Molas B300 Wind speed refactoring method for complex terrain

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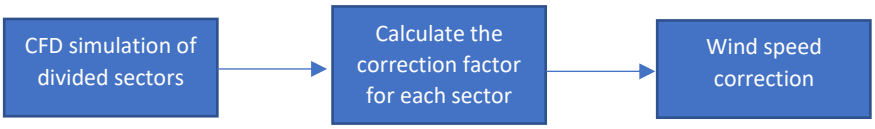
1. Summary

For complex terrain, Molas B300 adopts a sectorized flow field coefficient correction method to ensure the accuracy of wind speed measurement. This article introduces the complex Refactoring method of wind field in complex terrain, and the comparison result of actual measurement on a given wind measurement site.

2. Refactoring Method

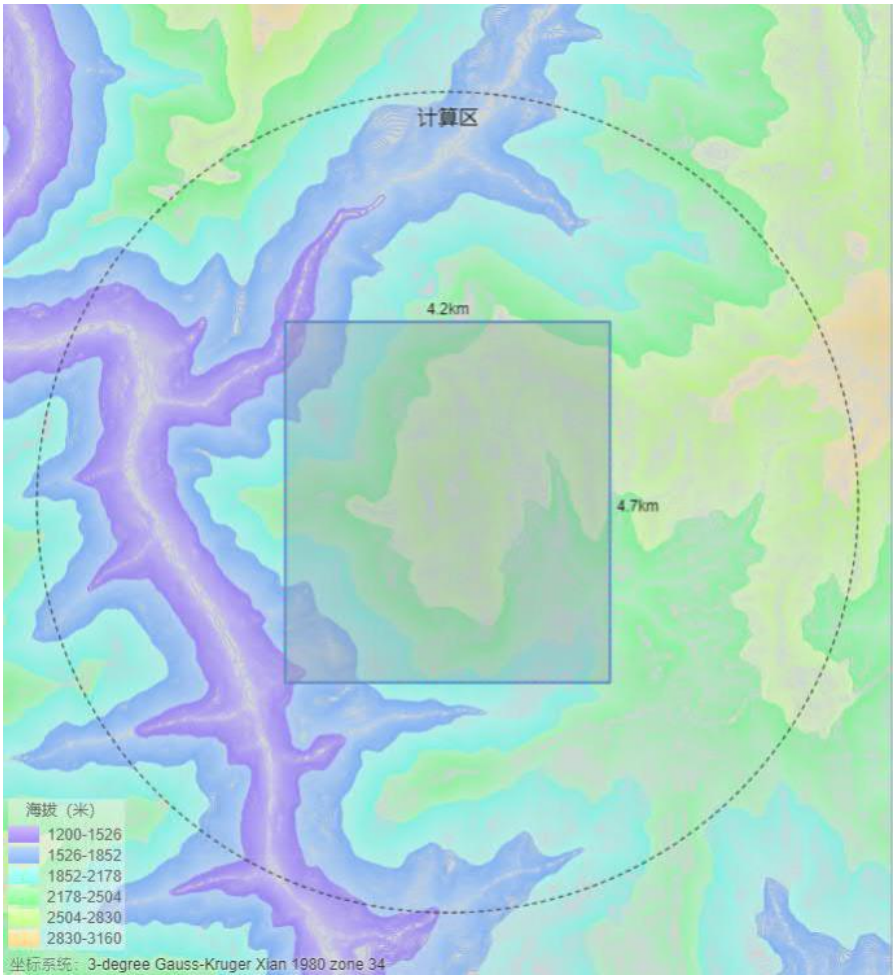
The process of wind speed refactoring is shown below:



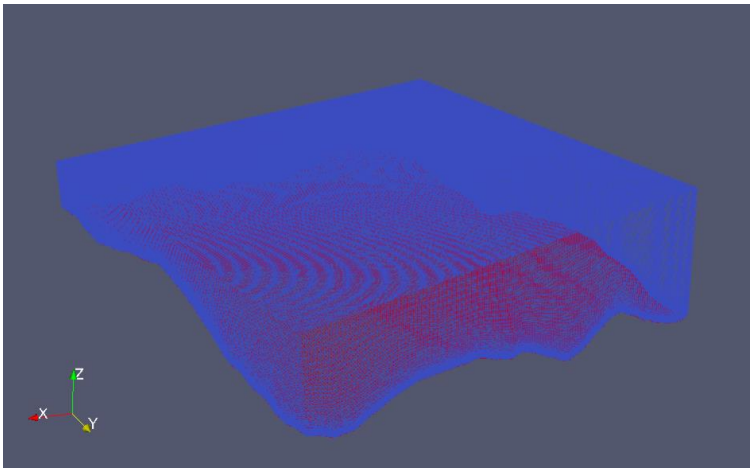
2.1 CFD simulation

A wind field simulation software developed based on Openfoam is used to simulate the flow field. The calculation process is as follows:

(1) Set the area of interest as shown in the figure below.



(2) Set the horizontal resolution and vertical resolution to generate a computational grid, as shown in the figure below.



(3) Select the solver and the turbulence model (such as RANS), perform directional calculations on each sector respectively, set the maximum number of iterations, and iterate to convergence.

(4) Extract wind vector $\boldsymbol{P}_r = (u, v, w)^T$;

2.2 Calculate the correction factor

Combined with the wind vector extracted by CFD $\boldsymbol{P}_r = (u, v, w)^T$, calculate the radial wind speed projected to each beam direction of the Lidar V_{LOS}^i, then solve the minimum value of the following formula, get reconstructed wind speed $\widehat{\boldsymbol{P}} = (\hat{u}, \hat{v}, \hat{w})^T$

$$\boldsymbol{F}(\boldsymbol{P}) = \frac{1}{2}\sum_{i=1}^{8}\left(V_{LOS}^i - V_{LOS_{proj}}^i\right)^2$$

$\widehat{\boldsymbol{P}} = (\hat{u}, \hat{v}, \hat{w})^T$ represents the wind vector to be calculated, $V_{LOS_{proj}}^i$ is the wind vector $\widehat{\boldsymbol{P}}$ projected wind speed on the No. i beam of light.

Then the correction factor can be calculated as:

$$coef = \sqrt{\frac{(\hat{u}^2 + \hat{v}^2)}{(u^2 + v^2)}}$$

2.3 Wind speed correction

The correction coefficients of different sectors are calculated separately, combined with the lidar measurement of the wind direction, the correction coefficient of the same

sector is selected, and then the lidar measured wind speed is directly multiplied by the correction coefficient to obtain the corrected wind speed.

3. Verification of the method

The lidar wind measurement data and the wind measurement tower data in a certain area are selected for comparison and verification, and the results are as follows. Among them, X Data is the wind measurement tower data, Y Data is lidar wind data.

3.1 **the comparison result**

(1) The result of comparison at 50m

Table 1 The result of comparison at 50m

	Slope	**Intercept**	**R^2**	**Mean Dev.**	**Relative Mean Dev.**	**Std of Mean Dev.**
Raw Data	0.9575	0.0470	0.9976	-0.261	-3.60%	0.143
Corrected Data	1.0129	0.0295	0.9967	0.123	1.70%	0.133

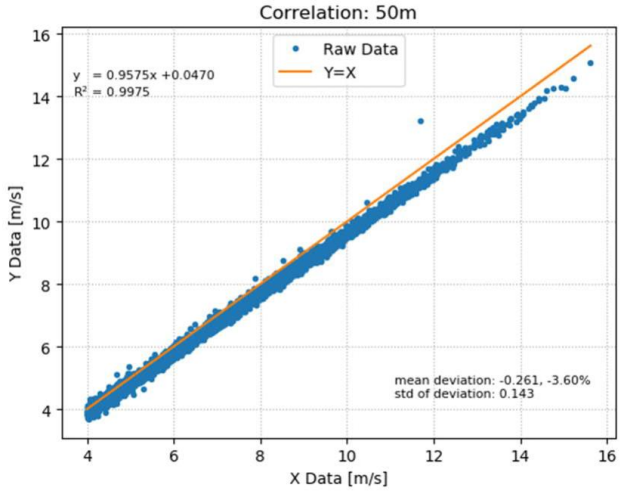


Figure 1 Correlation analysis diagram of 50m wind speed (raw data)

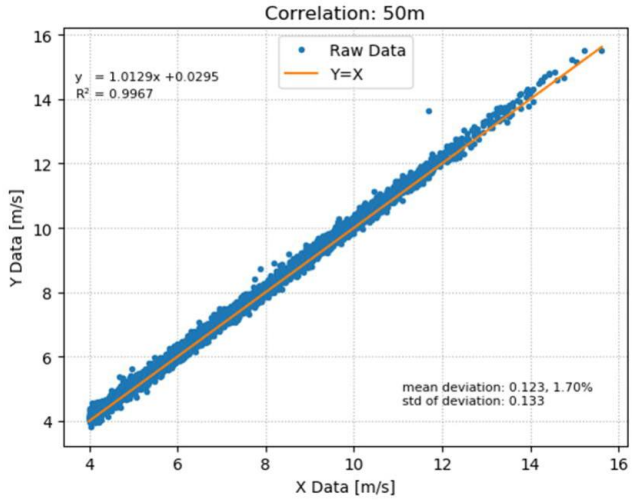


Figure 2 Correlation analysis diagram of 50m wind speed (corrected data)

(2) The result of comparison at 70m

Table 2 The result of comparison at 70m

	Slope	**Intercept**	**R^2**	**Mean Dev.**	**Relative Mean Dev.**	**Std of Mean Dev.**
Raw Data	0.9535	0.0488	0.9971	-0.292	-3.98%	0.155
Corrected Data	1.0016	0.0627	0.9964	0.074	1.01%	0.135

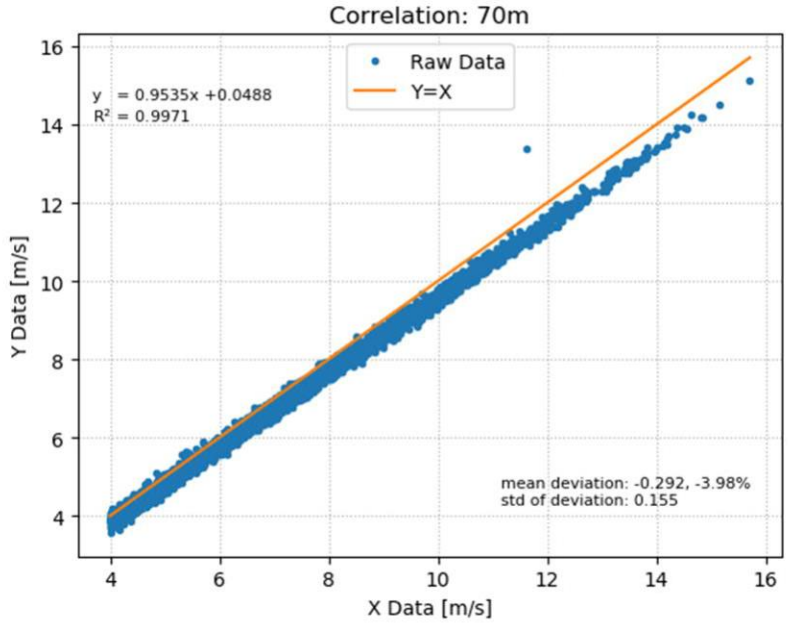


Figure 3 Correlation analysis diagram of 70m wind speed (raw data)

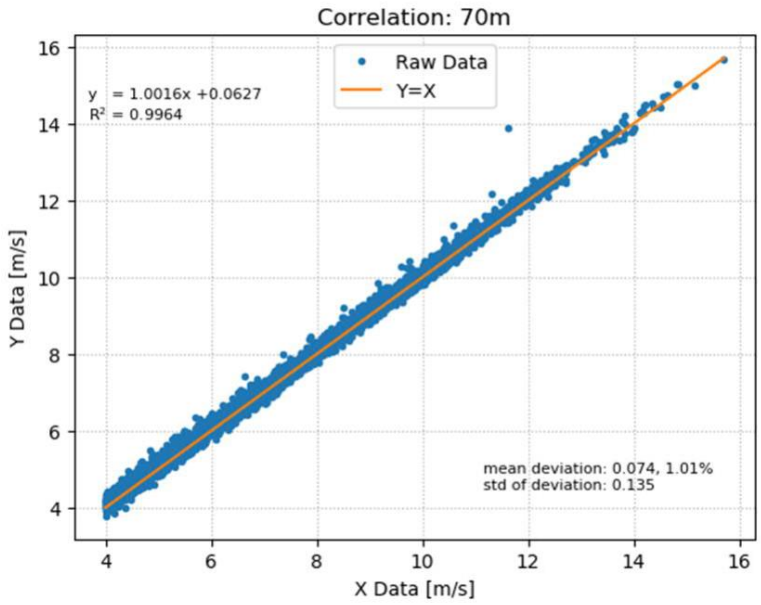


Figure 4 Correlation analysis diagram of 70m wind speed (corrected data)

(3) The result of comparison at 90m

Table 3 The result of comparison at 90m

	Slope	**Intercept**	**R^2**	**Mean Dev.**	**Relative Mean Dev.**	**Std of Mean Dev.**
Raw Data	0.9489	0.0328	0.9968	-0.346	-4.67%	0.164
Corrected Data	1.0192	0.0184	0.9969	0.160	2.16%	0.132

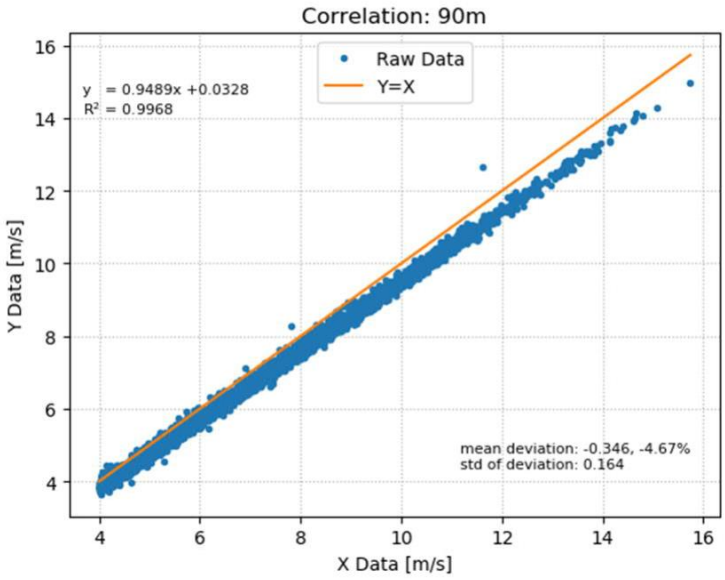


Figure 5 Correlation analysis diagram of 90m wind speed (raw data)

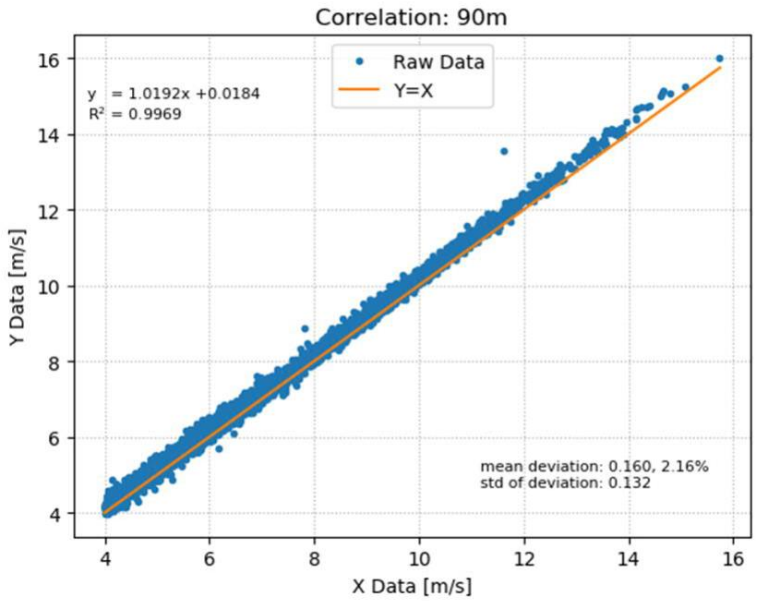


Figure 6 Correlation analysis diagram of 90m wind speed (corrected data)

3.2 Conclusion

It can be seen from the results that the slope and average deviation between the wind speed and the wind speed of the wind measurement tower have been significantly improved after correction.