Wind Insights & Predictions
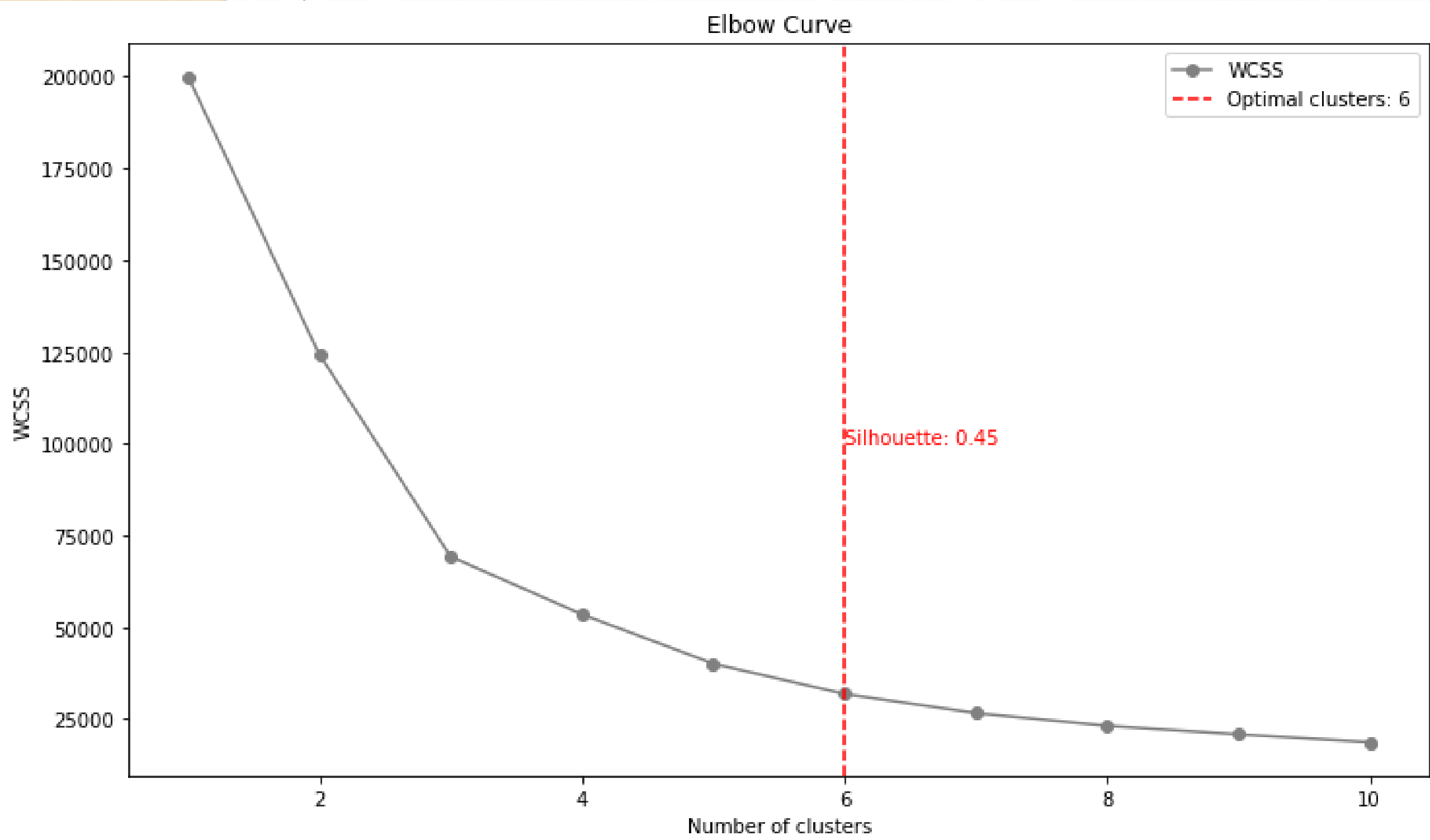

Elbow Curve

Histograms of Average Wind Direction and Speed (2011-2014)

Introduction:

In a quest to transform meteorological data into practical knowledge, this study employs advanced data analysis techniques to reveal underlying wind patterns, offering a predictive edge in industries where understanding and anticipating wind behaviour is vital.

Abstract:

Utilizing K-Means clustering and polynomial regression, this analysis deciphers wind data from 2011 to 2014, uncovering six distinct patterns crucial for forecasting and strategic planning in sectors like renewable energy and agriculture.
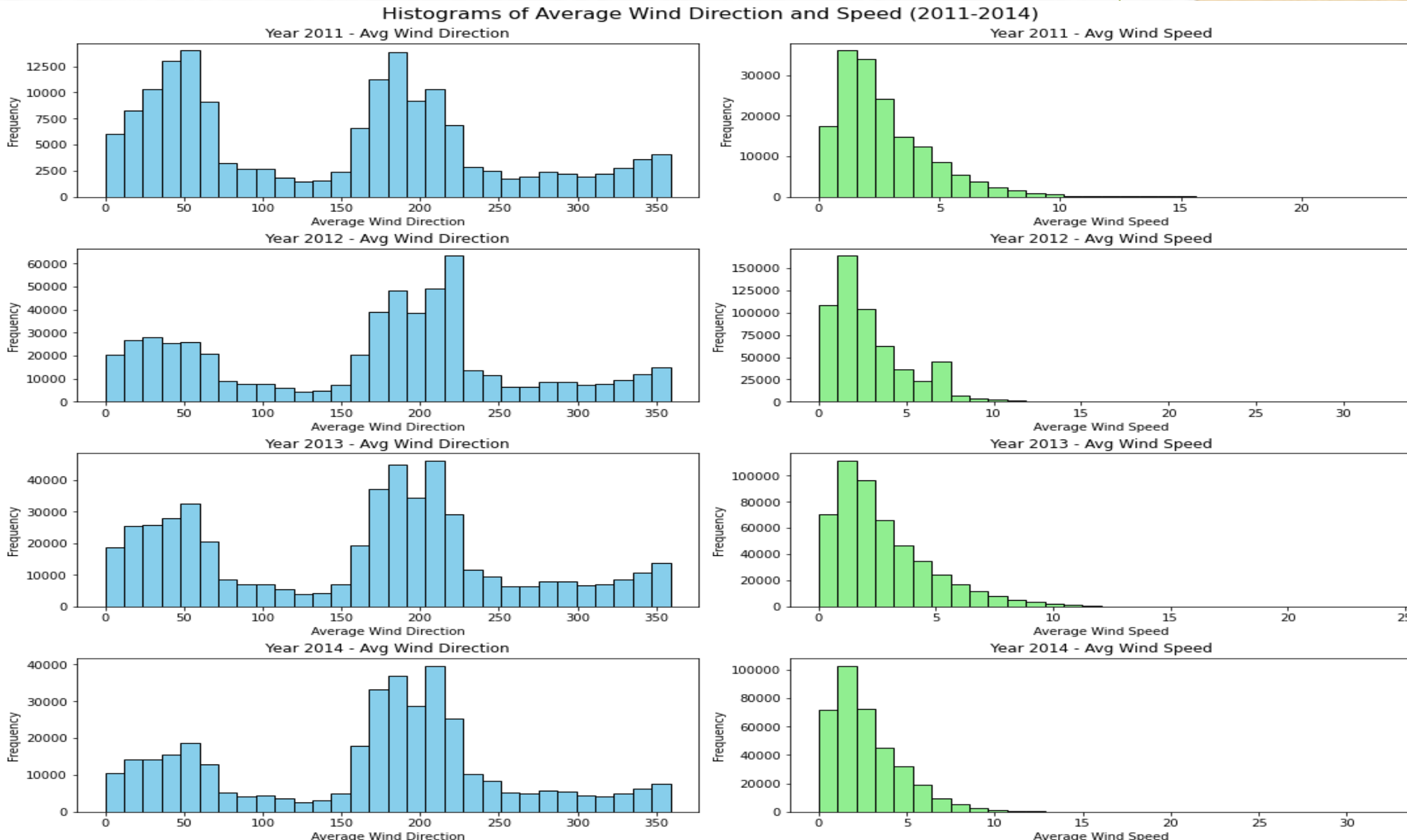
Strategic Clustering:

Our analysis distilled the wind data into six distinct clusters, striking a balance between simplicity and detail. The chosen cluster number, reinforced by a moderate silhouette score, highlights clear, separate wind patterns. This clustering not only explains current wind behaviour but also serves as a foundation for developing wind-related strategies, from urban planning to renewable energy sourcing.

Speed-Direction Interaction:

Cluster centers chart the wind's course, revealing pivotal directions for peak speeds. These insights are critical for optimizing wind farm placements and predicting energy yields.

Curve Fit with Prediction and Uncertainty
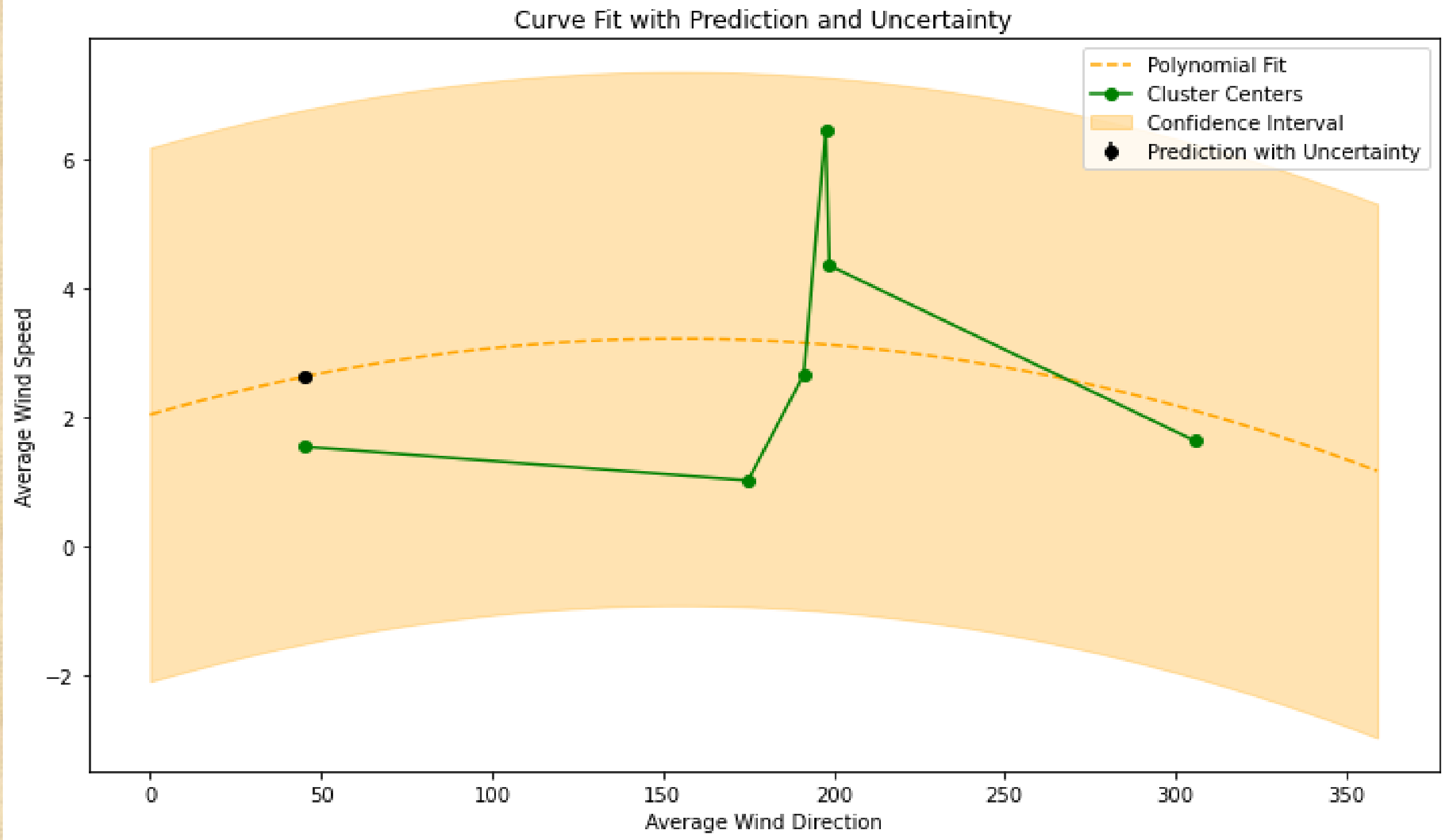
Yearly Wind Shifts:

Comparative annual histograms reveal subtle shifts, suggesting a link to broader environmental changes. This could guide adaptations in sectors from agriculture to urban planning.

Predictive Edge:

The chart depicts a polynomial fit for wind speed versus direction, with visible cluster centers for data groupings and a shaded area representing the confidence interval. A single outlier is marked, illustrating a prediction with associated uncertainty.


Curve Fit and K-Means Cluster Centers
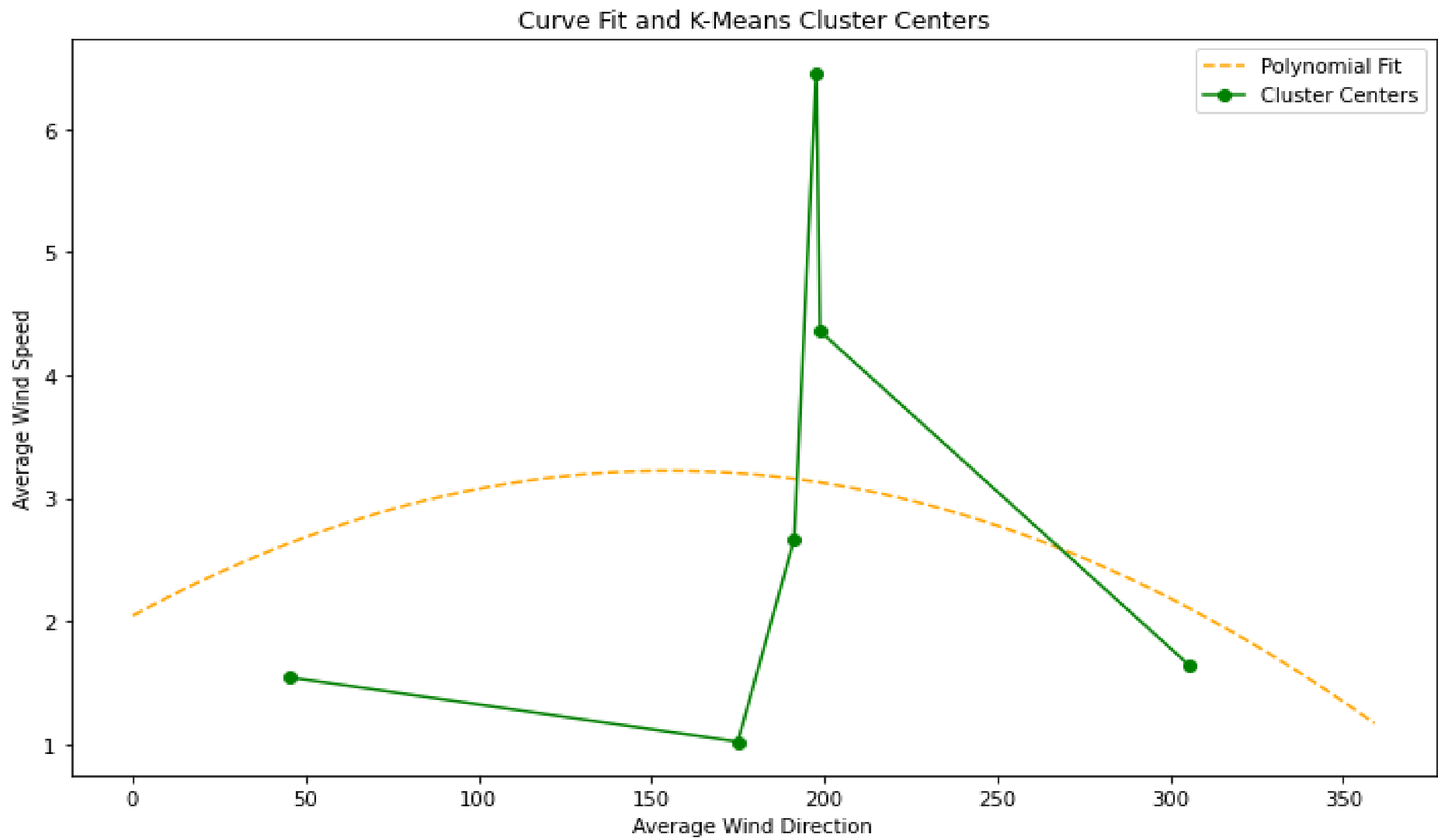
Trend Forecast:

A quadratic perspective distills the complexity into a clear trend line, providing a simplified forecast model for long-term strategic decisions. It shows a polynomial trend of wind speed against direction and distinct K-means cluster centers, with the highest wind speed occurring slightly beyond 200 degrees.

Analysis of Wind Speed Variability by Direction with Quadratic Modelling:

The scatter plot presents individual data points for average wind speed against wind direction, overlaid with a quadratic fit line that suggests a non-linear relationship. The data appear randomly distributed.

Quadratic Fit for Average Wind Speed vs. Average Wind Direction
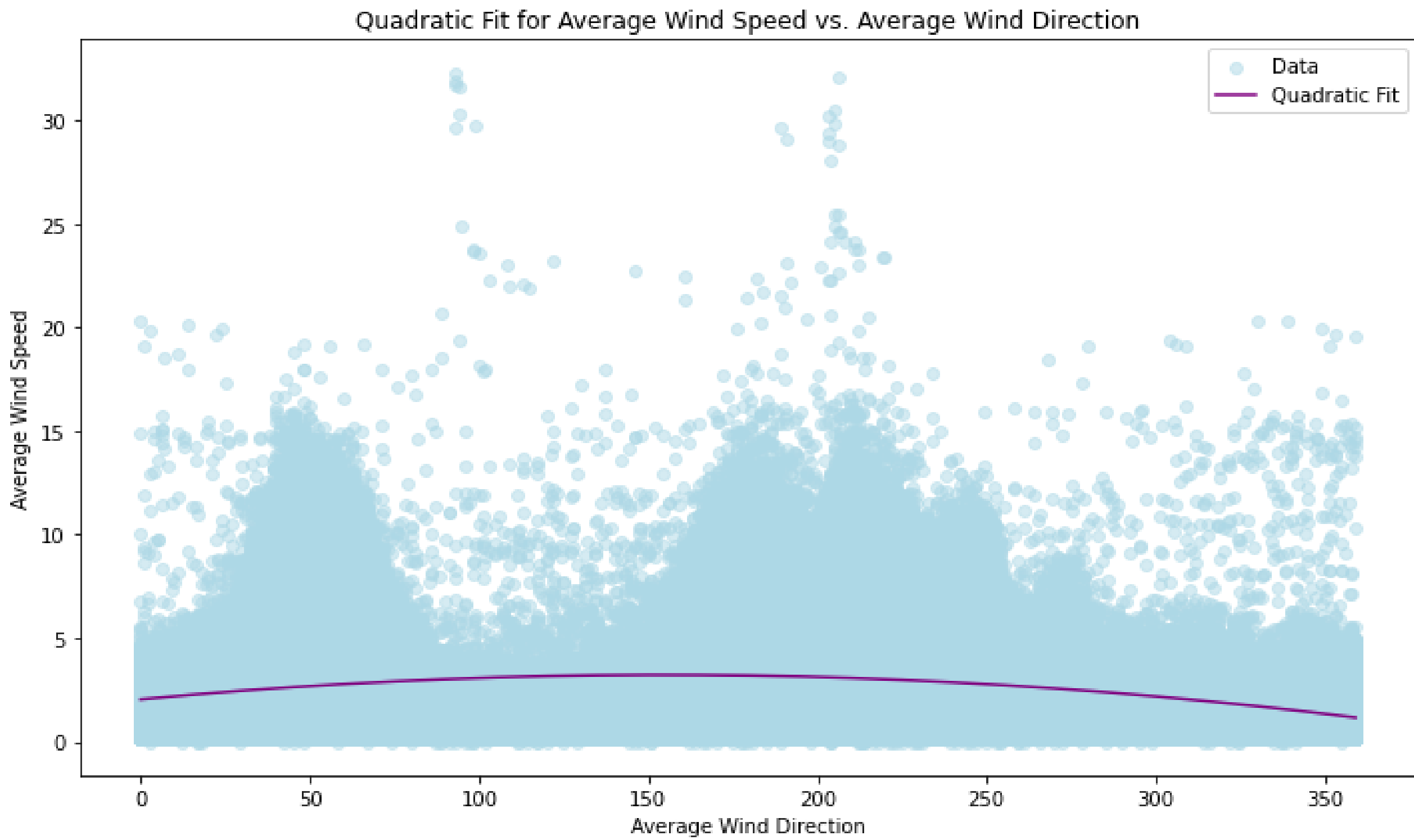
Our data narrative elucidates the intricate dance between wind direction and speed. By harnessing these insights, we unlock predictive capabilities that extend beyond mere academic interest, offering tangible benefits and informed guidance for industries and sectors where the wind plays a crucial role.

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GITHUB REPO LINK: https://github.com/Amulya07534776064/ADS1-ASSIGNMENT3