

Eddy-Covariance Measurements – An Introduction

GEO2310 – Oblig 2: PBL
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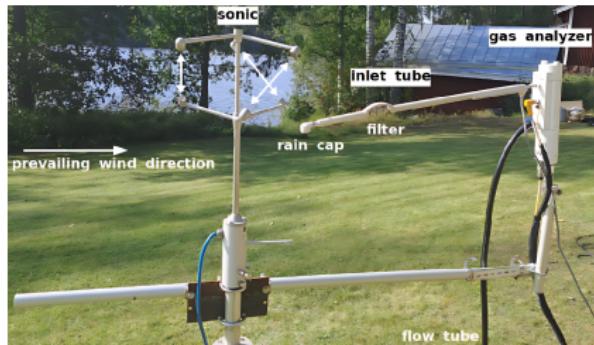
Eddy-covariance measurements to study land-atmosphere exchange processes



Eddy-covariance measurements

Setup

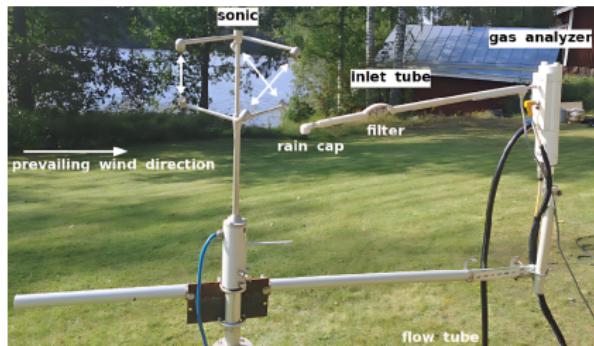
- ▶ sonic: u, v, w, T
- ▶ gas analyzer: H₂O, CO₂, CH₄, NO, particles
- ▶ high sampling frequency (e.g. 20 Hz)



Eddy-covariance measurements

Setup

- ▶ sonic: u, v, w, T
- ▶ gas analyzer: H_2O, CO_2, CH_4, NO , particles
- ▶ high sampling frequency (e.g. 20 Hz)



Eddy-covariance method

- ▶ Reynolds averaging:

$$x = \bar{x} + x', \quad \bar{x} := \frac{1}{t_s} \int_0^{t_s} x \, dt$$

- ▶ flux calculation:

$$\begin{aligned}\overline{xy} &= \overline{x} \overline{y} + \overline{x} \overline{y'} + \overline{x'} \overline{y} + \overline{x'} \overline{y'} \\ &= \overline{x} \overline{y} + \overline{x' y'}\end{aligned}$$

usually:

w : vertical velocity

x : scalar

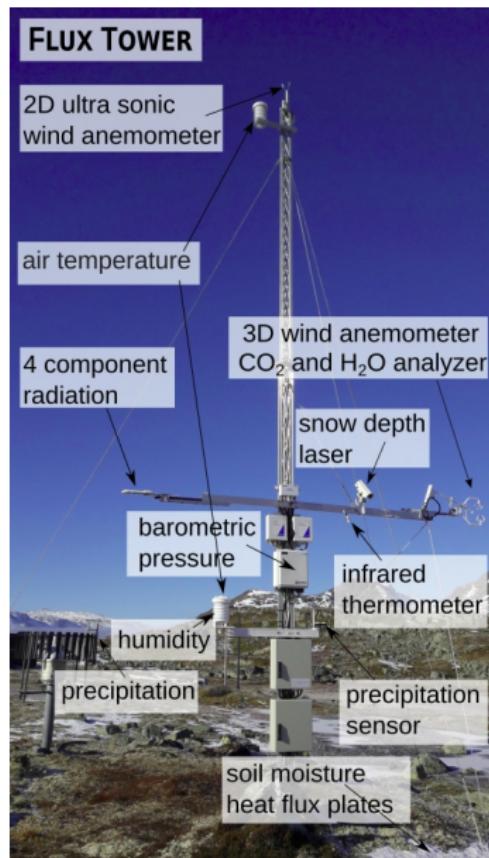
$\overline{x' w'}$: vertical flux of x

- ▶ a lot of post-processing
- ▶ How to determine the averaging time?
→ here: use 30 min

Eddy-covariance site @ Finse

data used in the assignment:

- ▶ eddy-covariance measurements:
 u , v , w , T , H_2O , CO_2
(frequency: 10 Hz → average to 30 min)
- ▶ radiation measurements
(from pyranometers)
- ▶ ground heat flux measurements



(picture: <https://www.mn.uio.no/geo/english/research/groups/latice/infrastructure/>)

Quadrant analysis

Surface energy balance

surface energy balance