



### MICMoR Summer School 2013

Observations and experimental methods in an inhomogeneous atmosphere:  
How to make sense of the atmosphere in mountain regions

Institute of Meteorology and Climate Research  
KIT/IMK-IFU, Garmisch-Partenkirchen, Germany  
September 17-26, 2013



The assessment of regional climate change requires measurements and modelling of atmospheric flows and exchanges. Of particular interest are exchanges of energy and matter between the surface and the atmosphere. Many techniques for the description of these exchange processes have assumed horizontal homogeneity so far. In complex and mountainous terrain this is no longer valid. Both measurements and modelling strategies have to be adapted to such more complex conditions.

This Summer School provides training on leading-edge techniques available today to address the challenges of making measurements in complex environments, especially focusing on mountainous regions. Much of the coverage of this course is also applicable to other complex situations, such as urban canopy and urban boundary layer structures, forested or diverse agricultural environments.



#### Lecturers

Prof. Dr. Stuart Bradley (Auckland University, New Zealand) - *Main Lecturer*  
Prof. Dr. Jens Bange (University of Tübingen, Germany)  
Prof. Dr. Stefan Emeis (KIT/IMK-IFU, Germany)  
Prof. Dr. Richard Grant (Purdue University, USA)  
Dr. Robert Banta (NOAA, USA)  
Prof. Dr. Jacob Mann (Technical University of Denmark)  
Prof. Dr. Klaus Schäfer (KIT/IMK-IFU, Germany)  
Prof. Dr. Mark Wenig (LMU, Germany)  
Dr. Peter Werle (KIT/IMK-IFU, Germany)



#### Who can apply?

The Summer School invites PhD students and Postdocs in environmental sciences, also excellent Master students preferably with a math-physics background. We expect all participants to be familiar with basic atmospheric or environmental sciences, to have good background math skills (e.g. for descriptions of turbulence, for data analysis) and to be able to read and familiarize themselves with technical descriptions of remote sensing instruments (e.g. laser devices, pulsed signals).

The number of participants is limited to 30 persons.

#### Application

Application deadline is June 30, 2013. There is no tuition fee; however, participants must cover travel and accommodation costs. For application, please send a cover letter with statement of motivation, CV and letter of recommendation from your graduate supervisor to the MICMoR Coordination Office: [info@micmor.kit.edu](mailto:info@micmor.kit.edu)

MICMoR Coordination Office  
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[info@micmor.kit.edu](mailto:info@micmor.kit.edu)

**Date:** Tuesday, 17 September 2013, 9 am – Thursday, 26 September 2013, 1.30 pm (8 full days)

**Venue:** Karlsruhe Institute of Technology (KIT), Institute of Meteorology and Climate Research – Atmospheric Environmental Research (IMK-IFU)

**Schedule & Contents:**

	Tuesday, 17.09.2013	Wednesday, 18.09.2013	Thursday, 19.09.2013	Friday, 20.09.2013	Monday, 23.09.2013	Tuesday, 24.09.2013	Wednesday, 25.09.2013	Thursday, 26.09.2013
<b>Theme for day</b>	<i>Atmospheric structure</i>	<i>Measurements of wind, turbulence</i>	<i>Field laser applications</i>	<i>Area source strength &amp; fluxes</i>	<i>Complex structures</i>	<i>Flow over complex terrain; modelling</i>	<i>Atmospheric boundary layer; UAVs</i>	
<b>9 am - 12 noon</b>	<b>Bradley</b> Welcome, course outline  <b>Banta</b> MOS, wind & temperature profiles, turbulence, limitations	<b>Emeis</b> Surface measurement instrumentation, vertical profiles with masts, sodars, RASS ceilometers radiosondes, horizontal data from scintillometers	<b>Werle</b> Laser gas analysers: Principles, performance & perspectives	<b>Grant</b> Determination of area source strengths & fluxes: Basics & quality assurance; quality control methods	<b>Bange</b> Atmospheric layers, transitions and diurnal variations	<b>Mann</b> Turbulence	<b>Wenig</b> Introduction to modelling of radiative and dynamical processes	<b>Bradley</b> Project work, summary of course
<b>12 - 1.30</b>	Lunch	Lunch	Excursion / lunch at Lake Starnberg	Lunch	Lunch	Lunch	Lunch	Lunch
<b>1.30 - 6 pm</b>	<b>Bradley</b> Time scales & length scales, sampling, filtering, autocorrelation, spectra	<b>Banta</b> Principles of Lidars for wind & turbulence measurements, examples	<b>Werle</b> Schechenfilz field site visit, operating field laser (NDIR & CO <sub>2</sub> , H <sub>2</sub> O, CH <sub>4</sub> , N <sub>2</sub> O, sonics, fluxes, scintillometers)	<b>Schäfer</b> Determination of area emission source strengths & fluxes: methods & applications	<b>Emeis</b> Mixing layer height, low level jets	<b>Mann</b> Flow over complex topography, the Bolund Experiment	<b>Bange</b> Principles & use of Unmanned Aerial Vehicles (UAVs), new developments in UAVs	Departure
<b>7 - 9 pm</b>	Ice-Breaker					Social Event		

**Credit Points:** 4 ECTS Credit Points after submission of report

**What to bring:** If possible each participant should bring a laptop, however some laptops can also be provided.

**For further reading:** See Emeis (2010): Measurement Methods in Atmospheric Sciences, Borntraeger, Stuttgart.