



Short Course:

Flux Measurement Fundamentals

**July 29 to
August 02, 2019**

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, Rainer Steinbrecher, Ingo Völksch, Luise Wanner,
Karlsruhe Institute of Technology (KIT), IMK-IFU, Garmisch-Partenkirchen

- **Contact:** rainer.steinbrecher@kit.edu

Monday, 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, Mauder, Steinbrecher, Völksch, Wanner</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.	<u>reading:</u> Aubinet et al.,.2012;
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.	<u>reading:</u> Aubinet et al.,.2012;
05:00 PM	End	

Tuesday, 09:00 AM	<i>Seminar Room:</i> Turbulent exchange measurements – theory (2) (continued)	<i>Schmid</i> <u>reading:</u> Aubinet et al.,2012;
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,</i> <i>Steinbrecher, Völksch,</i> <i>Wanner</i>
03:00 AM - 03:30 PM Coffee	<i>Seminar Room:</i> Calculations of turbulence statistics (R-Software): mean and fluctuations; variance, turbulence intensity; TKE; covariance; lagged covariance function; momentum, heat and gas fluxes;	<i>Wanner, Schmid</i> <u>reading:</u> Stull 1988;
05:00 PM	End	

Wednesday, 09:00 AM	<i>Field site:</i> Group: download data and check system; preview data	<i>Völksch, Wanner</i>
09:30 AM	<i>Seminar Room:</i> Flux calculations (1) Coordinate rotations; Schotanus correction; WPL conversion;	<i>Schmid, Wanner</i> <u>reading:</u> Aubinet et al. 2012
10:30 AM - 10.45 AM Coffee		
12:15 AM - 01:00 PM	Lunch	
01:00 PM	<i>Seminar Room:</i> Flux calculations (2) stationarity; detrending; block-averaging; impact of varying average interval;	<i>Schmid, Wanner</i> <u>reading:</u> Finnigan et al. 2003; Leuning 2007
03:00 PM - 03:30 PM Coffee		
05:00 PM	End	

Thursday, 09:00 AM	<i>Field site:</i> Group: download data and check system; preview data	<i>Steinbrecher, Wanner</i>
09:30 AM	<i>Seminar Room:</i> QA/QC of long-term flux measurements: Uncertainty and systematic errors (spectral cut off at low/high frequency; fetch/footprint; low-turbulence / u^*)	<i>Mauder</i>
10:30 AM - 10.45 AM Coffee	Introduction in the software TK3 and presentation of other freely available software packages such as EddyPro.	<u>reading:</u> <i>Mauder et al. 2013</i>
12:15 AM - 01:00 PM	Lunch	
01:00 PM	<i>Seminar Room:</i> Comparison of different flux calculation schemes own scripts vs. TK3 results	<i>Mauder, Steinbrecher, Wanner</i>
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, Steinbrecher, Wanner</i>
05:00 PM	End	
07:00 PM	Joint course dinner	

Friday, 09:00 AM	<i>Seminar Room:</i> Presentations of Results and Panel Discussion (led and moderated by students) Active participation required for conferral of ECTS	<i>Schmid, Mauder, Steinbrecher, Wanner</i>
10:30 AM - 10.45 AM Coffee		
12:15 AM - 01:00 PM	Lunch	
01:00 PM	<i>Field site:</i> Group: take down instruments <i>Seminar Room:</i> Wrap-up	<i>Schmid, Mauder, Steinbrecher, Völksch, Wanner</i>
03:00 PM	Departure	
