Onderwijsinstituut Aardwetenschappen  
Study guide for MSc course Fluvial Systems GEO4-4436

General information
- Name of the course: Fluvial systems
- Code: GEO4-4436
- Duration: 7.5 ECTS
- Level: MSc
- Period: 1, 3 Sept – 5 Nov, time slot A (Monday morning and Wednesday morning)
- Contact hours per week: 8 including computer classes
- Language: guess what
- Course website/WebCT: http://www.geo.uu.nl/fg/mkleinhans
- Coordinator: Prof. dr. Maarten G. Kleinhans, m.g.kleinhans@uu.nl, Zonneveld 207
- Other lecturers: Dr. Gilles Erkens, gilles.erkens@deltas.nl
  Anne Baar, MSc, a.w.baar@uu.nl, Zonneveld 207 (will change)
  Dr. Esther Stouthamer, e.stouthamer@uu.nl, Zonneveld 108
  Prof. dr. Hans Middelkoop, h.middelkoop@uu.nl, Zonneveld 107

Position in curriculum
The course is part of the MSc program Earth Surface Dynamics and water, track Coastal dynamics and fluvial systems. It prepares for fluvial process-based and/or Quaternary reconstruction MSc Thesis work. In periods 2 and 3 this course will be followed by Tidal Systems and Wave-dominated coasts.

Prerequisites
River Morphodynamics (GEO3-4305), Coastal Morphodynamics (GEO3-4306), Fluid Mechanics 1 (GEO3-4307) or similar courses.

Entry requirements
- Having finished a BSc earth science or equivalent study
- Doing only 2 courses simultaneously (only 1 course next to this one)

Content - summary
Fluvial systems will be studied at all relevant scales from morphodynamics in a channel, to river pattern variation in a valley, to distributary dynamics in a delta. The course alternates between reach and system scale, for longitudinally simple cases (one source, one sink) to complex systems with multiple sedimentation basins and terraced floodplains. The course content is structured in four themes with increasing length and time scales of evolution. Within each theme, the necessary initial and boundary conditions for certain phenomena are studied, the underlying physical processes identified and derived, and the consequences for morphology, stratigraphy and so on described. Advanced generic understanding is taught – intended to serve the students in MSc Thesis and Internship project case studies later in the curriculum and prepare for jobs. Application examples and theoretical examples are used in lectures and practicals on the basis of scientific literature, numerical modelling and data analysis. This course develops the knowledge, understanding and quantitative skills required for future work in engineering and geological companies and research institutes. The students explore a chosen subject in more depth using data and/or modelling in matlab.
Course aims
The general aims are to acquire integrated physics-based, geomorphology-based and sedimentology-based understanding of the formation and dynamics of rivers and deltas, and acquire basic data analysis and modeling skills. Specifically, after a successful course the student:

- has acquired knowledge, explanations and advanced understanding of fluvial morphodynamics at length scales ranging from particles to valleys and deltas and seconds to millennia
- has advanced his/her knowledge and understanding of fluvial morphodynamics and system response to changing boundary conditions, thereby crosscutting disciplinary boundaries of fluvial morphodynamics, engineering, sedimentology and geology both in understanding and language of concepts
- has developed quantitative skills, including physics of flow, sediment transport and morphodynamics, reconstruction and budgeting techniques, and programming
- is able to develop empirical, analytical, experimental and numerical tools to reconstruct and predict fluvial phenomena, and is able to evaluate critically the power and limits of these approaches
- is able to position the knowledge and understanding in the wider societal context of river basin and delta management, engineering and nature rehabilitation with the boundary condition of global change
- is able to analyse and interpret scientific data and literature on fluvial processes, morphology and modeling, and is able to apply this within the fluvial system framework of this course, and clearly present this in writing or oral presentations.

Programme and schedule
The course provides introductory lectures aimed at an overview that should help the student's own literature studies, practicals and project work. The practicals/tutorials are to help start the work by the students under (limited) supervision that they will continue and finish in their own time (assuming a study load of at least 20 hrs per week for a period of 9 weeks). It is further assumed that team members make their own appointments. The preliminary schedule is given below (check the course website for changes):

<table>
<thead>
<tr>
<th>Week</th>
<th>Day</th>
<th>Date</th>
<th>Type</th>
<th>Start</th>
<th>End</th>
<th>Room</th>
<th>Topic</th>
<th>Lecturer</th>
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<td>Wednesday</td>
<td>03/09/2014</td>
<td>Computer pract</td>
<td>09:00</td>
<td>12:45</td>
<td>UNNIK - 402 GIS</td>
<td>intro matlab</td>
<td>Baar, Kleinhans</td>
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<td>MIN - 021</td>
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<td>UNNIK - 402 GIS</td>
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<td>BBG - 201</td>
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<td>UNNIK - 402 GIS</td>
<td>budgeting and explanation</td>
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<td>5 min ppt presentat creative matlab projects</td>
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<td>12:45</td>
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<td>15/10/2014</td>
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<td>09:00</td>
<td>12:45</td>
<td>UNNIK - 402 GIS</td>
<td>Delta project</td>
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<td>BBG - 401</td>
<td>bifurcations and avulsion</td>
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<td>22/10/2014</td>
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<td>09:00</td>
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<td>UNNIK - 402 GIS</td>
<td>Delta project</td>
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<td>09:00</td>
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<td>BBG - 401</td>
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<td>written exam</td>
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<td>EDUC - BETA</td>
<td>Oral resit exam takes place much sooner</td>
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</table>
Four scales in the course

1. River morphodynamics and autogenic processes:
The basics of flow, sediment transport and morphodynamic development will be repeated in one lecture. This also leads to understanding of intrinsic time scales of systems: large systems take a long time to respond to some change in forcing. The first Matlab exercise involves one element of this (also done in excel in the BSc3 course River Morphodynamics).

2. River patterns and fluvial styles:
This part reviews empirical descriptors and analytical predictors for river patterns (which refers to bar pattern, channel pattern and to some extent floodplain pattern). This is compared against numerical modelling results and natural systems. Furthermore the essentials of floodplain formation including vegetation and peat are reviewed. This is studied in cases where the some boundary conditions change, in particular the Rhine delta.

3. River displacement and alluvial architecture:
Rivers fill larger spaces by migration and displacement (avulsion). Subjects here include the physics of bifurcation evolution and avulsion, necessary and sufficient (allogenic) conditions for avulsion and the role of accommodation space creation. All this leads to alluvial architecture in valleys and deltas. This will be illustrated with natural data, experimental data and numerical models of varying scale and physical realism.

4. Mass conservation and sediment budgets from source to sink:
Rivers transfer sediment from source to sink. In river valleys sediment may temporarily be stored and sediment budget analysis reveals how the principle of mass conservation can be used to reconstruct past environmental conditions.

These subjects cross disciplinary boundaries and therefore require that both the lecturers (from different disciplines) and the students explain and link the languages and concepts. This also requires basic understanding of the concepts and tools to quantitatively analyse data or to do numerical modelling.

Academic attitude and skills development in the course

a. In-depth analysis and modelling:
You will analyse various types of natural data using Matlab (a programming language, a spreadsheet and GIS. Furthermore we will build model components to develop a one-dimensional model for fluvial morphology in order to gain understanding of more complicated models that are used in practice and in science. As part of this you will learn how to solve programming problems independently.

b. Concise reporting and presentation:
You will write two concise (meaning dense and very clear) scientific abstracts about your coursework and present twice in a powerpoint. The first of both is individual, the second with a small group working on an interdisciplinary project. You will also review another individual abstract.

c. Interdisciplinary team work:
As a team you will collaborate to connect your pieces of work on a particular delta and present an integrated result.

Study material
A good book with the material covered by this course does not exist. Books either cover sedimentology, or geomorphology, or engineering, but not all of this. Instead we will work with (review) papers, where the lectures and powerpoints provide guidance and overview for the reading. The powerpoint slides of the lectures will be provided as low-resolution pdf files on the course website. Web site: http://www.geo.uu.nl/fg/mkleinhans (go to teaching). Tutorial guides will be made available on this website as well for programming, case studies and the individual projects.
**Papers:**
Papers needed for regular classes will be made available through the library as the course progresses. Papers needed for specific projects will partly be suggested but literature search by students will be required for specific subjects. For several key papers we provide a list of questions that you will use to test whether you understand the paper. A preliminary list of papers that you can already start studying is (more on the website):


**Assessment**
The course grade will be determined from three parts: programming and creative assignment in student pairs (“the Matrix”), full geological and geomorphological analysis of a delta presented by your team (“the Delta Force”) and a final individual exam testing insights (“the Final Frontier”). Furthermore you must have reviewed another student’s abstract of the creative matlab assignment.

**Products to hand in:**

- Matlab code for four practical exercises (in changing student pairs, 35% of grade):
  - evaluated as follows: 1. does the program run? 2. can the lecturer read/understand it (enough comments)? 3. does it do the right thing?
  - the last (creative) exercise gives you some freedom of subject and method and with which you can distinguish yourself (earn higher grades) and the resulting code of which can be used in the delta project.
  - the creative exercise will be presented using powerpoint in max 5 minutes, which you must also hand in
  - the creative exercise must be reported in an abstract of 500 words max, which you must hand in as four printed hardcopies and in digital form including the first version with comments at the date of presentation
  - the creative exercise is worth 20% and the other three exercises are worth 5% each of the final grade

- Delta project presentation and ppt (team effort, 30% of grade)
  - For each team a different delta is chosen. The aim is to understand its evolution from initial and boundary conditions and generic processes. This will be presented using powerpoint. All teams evaluate and discuss the work of all other teams.
  - The powerpoint must be handed in.
  - An extended abstract in prescribed format (will be made available, is 2 pages including figures) must be handed in a few days before the presentation (deadline will be given later) and will be made available to all students
  - Team work is divided between individuals based on themes/aspects of delta evolution. A specification of individual tasks is given on a third page following the abstract.

- Written exam (individual, 35% of grade)
  - This exam tests insight, not reproduction of knowledge, and tests your application of your insights to new situations. See example exam of last year.
**Conditions for participation:**
Presence during lectures and practicals is strongly recommended (if they were not the lecturer would not bother delivering them). Preparing for the exercises and lectures by reading the relevant literature as indicated on the website **in advance** (which is quite typically what we mean with **preparation**, as opposed to postparation) is also strongly recommended.
This is an MSc level course so the learning curve will be steeper than in the Bachelor’s. We also expect you to plan well ahead, take responsibility for your own development (and for example let us know asap, not afterwards, when you are ill), prepare well, come to class well-rested, and take an active role in discussions and questions. Also we expect you to be constructive in your comments on other people’s work so that you learn from giving good, helpful criticism and others learn from your comments. Most importantly, we expect you to recognise where you need help and to ask questions about the course content, academic skills and how to study. Be a professional. This also entails that you present your work without all the mistakes and problems you hopefully did not get away with at the end of your bachelor of science, meaning no spelling errors, no grammatical errors, decent graphs following standards in scientific papers and not standard excel output, clear layout, and so on. This is so unintelligent that to make such errors is unacceptable and will have consequences for your grade, not because the lecturers are perfectionist freaks but because you need to be professionals that will not waste costly time of the lecturing professionals. You will get feedback on your thinking, your development and the academic quality of your products, which is different from the feedback you may have had in the Bachelor of Science.

**Conditions for valid assessment:**
- Students who handed in all required products in time and obtained a final grade between 4.00 and 5.49 will be given the opportunity to make an oral or resit exam if the exam had the lowest grade, or to make an assignment for reparation of the delta project work if this had the lowest grade, or of the programming work if this had the lowest grade. Which of these three it will be is decided by the course coordinator. Students who pass the resit exam or repair will obtain a PASS (Voldaan, maximum 6.0) as final grade; students who do not will obtain their original grade.
- Failure to show up in time at the final exam, or failure to meet any of the deadlines, means that not all required products were handed in in time so that the student failed the entire course. If you have a serious reason why you cannot meet a deadline contact the course coordinator.
- If you are ill or have another good reason why you cannot show up at the final exam or any of the practicals, excursion and tutorials, you have to notify Kleinhans and Mrs I.C.J.M. Beekman (i.beekman@uu.nl) beforehand with the reason explained, and may have to show an MP note after having recovered from illness.
- Doing three courses simultaneously (two in addition to this course) is not a valid reason for not keeping to deadlines. Unfortunately, neither is falling in love or breaking up.
- The exam in this course requires application of learned concepts to material not previously seen. The exam will be open book and course materials may be brought in as well.
- You will do the matlab programming together with someone else, but you must change partner for each exercise and may not write more than one code together with the same person. Working with three persons on one report is not allowed except for one group in case of an odd number of participants. Individual work is allowed if there are sufficient computers.
- The delta project is a group effort but the individual contributions must be made clear and the lecturers may give different grades to members of the same team.
- The matlab codes have to be handed in to Anne Baar by email on Friday at 4 PM in the week following the computer practical.

These are the rules, but if you have a problem, just come to the course coordinator and we will see what we can do!
**Additional rules that almost go without saying:**

- It is highly recommended to check the course website regularly.
- It is the student's responsibility to obtain the course materials and changes to the lecture calendar that are presented at this website. Practicals will be explained in classes and not during practicals.
- All students are expected to attend class regularly and be on time for class with cell phones turned off (except for things such as family emergencies).
- Rounding of grades is done AFTER averaging the grades in accordance with practice in science.
- Bring a scientific calculator to the lectures and practicals.
- Cell phones, wireless, internet and any other means of communication with the world outside the classroom are strictly prohibited during classes and the exam.
- The language during lectures and practicals is English. The language during the breaks is also English if there is one non-native speaker. If there are only native Dutch speakers then I don't mind which language or dialect you use.
- It is not allowed to waste the lecturers' time by nagging about low grades. If you are 0.1 or 0.2 points short of passing the exam, you are in reality 2 or 3 points short of becoming a good academic.
- Almost no question is stupid and I expect you to ask questions. The two stupid questions that I do not appreciate are:
  - "Do I really need to do all that work?" Yes. This is a full course making the most of your time and your tuition fee. We expect you to work at least 20 hours per week on average on this course.
  - Questions that can be answered by reading hand-outs, instructions for practicals/reports and this study guide. READ them. (Well, you probably did that since you arrived at this end.)
**Expected minimum work load and contact hours**
The minimum work load is indicated in the table and fulfills the requirement of the minimum number of hours spent on a 7.5 ECTS course of 28x7.5=210 hours. However, as with playing musical instruments, you learn a lot more if you spend more time on the subject. It may also be insightful to estimate the costs of university infrastructure and university professors and find out that the tax payer actually covers two-thirds of the costs of your MSc degree. Although this may come across as rather sarcastic, I am quite happy to see that many students work hard and make the most of academic education, and I am looking forward to the course and the teaching.

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