



Characteristic of Wind Speed, Direction, and Profile in the West Belitung Coastal Area

Indriyanti Syhputri¹, Dinar Dwi Anugerah Putranto^{2*}, Putri Kusumawardani³

¹ Post Graduate Program of Civil Engineering, Faculty of Engineering, Sriwijaya University, Jl. R. Soeprapto, Bukit Besar, Palembang, South Sumatera, Indonesia

^{2,3}Department of Civil Engineering and Planning, Faculty of Engineering, Sriwijaya University, Jl. Raya Palembang-Prabumulih Km. 32, Inderalaya, South Sumatera, Indonesia.

*Corresponding Author

Dinar Dwi Anugerah Putranto

Department of Civil Engineering and Planning, Faculty of Engineering, Sriwijaya University, Jl. Raya Palembang-Prabumulih Km. 32, Inderalaya, South Sumatera, Indonesia.

Article History

Received: 22.07.2025

Accepted: 02.10.2025

Published: 18.10.2025

Abstract: The characteristics of wind speed, direction, and profile are meteorological elements that are important in the planning as well as development of a coastal area. The area of Tanjung Pandan City in the coastal area of East Belitung makes wind conditions to require regular information, in every air, sea, and other urban transportation activities. A method to analyse wind direction and speed conditions is through the Windrose. Therefore, this study aimed to determine the condition of wind direction and speed in the coastal area of Tanjung Pandan City throughout 2024. The analysis was conducted using the WRPLOTS (Windrose Plot) application for some days with 24-hour specifications, having a time span of 1 year from January to December 2024. The results showed that the highest wind speed was dominated from the east throughout 2024 with an average range of 3.60-5.70 m/s. Following the discussion, the dominant wind direction in the months of the transition season had a smaller percentage than in other months, namely 0.5 - 2.1 m/s. The highest wind direction came from the west and northwest in December, January, February, as well as March, while other months were dominated by wind from the east.

Keywords: Wind profile, wind speed, windrose, WRPLOT.

Cite this article:

Syhputri, I., Putranto, D. D. A., Kusumawardani, P., (2025). Characteristic of Wind Speed, Direction, and Profile in the West Belitung Coastal Area. *ISAR Journal of Science and Technology*, 3(10), 39-44.

1. Introduction

The coastal area is a transitional area between land and sea, where each activity influences the other. For example, sedimentation and freshwater flow affect the ocean, while tides, sea breezes, and saltwater infiltration shape conditions on the land (Iovino, 2022). In this context, the rapid development of the coastal area has led to highly dynamic changes. The modifications are also influenced by tidal processes, currents, and coastal waves, making the coastal area vulnerable. (Collins et al., 2021)

Belitung is an island in Bangka Belitung Province that have two regencies in the West and East. The cities within the West and East are Tanjung Pandan and Manggar, respectively. According to Bhudiharty (2019), Tanjung Pandan is a trade and sea transportation route to other islands. To ensure safety in transportation, there is a need to provide regular and accurate information on wind characteristics in this area (McFadden et al, 2001; Geske et al, 2024; Zhu et al, 2019).

Windrose diagram has proven to be a good method of showing wind events per time from various directions at specific speed

(Messaoud, 2021). The diagram contains radial lines that shows direction and percentage of wind events for a period (Wu et al, 2022; Qian et al, 2019). Aside from analyzing speed and direction, Fadholi, (2013) emphasized that the method can be used to compare wind blowing in different direction. Prasetyo (2024) use windrose as energy predictor to determine wind energy potential in Baron Techno Park, and found that energy generated was relatively small. To determine the wind energy potential in West Belitung, the current study compiled previous findings to analyze wind speed and direction.

2. Method

During the analysis, WRPLOT View was used as the windrose program for meteorological data. This software provided the windrose diagram display, frequency analysis, and diagrams for several meteorological data formats.

Windrose showed the frequency of wind events for each specific wind area and speed for every area over a certain period (Zheng et al, 2022; Abdala et al, 2023; Khaled et al, 2020; Lakes Environmental, 2013). The selected study method was descriptive analysis, which described the analysis object based on collected



data or samples, without further analysis or concluding applicable to the public. In addition, the application used in the method was the WRPLOT (Windrose Plots for Meteorological Data). This showed the direction or difference in wind speed between one class and another as a supporting analysis, including the windrose graph of the wind speed that occurred. (Ceswaraningrat et al., 2024). Wind direction and speed data were processed by classifying the direction into eight cardinal directions, including 360° (North), 45° (Northeast), 90° (East), 135° (Southeast), 180° (South), 225° (Southwest), 270° (West), as well as 315° (Northwest). During the process, the wind data used are surface wind observations from a 10-meter anemometer located along the shipping lanes around the Tanjung Pandan coast. These data represented hourly surface observations routinely recorded by the Tanjung Pandan maritime meteorological station from January to December 2024. (Lusiani & Wardoyo, 2017).

The analysis of Windrose conditions in Tanjung Pandan was conducted using WRPLOTS daily with a 24-hour timeframe over a year. In this study, daily wind speed and direction data were used with a time span of 1 year (12 months) from January to December 2024.

3. Results and Discussion

Geographically, Tanjung Pandan District is located between 107°36'33.5" - 107°42'41.4" East Longitude and 2°41'32.4" - 2°47'13.0" South Latitude. The data used during the analysis was obtained from the Tanjung Pandan Meteorological Station at: <https://power.larc.nasa.gov>, then converted into .sam format to be processed in the WRPLOT application. The results of processing wind condition data in the Tanjung Pandan coastal area from January to December 2024 were shown in Figure 1.

Windrose diagram from January to December

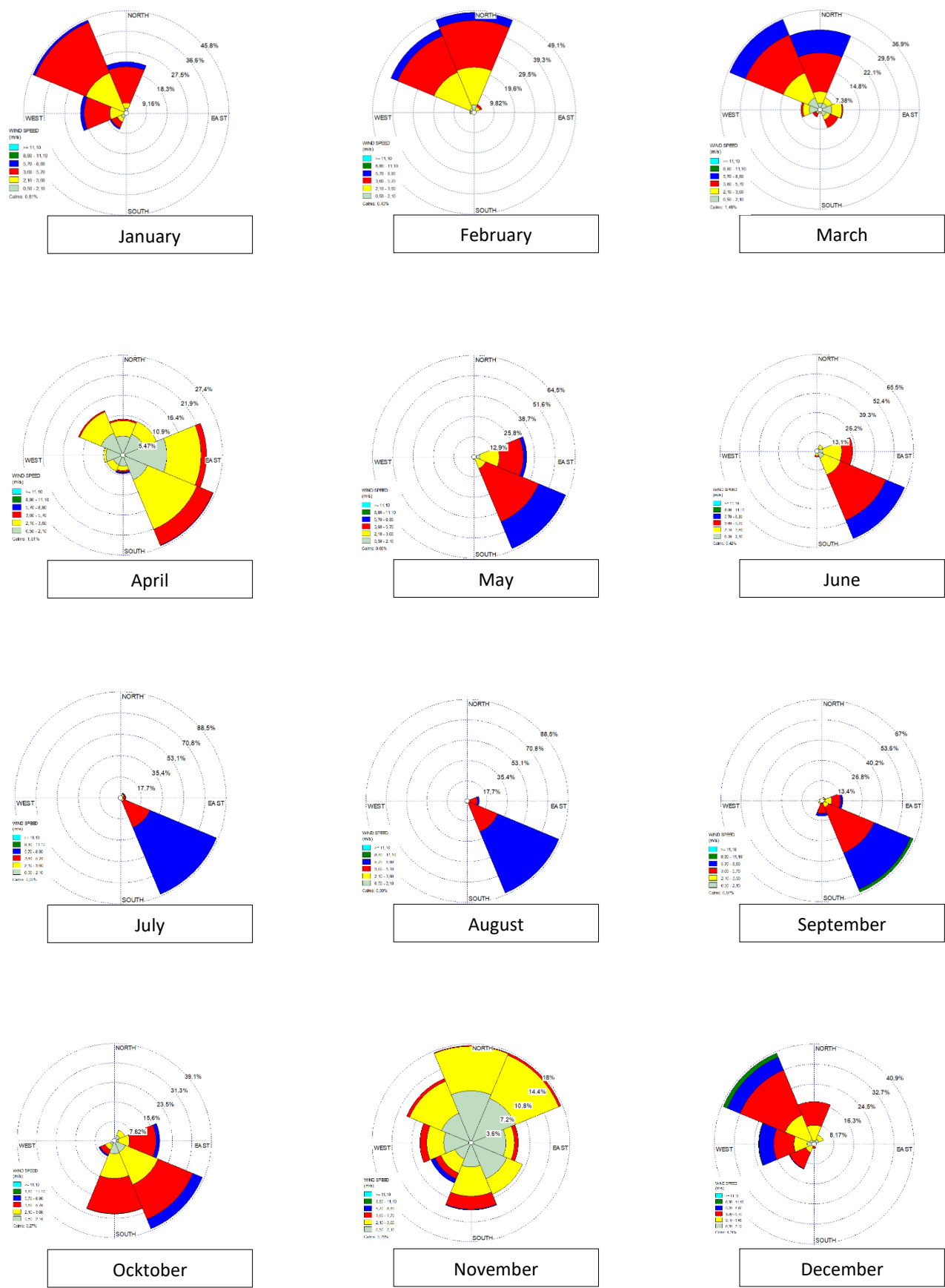
Based on Figure 1, the wind on the Tanjung Pandan coast was dominated by northwest, west, and north directions. The average speed was 3.60–5.7 m/s, while the highest was 5.70–8.80 m/s from the northwest. This condition showed that the wind blowing on the coast was only influenced by the dominant monsoon wind pattern from the west in January. During February, the wind on the Tanjung Pandan coast were dominated by north and northwest directions, accounting for 48%. Following the discussion, the average wind speed was 3.60–5.70 m/s, with the highest being 5.70–8.80 m/s, dominated from the north. The wind direction conditions in February were the same as in January. In March, the wind was still dominated by northwest and north directions at 34.9% as well as 29.5% respectively. The average wind speed was 3.60–5.70 m/s, while the highest was 8.80 m/s, dominated by the northwest. In April, the Tanjung Pandan Windrose started to change, dominated by the southeast as well as east directions, at 28% and 22%. During this period, the average speed was 2.10–3.60 m/s, and the highest was 5.70 m/s, dominated by the southeast. In May, the coast was dominated by wind from the southeast and

slightly greater from the east, at 63% as well as 30%, respectively. The average speed in southwest was 3.60–5.70 m/s, with the highest peaking at 8.80 m/s. Observation showed that the direction did not change significantly in June, but still dominated by the southeast and slightly from the east, at 65% and 21%, respectively. In Tanjung Pandan, the average wind speed was 3.60–5.70 m/s, with the highest being 8.80 m/s from the southeast, indicating that the southeast monsoon wind in dominant.

In July, the wind was predominantly from the southeast, with an average speed of 87%, ranging between 5.70–8.80 m/s. The highest speed in this area was 8.80 m/s, which was quite similar to April, May, June, and August. These results showed the dominant southeast monsoon wind in the Tanjung Pandan coastal area during the months. The windrose diagram in September showed that wind on the coast was dominated by the southeast direction at 66%. Average speed during this period was 3.60–5.70 m/s, with the highest being 11.10 m/s in the southeast. In October, the wind on the coast was dominated by the direction of the landmark at 36%. However, there were additions from other directions, such as the south and east. The result showed that average speed was 3.60–5.70 m/s, and the highest was 8.80 m/s, which was dominated by the southeast. The wind pattern in October was similar to September, with an increase from south to east compared to previous months. In November, wind on the Tanjung Pandan coast started to change direction, dominated by the north at 18% and the northeast at 17%. During this time, the average speed was 0.5–2.1 m/s, and the highest was 8.80 m/s, with wind coming from all directions, signifying the seasonal transition. At the end of the year, as shown in the December windrose diagram, wind on the Tanjung Pandan coast was again dominated by the northwest (40%) and the east. Average wind speed was 3.60–5.70 m/s, and the highest at 11.10 m/s, which was dominated by the northwest. In December, the west monsoon returned to dominate the Tanjung Pandan coastal area.

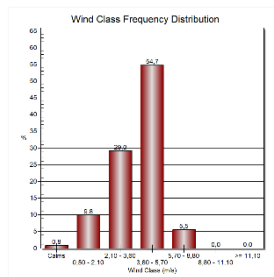
Bar chart of wind speed from January to December

According to the wind speed graph in January, the wind speed was 3.60–5.70 m/s with a frequency of occurrence of 54.7% in a month. In February, the highest wind speed was 3.60–5.70 m/s with a frequency of occurrence of 42.8%. The highest wind speed in March was 3.60–5.70 m/s with a frequency of 34.9% in a month. In April, the highest wind speed was 0.60–2.10 m/s, having an occurrence of 48.2%. Minimal difference from the previous month was observed in May as the highest wind speed was 3.60–5.70 m/s with an occurrence of 52.8%. In June, the highest wind speed was 3.60–5.70 m/s having occurring at 41.5% in one month. Furthermore, the highest wind speed in July was 5.70–8.80 m/s with an occurrence of 62.5%. The highest wind speed was 5.70–8.80 m/s with a frequency of occurrence of 60.9% in August. Following the discussion, the highest wind speed was 3.60–5.70 m/s with a frequency of 45.3% in September.

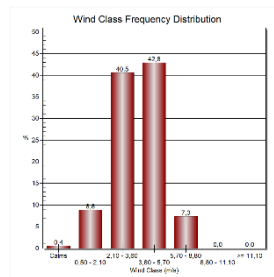


When reaching the end of the year, the highest wind speed was 3.60-5.70 m/s, having a frequency of occurrence of 41.9% in October. The highest wind speed was 0.50-2.10 m/s in November,

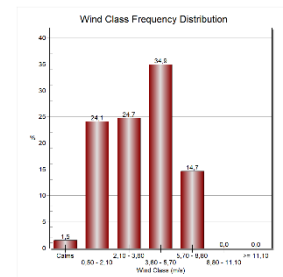
with an occurrence of 50.1% in one month. At the end of the year, the highest wind speed was 3.60-5.70 m/s with a frequency of occurrence of 45.6% in one month.



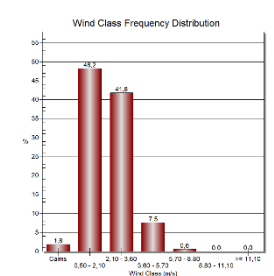
Januari



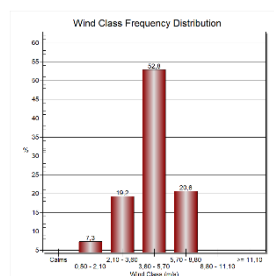
Februari



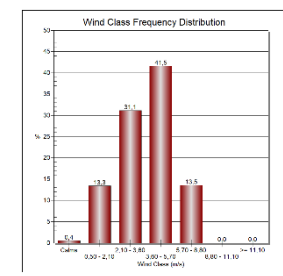
Maret



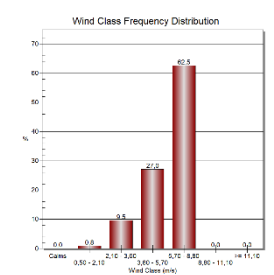
April



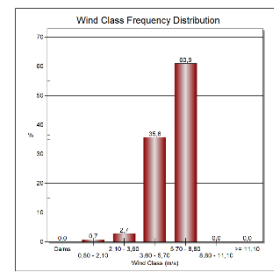
Mei



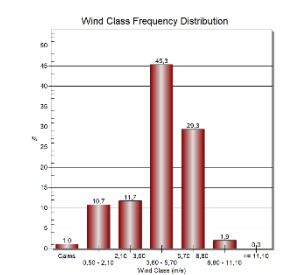
Juni



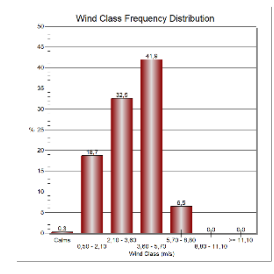
Juli



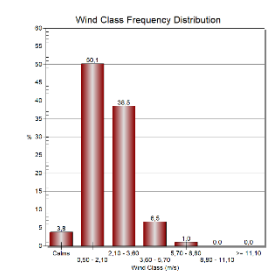
Agustus



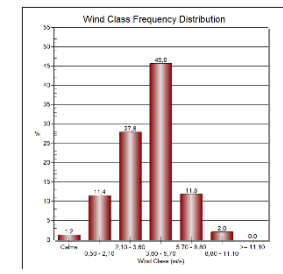
September



Oktober



November



Desember

Figure 2. Graphic of Wind Speed in Tanjung Pandan for January – December 2024

Table 1 showed the highest wind speed of 5.70-8.80 m/s along the Tanjung Pandan coast from January to December. This occurred from the southeast, having a frequency of 1,328, followed by 129 for the northwest and the north with 85.

The windrose diagram for the Tanjung Pandan coast from January to December 2024 showed that monsoonal wind patterns significantly influenced surface wind in the area. This was signified by the strengthening or weakening of westerly or easterly wind. Throughout the month, the highest wind speeds often

occurred from the east. This showed that southeaster wind had higher speed than wester wind. In the transitional months of April and November, the dominant wind direction had a lower percentage than in others. These results could be used by the public and government to gather wind information on the Tanjung Pandan coast, for maritime transportation purposes, fishing considerations in the waters around the area, and other purposes. The information could also be used by the public as a basis for wave analysis and coastal building planning.

Table 1. Table of Wind Speed in Tanjung Pandan for January – December 2024

No.	Wind Direction/ Wind Class	0,50 - 2,10	2,10-3,60	3,60-5,70	5,70-8,80	8,80- 11,10	> = 11,10	Total
1	North	194	328	459	109	0	0	1090
2	Northeast	205	212	16	5	0	0	438
3	East	278	375	378	54	0	0	1085
4	Southeast	236	441	1296	1328	14	0	3315
5	South	128	153	205	41	0	0	527
6	Southwest	115	95	107	18	0	0	335
7	West	151	144	162	56	2	0	515
8	Nortwest	178	509	592	129	13	0	1421
9	Sub Total	1485	2257	3215	1740	29	0	8726
10	Calm							81
11	is lost							1
12	Total							8808

4. Conclusion

In conclusion, the following assumptions were drawn from the analysis.

- 1. The highest wind speed was predominantly from the east throughout 2024, with an average monthly speed of 3.60-5.70 m/s.
- 2. The dominant wind direction during the transitional season months was less than others, such as April and November.
- 3. The average wind speed range along the Tanjung Pandan coast was relatively minimal at 0.5-2.1 m/s, with the highest wind speed ranging from 8.80-11.10 m/s.
- 4. The highest wind speed from the west and northwest occurred in December, January, and February. Meanwhile, in March, the dominant wind direction was from the east, southeast, and northeast, with relatively lower speed.

Acknowledgments

The authors are grateful to the Ministry of Higher Education Science and Technology, Universitas Sriwijaya, who has provided research funding through Professional Research grants 2025. In accordance with the Rector’s Decree Number : 0029/UN9/LPPM.PT/2025, on September 17,2025

References

1. Abdalla A, W. El-Osta, Y. Nassar, W. Husien, E. Dekam, G. Miskeen, Estimation of dynamic wind shear coefficient to characterize best fit of wind speed profiles under different conditions of atmospheric stability and terrains for the assessment of height-dependent wind energy in Libya, Appl. Sol. Energy 59 (3) (2023) 343–359, <https://doi.org/10.3103/S0003701X23600212>.

2. Ben Messaoud M, A thorough review of aircraft landing operation from practical and theoretical standpoints at an airport which may include a single or multiple runways, Appl. Soft Comput. 98 (2021), <https://doi.org/10.1016/j.asoc.2020.106853>

3. Bhudiharty, S. (2019). Analisis Potensi Wisata Bahari Dan Budaya Di Belitung, Kab. Belitung Barat. *Jurnal Industri Pariwisata*, 2(1), 36–50. <https://doi.org/10.36441/pariwisata.v2i1.29>

4. Collins, S. P., Storrow, A., Liu, D., Jenkins, C. A., Miller, K. F., Kampe, C., & Butler, J. (2021). *No Title No Title No Title No Title*. 7(Cvi), 167–186.

5. Gede Yamuna Ceswaraningrat, I. B., Aryashta, D., & Hermansyah, M. (2024). Analisis Angin Permukaan

- Menggunakan Diagram Wind Rose untuk Keselamatan Penerbangan di Bandara Internasional Juwata. *Euler : Jurnal Ilmiah Matematika, Sains Dan Teknologi*, 12(1), 45–56. <https://doi.org/10.37905/euler.v12i1.25271>
6. Geske A.M, D.M. Herold, S. Kummer, Artificial intelligence as a driver of efficiency in air passenger transport: a systematic literature review and future research avenues, *J. Air Transp. Res. Soc.* 3 (2024) 1–13, <https://doi.org/10.1016/j.jatrs.2024.100030>.
7. Iovino, M. (2022). Oxytocin Signaling Pathway: From Cell Biology to Clinical Implications. *Endocrine, Metabolic & Immune Disorders - Drug Targets*, 21(1), 91–110. <https://doi.org/10.2174/22123873mta2cnz0>
8. Jie Wan, Kun Yao, Guorui Ren, Ke Han, Qi Wang, Jilai Yu Spatiotemporal Diurnal Modulation Characteristic of Wind Speed and Power Generation Revealed by Its Measured Data Processing
9. Lian W, B. Hou, J. Sun, C. Wang, T. Zhang, Numerical analyses of airdrop landing process impacting the rigid and soil ground, *Adv. Aeronaut. Sci. Eng.* 13 (01) (2022) 68–75, <https://doi.org/10.16615/j.cnki.1674-8190.2022.01.07> (In Chinese).
10. Lusiani, & Wardoyo, T. (2017). Analisis Arah Dan Kecepatan Angin Dengan Aplikasi Wrplots. *Jurnal Ilmu-Ilmu Kemaritiman, Manajemen Dan Transportasi*, 25, 19–29.
11. McFadden K.L, B.S. Hosmane, Operations safety: an assessment of a commercial aviation safety program, *J. Oper. Manag.* 19 (2001) 579–591, [https://doi.org/10.1016/S0272-6963\(01\)00062-6](https://doi.org/10.1016/S0272-6963(01)00062-6).
12. Meier D, S. Fiorino, Application of satellite- and NWP-derived wind profiles to military airdrop operations, *J. Appl. Meteorol. Climatol.* 55 (10) (2016) 2197–2209, <https://doi.org/10.1175/JAMC-D-15-0296.1>.
13. Qian S, L. Zhao, X. Wang, H. Li, Effects of the Boreal Summer Intraseasonal Oscillation on tropical cyclone activity in the northwest Pacific Ocean, *J. Trop. Meteorol.* 35 (5) (2019) 664–672, <https://doi.org/10.16032/j.issn.1004-4965.2019.060> (In Chinese)
14. Wu L, F. Qiao, Wind profile in the wave boundary layer and its application in a coupled atmosphere-wave model, *J. Geophys. Res. Ocean* 127 (2) (2022) e2021JC018123, <https://doi.org/10.1029/2021JC018123>.
15. Wu L, F. Qiao, Wind profile in the wave boundary layer and its application in a coupled atmosphere-wave model, *J. Geophys. Res. Ocean* 127 (2) (2022) e2021JC018123, <https://doi.org/10.1029/2021JC018123>.
16. Wang Z, W. Liu, Wind energy potential assessment based on wind speed, its direction and power data, *Sci. Rep.* 11 (1) (2021) 16879, <https://doi.org/10.1038/s41598-021-96376-7>.
17. Wang Y, J. Sun, B. Hou, Y. Zhang, Cushioning performance analysis of landing buffer airbag for small electronic equipment, *Spacecr. Recovery Remote Sens.* 39 (5) (2018) 25–33, <https://doi.org/10.3969/j.issn.1009-8518.2018.05.004> (In Chinese).
18. WRPLOT software accessed through <http://www.weblakes.com/products/wrplot/index.html> at July, 29, 2025.
19. Zhu Q, J. Pei, X. Liu, Z. Zhou, Analyzing commercial aircraft fuel consumption during descent: a case study using an improved K-means clustering algorithm, *J. Clean. Prod.* 223 (2019) 869–882, <https://doi.org/10.1016/j.jclepro.2019.02.235>.
20. Zhang Y, J. Sun, B. Hou, Process of inflating and canopy collapsing for small parachute, *J. Tianjin Norm. Univ. (Nat. Sci. Ed.)* 42 (04) (2022) 23–30, <https://doi.org/10.19638/j.issn1671-1114.20220405> (In Chinese).
21. Zheng D, Z. Ni, Y. Qing, Z. Sun, J. Zhang, S. Li, Wind characteristics in the surface layer on different underlying surfaces in high altitude areas of central and western China, *Atmosphere* 13 (12) (2022) 2108, <https://doi.org/10.3390/atmos13122108>.