<u>Preliminary</u> Time schedule and literature list for PhD course:

Environmental Biophysics – states and processes in plant canopies 3 hp

Research in plant ecophysiology and biogeochemistry has developed to be increasingly quantitative. This means that methods to asses fluxes of e.g. radiation, CO_2, water vapour, heat, biogenic VOCs and air pollutants (including greenhouse gases) is becoming more important, as well as quantitative characterisation of the state of different (micro)environments with respect to temperature, humidity in air and soil, radiation, wind speed and concentrations of different compounds. There has developed an area of theory and methods called ”environmental biophysics”, which covers these research issues.

The course is largely based on the book “An Introduction to Environmental Biophysics” by GS Campbell and JM Norman. In addition, a number of further relevant aspects of abiotic conditions in plant canopies not directly covered by book are included in the course, such as mechanistic ecosystem-modelling (CoupModel), measurement techniques (e.g. eddy covariance for gas fluxes and significance of radiation protection in observations of temperature and air humidity), horizontal gradients of e.g. temperature and humidity in the landscape and the response of plants to different qualities (wavelengths) of light. The participants will be provided with data files from real observations of meteorological variables and gas concentrations. Based on the data the participants are expected to solve a number of quantitative problems, solution of which required to be submitted to pass the course.

Time period: 7 – 11 December 2020, with reading and preparation before and submission of calculation exercise after the course week

Distributed using Zoom **Zoom link to use for lecture and exercise during the course week**

https://gu-se.zoom.us/j/64615772708?pwd=dnRURVppRkJDOXRQNVBsSm9BbHRUQT09

Meeting ID: 646 1577 2708

Passcode: 749385

Course leader: Håkan Pleijel BioEnv GU, hakan.pleijel@bioenv.gu.se

Teachers: Johan Uddling, BioEnv GU, johan.uddling@bioenv.gu.se

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To pass the course, solutions to a number of calculation tasks have to be submitted.

	Time	Subject	Teacher
	Before the course week	Read papers Prepare for work with Coup model	H Pleijel A Gärdenäs
7 Dec	09:00-09:45 10:00-10:45	Temperature, gases, liquid water and wind in and near plant canopies	H Pleijel
	11:00-12:00	PhD students present themselves, their project and how environmental biophysics is relevant to their work. PowerPoint presentation by each student of maximum 3 slides/5 minutes	Teachers present
	12:00-13:00	*Lunch*	
	13:00-14:3 0	Introduction to calculation exercise Calculation examples	H Pleijel
	14:30-16:30	Calculation exercise – by students	
8 Dec	09:00-09:45 10:00-10:45	Heat and mass transport near and in plant canopies	H Pleijel
	11:00-12:00	Time for questions and discussion	H Pleijel
	12:00-13:00	*Lunch*	
	13:00-13:45 14:00-14:45 15:00-16:00	Eddy covariance - theory, equipment, examples of observed gas fluxes over canopies	L Klemedtsson/P Weslien
9 Dec	09:00-09:40- 09:50-10:20	Radiation and radiation fluxes above and in plant canopies, energy budgets for canopies	H Pleijel
	10:30-11:10 11:20-12:00	Energy budgets for canopies and leaves	J Uddling
	12:00-13:00	*Lunch*	
	13:00-15:30	Ecosystem fluxes and canopy/leaf temperatures – exercise	J Uddling
10 Dec	09:00-09:45	Plant perception of light	PE Karlsson
	10:00-10:45	Temperature and humidity measurements, radiation protection, examples of microclimatic variation	J Klingberg
	11:00-12:00	Discussion about scientific papers – among students	
	12:00-13:00	*Lunch*	
	13:00-14:00	Discussion about scientific papers – with teachers	
	13:00-14:00	Supervision for calculation exercise	H Pleijel
	14:00-16:30	Calculation exercise	
11 Dec	09:00-09:45 10:00-10:45	Heat and water flow in soils	A Gärdenäs
	11:00-12:00	CoupModel – introduction **#**	A Gärdenäs
	12:00-13:00	*Lunch*	
	13:00-14:30	Coup modelling exercise	A Gärdenäs
	14:30-15:00	Discussion results modelling exercise	All participants
	15:15-16:00	Time for questions, course evaluation	H Pleijel
	After the course week	Finalize and submit calculation exercise	H Pleijel

Literature and discussion of papers

Course textbook

The course is based on the textbook: Campbell GC & Norman JM. (2000). Introduction to Environmental Biophysics. Springer, 286 pp.

The following chapters are covered by the course: 1-11, 14-15

Papers – reading instruction to be communicated later

Alkama & Cescatti (2016). Biophysical climate impacts of recent changes in global forest cover. Science 351, 600-604.

Alvenäs & Jansson (1997). Model for evaporation, moisture and temperature of bare soil: calibration and sensitivity analysis. Agricultural and Forest Meteorology 88, 47-56.

Hansson et al (2018). Soil temperature and water content dynamics after disc trenching a subxeric Scots pine clearcut in central Sweden. Geoderma 327, 85-96.

Jansson & Madani (2014). First Simple Technical Tutorial, CoupModel.

Klingberg et al (2012). Variation in ozone exposure in the landscape of southern Sweden with consideration of topography and coastal climate. Atmospheric Environment 47, 252-260.

Pleijel et al (2002). Stomatal conductance and ozone exposure in relation to potato tuber yield - results from the European CHIP programme. European Journal of Agronomy 17, 303-317.

Rinne et al (2020). Effect of the 2018 European drought on methane and carbon dioxide exchange of northern mire ecosystems Philosophical Transactions of the Royal Society 375, 20190517.

Vårhammar et al (2015). Photosynthetic temperature responses of tree species in Rwanda: evidence of pronounced negative effects of high temperature in montane rainforest climax species. New Phytologist 2016, 1000-1012.

Preparation for work Coup model

CoupModel# The model and some tutorials are freely available at www.coupmodel.com**.** All participants are kindly, but firmly, asked to download CoupModel and carry out the tutorial called ***First or Technical Tutorial, CoupModel*** a simple exercise to become acquainted with the model before 7 December (follow link or see literature list). This tutorial also guides you through the installation process. Annemieke Gärdenäs will be available Fri 4 Dec 1-3 pm on-line at ZOOM (see link below) to answer questions if needed. Hereby we hope to avoid losing valuable time during the intensive course week with installation and up-start of the model.

Fri 4 Dec 1-3 pm CoupModel startup Join Zoom Meeting

https://gu-se.zoom.us/j/69886657336?pwd=NU5GQ0pla1cvNkVCNWxycjdvcEZ3QT09

Meeting ID: 698 8665 7336

Passcode: 286860