Englischsprachige Lehrveranstaltung im Sommersemester 2010:

Evgeni Fedorovich: *Numerical Modeling and Simulation of Atmospheric Boundary Layer Flows with Complex Forcings*

Ort: Geomatikum, Raum 1536c
Zeit: Mittwochs von 12:30 – 14:00 Uhr
Beginn: 14.04.2010

Modul (Modulkürzel):	
Modultitel:	***Numerical Modeling and Simulation of Atmospheric Boundary Layer Flows with Complex Forcings***
Modultyp:	*Wahl*
Angestrebte Lernergebnisse	*Students will learn fundamental approaches toward numerical modeling and simulation of turbulent flows in the atmospheric boundary layer. The teaching effort will be focused on the exposing course participants to the quantitative description of complex boundary layer flows driven by combined (mechanical and buoyant) forcings in association with Coriolis force and thermal stratification. Students will acquire knowledge about spectral properties of boundary layer turbulence and apply learned skills to the analysis and implementation of state-of-the-art turbulence parameterization schemes. It is expected that course participants will be able to operate with equations of atmospheric dynamics in a variety of boundary layer approximations and use numerical algorithms for their solution.*
Inhalt:	*Basics of dynamics and thermodynamics of the atmospheric boundary layer flows with complex forcings will be taught in conjunction with fundamentals of the turbulence theory and its applications to the boundary layer modeling and simulation. Individual sections of the course will cover:* *1. Representative types of atmospheric boundary layer (BL) flows. Notion of planetary boundary layer. Observational data on the structure of convective, neutral, and stably stratified atmospheric BLs. Slope winds as BL flows along inclined surfaces.* *2. Governing equations of BL dynamics and thermodynamics. Approximate forms of governing equations for particular BL flow types.* *3. Turbulent character of BL flows. Turbulence spectra. Implications of the knowledge of turbulence spectral structure for modeling and simulation of the BL flows.* *4. Reynolds decomposition and averaging. Averaging procedures employed in the BL modeling. Problem of turbulence closure. Closure approaches based on the turbulence kinetic energy (TKE) equation.* *5. Direct (DNS) and large eddy (LES) numerical simulation techniques. Filtering equations of the BL dynamics in the LES applications. Closure of LES equations. Commonly employed subgrid/subfilter closure schemes.* *6. Description of turbulence in the near-surface region of the BL flow (atmospheric surface layer, ASL). Monin-Obukhov similarity and flux-profile relationships in the ASL. Implications for formulation of surface boundary conditions for BL modeling and simulation.* *7. Dynamics of slope flows. Prandtl model of slope wind and its extensions. DNS of slope flows.*

	8. Applications of LES to BL flows with complex forcings. Specifics of katabatic wind and stably stratified BL flow cases. *The course will be basically organized in the form of a lecture sequence, but will also include in-class problem-solving exercises and computer demonstrations.*			
Lehrform/SWS:	*Vorlesung mit Übungen, 2 SWS; Gruppengröße max. 25 Studierende. Bearbeitung von Übungsaufgaben als Hausaufgabe.*			
Voraussetzungen für die Teilnahme:	*- verbindliche: keine* *- empfohlene: in den Anfangssemestern erworbene mathematisch-physikalische Grundkenntnisse.*			
Unterrichtssprache:	*Class will be taught in English. Students will be provided with class notes and problem-solving instructional materials.*			
Verwendbarkeit des Moduls	*Der Kurs wird als Wahlfach angeboten. Er eignet sich besonders für den Studiengang B. Sc. und M. Sc. Meteorologie, steht aber auch Studierenden aus anderen mathematisch-physikalisch ausgerichteten Studiengängen offen.*			
Arbeitsaufwand (Teilleistungen und insgesamt)		*Präsenz-/*	*Selbststudium*	*Prüfungsvorbereitung*
	Vorlesung mit Übungen	*30 Std.*	*40 Std.*	*20 Std.*
	Gesamtaufwand 3 LP	*30 Std.*	*40 Std.*	*20 Std.*
Art, Voraussetzungen und Sprache der (Teil)-Prüfung(en)	*Der Kurs wird mit einem 1-stündigen Gruppengespräch in deutscher oder englischer Sprache abgeschlossen.*			
Studiensemester/ Referenzsemester	*Studiensemester: nach Wahl des Studierenden.* *Referenzsemester: keins*			
Häufigkeit des Angebots	*einmalig im SS 2010*			
Dauer	*1 Semester*			
Modulverantwortliche(r):	*Prof. Dr. Evgeni Fedorovich*			
Ggf. Lehrende	*Prof. Dr. Evgeni Fedorovich*			
Ggf. Medienformen:	*-*			
Literatur:	*Garratt, J. R., 1994: The Atmospheric Boundary Layer. Cambridge University Press, 316pp.* *Stull, R. B., 1988: An Introduction to Boundary Layer Meteorology. Kluwer, 666 pp.* *Sorbjan, Z., 1989: Structure of the Atmospheric Boundary Layer, Prentice Hall, 317 pp.* *Tennekes, H., and J. L. Lumley, 1972: A First Course in Turbulence, The MIT Press, 300 pp.*			