UNIVERSITY OF GOTHENBURG
DEPARTMENT OF EARTH SCIENCES

Oceanographic models (OC6310)

Course Coordinator and Examiner
Anders Omstedt, Department of Marine Sciences, University of Gothenburg. E-mail: Anders.Omstedt@gvc.gu.se
Göran Broström, Department of Marine Sciences, University of Gothenburg. E-mail: goran.brostrom@gu.se

Planning Group
The course is planned and organized by a planning group consisting of Anders Omstedt (GU), Göran Broström (GU) and Torsten Linders (GU).

Teaching staffs
Anders Omstedt, Selma Pacariz, Kai Christensen and Göran Broström.

Course Aim
The main aims of the present course are to provide good understanding about how analytical and numerical models can be applied in different aquatic problems. The course will provide the student with scientific understanding and well-tested computer codes for aquatic studies of lakes, coastal seas and oceans. By starting from simple models the participants will learn how to build up a more advanced understanding and getting confidence in the numerical modelling. Part I of the course introduces the student into process based numerical modelling and defining a number of relevant aquatic problems. Part II of the course introduces the students into 3D ocean modelling, and the basic theory of large scale ocean dynamics using the freely available code from MIT (mitgcm.org).

Prerequisites
Students are expected to have some background in hydrodynamics and competence and skill in use of MS Windows based PC. Also some basic knowledge about FORTRAN and Linux or interest in learning FORTRAN and Linux by doing during the course.

Structure of the course
Part I (7.5 ECTS credits) Process based modelling and will include the following parts:

1. Seminars on basic aspects of the aquatic systems including turbulence, air-sea interaction, ice, strait flows and estuarine circulation, oxygen, nutrients, primary production, ecosystems, carbon dynamics, pH and climate change. The seminars also include some aspects of numerical modelling, the PROBE equation solver and Visual Fortran.
2. Exercises on different aspects of the marine system.
3. Examination through written reports on the exercises.

Part II (7.5 ECTS credits) 3D ocean modelling and will include the following:

UNIVERSITY OF GOTHENBURG

DEPARTMENT OF EARTH SCIENCES

1. Geophysical fluid dynamics including shallow water theory, long gravity waves, Rossby adjustment process, upwelling and Kelvin waves, equatorial Kelvin waves, Rossby waves and topographic Rossby waves, and general ocean circulation in a simple geometrical setting (including Stommels theory for wind driven ocean currents)
2. Exercises with MITgcm ocean model. Several physical cases will be described in lectures, and students will set up numerical experiments to further investigate limitations of theoretical results though analysis of model results.
3. Examination through written reports and oral presentation.

Registration

All participants need to make registration by sending an e-mail to Andres.Omstedt@gvc.gu.se not later than 15 September, 2015.

Course material

Part 1 Process modelling:

Omstedt A. (2015).Guide to process based modelling of lakes and coastal seas. Second-Edition. Springer-Praxis books in Geophysical Sciences. Springer-Verlag Berlin Heidelberg. The second edition is planned to be public available in September, 2015.

If this is not ready we will use:

Omstedt A. (2011).Guide to process based modelling of lakes and coastal seas. Springer-Praxis books in Geophysical Sciences. Springer-Verlag Berlin Heidelberg. DOI: 10.1007/978-3-642-17728-6. This book is also available through open access when downloading through University of Gothenburg.

Part 2 3 D ocean modelling:

Lecture notes. For mitgcm see http://mitgcm.org/.

Time table for Oceanographic models (OC6310)
autumn 2014 Part I (7.5 ECTS):

Day	Date	Time	Type	Teacher
Tuesday	3/11	1015-1200	Introduction: Chapter 2.1-2.6	Anders Omstedt
Tuesday	3/11	1315-1500	Exercises 2.6 and FORTRAN	
Wednesday	4/11	1015-1200	Introduction Chapter 2.6-2.11	Anders Omstedt
Thursday	4/11	1315-1500	Exercises Visual FORTRAN	
Tuesday	10/11	1015-1200	Modelling	Anders Omstedt

			Chapter 3.1-3.2-	
Tuesday	10/11	1315-1500	Numerical methods, finite volume method and PROBE	Kai Christensen
Thursday	12/11	1015-1200	Lakes and air-sea interaction Chapter 3.4	Anders Omstedt
Thursday	12/11	1315-1500	Exercises Ex. 3.1, 3.2	
Tuesday	17/11	1015-1200	Oceans and ice Chapter 3.5-3.6	Anders Omstedt
Tuesday	17/11	1315-1500	Exercises Ex. 3.3, 3.4	
Thursday	19/11	1015-1200	Turbulence and tides Chapter 3.7-3.8	Anders Omstedt
Thursday	19/11	1315-1500	Exercises Ex. 3.4	
Tuesday	24/11	1015-1200	Biogeochemical and oxygen dynamics Chapter 4.1-4.3	Anders Omstedt
Tuesday	24/11	1315-1500	Exercises Ex. 4.1	
Thursday	26/11	1015-1200	Plankton and nutrients dynamics Chapter 4.4-4.5	Anders Omstedt
Thursday	26/11	1315-1500	Exercises Ex. 4.2, 4.3	
Tuesday	1/12	1015-1200	Carbon and pH Chapter 4.6-4.7	Anders Omstedt
Tuesday	1/12	1315-1500	Exercises Ex. 4.4 and 4.5	
Thursday	3/12	1015-1200	Climate change	Anders Omstedt
Thursday	3/12	1315-1500	Exercises	

Examination part 1: Exercises as written reports should be ready not later than Monday 10/12 2015. The written report should be delivered to Anders Omstedt through e-mail (anders.omstedt@gvc.gu.se).

UNIVERSITY OF GOTHENBURG

DEPARTMENT OF EARTH SCIENCES

Time table for Oceanographic models (OC6310)
2014 Part II (7.5 ECTS): Preliminary scedule

Day	Date	Time	Type	Teacher
Monday	30/11	10-12	Lecture, Intro to 3D modelling	GBr
Monday	30/11	13-15	Getting started	GBr
Tuesday	1/12	9-12	Lecture, Geophysical fluid dynamics, shallow water equations	GBr
Wednesday	2/12	9-12	Lecture, Rossby adjustment	GBr
Wednesday	2/12	13-14	Help hour	GBr/KHC
Thursday	3/12	15-16	Help hour	GBr/KHC
Tuesday	8/12	9-12	Lecture, Kelvin waves	KHC
Thursday	10/12	15-16	Help hour	GBr/KHC
Tuesday	15/12	9-12	Lecture, Topgraphic waves	GBr/KHC
Thursday	17/12	9-12	Help hour	GBr/KHC
Christmas				
Thursday	7/1	13-16	Lecture, Ocean circulation , Stommel theory	GBr
Tuesday		13-14	Help hour	GBr/KHC
Wednesday	15/1 -16	10-12, 13-15	Presentations	GBr/KHC

Examination part 2:
Exercise 1, Rossby adjustment, Friday 11/12, 2015.
Exercise 2, Kelvin Waves, Friday 18/12 2015.
Exercise 3, Topographic waves, Friday 8/1 2016.
Exercise 4, ocean circulation, Friday 15/1 2016.
Presentation of one exercise, Friday 15/1, 2016.