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Advancing Sounding Capabilities within the Atmospheric Boundary Layer Using Multirotor Unmanned Aerial Vehicle

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Abstract

Taiwan's complex terrain, dominated by the Central Mountain Range that runs north to south and divides the island into eastern and western regions, results in significant regional meteorological variability. Over the years, Central Weather Administration (CWA) has built a comprehensive surface weather observation network. Recently, efforts have increased to improve observation capability within the atmospheric boundary layer by developing vertical profile techniques, such as Multirotor unmanned aerial vehicle (UAV) Observation System and Mini-sonde Observation System, aiming to enhance the completeness of three-dimensional meteorological data.

This study primarily introduces the UAV weather observation system (Mini-sonde observation system will be presented in another article). The system is equipped with the compact sensor capable of measuring essential meteorological parameters such as temperature, humidity, air pressure, wind direction, and wind speed, as well as a PM_{2.5} concentration sensor. It allows atmospheric and environmental monitoring from the surface up to approximately 3 km altitude.

The UAV Observation System is characterized by their flexible deployment and mission-oriented operation, allowing customization based on specific observational objectives. Notably, during Intensive Observational Periods (IOPs), the UAV system can conduct hourly vertical profiling to provide high-temporal-resolution data, significantly contributing to the understanding of regional weather phenomena and improving short-term weather forecasting capabilities.

Key words : Multirotor unmanned aerial vehicle (UAV), Atmospheric boundary layer