

Measurement of Characteristic Parameters of Atmospheric Turbulence and Statistics of its Climate feature in Taiwan Area

*MIN-SZU CHIEN¹, SHIH-CHIAO TSAI¹, YUNG-CHING LIN¹

1. Chung Cheng Institute of Technology

Near the atmospheric boundary layer, vertical wind shear accompanied by turbulence often poses a great threat to flight safety. The "clear-air turbulence" is more prone to flight accidents because it cannot be seen directly with the naked eye or optical instruments. Moreover, the disturbance and the discontinuity in the vertical direction of the refractive index of light and electromagnetic waves caused by the turbulence, will cause effects such as flicker, glow and beam expansion, which will further affect astronomical observations, radio communications, and satellite observations of the earth. The purpose of this research is through long-term collection of atmospheric parameters such as wind direction, wind speed, temperature and humidity in Taiwan, to obtain the refractive index structure constant(C_n^2). After debugging and sorting out related data, the monthly distribution climate model of C_n^2 with monthly statistical analysis could be made. Simultaneously, this research compare various methods of measuring C_n^2 of Kolmogorov and nonKolmogorov in the past, and analyze the difference of its value under different seasons and turbulence intensity. In addition, we also uses the hightime resolution atmospheric parameter profile data obtained by ultrasonic anemometer, lidar wind profiler, and profiling radiometer, to calculate the vertical profile distribution of C_n^2 , and compare it with the theoretical model, to further establish the correlation between the possibility of turbulence and the vertical profile variation of C_n^2 . The results obtained from this study are expected to improve the understanding of the vertical structure of atmospheric turbulence, contribute to astronomy, clear-air radar observation, satellite observation, electromagnetic wave communication and flight safety.

In this study, two sets of ultrasonic anemometers and thermo-hygrometers erected in the Longtan area of Taoyuan were used to collect atmospheric parameters such as wind direction, wind speed, temperature, humidity, and pressure at the two locations. Calculation of C_n^2 by two methods such as the perturbation method, establishing long-term statistical data and comparing the consistency or difference of different methods. The statistical results show that the C_n^2 in the two places shows a seasonal distribution of lower in winter and higher in summer, and the value is relatively high during the day (08:00 to 17:00), and relatively higher in the afternoon to early morning (18:00 to 07:00). Low; while the C_n^2 calculated by the two methods showed a high positive correlation, showing that the calculation results have a certain degree of credibility. In addition, this study also selects the cases where C_n^2 has a significant increase and decrease in value for analysis, explores the relationship between the change trend of its value and the weather system, and examines its relationship with various meteorological parameters through the calculation of deviation values and correlation coefficients. Correlation. The results of the study found that the disturbance of temperature over time is highly correlated with C_n^2 , showing that the temporal distribution of temperature is an important condition for judging the physical quantity of atmospheric turbulence.

Keywords: Atmospheric Boundary Layer, Refractive Index Structure Constant, Clear-Air Turbulence, Ultrasonic Anemometer, Profiling Radiometer

