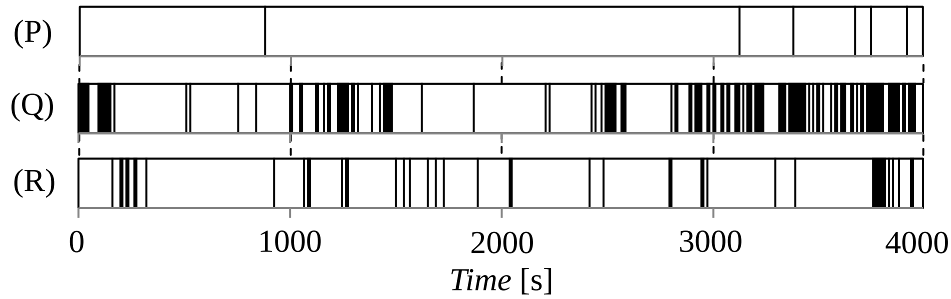


Figure 5. *Frequency and duration of gust*

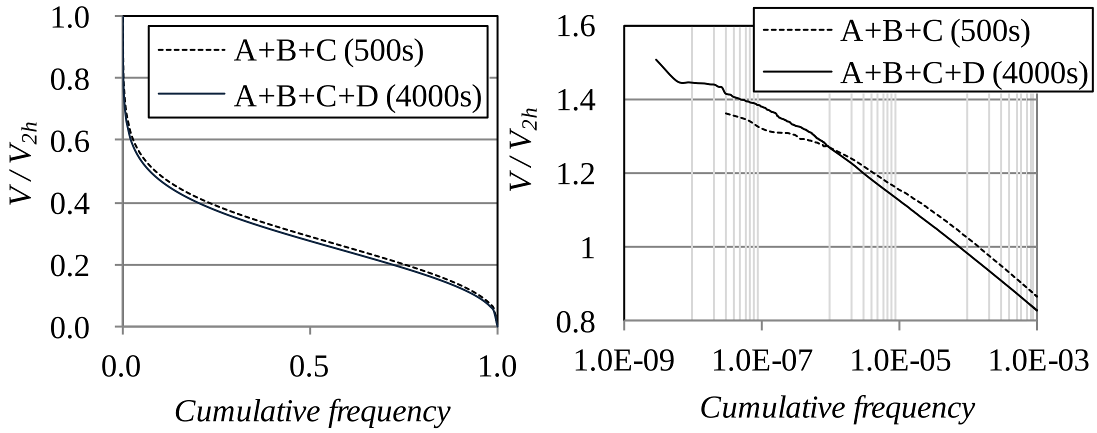
DISCUSSION: ON DETERMINING GUST CRITERIA

Cumulative distribution function (CDF) is calculated in whole the data of target area and sampling period to evaluate the probability of gust event at a pedestrian level explicitly. The authors defined CDF for gust analysis as following equation:

$$F(\Phi) = \int_{\Phi}^{\infty} f(\varphi) d\varphi \,, \tag{1}$$

where Φ is a threshold, $F(\Phi)$ is CDF, and $f(\varphi)$ is the probability distribution function (PDF) for a variable φ. The result for two cases of target area and sampling period are shown in ***Figure 6***: one is district A+B+C with 500 seconds, and the other is district A+B+C+D with 4000 seconds (i.e., the case of largest sample number). Generally, it is believed that when the sampling time sequence increases, the amplitude of rare and strong wind event becomes larger because low frequency oscillation of the flow is resolved; however, the graph indicates the case A+B+C, 500s shows larger wind speed over all the range of cumulative distribution. This is because the gust event appears at early moment during the time steps in the case of A+B+C, 500s, and it causes such a probability distribution of entirely larger wind speed. This indicates that, if the total sampling number is statistically insufficient, probability distribution of wind speed can easily change depending on at which moment the sampling is started. Actually, the maximum level wind speed of the case A+B+C+D, 4000s is larger than the other, although this tendency appears only in the range of considerably low cumulative frequency, as shown in ***Figure 6****(b)*.

Meanwhile, determining the criteria should be carefully done because the wind speed varies drastically at less than around 10th percentile due to the steep slope of CDF; for example, the difference between 1st and 5th percentile is around 24%, whereas that between 10th and 15th percentile is only about 9% for the case of A+B+C+D, 4000s.



(a) Whole view *(b) Enlarged view*

Figure 6. *Cumulative distribution function of wind speed*

CONCLUSIONS

The LES database of the instantaneous wind speed within the uniform staggered block arrays with λ_p=16% is analyzed to assess the criteria of statistics for gust analysis in a pedestrian space. Based on the results, following things are clarified:

1) Among the turbulence statistics of mean value, standard deviation, the convergence of skewness and kurtosis are strongly affected by the sampling period. Especially, kurtosis requires the longest sampling period; thus, the convergence of kurtosis can be one of the statistical criteria for gust analysis.
2) The difference of wind speed between 1st and 5th percentile is around 24 %, whereas that between 10th and 15th percentile is only about 6%; thus, defining criteria with the idea of percentile should be carefully done.

In addition, the fundamental research on pedestrian gust characteristics is performed. The authors calculated gust duration for each grid point. As a result, we revealed that gust duration is relatively large at the block corner and it seems that there is some characteristic frequency for gust events; it should be analyzed in future work.

ACKNOWLEDGEMENTS

This research was financially supported by JSPS KAKENHI Grant Number - 22360238, 25820282.

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