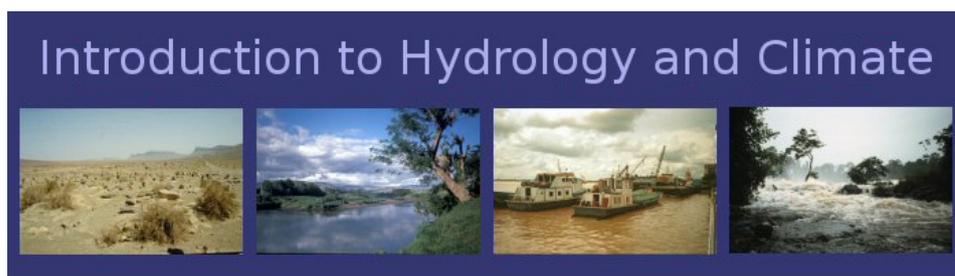


Introduction to hydrology and climate (AB_1074, 6 ECTS)

Maarten Waterloo



Study guide, February 2016

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1 Lecturers

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2 Introduction

3 Why this course?

Climate and hydrology are strongly linked and changes in climate affect hydrology and *vice versa*. Hydrology is the science dealing with the occurrence, distribution, circulation and physical and chemical properties of water on earth. Water is the most abundant substance on our planet and is of fundamental importance in the earth sciences and our economy because it

- is important for regulation of climate through energy transfer
- is a natural resource that is crucial for sustaining all life,
- plays an important role in many geological processes (e.g. sediment transport, erosion),
- plays a central role in chemical reactions (rock weathering) and the transport of dissolved solutes and pollutants,
- exerts great influence on the Earth's climate by redistributing energy (heat) and because (in gaseous) form it is the principal greenhouse gas (10 times stronger than CO₂),
- is needed for all food, energy and industrial production.

The sciences of climate and hydrology are important for our society because these provides the knowledge that is needed for the proper management of our surface water and groundwater resources. The need for understanding of climate and hydrological processes is especially relevant today since population growth, pollution, deforestation and climate change impose increasing stress on water reserves and valuable ecosystems.

Whereas salt water oceans are important regulators of climate, the hydrological part of this course will be restricted mainly to freshwater resources in continental areas because this is the water that is most important for use in our society.

4 Objectives

The general aim of this course is to provide the student with a base level of knowledge of climatic and hydrologic concepts and processes that enables her/him to study scientific literature and set up a basic research project in climate and/or hydrology. More specifically, after following the course, you will be able to:

- explain the processes that regulate our climate
- Describe the hydrological cycle, and its importance to our climate
- Explain the processes that govern the flow of water through the environment,
- Use proper descriptions for hydraulic properties of sediments and rocks,
- Explain the the concept of hydraulic head,
- Perform basic calculations of groundwater flow,
- Describe the chemical processes that determine groundwater quality,
- Describe the physical processes of rainfall generation, rainfall interception and transpiration,
- Calculate evaporation rates from meteorological data,
- Describe the various processes of runoff,
- Indicate what equipment should be used for measuring river flow rates.

5 Place of the course in the BSc Earth Sciences and Earth and Economy Programmes

Many processes in Earth Sciences are linked to the presence of water and the interaction of water with the lithosphere (*e.g.* erosion and sedimentation, weathering, mineral formation, thermal processes, etc.). Water resources also play an important role in our economic and agricultural activities.

This course will provide an in-depth treatment of the basic hydrological concepts that were introduced in the first-year courses of 'Systeem aarde (450067)' and 'Global Change (450234)'. It also aims to provide a base-level knowledge for the third-year course 'Hydrologie van Nederland (450085)' and for the master's programmes of Hydrology and Earth Sciences (*e.g.* Applied Geo-environmental sciences track). Moreover, knowledge of hydrological processes might be of use for your BSc project.

The course contributes to the following Final Attainment Levels set for the BSc Earth Sciences and Earth and Economy Programmes:

1. Knowledge and understanding – The graduate has profound knowledge of and insight in:

- climate and hydrological terminology and theory that is required to understand the development of new theory and research issues that are presently deemed of major importance in natural sciences;
- all aspects of the global water cycle and the role of the hydrological cycle in the Earth's climate system;
- the links between climate, hydrology and related sciences (earth and soil sciences, ecology, microbiology, physics, meteorology).

2. Application of Knowledge and understanding – The graduate is able to:

- define a specific Earth sciences or Earth and Economy research question, establishing hypotheses and explanations and designing a strategy for a solution and of implementing this strategy (problem solving skills);
- think in a multidisciplinary way and can make connections between different informational content.

3. Critical judgement – The graduate should:

- be capable of reading, comprehending and critiquing non-specialist journals and reports in the field of the Earth sciences or Earth and Economy.
- understand the domain of the Earth sciences or Earth and Economy and the existence and significance of specific, adjacent professional areas.
- The graduate understands the scope, application and responsibilities of the field and the role of Earth sciences or Earth and Economy in science, society and professional practice;
- The graduate is capable of giving due consideration to the ethical aspects of science and its applications;

6 Required subjects

There are no required subjects for this course but it is assumed that students are familiar with general Earth-scientific, physical, chemical and mathematical principles as taught in first-year BSc courses 'Systeem Aarde (450067)', 'Global Change (AB_1062)', 'Fysica voor aardwetenschappers (450064)', 'Geochemie voor aardwetenschappers (450068)' and 'Wiskunde en computergebruik (450063)'.

7 Course outline

The course has a study value of 6 ECTS (140 study hours). The number of hours spent on lectures and the excursion totals 33 hours. The remainder of the time (107 hours) is available to the student to study the course book, lecture notes and scientific papers and to make assignments. Lecture notes and scientific papers will be made available during the lectures and through the Blackboard digital learning environment (see Section 10).

The course consists of a series of lectures. The course schedule is listed in Table 1. Please note that the several lectures (Fridays in February) are scheduled but will be used for self study instead. Although the lectures are not mandatory you are strongly encouraged to attend them as the lecture notes and handouts need to be studied for the examination (see Section 8).

7.1 Lectures

A subdivision is made into groundwater and surface water resources. The part on groundwater hydrology will be lectured by Koos Groen. Maarten Waterloo will lecture on atmospheric processes and on surface water hydrology.

8 Course material

All relevant documents are made available during the course, either in digital form (see the sub-section on the Blackboard Digital Learning Environment) or as hard-copy handouts. We distinguish between two types of documents:

- Those that you need to study for the examination, which includes the course reader and the lecture notes. They may also include handouts.
- Those that we recommend you to read for background information and often do contain information that will help you to better understand the hydrological processes. We will not ask about the specific contents of these documents during the examination.

The course reader will be made available through Blackboard. The chapters in the reader reflect the contents of the lectures and the student is expected to read the relevant chapters before attending the lectures. The student is also encouraged to ask questions about the material during the lectures.

The lecture notes will be available on Blackboard prior to the course. We recommended that you print these files in advance of the lecture so that you can use them to make notes on.

Table 1: Course schedule.

Day	Date	Time	Subject	Location	Lecturer
Mon	01-02-2016	9:00-12:45 h	Introduction, precipitation I	D107	Waterloo
Thu	04-02-2016	11:00-12:45 h	Precipitation II	D107	Waterloo
Mon	08-02-2016	09:30-12:45 h	Evaporation I	D107	Waterloo
Thu	11-02-2016	11:00-12:45 h	Evaporation II	D107	Waterloo
Mon	15-02-2016	9:30-12:45 h	Soil physics I	D107	Waterloo
Thu	18-02-2016	11:00-12:45 h	Soil physics II	D107	Waterloo
Mon	22-02-2016	11:00-12:45 h	Runoff I	D107	Waterloo
Thu	25-02-2016	11:00-12:45 h	Runoff II	D107	Waterloo
Mon	29-02-2016	11:00-12:45 h	Hydrogeology I	D107	Waterloo
Fri	04-03-2016	09:30-12:45 h	Hydrogeology II	D107	Waterloo
Mon	07-03-2016	11:00-12:45 h	Water Quality I	D107	Waterloo
Fri	11-03-2016	09:30-12:45 h	Water quality II, questions	D107	Waterloo
Fri	27-03-2015	12:00-14:30 ^a	Examination	WN-C623, C629, C659	
Mon	29-06-2015	12:00-14:30 ^b h	Re-examination	WN-M 607, M 623 WN-Q105	VU staff VU Staff

^a30-min extra time for people suffering from dyslexia, please inform Dr. M.J. Waterloo

^b30-min extra time for people suffering from dyslexia, please inform Dr. M.J. Waterloo

8.1 Other references

A glossary containing definitions of the terms that are widely used in hydrological sciences <http://webworld.unesco.org/water/ihp/db/glossary/glu/hindent.htm>. Other good references will be made available through Blackboard.

9 Mode of assessment

The mode of assessment consists of a multiple choice exam with 50 questions given at the end of the course. You should bring a dark pen (black or blue ink color) and, as calculations may be part of the examination, you should not forget to bring your calculator.

A selection of previous (open questions) exams and multiple choice questions will be published on Blackboard and at the end of each chapter in the reader. When you are studying, please try to make multiple choice questions by yourself. This will help to prepare you better for the exam.

10 Blackboard

The course will make extensive use of 'Blackboard'. Blackboard is a digital learning environment used by our university to assist and activate students in their study. To use Blackboard, the student needs a computer and an internet connection. The Blackboard site can be reached at <http://bb.vu.nl>. You need a username (VUnetID) and password. Students that registered for this course in TIS are automatically enrolled in Blackboard, but two sites may be visible. Got to the site ending with _9999. If the course does not appear when you login to Blackboard, please contact Dr. Waterloo (maarten.waterloo@acaciawater.com).

Blackboard will be used to notify you of changes in the course and for other communications. Please check Blackboard regularly for new information.