Onderwijsinstituut Aardwetenschappen
Bachelor Aardwetenschappen / Master Earth Sciences

General
- Name: AW-River Morphodynamics
- Code: GEO3-4305
- Study points: 7.5 ECTS
- Level: 3
- Timing: period 3, February – April 2015
- Contact hours: variable (always check latest schedule in latest version of these course guidelines on blackboard)
- Language: English
- Website: http://www.geo.uu.nl/fg/mkleinhans/, go to ‘teaching’
- Lecturer and coordinator: Prof. dr. Maarten G. Kleinhans, m.g.kleinhans@uu.nl, room 207, Zonneveldvleugel, Heidelberglaan 2 (entrance Van Unnik or Educatorium), Wouter Marra (MSc), w.a.marra@uu.nl

Position in curriculum
This course is part of the fluvial/coastal track of physical geography, and is required for MSc-thesis work on river and coastal morphodynamics. In-depth knowledge of fluid mechanics and sediment transport as well as longterm landscape and sedimentary basin evolution is provided in subsequent MSc courses and will be covered lightly and applied to rivers in this course without assuming the in-depth knowledge. This course is complementary to coastal and river modelling and/or management, reconstruction of quaternary environments, sedimentology, stratigraphy, surface hydrology and land degradation courses of earth science earlier in the bachelor and later in the master.

Prerequisites
No prerequisites; fluid mechanics, coastal morphodynamics and sedimentology recommended.

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

Content - summary
Fascinating patterns emerge when water moves sediment: ripples, dunes, bars, channels, alluvial fans and deltas. These patterns are partly explainable from the physics of flow and sediment transport. During flume experiments, we will collect data on such patterns. Using existing data combined with your own data, and models (provided) you will understand small-scale processes, how they integrate to large-scale rivers and deltas, and how climate change and sea-level change affect the systems. This will bring you to the limits of our understanding of rivers, for example, on the patterns that cannot yet be explained physically. We will also apply these insights to some actual problems in the practice of Dutch and world-wide river management (floods and mitigation, river rehabilitation). This course bridges the gap between (Quaternary) geology+sedimentology, physics and civil engineering. Specifically, subjects are:
- floods and the force of turbulent flow on sediment
- river management/flood mitigation (calculations and newspapers)
- ripples, dunes and hydraulic roughness (experiments, prediction)
- sediment transport (experiments, prediction)
- river patterns: bars and channel patterns (experiments)
- fluvial morphology: average characteristics of channels from all over the world (calculations)
- delta formation under constant conditions and effects of climate change and/or sea-level change (experiment and modelling)
- case studies of actualities
Aims
The general aims are to acquire integrated physics-based and geomorphology-based understanding of the formation and dynamics of rivers, and acquire basic experimental and river modelling skills.

Specifically, after a successful course the student:
- has acquired knowledge, explanations and basic understanding of fluvial morphodynamics at length scales ranging from particles to channel patterns and seconds to centuries;
- is able to apply empirical, analytical, experimental and numerical tools scientifically to predict fluvial morphodynamics phenomena;
- is able to process empirical data collected in the field and in laboratory experiments, to analyse these analytically and with numerical models, and present them in graphs;
- is able to produce written reports in English with graphs and other illustrations up to the standard of scientific publications;
- is able to position the knowledge and understanding in the wider societal context of river basin management, river engineering and renaturalisation with the boundary condition of global change.

Programme and Schedule
The logic behind this course is threefold (see figure below):

1. The morphodynamic system: flow of water moves sediment, this causes morphological change, which in turn affects the flow of water, and so on. We therefore start with the flow and with sediment transport, then move on to morphology.

2. Quantitative and qualitative knowledge: we provide the bare essentials of the physics of flow and sediment transport, and a simple spreadsheet model with a simple, understandable physics-based model to demonstrate the morphodynamic system (and the effects of discharge change or sea level rise). This will also be demonstrated in flume experiments wherein the group will do measurements, and datasets made available for analysis. This will bring you to the limits of our understanding of rivers.

3. Application: engineering, river management, floods and river rehabilitation. These are important issues that you will definitely meet in the practice of river management, so we provide a basic understanding to help you there. There will be guest lectures from researchers on fluvio-deltaic morphodynamics (also on planet Mars), fluvial sedimentology and geology, remote sensing and rivers, and on the practice of consultancy for rivers in the Netherlands.

Preliminary schedule (updated regularly within this document!)

<table>
<thead>
<tr>
<th>nr</th>
<th>Week</th>
<th>Day</th>
<th>Date</th>
<th>Start</th>
<th>End</th>
<th>Location</th>
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<tr>
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<td>7</td>
<td>Wednesday</td>
<td>11/02/2015</td>
<td>13:15</td>
<td>15:00</td>
<td>UNNIK - 312</td>
<td>Lecture Intro, fluid mechanics</td>
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<td>Friday</td>
<td>13/02/2015</td>
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<td>UNNIK - 312</td>
<td>Lecture/Tutorial Bedforms and sediments</td>
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<td>Wednesday</td>
<td>18/02/2015</td>
<td>13:15</td>
<td>17:00</td>
<td>Zonneveld K2a</td>
<td>Experiment 1: Bedforms and sediment transport</td>
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<td>20/02/2015</td>
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<td>UNNIK - 312</td>
<td>Lecture/Tutorial Sediment transport</td>
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<td>UNNIK - 101</td>
<td>Computer 1: Bedforms and sediment transport</td>
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<td>Lecture/Tutorial Channel dimensions</td>
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<td>27/02/2015</td>
<td>09:00</td>
<td>12:45</td>
<td>UNNIK - 312</td>
<td>Lecture/Tutorial Bars and River patterns, DEADLINE+discuss Rep1</td>
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<td>27/02/2015</td>
<td>13:15</td>
<td>17:00</td>
<td>UNNIK - 101</td>
<td>Computer 2: Channel dimensions and river patterns</td>
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<td>Wednesday</td>
<td>04/03/2015</td>
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<td>17:00</td>
<td>Bot. Garden</td>
<td>Experiment 2: bars, channel patterns and morphodynamics</td>
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<td>06/03/2015</td>
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<td>Lecture Hydraul roughness, Tutorial Popup+ppt</td>
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<td>Friday</td>
<td>13/03/2015</td>
<td>09:00</td>
<td>12:45</td>
<td>UNNIK - 312</td>
<td>Question hour, DEADLINE+discuss Rep2</td>
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<td>Wednesday</td>
<td>18/03/2015</td>
<td>13:15</td>
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<td>UNNIK - 312</td>
<td>Tutorial: 5 min Popup Presentations ALL students</td>
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<td>20/03/2015</td>
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<td>UNNIK - 101</td>
<td>Computer 3: Numerical morphological modelling</td>
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<td>01/04/2015</td>
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<td>08/04/2015</td>
<td>13:15</td>
<td>15:00</td>
<td>UNNIK - 312</td>
<td>Spare/guest lecture, (prepared) questions from students</td>
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<td>17</td>
<td>13</td>
<td>Wednesday</td>
<td>15/04/2015</td>
<td>13:30</td>
<td>16:30</td>
<td>UNNIK - 220</td>
<td>Exam and course evaluation</td>
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Study material

Lecture notes:
The powerpoint slides of the lectures will be provided as low-resolution pdf files on the course website. Web site: blackboard

Books:
- 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 and an e-book
- free E-book: http://vtchl.uiuc.edu/people/parkerg/morphodynamics_e-book.htm (a few chapters)

Papers include (get from the website and library):
- Van den Berg, J., and A. Van Gelder (1993), A new bedform stability diagram, with emphasis on the transition of ripples to plane bed in flows over fine sand and silt, vol. 17, pp. 11–21, International Association of Sedimentologists (will be posted on the website)
- Van den Berg, J., and A. Van Gelder (1998), Discussion: Flow and sediment transport over large subaqueous dunes: Fraser River, Canada, Sedimentology, 45, 217–221 (will be posted on the website)

Assessment

Products to hand in at deadlines specified in the time schedule:
- Three reports on flume and computer assignments
  - consists of answers to questions in the assignments
  - with formats specified during preparatory classes,
  - written by student pairs (not by dividing the work but by working together), never with the same partner (i.e. new partner for new report)
  - improved on the basis of reviews (constructive comments) by another student pair
  - each report counts as 15% of final grade each
  - all reports have a half-page summary in your own words on the aim of the analysis/experiment/modelling and what you learned from it.
  - Some reports have an extra assignment that give you freedom of subject and method and with which you can distinguish yourself (earn higher grades).
- Three reviews (constructive comments) of a report of a fellow student pair (as pair, all reviews together are 10% of final grade)
- Popup: A creative small bit of research to answer your own question, and a 5 minute powerpoint presentation (individual, 15%, will be explained in first lecture)
- One-minute papers for each lecture (individual, necessary condition for final grade, will be explained in first lecture).
- Written exam (individual, 30%).

Conditions for participation:
Presence during tutorials, practicals and paper discussions is compulsory; presence during lectures is strongly recommended (if they were not the lecturer would not bother delivering them). Have a fellow student take notes for you in case of your absence for a compelling reason. Preparing for the exercises and lectures by studying (which is more thorough than just reading) the relevant literature as indicated on the website is necessary in order to be able to follow the lecture and do the exercises. Lecturers in general tend to be disappointed with you if they prepared for class but you did not...
The contact hours and self-tuition hours are indicated in the table below. Note, however, that the real self-tuition hours depend on your ambition and qualities. Further note that all prize-winning scientists report that they work >60 hours per week and top musicians likewise spend a great many hours.

<table>
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<tr>
<th>Contact hours with classroom reservations in Syllabus+</th>
<th>wk 1</th>
<th>wk 2</th>
<th>wk 3</th>
<th>wk 4</th>
<th>wk 5</th>
<th>wk 6</th>
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<td>Other, e.g. presentations</td>
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<th>Programmed contact hours without classroom reservation</th>
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<td>Excursion</td>
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<td>Atelier</td>
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<tr>
<td>Meeting between lecturer and student (real life or digital)</td>
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<td>Supervision of paper/assignment (real life or digital)</td>
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<td>Open office hours lecturer (real life or digital)</td>
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<td>Peer feedback (real life or digital)</td>
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<td>Inter-student meetings (real life or digital)</td>
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**Conditions for valid assessment:**

- To pass, the minimum grade for a report is 4.5 and for the written exam is 5.5, but only one report may be below 5.5. The student is eligible to an additional (oral) exam, if the end score is between 4.00 and 5.49 AND the score of only one of the reports is 5.0 or more, AND the other two reports are rated at least 6.0. The lecturer will decide on the topic of this exam.

- Students who meet the above requirements and have obtained a final grade between 4.00 and 5.49 will be given the opportunity to make a resit exam (additional exam / aanvullende toets). Students who pass this exam will obtain a PASS (Voldaan, maximum 6.0) as final grade; students who do not will obtain their original grade. Depending on the number of students the course coordinator may decide to take an oral resit exam.

- You will do the analyses and write the report together with someone else, but you must change partner for each report and may not write more than one report 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.

- The popup research and presentation is individual.

- The exercises have to be handed in to Kleinhans in the break of the lecture of one week later at the latest. If you fail this deadline, the exercise will be marked with ‘1’. If you are not able to hand in the reports in time, you should notify Kleinhans before the beginning of the subsequent lecture (not in the break) with a valid reason.

- 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 Beekman (i.beekman@geo.uu.nl) beforehand with the reason explained.

- Officially you will have to submit a declaration by your Medical Practitioner that you were ill in order to be eligible for a resit exam.

- For the reports, tentative grades will be given. If this tentative grade is below the minimum needed to pass for the course, then you may request an opportunity to revise the report, and one report only. Such a request may be granted under the condition of reporting some extra analysis.

- Doing three courses simultaneously (two in addition to River Morphodynamics) is not a valid reason for not keeping to deadlines.

- Failure to show up at the final exam will be marked with ‘1’.

- Failure to hand in a report will be marked with ‘1’.

- 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. A scientific calculator will be necessary to solve some of the problems.

These are the rules, but if you have a problem, just come to me 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.

- All students are expected to attend class regularly and be on time for class. Practicals will be explained in classes and not during practicals.

- It is expected that the students will complete the assigned reading and reports before coming to class for the day.

- Rounding of grades is done AFTER averaging the grades as in science.

- Bring a scientific calculator to the practicals. In fact, you can and have to become pretty good in calculations in your head if you want to come without. I recommend reading Richard Feynman's autobiography "Surely you are joking Mr Feynman" on this.

- Cell phones are strictly prohibited during any classes and the exam.

- 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.
  - 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.)