Eddy covariance (EC) measurement operates fundamentally over the hypothesis of stationarity, so that averaging problems are an inherent issue in the EC measurement. Therefore, it is valuable to estimate a relative sampling error in a classical time-averaging length in terms of the performance estimation of EC measurement.

In classic quality control and quality assessment (QCQA), 1) it is the arbitrary values that the rank of qualities with an integral turbulence characteristics (ITC) and a stationarity; 2) measurement gaps are inevitably increased in accordance with QCQA filtering; and 3) no further information coming from the averaging problem is regarded. If \( z \) represents ITC, it will be a convenient and comfortable parameter for scaling both error and quality of EC measurements.

The \( z \) will contribute to the investigations to compare vegetation responses in climate change, and to integrate regional or global values of the exchange, as well as to validate model performance or satellite analysis, and to synthesize the quantitative values by data assimilation. Therefore, in consideration of turbulent characteristics the averaging method of EC measurement is to be mediated.

### MATERIALS & METHODS

**Key governing equations**

1. Relative sampling error (Kan et al. 2015)
   \[ \varepsilon = \frac{\sigma_{\text{mis}}}{\sigma_{\text{true}}} \]

2. Sampling error (Finkelstein and Sims 2001)
   \[ \sigma_{\text{mis}} = \frac{1}{N} \left( \sum_{i=1}^{N} \left( \frac{X_i - \mu}{\sigma} \right)^2 \right) \]

3. Weighted average (Kan et al. 2015)
   \[ \varepsilon = \frac{1}{N} \sum_{i=1}^{N} \frac{X_i}{\sigma_i} \]

**Measurement site**

- Gangneung, Gangwon, Korea (20°48' N, 129°03' E)

**Instrumentation**

- Open path gas analyzer: LE2100, LI-COR, Lincoln, USA
- Sonde anemometer: CSAT3, Campbell Scientific, Utah, USA
- Open-path gas analyzer: LE2100, LI-COR, Lincoln, USA

### RESULTS

#### Relative Sampling Error vs Similarity Parameter

Table 1 presents the similarity parameters of the relative sampling error in log-log relationship. The similarity parameter becomes 1.35±0.17 MJ m⁻² for the experiments in accordance with the classification of ITC. The similarity parameter is classified into four seasons. The seasonal classification is as follows: winter, spring, summer, and fall. The similarity parameter is obtained by the statistical method and it might be that a large similarity parameter is not suitable for the data assimilation because the similarity parameter is a weighting factor and its uniform quality to estimate the mean of measurements with the equation proposed by Finkelstein and Sims (2001) because of considering uncertainty according to approximation of \( \epsilon \) and \( L \).

### DISCUSSION

**Figure 1** presents an autocorrelation function of the integral turbulence characteristics. Therefore, estimation is valuable for a relative sampling error in climate change, and to integrate regional or global values of the exchange, as well as to validate model performance or satellite analysis, and to synthesize the quantitative values by data assimilation. Therefore, in consideration of turbulent characteristics the averaging method of EC measurement is to be mediated.

Fig. 2 shows the relationship between \( \epsilon \) and \( \sigma_{\text{true}} / \sigma_{\text{mis}} \) which is the relative sampling error. These results are not surprising because, according to Monin-Obukhov Similarity Theory, the atmospheric statistic normalized by an appropriate power of the existing parameter becomes the universal function of the atmospheric stability. Therefore, integral turbulence characteristics (ITC) could be described as ITC = \( \text{F}(\text{AR}, \text{AR} / H) \) based on Foken et al. (2014). Therefore, the similarity parameter is classified into four seasons. The seasonal classification is as follows: winter, spring, summer, and fall. The similarity parameter is obtained by the statistical method and it might be that a large similarity parameter is not suitable for the data assimilation because the similarity parameter is a weighting factor and its uniform quality to estimate the mean of measurements with the equation proposed by Finkelstein and Sims (2001) because of considering uncertainty according to approximation of \( \epsilon \) and \( L \).

Fig. 3 shows comparison results between the weighted and the arithmetic mean. The mean of the mean squared variation of EC measurements for two periods. While the results do not have a statistical significance, it is considerable in terms of dealing with a rule of land surface because the weighted mean of 0.33±0.05 MJ m⁻² is 3 days, while the arithmetic mean is 0.31±0.05 MJ m⁻² in just average. By adding the difference between the weighted and the arithmetic it is a systematic, and it might be that a large similarity parameter is not suitable for the data assimilation because the similarity parameter is a weighting factor and its uniform quality to estimate the mean of measurements with the equation proposed by Finkelstein and Sims (2001) because of considering uncertainty according to approximation of \( \epsilon \) and \( L \).