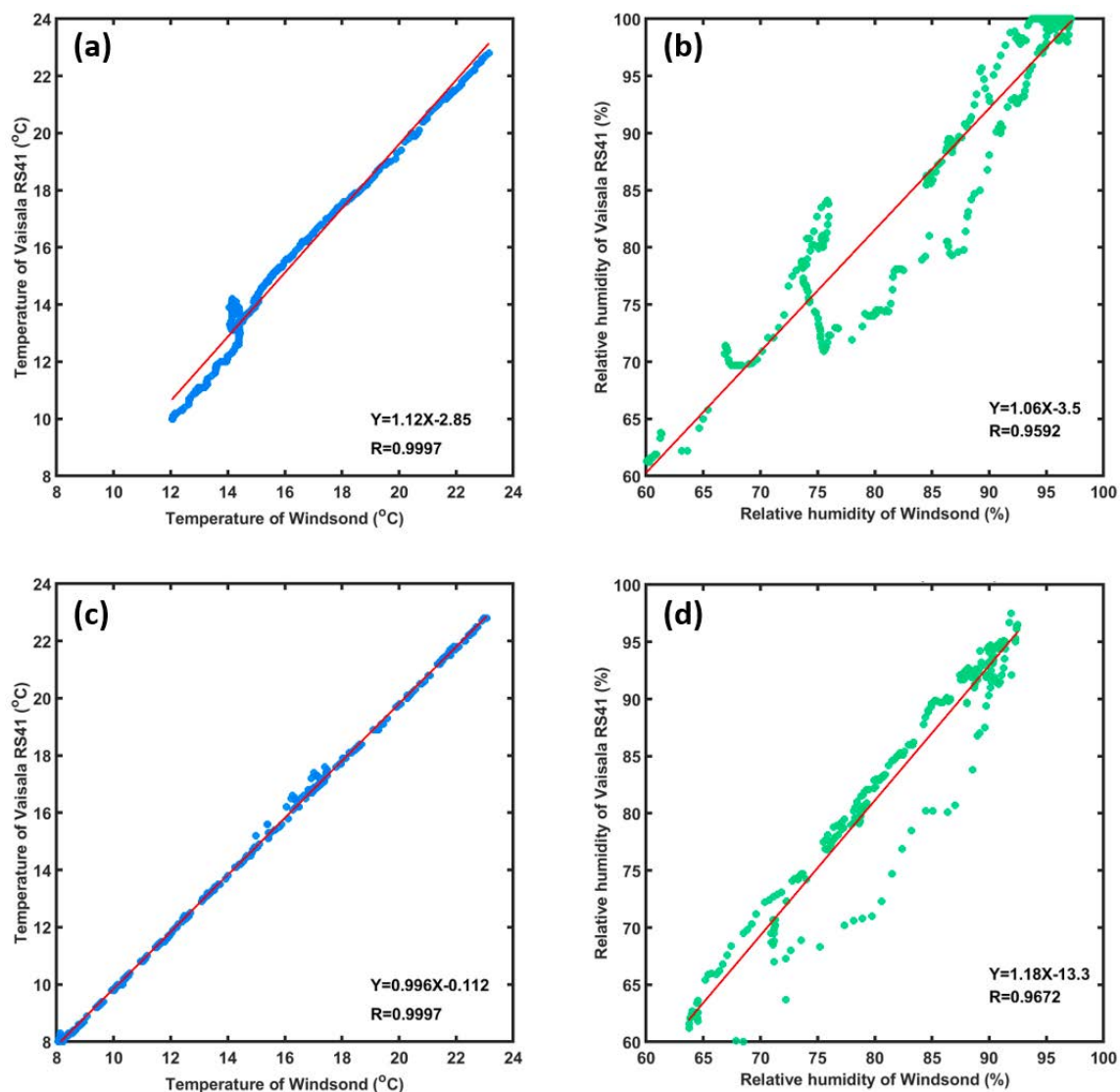


Fig. 2. The correlation between the Vaisala RS41 radiosonde and the Windsond system. R values indicate the correlation coefficients. (a)–(b) November 9, 2017 (08:00 LT); (c)–(d) November 27, 2017 (20:00 LT). (a) and (c) temperature (°C, blue dots); (b) and (d) relative humidity (%), green dots).

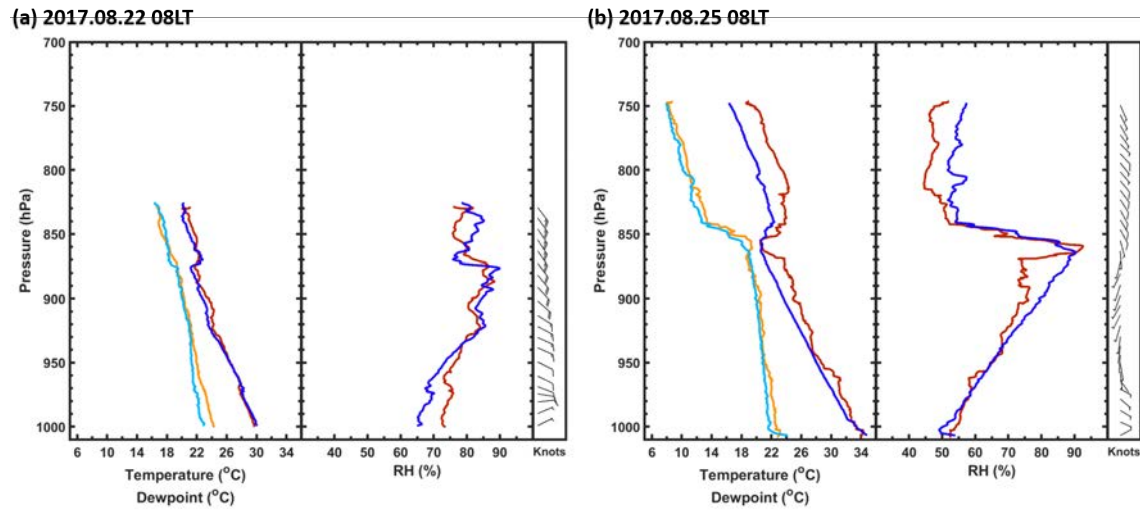


Fig. 3. Comparison of UAV measurements and Sounding observations on August 22, 2017 (08:00 LT, (a)–(b)) and August 25, 2017 (11:00 LT, (c)–(d)). For the temperature and RH plots, the blue lines and the brown lines represent the data collected by UAV and Sounding, respectively. For the dewpoint, the light blue lines and orange lines represent the results calculated from the data of UAV measurements and Sounding measurements, respectively.

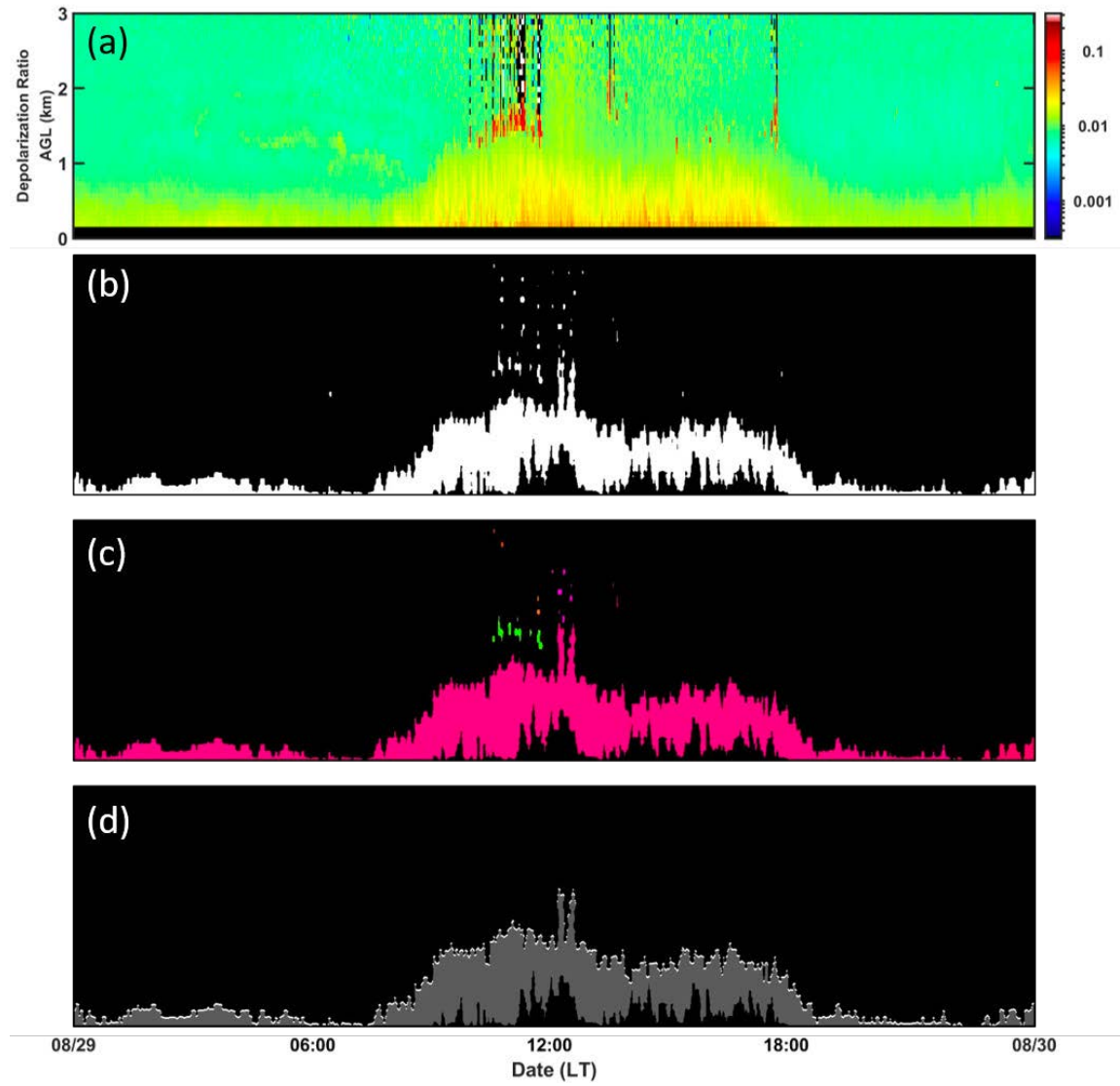


Fig. 4. An example for clustering data by color labeling. (a) The depolarization ratio measurement by MPL on August 29, 2017 at Banqiao station; (b) Bi-level thresholding; (c) Image region segmentation; (d) Locating the tip points.

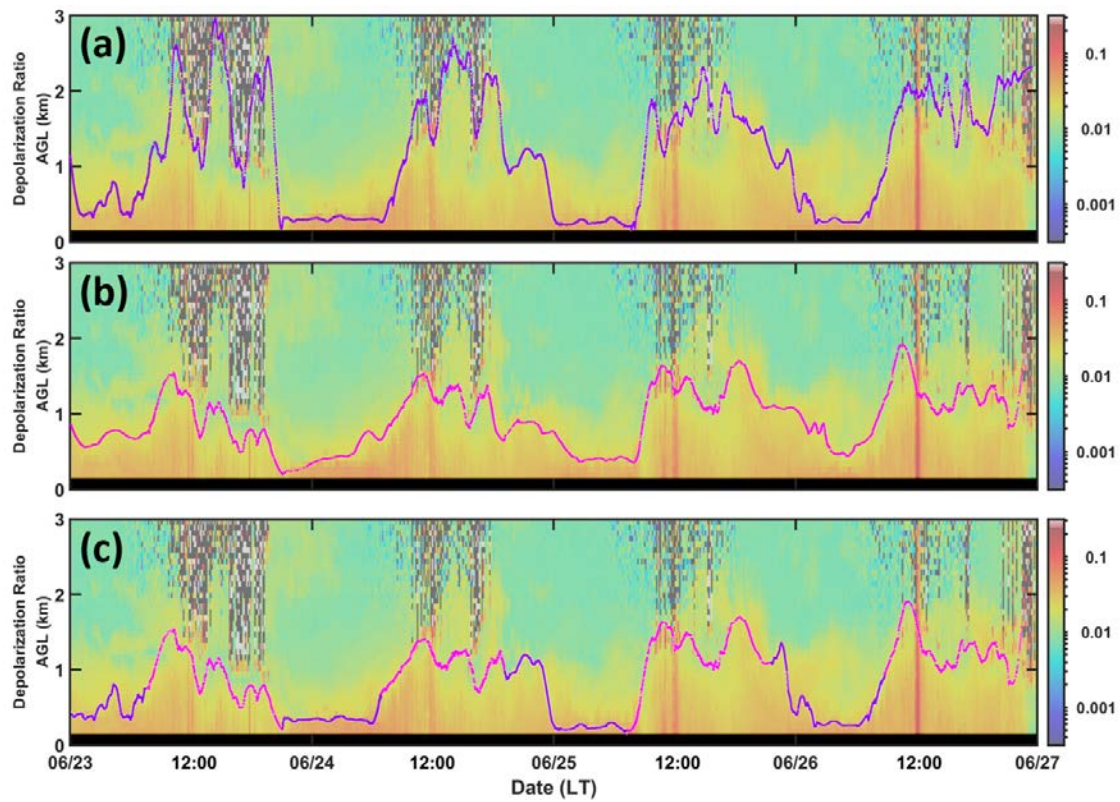


Fig. 5. The retrieval results of Case 1. (a) Gradient method; (b) δ -threshold method; (c) Combination of Gradient method (purple dot) and δ -threshold method (magenta dot).

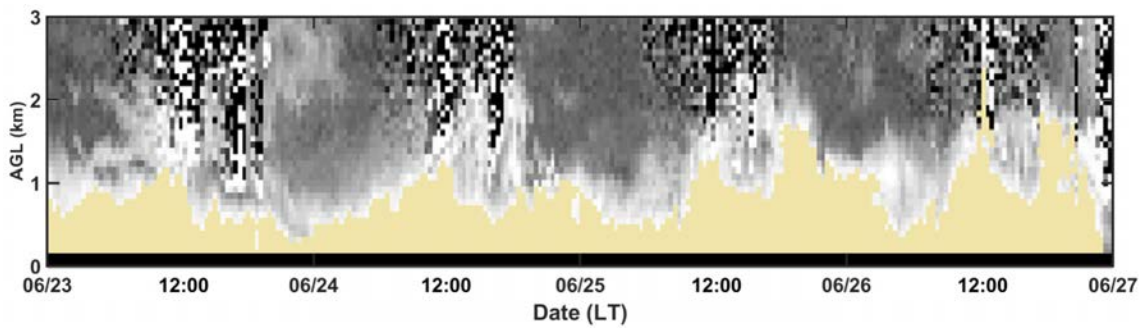


Fig. 6. The retrieval result from the Haar wavelet transform of Case 1. The light brown area represents the region within the PBL. Therefore, the upper edge of this area is the PBL top.

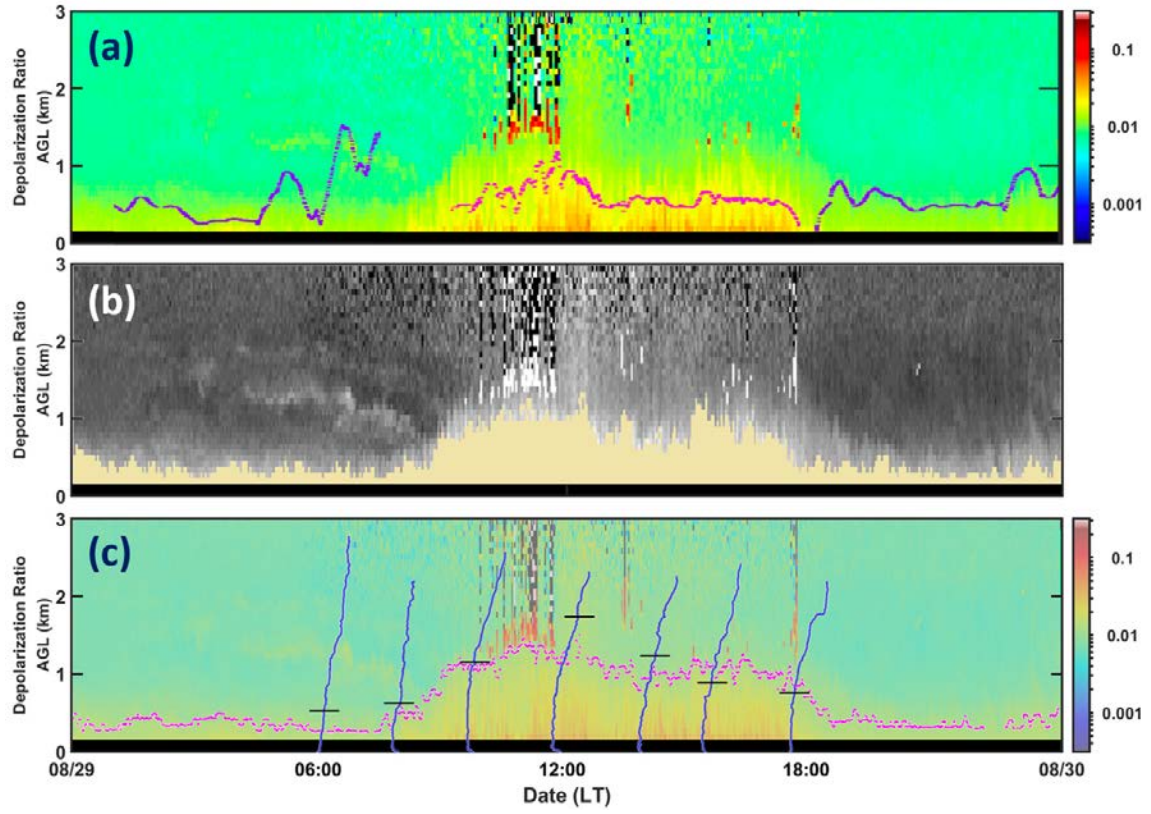


Fig. 7. Comparison of the PBLH by using different methods in Case 2. (a) Combining the Gradient method (in purple dot), and δ -threshold method (in magenta dot); (b) Haar wavelet transform; (c) θ profile from UAV measurements; the PBLH calculated from this profile is shown as short-horizontal blue lines, and the result of hybrid image processing as pink dot.