



Short Course:

Flux Measurement Fundamentals

August 08 to 12, 2022

A technical short course with focus on the use of micrometeorological methods to obtain and analyze fluxes of momentum, heat and gases by eddy-covariance.

Instructors: HaPe Schmid, Matthias Mauder[#], Ingo Völksch, Luise Wanner[#], Rainer Steinbrecher
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Course Fee: **the course is free;** but participants are responsible for their own travel and living costs. Lunches, refreshments, and a joint course dinner are provided by KIT-Campus Alpin.

Applications/Information: rainer.steinbrecher@kit.edu

Thematic Focus: The basic idea of the course is that participants will experience hands-on how an EC-station is set up, learn about the basic micrometeorological theory behind the EC approach to flux measurements, and gain insight into the consequences of fundamental assumptions and practical decisions necessary to arrive at reasonable flux values, starting from raw instrument output. Most EC-flux practitioners today use one of several well tested and user-friendly EC-flux software packages that, however, are often used like a “black box”. This course encourages participants to tinker with elements inside the software black boxes and learn what they contain, their power and limitations.

Monday, Aug. 8 09:00 AM	<i>Seminar Room and Field Site:</i> Welcome and orientation Introduction in EC instruments and station set-up in the field;	<i>Schmid, Völksch, Wanner, Steinbrecher</i>
10:30 AM - 10.45 AM Coffee	Wiring of instruments; connect to logger; data logger programming, test program and monitor instrument readings. Field set up. Instruments: CSAT-3/Gill HS50, LICOR 7500/7200, CR3000 logger. CR-Basic program.	
12:15 AM - 01:00 PM	Lunch	
01:00 PM	<i>Seminar Room:</i> Turbulent exchange measurements – theory (1) Boundary layer turbulence, Reynolds decomposition,	<i>Schmid</i>
03:00 PM - 03:30 PM Coffee	turbulence statistics, turbulent kinetic energy, buoyancy effects, atmospheric stability, Monin-Obukhov similarity, energy cascade, time series analysis, Measurements vs. theory, turbulent flux vs. land surface – atmosphere exchange, turbulent exchange drivers and control processes.	
05:00 PM	End of Day	

Tuesday , Aug. 9	<i>Seminar Room:</i>	<i>Schmid</i>
09:00 AM	Turbulent exchange measurements – theory (2) (continued)	
10:30 AM - 10.45 AM	Coffee	
Coffee		
12:15 AM - 01:00 PM	Lunch	
01:00 PM	<i>Field site:</i> Group: download data and check system; preview data	<i>Schmid, Völksch, Wanner, Steinbrecher</i>
	<i>Seminar Room:</i>	<i>Wanner, Schmid</i>
03:00 AM - 03:30 PM	Calculations of turbulence statistics (R-Software): mean and fluctuations; variance, turbulence intensity; TKE; covariance; lagged covariance function; momentum, heat and gas fluxes;	
Coffee		
05:00 PM	End	
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Wednesday , Aug 10	<i>Field site:</i>	<i>Völksch, Wanner</i>
09:00 AM	Group: download data and check system; preview data	
	<i>Seminar Room:</i>	<i>Schmid, Wanner</i>
09:30 AM	Flux calculations (1) Coordinate rotations; Schotanus correction; WPL conversion;	
10:30 AM - 10.45 AM		
Coffee		
12:15 AM - 01:00 PM	Lunch	
	<i>Seminar Room:</i>	<i>Schmid, Wanner</i>
01:00 PM	Flux calculations (2) stationarity; detrending; block-averaging; impact of varying average interval;	
03:00 PM - 03:30 PM		
Coffee		
05:00 PM	End of Day	

Thursday, Aug. 11	<i>Field site:</i>	<i>Steinbrecher, Wanner</i>
09:00 AM	Group: download data and check system; preview data	
09:30 AM	<i>Seminar Room:</i>	<i>Mauder</i>
10:30 AM - 10.45 AM	QA/QC of long-term flux measurements: Uncertainty and systematic errors (spectral cut off at low/high frequency; fetch/footprint; low-turbulence / u^*)	
Coffee	Introduction to the software TK3 and presentation of other freely available software packages such as EddyPro.	
12:15 AM - 01:00 PM	Lunch	
01:00 PM	<i>Seminar Room:</i>	<i>Mauder, Steinbrecher, Wanner, Steinbrecher</i>
	Comparison of different flux calculation schemes own scripts vs. TK3 results	
03:00 PM - 03:30 PM		
Coffee		
03:30 PM	Preparation of Results and Student Panel Discussion Student selected topics (ca. 10 min)	<i>Schmid, Mauder, Wanner, Steinbrecher,</i>
05:00 PM	End of Day	
07:00 PM	Joint course dinner	
Friday, Aug 12	<i>Seminar Room:</i>	<i>Schmid, Wanner, Steinbrecher</i>
09:00 AM	Presentations of Results and Panel Discussion (led and moderated by students) Active participation required for conferral of ECTS	
10:30 AM - 10.45 AM		
Coffee		
12:15 AM - 01:00 PM	Lunch	
01:00 PM	<i>Field site:</i>	<i>Schmid, Völksch, Wanner, Steinbrecher</i>
	Group: take down instruments	
	<i>Seminar Room:</i>	
	Wrap-up	
03:00 PM	Departure	
