# How strict selection of the raw eddy-covariance data influences gpp estimation of a temperate beech forest

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# HOW STRICT SELECTION OF THE RAW EDDY-COVARIANCE DATA INFLUENCES GPP ESTIMATION OF A TEMPERATE BEECH FOREST

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## 1.Abstract

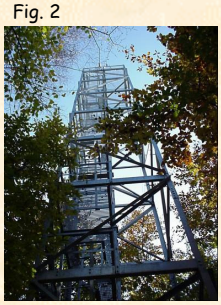
The **data quality** and the **selection** of the correct Eddy Covariance (**EC**) records become an important step in the $CO_2$ flux determination procedure. An **innovative combination** of existing assessment **tests** is used to give a relatively complete evaluation of the **net ecosystem exchange** measurements. For the 2005 full-leaf season at the Hesse site, the percentage of **bad quality** data is relatively high (**59.6%**) especially during night-time (68.9%). This result strengthens the importance of the data gap filling method. The **filtering** used does **not lead to** a real **improvement** of the accuracy of the relationship between the CO2 fluxes and the climatic factors. The **soil respiration spatial heterogeneity** (on a site with relatively homogenous vegetation pattern) seems to be too important to allow this improvement. However, the **data rejected** present some common characteristics. Their removal lead to a **10% increase** in the total amount of CO2 respired (**Reco**) and photosynthesised (**GPP**) during the 2005 full-leaf season. Consequently the application of our combination of multiple quality tests is able improve the inter-annual analysis. The question of a systematic application on the large database like the CarboEurope and FLUXNET is legitimate.

## 2.Hesse site

- Hesse beech (90%) plot
- Age: 39 years
- Height: 17 m
- Precipitation: 950 mm $yr^{-1}$
- Mean annual temp. : 10.1°C
- Soil type : Luvisol/Stagnic luvisol
- Soil texture: Sable 7%; Limon 64%; Argile 29%

Fig. 1

Fig. 2



## 3.Material

EDDY-COVARIANCE SYSTEM
- Tower (Fig. 2)
- IRGA LI6262 at soil level (Fig. 3)
- Sonic anemometer Gill R2 (Fig. 4)
- Tubing from sonic to IRGA (30 m)

Fig. 3

Fig. 4

## 4.Method

**Raw data tests (on high frequency [$CO_2$] and wind measurements)**
- Anemometer or IRGA problems: spikes, discontinuities of mean or variance, unrealistic data, large skewness, kurtosis and standard deviation (Vickers & Mahrt, 1997 )
- Mass Flow Controller (MFC) anomalies: constant airflow rate in the EC tubing

**$CO_2$ EC fluxes (Fc, computed each half-hour) tests**
- Flux stationarity during the half-hour (Foken & Wichura, 1996)
- Footprint, Fc flagged if 10% comes out of Hesse beech forest (Soegaard et al., 2003)
- U* threshold to dismiss horizontal advection periods

## 5.Results

| Quality test | % flagged |
|---|---|
| Anemometer problems | 1.6 |
| IRGA problems | 33.3 |
| MFC problem | 0.1 |
| Stationarity | 23.9 |
| Footprint | 1.5 |
| U* | 9.9 |
| **Total** | **59.6** |

Table 1

| Quality test | % flagged |
|---|---|
| Spikes | 0.1 |
| Mean discontinuities | 1.9 |
| Variance discontinuities | 2.1 |
| Absolute limits | 0.1 |
| Skewness | 14.5 |
| Kurtosis | 31.9 |
| Standard Deviation | 3.4 |
| **Total** | **33.3** |

Table 2

Table 1 : Percentages of half-hours flagged for the different tests
Table 2 : Percentages of half-hours flagged for the different IRGA problems

- Two tests appear to be highly **restrictive**: the **$CO_2$ IRGA kurtosis** anomalies and the **stationarity**
- The stationarity flag percentage is close to the one estimated by Rebmann et al. (2005) for the Hesse summer 2000 (28%).
- In Vickers and Mahrt (1997), the kurtosis test is also the more efficient among the IRGA problems ones (with % higher than here)
- The sum of all the % of the different tests exceeds the total value because of multi-flagged data.

- The data elimination changes the relationship between the $CO_2$ fluxes and the environmental factors
  ⇒ **Reco**, **GPP** and **NEE** for the 2005 full-leaf season vary all by about **10%**, with **more** important **photosynthesis** exchanges, **more** $CO_2$ produced by **respiration** processes and a **higher** net **sequestration when quality tests are applied**
- The selection of the non flagged data doesn't really improve the fit of Reco with soil t° function ($R^2$ stable) and water content function ( $R^2$ gains less than 5%) except for the u* test
  ⇒ **Unexplained temporal Reco variations** after u* filtering don't **come** from problems by the tests but rather **from different footprint** area **combined with** large **soil respiration heterogeneity**