Research in Water Science and Management

GEO4-6009

Period 4, 2022-2023

Master Water Science and Management

FACULTY OF GEOSCIENCES
UTRECHT UNIVERSITY

DISCLAIMER: Due to Covid-19 restrictions, it may be necessary to make last minute changes to the course compared to what has been described in this manual, e.g., lectures or exams may be held online or an exam may be replaced by an assignment. The course coordinator will keep students up to date with the latest information.

1. TABLE OF CONTENTS

2. GENERAL COURSE INFORMATION

a) Course information

Course title: Research in Water Science and Management
Course code: GEO4-6009
Number of EC points: 7.5
Level: Master - 1
Term: Period 4
Academic year: 2022-2023
Start date: 24 April 2023
End date: 30 June 2023
Language: English
Link to Blackboard:
https://uu.blackboard.com/webapps/blackboard/execute/announcement?method=search&context=course&course_id=_140171_1&handle=cp_announcements&mode=cpview

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Lecturers:
Dr. Stefanie Lutz – Assistant Professor, UU Copernicus Institute
Dr. Jacques Flores – Information/Collection Specialist, UU RDM
Helen de Waard – Research and Teaching Assistant, UU GeoLab
Desmond Eefting – Research and Teaching Assistant, UU GeoLab
Eric Hellebrand - Research and Education Assistant, UU GeoLab
John Fisher - Research and Education Assistant, UU GeoLab
Dr. Ruud Bartholomeus – Chief Science Officer, KWR
Thomas Berends - Data Science Team Lead, Nelen & Schuurmans
Dr. Nicolette Volp - Consultant/Developer, Nelen & Schuurmans
Martijn Krol – Consultant, Nelen & Schuurmans

b) Place in the curriculum

The course *Research in Water Science and Management* (RiWSM) is a compulsory course for students following the Master's Programme in Water Science and Management (WSM). The course aims to partly prepare students for their master thesis.

c) Recommended prerequisites

Students are expected to have basic knowledge of research methodology which can be acquired through textbooks on natural science and/or social science research

methodology. Please consult the textbooks that you used in your bachelor and/or pre-master programme. Students are also expected to have basic knowledge of natural sciences that are relevant to water resources (e.g., earth sciences, physics, chemistry, physical geography, civil or environmental engineering, applied mathematics). Previous knowledge as an entrance requirement can be gained from formal introductory statistics coursework and/or by studying the following resources for self-study:

- Helsel, D.R., Hirsch, R.M., Ryberg, K.R., Archfield, S.A., and Gilroy, E.J., 2020, Statistical Methods in Water Resources - Supporting Materials: U.S. Geological Survey data release, https://doi.org/10.5066/P9JWL6XR.

- Witt, A. and Malamud, B. D., 2013, Quantification of Long-Range Persistence in Geophysical Time Series: Conventional and Benchmark-Based Improvement Techniques. Surv. Geophys. 2013 345 34, 541–651. https://doi.org/10.1007/s10712-012-9217-8

d) Entry requirements

It is required that the student is registered in the Master Water Science and Management degree programme.

3. COURSE CONTENT

a) General description of the content

The purpose of this course is to introduce you to the considerations, methods, and research best practices in water science and management. As future water sector professionals, it will be your task to understand the complexity that confounds many water science and management issues, and to formulate and implement reasonable courses of action for those issues. In order to do that, you will need a solid foundation in the various aspects of the research enterprise.

The **content of the course** is divided into three conceptually independent but functionally overlapping parts. Thus, the delivery of these parts will be made in no particular order.

Part 1: Preliminary Considerations
1.1 Introduction to Ethics and Integrity
1.2 Selecting a Research Approach (Ontologies, Designs, and Methods)
1.3 Reviewing the Literature
Part 2: Research Methods
2.1 Field techniques
    2.1.1 Hydrological characterization and monitoring (physical and chemical)
    2.1.2 Environmental tracers
2.2 Lab techniques
    2.2.1 C/N/H/O analysis
    2.2.2 ICP
    2.2.3 Ion chromatography and nitrate analysis
2.3 Data analysis and modeling
    2.3.1 Statistical techniques and numerical methods
    2.3.2 Assessing qualitative data reliability in water research
    2.3.3 Data warehousing and analytics
Part 3: Academic Research Writing
3.1 Research questions
    3.1.1 Formulating and Testing Hypotheses
    3.1.2 Conducting Exploratory Research
3.2 Methods section
3.3 Results and discussion
3.4 Data Management

The **organization of the course** is divided into four parts. You will:

1) Follow lectures and tutorials to gain theoretical knowledge (weeks 1-9)
2) Review two completed master theses (weeks 1-3). This will train you to look for strong and weak aspects of the underlying research
3) Write your own research proposal (weeks 2-9)
4) Attend the field and lab excursions

b) Changes to the course due to evaluation results from previous year

This is the third year that RiWSM is offered. Prior to when this course was offered, all WSM students had to follow the course Research Design (GEO4-2314) together with students from other programs within the Copernicus Institute of Sustainable Development. Thus, RiWSM was designed to cater to the unique research needs of WSM students. Notwithstanding, RiWSM, being an offshoot course, carried over some of GEO4-2314's course goals, activities, assessments, and policies. One of these policies, implemented in the previous year (AY 2021-22), was a strict rubric on *attendance and effort requirements*. RiWSM's adoption and implementation of such a rubric, however, revealed a wide range of differences in how rules on attendance and effort requirements have been implemented across Copernicus. Such differences are expected to be addressed in a future revision of the Teaching and Examination Regulations (*Onderwijs- en examenregeling*, OER). Hence, until a revised OER is published, the course coordinator has decided to temporarily suspend the adoption and implementation of the pertinent rubric this year.

Another change is that presentations of reviews of past WSM theses (see *Part 2: Reviewing completed MSc theses*) are moved by a week later than the case was in the previous two years. This is in response to student feedback expressing preference for more time to read and critique the theses, and prepare for the presentations.

Furthermore, in keeping with the expressed interest of students in learning a computer programming language that they may use during and/or after their graduation from the WSM program, the course included a substantial programming component in the previous year (see *Part 5: Computer programming tutorials*). Implemented in MATLAB/GNU Octave language, *Part 5* will introduce you to some applications of the language that are relevant in earth and environmental sciences, as well as water science and management. In the previous year, however, the associated assessment for *Part 5* was in the form of a take-home exam. This year, the course coordinator has decided to conduct the exam on campus (i.e., in a computer room, see Annex 2) and adjust the learning goals accordingly.

A summary of the changes to the course in terms of assessment activities and their relative weights to the final grade are shown in the following table:

Assessment	**Contribution to final grade (%)**		
	2020-21	2021-22	2022-23
Reviewing completed MSc theses	15	10	10
Do-it-yourself research proposal	70	40	35
Digital exam	15	20	30
Programming ('coding') exam	-	30	25

An important note on *Part 2*

The conduct of *Reviewing completed MSc theses* activity (see *Part 2* for details of the activity) during the first year when the course was offered was generally satisfactory. That is, the learning goals set for the activity were achieved. Unfortunately, a few students resorted to *ad hominem* statements in their reviews of the theses. Examples of such statements were:

- *This is such a terrible thesis. I cannot believe the supervisor gave it a passing grade!*
- *My bachelor's thesis was better than this.*

There are two main reasons why such statements are not acceptable: (1) the statements were not constructive, i.e., the language lacked precision in terms of offering an overall impression of the completed work, let alone suggestions as to how the thesis could be improved; (2) the statements were an unnecessary display of misplaced arrogance.

While you are encouraged and expected to be critical, disparaging and derogatory remarks similar to the examples above are unacceptable, unnecessary, and are unequivocally discouraged. This activity is not a venue for misplaced arrogance, especially if the completed WSM thesis had been given a "Pass" or "Satisfactory" mark by a competent and qualified instructor. The Course Guide in the first year when the course was offered was silent on what is acceptable and unacceptable behaviour when reviewing a peer's work. This year, in performing this activity, you are enjoined to observe appropriate behaviour by striving to be as precise and as constructive as you possibly can.

c) Course aims

The course will introduce you to the considerations, methods, and best practices in research in water science and management so that you can:

1. Understand and apply Preliminary Considerations for conducting research, particularly regarding ethics and integrity, literature review, and an appropriate research approach
2. Understand and apply appropriate Research Methods, which include acquiring knowledge and skills on a range of techniques, and obtaining knowledge on several laboratory methods and modeling approaches in water resources research
3. Understand and apply methods in Academic Research Writing, which include formulating and testing hypotheses, conducting exploratory research, writing the methods, results, and discussion sections, and best practices in Data Management

d) Relationship with career development

You are working towards obtaining a [research] master's degree. Thus, developing, executing, and/or commissioning research will likely constitute an important part of your future profession. To become an effective researcher, you will need to acquire the knowledge and skills in executing your own research, and to assess the soundness of the research executed by others (i.e., as a peer reviewer). Whether you are working at a consultancy, a drinking water company, a water authority, or at a research institute, you will likely encounter questions such as:

- What is the greater body of knowledge in which this research is going to contribute?
- What choices should I/have others made in order to design a research that is likely going to contribute to this greater body of knowledge?
- Can I/can others defend the choices made?
- Is this project going to be feasible?
- Should I/should others allocate resources (money, time, personnel) for this project?

The RiWSM course teaches you the necessary knowledge and skills for addressing these questions, which then form the basis for the conduct of research.

Furthermore, water science and management professions often involve varying degrees [nature and extent] of work in the field, in indoor laboratories, or in performing desk research. The RiWSM course introduces you to some field techniques, laboratory methods, and computer programming skills that are relevant in water resources research. The *field techniques* will be realized in a field excursion. The *laboratory*

methods will be realized in an on-site lecture and visit to the GeoLab. The computer programming skills will be taught within the MATLAB/Octave environment.

e) Programme and schedule

The programme entails lectures, reviewing completed MSc theses, do-it-yourself proposal writing, field and lab excursions, computer programming tutorials, and an exam. The programme is presented in Annex 2. Annex 3 shows the rubric that peers and course instructors will use in evaluating the quality of your analysis of completed MSc theses. Annex 4 presents the format of the research proposal. Annex 5 shows the rubric for the final research proposal.

Part 1: Lectures

See Annex 2 for the schedule of lectures. You will be provided with reading resources that supplement the lectures. As master's students, you are expected to decide on the depth of knowledge and/or skills that you may acquire in relation to a particular topic. For example, you will be introduced to several analytical lab techniques that are relevant to environmental and water sciences. You will be introduced to best practices in data management. You will also be introduced to topics in water resources research (e.g. environmental tracers, assessing qualitative data reliability in water research). Among others, these lectures will cover the *breadth* of the topics that have been identified for this course. The *depth* in the acquisition of knowledge and/or skills in relation to any particular topic, however, will be mainly determined by you – first, via reading resources that will be made available on Blackboard; second, by leveraging the expertise of respective lecturer(s); and, finally, by self-reading during and throughout the duration of your master studies. Which lecture topic(s) is relevant for your master thesis will be determined by your interest and/or future research opportunities.

Part 2: Reviewing completed MSc theses

In this section of the course, you will **critically** examine and discuss completed WSM MSc theses while maintaining a **constructive and respectful** approach [see last three paragraphs in 3b]. You will work in groups to analyze two MSc theses. To effectively evaluate and compare them, your group should read both theses and draw insights for your own research. You will then present your analysis to your peers in a tutorial. Your work will be assessed based on the quality of your analysis and presentation, following the rubric provided in Annex 3. All the WSM MSc theses to be reviewed will be available on the course's Blackboard page.

During a tutorial on **10 May 2023**, your group will present a review of the selected WSM theses, allotting approximately 10 minutes per thesis or 20 minutes per group. This will allow time for instructors and peers to ask questions. It is up to your group to decide how to delegate tasks during the presentation, but it should be evident that all group members have read both theses and have a comprehensive understanding of their strengths and weaknesses.

Apart from presenting a brief summary of the thesis, you have to address the following questions in the presentation:

- What is the key topic of the thesis?
- Are the background information relevant and complete?
- What is the definition of the problem?
- What are the key water science and management concepts, and are they well defined?
- Is the research objective useful, feasible, and clear?
- Are the main research question and sub-questions sufficient?
- Are the research methods clear and appropriate?
- Do the research methods align with corresponding research questions?
- What is the possible impact of the chosen research methods on the conclusions?

- A brief comparison (strengths and weaknesses) between the two theses: what can they learn from each other?

The PowerPoint presentations will need to be uploaded on Blackboard before the start of the tutorial.

Part 3: Do-it-yourself research proposal
Each student will develop his/her own research proposal following the format provided in Annex 4. The proposal should not exceed 5,000 words. This limit pertains to all texts of the main content. It does not include the word count in the Abstract, Table of Contents, Reference list, Tables, Graphs and Annexes (note that Annexes may not contain information which is crucial to understanding the main text).

The research proposal should at least contain the following elements:
- Background of the research problem (i.e., *what is the problem?*)
- Problem description
    - The *scientific* relevance of the research and its connection to the wider debates in water science and management
    - The *societal* relevance of the research and its connection to water resources sustainability policies and relevant stakeholders
- Previous work done on the problem
    - *What is the status quo?*
    - *What is wrong with the status quo?*
    - *Why this is a problem?*
- The research aim (i.e. *how you intend to solve the problem?*)
- The main research question, and sub-questions
- Materials and methods
    - The general approach or setup
    - Methods of data collection (literature, fieldwork, experiments, interviews, etc.) and the kinds of data you will collect
    - Methods of data analysis (e.g. multivariate statistics, spatial analysis, modelling, etc.)
    - Uncertainty analysis (applicable to quantitative and qualitative research)
    - How will the methods, or combinations thereof, and data analysis answer your research questions?
- Discussion (Expected results)
- Activities and time table
- Reference list

The development of the research proposal consists of three phases:

Phase I. First draft (25% version): select a topic (clearly linked to water science and management), present a problem definition and knowledge gap, and define a research question (and sub-questions). Moreover, list the ten most relevant papers or books about the issue.
*You will submit your first draft to your assigned supervisor before midnight **10 May 2023 by email**. You will discuss your first draft with your supervisor in an individual meeting on Wednesday **17 May 2023** between 09:00 and 12:45* [20 min per student]*.*

Phase II. Second draft (75% version): this draft should contain the full draft through to Materials and Methods (see Annex 4).
*You will have quite some time to work on this draft. You will submit your second draft before midnight **5 June 2023**. Instructions on where to submit and how to provide feedback to peers will be posted on Blackboard. All second drafts will be discussed in tutorials on **14 June 2023**. The tutorials combine peer and teacher-led feedback.*

Phase III. Final version: this final version should contain all the required elements of a research proposal.
*You will submit the final version of your proposal to your supervisor before midnight **27 June 2023**. In case you want to discuss your supervisor's comments and/or marks on the final version, you can contact him/her for an individual feedback meeting.*

As the text above suggests, each student will be assigned a supervisor (either S. Lutz or J. Evaristo) who will facilitate the development of the research proposal. In addition, students will review the work of peers in small groups. Peer feedback is mandatory for the second draft. The same is highly encouraged as you work on developing your research proposals through to its final submission.

Second draft proposals will be discussed with supervisor and with peer students in the ***14 June 2023*** tutorial. Make sure you prepare for all meetings well. When you submit a more advanced draft, your supervisor and fellow students can give you more detailed feedback. Also try to do your utmost best to give appropriate feedback to your fellow students.

Part 4: Field and lab excursions
To acquire knowledge and skills on a range of field and laboratory techniques that are relevant in water resources research, you will participate in two excursions – a field excursion and a lab excursion.

The details (activities, logistics) of the field excursion will be communicated on Blackboard, as are the details (group assignments) of the lab excursion.

Part 5: Computer programming tutorials
The last 10-15 years saw an unprecedented growth in the demand for jobs in 'data science', broadly defined. Driven by the growth in the amount and variety of data generated, and continue to be generated at ever-increasing rates, data science has found many applications in many fields – from finance, public policy, and healthcare, to urban planning, economics, and higher education. The earth and environmental sciences, in general, and water science and management, in particular, are surely no exceptions. The water sector will continue to need practitioners who are competent in analyzing natural and socio-economic sciences data.

In this course, you will be introduced to MATLAB, a high level computer programming language that enables you to analyze and manipulate data. Alternatively, you may use Octave (equivalent to MATLAB but free of cost). As UU student, however, you may install MATLAB locally (free of charge) on your own laptop. **You are required to install MATLAB locally for this course**. Nevertheless, you should know that Octave exists as a subscription-free alternative to MATLAB, which you may find useful beyond your education program at UU.

There are two expectations that you need to meet *prior to starting the first tutorial/lecture* using MATLAB (see Annex 2).

1. You are expected to have installed MATLAB locally. To install MATLAB, follow the instructions in the following link and scroll down to *Other Software >> MATLAB*: https://students.uu.nl/en/practical-information/it-facilities/software-for-free
2. You are expected to have completed the following modules in the MATLAB self-paced online course *MATLAB Onramp.* The times associated with each module are enclosed in parentheses and count towards your self-study hours. Completing these modules will help you in 'getting up to speed' with the course material:
    a. *Commands* (20 min)
    b. *MATLAB Desktop and Editor* (15 min)
    c. *Vectors and Matrices* (15 min)
    d. *Plotting Data* (10 min)

To access the self-paced *MATLAB Onramp* course, go to:
https://matlabacademy.mathworks.com/
Note: If you don't have a MathWorks account, you may need to create one first on the MathWorks Portal.

The lectures and tutorials for this part of the course will cover the following topics. These topics will be distributed over four meetings (see Annex 2). Thus, you are required to bring your own laptop with you to these meetings.

Lecture/Tutorial	Topic
1	Matrix manipulation and simple statistics
2	Random walk, statistics, and time series analysis
3	Time series analysis (continued)
4	Numerical differentiation and integration

Part 6: Exam
The course has a two-part exam – digital ('theory') and computer programming exam. Both exams take place on campus.

1) A digital written exam will be administered on **20 June 2023**. The digital exam will cover parts of the lectures from 08 May through to 12 June.
2) A programming exam will be administered on **27 June 2023**. The exam will cover parts of MATLAB and Krippendorff's Alpha tutorials.

f) Study material

The following reference is mandatory:

- J. Evaristo (2023): Course Guide Research in Water Science and Management. Faculty of Geosciences, Utrecht University.

Assigned readings will be made available on Blackboard as are the lists of assignments and other course information.

g) Study load

Contact hours with classroom reservations	**Wk 1**	**Wk 2**	**Wk 3**	**Wk 4**	**Wk 5**	**Wk 6**	**Wk 7**	**Wk 8**	**Wk 9**	**Wk 10**	**Wk 11**	**Total**
Lectures	1.5		3.2	3.2			3.2	3.2				**14**
Tutorial/workshop/seminar	1.5	3.2	3.5	3.5	3.2		3.2	3.2	3.2			**25**
Exam (on campus, digital)									3	2		**5**
Programmed contact hours without classroom reservation*												
Field / Lab excursion					3.2	3.2						**6**
Supervision of proposal (face-to-face or online)				0.5				1.5				**2**
Peer feedback (face-to-face or online)								0.5				**0.5**
Total contact hours	3	3.2	6.7	7.2	6.4	3.2	6.4	8.4	6.2	2		**53**
Self-study and/or proposal writing	18	18	14	14	15	18	15	13	15	19		**158**
Total study load	21	21	21	21	21	21	21	21	21	21		**210**

*Note: hours per student

4. TESTING AND ASSESSMENT

a) Testing, deadlines and feedback

Information about tests, deadlines, and feedback are detailed in the description of the course's programme and schedule (Annex 2). The relationship between the course's intended learning outcomes and the different moments of testing is as follows:

Course aims (right) **and assessment** (below) **alignment matrix**	Understand and apply Preliminary Considerations for conducting research, particularly regarding ethics and integrity, literature review, and an appropriate research approach	Understand and apply appropriate Research Methods, which include acquiring knowledge and skills on a range of field techniques, and obtain basic knowledge on several laboratory techniques methods in water resources research	Understand and apply methods in Academic Research Writing, which include formulating and testing hypotheses, conducting exploratory research, writing the methods, results, and discussion sections, and best practices in Data Management
Reviewing completed MSc theses		X	
Do-it-yourself research proposal	X	X	X
Field and lab excursions		X	
Digital exam	X	X	X
Programming exam		X	

b) Rules during an examination

It is of the utmost importance that you can identify yourself during the exam. This means bringing and showing your **ID card with photo**. If you cannot show this, you may be excluded from the exam. Some additional rules during an exam:

- You may not leave the room during the first 30 minutes of the exam.
- Latecomers will be admitted only until 30 minutes after the start of the exam.
- All electronic equipment needs to be switched off (including phones and smartwatches!), except for equipment which the examiner has allowed.
- Put coats and bags on the floor. Bags need to be closed.
- If you need to use the toilet, inform an invigilator. Someone will escort you there.
- Raise your hand if you have questions, if anything is unclear, or if your need extra paper etc.

You can find further instructions on the examination paper. Always follow these rules. For courses with a digital exam, the rules are different. You can find them on the examination paper.

c) Assessment

The final grade will be calculated as follows:

- Reviewing completed MSc theses 10%
- Do-it-yourself research proposal 35%
- Digital exam 30%
- Programming exam 25%

100%

Final course grade: The final course grade will be satisfactory (pass) or unsatisfactory (fail) and will be expressed in numbers of 6 or higher and 5 or lower, respectively. The final grade will be rounded off to one decimal place (e.g. 7.4 or 8.7). A final course grade of 5 does not have any decimal places; an average grade of 4.50-5.49 is unsatisfactory, an average grade of 5.50-5.99 becomes a 6.0.

If you have fulfilled all course obligations but failed to obtain a final grade of 6 or higher, you will be given one chance to repair, via a supplementary test ("*aanvullende toets"*). If the supplementary test has been passed, the final grade of the course will be 6.0.

According to the Teaching and Education Regulations, you also have the right to a supplementary test if you have not fulfilled the minimum grade (5.50) of no more than 1 partial test, even though your final non-rounded grade is 5.50 or higher. If that supplementary test has been passed, it will count as a 5.50 when calculating your new final grade.

This course has no minimum grade requirement for a partial test.

A non-rounded-off final grade <4.00 implies a definite fail, i.e. in such cases there is no right to a supplementary test or supplementary partial test.

The character and content of the supplementary (partial) test will be decided upon by the course coordinator.

Attachment 1 shows the scheme regarding supplementary testing.

Note that a replacement test ("*vervangende toets"*) is only applicable in demonstrable circumstances beyond your control (such as serious illness). There is only one opportunity to sit a replacement test. If you are not present at the replacement test, or fail to meet the terms of the replacement test in good time, you will not be offered another opportunity. In case of dispute, reference is made to the Teaching and Examination Regulations (OER) of the degree programme and the Regulations of the Board of Examiners.

d) Attendance and effort requirements

If you cannot attend a mandatory exam due to serious illness or other reasons beyond your control, mandatory attendance will not apply. You must be able to prove that the reason for absence was beyond your control, if the course coordinator asks you to do this. Ultimately, the course coordinator will decide and approve this.

Absence must be announced via the webform: (https://fd21.formdesk.com/universiteitutrecht-geo/AbsenceForm) which can be found on the students' website or on the Blackboard community of your programme.

Absence or illness does not relieve you of your obligation to perform to the best of your ability. In other words, if you have not been able to complete a paper or give a presentation, contact the course coordinator to find out whether it may be rescheduled to another date.

If the quality or quantity of your attendance has been insufficient, the course coordinator may exclude you from the remainder or from part of the course.

Group work
There is an effort requirement for group work. Insufficient contribution to group work (or 'free-riding') can result in receiving zero grade for the activity in question. In case a group member does not contribute sufficiently, it is the responsibility of the group members to address this within the group **and** to inform the course coordinator in time. Whether a student has sufficiently contributed will be decided by the course coordinator.

e) Studying with disabilities, physical and/or mental impairment

The Copernicus Institute of Sustainable Development tries to meet the needs of students with a disability, physical and/or mental impairment as much as possible by offering facilities for their studies. However, students play an active part in this as well. Only students who have a contract with the department are eligible for facilities and special regulations. Students with a contract will be registered in Osiris. The lecturer will see which students have special facilities (and what kind of facility) when they receive the attendance list of their course. If you think you are entitled to a facility which is not yet mentioned in Osiris, please contact the study advisor. Do this well in time, well before the first test takes place.

5. FRAUD AND PLAGIARISM

You are always expected to hand in your own authentic work. Discussion with others can be enriching but the final product always has to be your own. All scientific research, including that of students, builds on the results of the work of other researchers, either in a positive or in a negative sense. Those other researchers deserve the credits for their work, in the form of a correct acknowledgement.

In short, quoting is allowed (and even necessary), but copying other researchers' work and presenting it as if it were one's own is plagiarism: unacceptable behaviour in the world of science. Lecturers have software to check texts for plagiarism and they will apply this software. Students who plagiarise run tremendous risks: in the worst-case scenario they will be expelled from the programme for a year. More details about the sanctions involved in plagiarizing can be found in the Teaching and Examination Regulations of the programme: http://students.uu.nl/en/practical-information/academic-policies-and-procedures/regulations

More information about fraud and plagiarism can be found here: http://students.uu.nl/en/practical-information/academic-policies-and-procedures/fraud-and-plagiarism.

On the website https://www.wix.com/wordsmatter/blog/2020/02/ways-to-avoid-plagiarism/ you can find tips on how to avoid plagiarism.

Fraud and plagiarism are defined as an action or failure to act on the part of a student, as a result of which a correct assessment of his knowledge, understanding and skills is made impossible, in full or in part.

Fraud includes:

- cheating during tests. The person offering the opportunity to cheat is an accessory to fraud;
- share answers with others while taking a test;
- seeking the help of third parties during a test;
- having within reach tools and resources during tests, such as a pre-programmed calculator, mobile phone, smartwatch, smartglasses, books, course readers, notes, etc., unless consultation is explicitly permitted;
- having others carry out all of part of an assignment and passing this off as own work;

- gaining access to questions, assignments or answers of a test prior to the date or time that the test takes place;
- perform (or try to perform) technical changes that undermine the online testing system;
- fabricating survey or interview answers or research data.

Plagiarism is defined as including data or sections of text from others/own work in a thesis or other paper without quoting the source. Plagiarism includes the following:

- cutting and pasting text from digital sources such as encyclopaedias and digital magazines without using quotation marks and referring to the source;
- cutting and pasting text from the internet without using quotation marks and referring to the source;
- using excerpts from texts of printed material such as books, magazines and encyclopaedias without using quotation marks and referring to the source;
- using a translation of the abovementioned texts without using quotation marks and referring to the source;
- paraphrasing of the abovementioned texts without clearly referring to the source: paraphrasing must be marked as such (by explicitly linking the text with the original author, either in text or a footnote), so that the impression is not created that the ideas expressed are those of the student;
- using visual, audio or test material from others without referring to the source and presenting this as own work;
- resubmission of the student's own earlier work without referring to the source, and allowing this to pass for work originally produced for the purpose of the course, unless this is expressly permitted in the course or by the lecturer;
- using the work of other students and passing this off as own work. If this happens with the permission of the other student, the latter is also guilty of plagiarism;
- in the event that, in a joint paper, one of the authors commits plagiarism, the other authors are also guilty of plagiarism, if they could or should have known that the other was committing plagiarism;
- submitting papers obtained from a commercial institution (such as an internet site offering excerpts or papers) or having such written by someone else whether or not in return for payment.

Fraud and plagiarism in groupwork

In case of group work, the group as a whole is responsible for the work that is handed in. If one of the group members commits fraud or plagiarism, the work cannot be assessed and the whole group will be called in front of the Board of Examiners. If the Board of Examiners determines that fraud or plagiarism has been committed, an appropriate sanction will be determined for each group member separately and the work will be declared invalid. If group members not guilty of the fraud or plagiarism want to receive a grade, the product will have to be re-written in such a way that a plagiarism-free work can be assessed. Make sure you are aware of your team members' work. Check each other's work and call attention to someone's work if necessary.

6. QUALITY ASSURANCE: COURSE EVALUATIONS AND COURSE FEEDBACK GROUP

a) Course evaluation

Each course is evaluated afterwards by the students. The lecturer proposes measures for improvement based on the evaluation results. It is important to fill in the evaluation questionnaire seriously because the evaluation results and lecturer's recommendations are discussed in the education committee and the management team. The evaluation results will be published in the Blackboard community 'Course evaluations Geosciences'. If you cannot log on to that community, and you would like to know the results, you can ask the lecturer for a copy of the evaluation results.

b) Course feedback group

A course feedback group (CFG) consists of a group of students in a course and serves as a point of contact for fellow students and the lecturer during the course. Its purpose is to find out during the course what is appreciated, what is going well and what practical issues can be improved. Please remember that this does not concern aspects which have already been determined, such as the choice of literature, set-up of tutorials or class times. Course feedback groups are about fine-tuning, for example, are the slides readable, can everyone hear the lecturer, and has information been put on Blackboard on time. *The CFG should not be confused with the regular end-of-course evaluation.*

Examples of questions for discussion:

- What is going well in the course? What do you like about the course?
- How can the quality of the lectures/tutorials be improved further?
- How can the organization of the lectures/tutorials be improved further?
- How can the quality of the slides and/or the information on Blackboard be improved further?
- Does the lecturer explain the literature well enough? Both content and presentation.
- Is it possible to communicate with the lecturer outside class hours?
- Any other issues you may have.

Such a group consists of 4-5 students per course who discuss with the lecturer during the break how the course is going. The names of the students in the course feedback group of this course will be posted on Blackboard.

The course feedback group and the lecturer will meet on the following days and times to discuss the course:
10 May 2023, right after class meeting
05 June 2023, right after class meeting
19 June 2023, right after class meeting

7. PROFESSIONALISM

We expect students to observe and maintain a high degree of professionalism in all their study activities, both out of respect for our university and in preparation for the highly competitive labor market. In particular, we encourage students to adhere to the following guidelines:

1. Adhere to deadlines. The Copernicus Institute follows a zero-tolerance policy regarding deadlines. If papers are submitted after their deadline has passed, we will reduce the final grade by one point. If handed in later than 24 hours, the student will receive a fail.

2. Present your work, including drafts, in an acceptable layout. We do not provide templates, but expect the overall layout of student papers to be consistent, coherent, professional, and readable. Be sure that the fonts you use, the distance between lines, and the styles are all consistent.

3. Ensure that the front page and the file name include your name. Your supervisor receives dozens of student papers often at the same time. Many download them and work from tablet computers; others print them out in large numbers. Printed drafts with no name and student number on the front page, or files with no proper file name, cause confusion and are unprofessional. Also, add page numbers to all pages of your document.

4. Present your academic work in professional English. Most of our students are non-native speakers, thus, absolutely flawless English is not to be expected. However, we expect submitted papers, including drafts, to be free of spelling and grammar

mistakes that could be detected by using standard spelling and grammar check programmes available in a text software (e.g., MS Word). If there are indications that a spell check has not been done, the grade will be lowered accordingly. We have no preference for styles of the English language. However, regardless of whether you prefer British, American, Australian or Indian English, you are expected to observe consistency in your chosen style.

5. Be professional in the spelling of proper names. Be especially careful in spelling proper names, including the names of persons, places, organizations, programmes, and so forth. Special characters in non-English languages—such as in Swedish, Hungarian or French—are part of the name and need to be reproduced correctly.

6. Be professional in citations and references. All cited sources must be given, with full details, in a list of references. Include all needed information in the list of references, including the name and first name of authors, the year of publication and title of publication, as well as (if applicable) the title of an edited volume, the names of editors, the name of a journal, the place of publication, and the publisher. If in doubt, follow the standards and 'author guidelines' from well-known journals, such as *Water Resources Research* or *Hydrological Processes*, which are all available online.

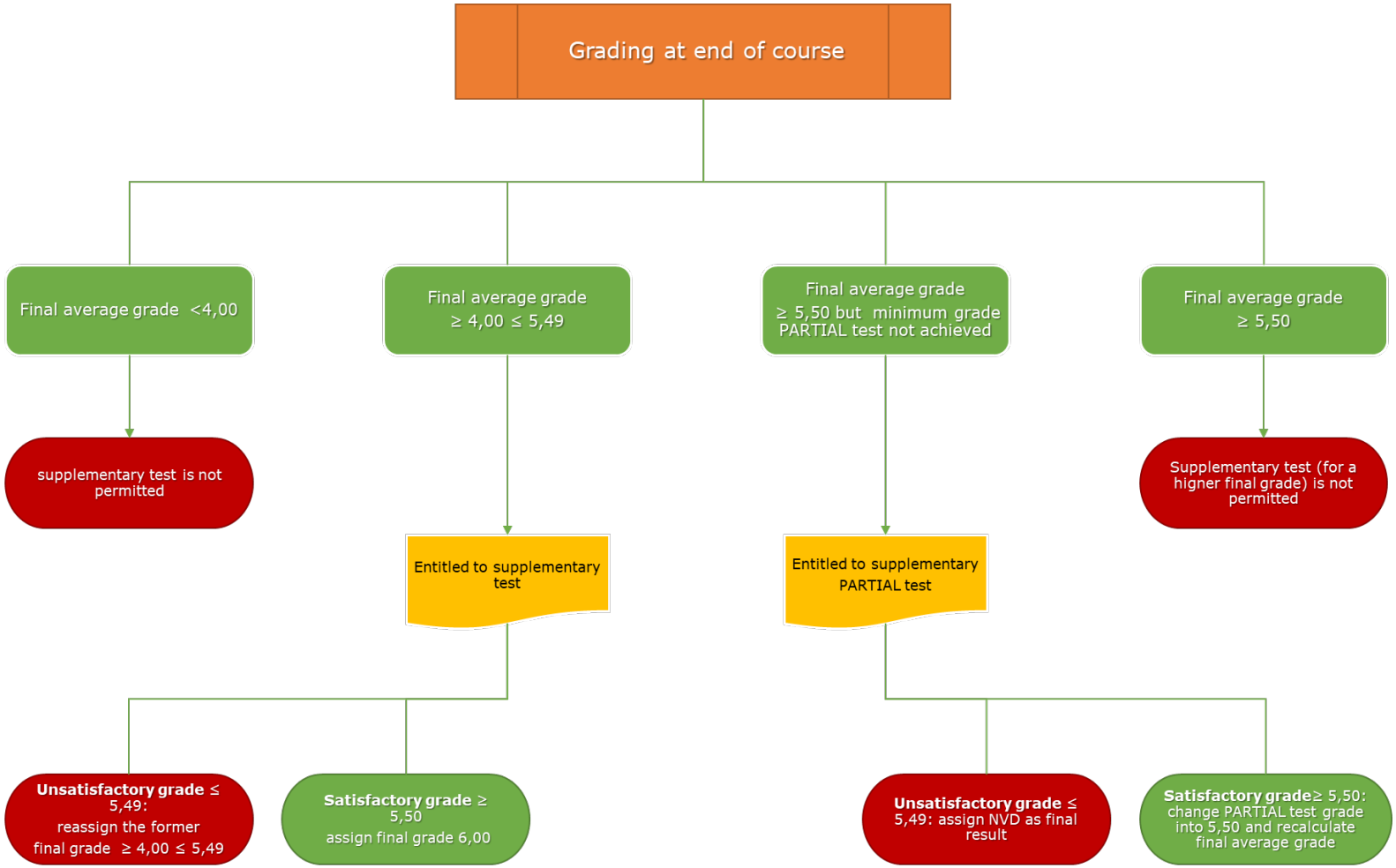
7. Try to improve the readability of your texts, among others by avoiding overly long sentences. This may be true especially if you are a native speaker of a language in which long sentences are common. Avoid use of the passive voice and complex jargons.

8. Never submit written work that still contains comments to yourself or comments from colleagues, such as internal notes, question marks, and so forth. If needed, familiarise yourself with the Comment function of your software, which allows you to hide internal comments while printing (including printing in PDF).

9. Be professional in your communication and correspondence. In the Netherlands, it is common today to address faculty members by their first names. It is not necessary to use professorial titles. This does not imply, however, that your correspondence should be entirely informal. E-mails are not to be written like SMS or WhatsApp messages. Correct spelling and grammar are important in all forms of professional communication.

10. If you plan to record a lecture for your personal use (that is, listening back again to the lecture), ask for the lecturer's agreement beforehand. Some lecturers might not want to allow this. The posting of any kinds of recordings online can breach the 'Portrait Right' of the lecturer and can be an illegal act.

Annex 1: Determining supplementary testing



3-4-2023

afd. Onderwijsbeleid en Studentzaken Geowetenschappen

Annex 2: Research in Water Science and Management Program Schedule

Date	Time		Instruction	Location	In-charge	Class Plan	Remarks
24-Apr	9.00	10.45	Lecture	BBG - 119	J. Evaristo	Ethics and Integrity; Selecting a Research Approach; Reviewing the Literature; Basic Elements of a Research Proposal	INSTRUCTIONS: Review of past WSM master theses
26-Apr	9.00	10.45	Tutorial	MIN - 0.18	J. Evaristo	Computer programming (MATLAB/Octave)	
01-May	-	-	-	-	Groups	No class. Pairs/groups meet to prep for presentations; draft 1 proposal writing	Students prep for presentations
03-May	9.30	12.45	Tutorial	MIN - 0.18	J. Evaristo	Computer programming (MATLAB/Octave)	
08-May	9.30	12.45	Lecture	BBG - 119	H.C. de Waard, D.D. Eefting, E.W.G. Hellebrand, J. Visser, J. Evaristo	LAB Techniques: lectures	
10-May	9.00	12.45	Tutorial	MIN - 0.18	J. Evaristo & S. Lutz	**PRESENTATIONS:** Review of past WSM master theses **(10%)**	***Submission 1st draft research proposal***
15-May	9.30	12.45	Lecture	BBG - 119	Jacques Flores (RDM) & S. Lutz	Data Management	
17-May	9.00	12.45	Tutorial	BBG - 007	J. Evaristo & S. Lutz	Individual consultation first draft (30 min/student)	**1st draft consult**
22-May	9.30	12.45	Lab	Geolab	H.C. de Waard, D.D. Eefting, E.W.G. Hellebrand, J. Visser, J. Evaristo	LAB Techniques: Geolab tour	
24-May	9.30	12.45	Tutorial	PADUALAAN - PORTA 1.14	J. Evaristo	Krippendorff's alpha tutorial; Computer programming (MATLAB/Octave)	
29-May	9.30	12.45	Holiday	-	-	No class	
31-May	9.30	12.45	Field	USP	J. Evaristo & S. Lutz	Field excursion: Utrecht Science Park (USP)	
05-Jun	9.30	12.45	Lecture	BBG - 119	Ruud Bartholomeus (KWR) & J. Evaristo	KWR	***Submission 2nd draft research proposal***
07-Jun	9.30	12.45	Tutorial	DALTON 500 - 1.19	T. Berends (Nelen & Schuurmans) & J. Evaristo	Lizard: Data Warehouse & Analytics Platform for Water & Climate	
12-Jun	9.30	12.45	Lecture	BBG - 119	S. Lutz	Field Methods: Environmental tracers	
14-Jun	9.30	12.45	Tutorial	MIN - 0.18	J. Evaristo & S. Lutz	Peer- and teacher-led feedback on 2nd draft	**2nd draft consult**
19-Jun	9.30	12.45	Tutorial	BBG - 119	J. Evaristo	Computer programming (MATLAB/Octave)	
20-Jun	17.00	20.00	Exam (digital)	EDUC - BETA	J. Evaristo	**DIGITAL EXAM (30%)**	
26-Jun	-	-	-	-	-	-	
27-Jun	17.00	19.00	Exam	MEINESZA - 1.16 GIS		**PROGRAMMING EXAM (25%)**	***Submission of final version of the research proposal (35%)***

Date	Time		Instruction	Location	In-charge	Class Plan	Remarks
03-Jul	-	-			-		-
05-Jul							
10-Jul	9.00	12.00	Resit (digital)	RUPPERT - 033	-	**Digital resit**	-

Note: UU MyTimetable may not be consistent with Annex 2. The latter is definitive. Any deviations will be announced in class.

Annex 3: Reviewing Completed MSc Theses Rubric

Name students (subgroup #): Date:

Title reviewed MSc thesis:

Teacher: Course: Research in WSM (GEO4-6009)

Criteria	Comments / Mark
Introduction (20%) -Clear summary of the thesis?	
Quality of the analysis (30%) -All questions (see Part 2 in Course Guide) answered properly? - Is the analysis consistent? - Is the analysis critical in the sense that strengths and weaknesses are indicated?	
Quality of the comparison (35%) -Clear and adequate comparison of differences in aim/scope and content of the thesis -Clear and adequate comparison of differences in quality of the content of the thesis -Explicit and clear overview of what the students have learned from reading and evaluating the two theses	
Quality of the presentation (15%) -Clear structure (intro, body, conclusion) -Within time limit, tempo ok (i.e., neither too fast nor too slow) -Use of media (# of slides, visibility) -Interaction with audience (eye contact, keeping the attention of the audience, gestures) -Manner of speaking (volume, language) -Quality of answers to questions from peers and instructors	
Final Grade	

Annex 4: Research Proposal Format

The research proposal should at least contain the elements below, and should not exceed 5000 words.

Front page
• Full title and sub title • Name, student number, email address
Key information
• Summary of the research proposal (250 words) • Key concepts (max 5 concepts) • Table of contents • Acknowledgements
Introduction (3,000 words)
• Introduction to the water science and management issues (i.e. *what is the problem?*) • Previous work done on the problem. Short introduction on how the problem has been approached by scholars to date and the main current understanding, or lack thereof (i.e., *what is the status quo?; what is wrong with the status quo?; why is this a problem?*) • Problem definition and knowledge gap • Research aim (i.e. *how do you intend to solve the problem?*) • Specific objectives • The main research question, and sub-questions • Hypotheses and/or assumptions to be tested (if applicable)
Materials and Methods (1,500 words)
• The general approach or setup • Methods of data collection (literature, fieldwork, experiments, interviews, etc.) and the kinds of data you will collect • Methods of data analysis (e.g. multivariate statistics, spatial analysis, modelling, etc.) • Uncertainty analysis (applicable to quantitative and qualitative research) • How will the methods, or combinations thereof, and data analysis answer your research question and sub-questions?
Discussion (500 words)
• Expected results • Contribution to the complex and multidisciplinary nature of the water science and management problem at hand • Short indication on the applicability of results in water management practices • Limitations and risks of the research • Ethical issues (if applicable)
Activities and time table
• Planning of research activities in a time table (30 weeks)
References

Annex 5: Final Research Proposal Rubric

Research in Water Science and Management (GEO4-6009)					
RESEARCH PROPOSAL				**FINAL MARK:**	
Name of Student: Name of Supervisor:				Date:	
	Unacceptable (< 4)	**Insufficient (4-5.5)**	**Acceptable (5.5-7)**	**Good (7-8.5)**	**Excellent (8.5-10)**
Introduction (35%)	There is no research problem, nor knowledge gap, nor is there a link to water science and management.	There is a broad research problem, but there is no clear link to water science and management *or* knowledge gap.	There is a broad research problem, and it is connected to water science and management *and* a knowledge gap.	There is a clear and concise research problem, with clear links to water science and management *and* well-defined knowledge gap.	There is a clear, concise and original research problem with strong connections to water science and management *and* a relevant knowledge gap.
	☐	☐	☐	☐	☐
Materials and Methods (50%)	Research materials and/or methods are not clear. Data collection and analysis do not match the research aim or question.	Research materials and/or methods are partly incomplete. Data collection and analysis are insufficient to answer research question.	Research materials and/or methods are described accurately and are justified. Research methods, data collection, and analysis follow clearly from research aim/question.	The selected research method(s) is novel and seems valid and suitable. Research methods, data collection, and analysis follow clearly from research aim/question.	The project has an original/innovative and appropriate methodological approach. The research method(s) is fully substantiated, and described transparently. A realistic use of multiple data collections and methods.
	☐	☐	☐	☐	☐
Discussion (10%)	Lack of expected results, nor contribution to water science and management problem at hand, no reflection on limitations	Reflection on water science and management problem at hand, and limitations of research. Marginal ideas about expected results.	Expected results, contribution to water science and management problem at hand and limitations are all reflected upon.	Critical reflection on expected results, contribution to water science and management problem at hand and limitations.	Critical reflection on all expects and provides well-considered arguments for the innovative information that this research will put forward.
	☐	☐	☐	☐	☐
Time planning (5%)	Planning activities unrealistic	Planning activities incomplete	Planning activities complete	Planning activities complete and realistic	Planning activities complete, realistic and precise/detailed
	☐	☐	☐	☐	☐

Research in Water Science and Management (GEO4-6009)		
All elements included, clear structure, correct language	*Insufficient* ☐ (in this case student has to adjust research proposal)	*Sufficient* ☐
References	*Insufficient* ☐ (in this case student has to adjust research proposal)	*Sufficient* ☐
Additional remarks		