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COMPARISON OF O_3 FLUXES MEASURED WITH THE EDDY COVARIANCE AND THE GRADIENT METHODS ABOVE A MAIZE FIELD

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INTRODUCTION. **The fluxes of ozone (O_3) are measured either with the gradient method or the covariance method. However, both methods are subjects to bias or uncertainties. The present poster presents a comparison of the two methods, list the potential biases and analyses some of them.**

THEORY. Flux measurements using either the gradient or the covariance method are based on the mass balance equation which can be expressed as :

$$\frac{\partial \bar{c}}{\partial t} = -\frac{\partial(\overline{w}\cdot\bar{c} + \overline{w'c'})}{\partial z} - \frac{\partial(\overline{u}\cdot\bar{c} + \overline{u'c'})}{\partial x} + Q_{chem}$$

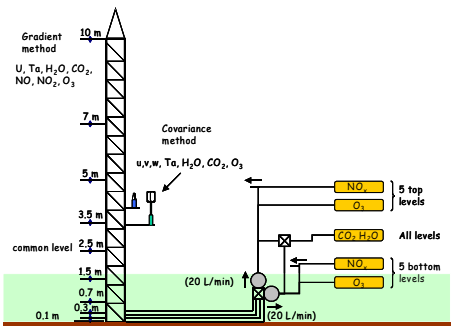
(F_z = vertical flux)

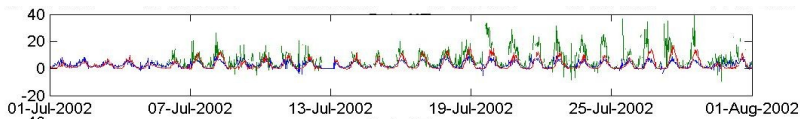
which gives after integration over z

$$F_z(z) = F_z(z_0) - \underbrace{\int_{z0}^{z} \frac{\partial \bar{c}}{\partial t} dz}_{\text{Storage}} - \underbrace{\int_{z0}^{z} \frac{\partial(\overline{u}\cdot\bar{c} + \overline{u'c'})}{\partial x} dz}_{\text{Local advection}} + \underbrace{\int_{z0}^{z} Q_{chem}\, dz}_{\text{Chemical reactions}}$$

This equation shows three potential errors common to the gradient and the covariance method: **storage**, **local advection** and **chemical reactions**

DATASET. Between June and September 2002, the fluxes of carbon dioxide (CO_2) and ozone (O_3), and nitrogen oxides (NO and NO_2) were measured above a growing maize crop, together with the components of the energy balance - sensible (H) , ground (G) and latent heat fluxes (H), net radiation (R_n) – , the meteorology, and the canopy structure. All the fluxes, except the NO_x, were measured simultaneously with the gradient and the covariance technique.



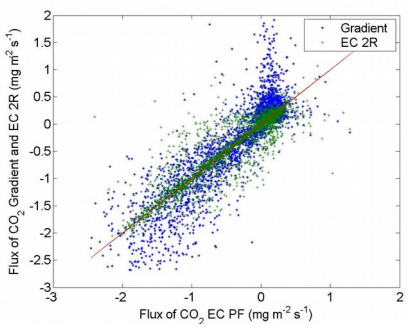


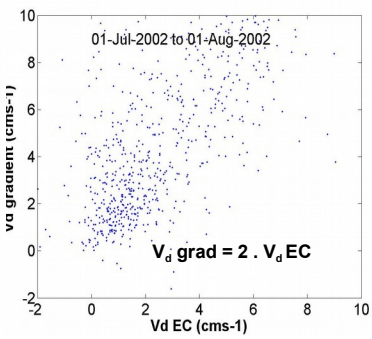
ERRORS SPECIFIC TO THE GRADIENT METHOD.

- **Chemical reactions in the tubes (O_3-NO)**
- **Chemical reactions over the gradient height (O_3-NO_x)**
- **Sequential sampling (assumes stationarity)**
- **Slope of the terrain**

ERRORS SPECIFIC TO THE COVARIANCE METHOD

- **High frequency attenuation in the tube**
- **Rotation of the ultrasonic anemometer ($\overline{w}$= 0 or not)**
- **High pass filtering (detrending)**





Estimation of flux errors estimates specific to the grad

Error	Expre
Chemical reactions in the tube	$[O_3]_{con}$
Chemical reactions over the gradient height	see pa
Sequential sampling	$[O_3](z,$
Vertical advection	Fzadv
Slope of terrain	$z^* = z$

Estimation of flux errors estimates specific to the e

Error	Magnitude of correction
Tube attenuation	up to 20%
Rotation / Averaging	10-25%
Angle of Attack	5-15%

CONCLUSIONS. **This analysis shows that :**

- **Attention must be paid to the gradient sequential sampling interval**
- **Tube attenuation corrections must be applied to covariance estimates**
- **Rotation and averaging procedures are should be compared**

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