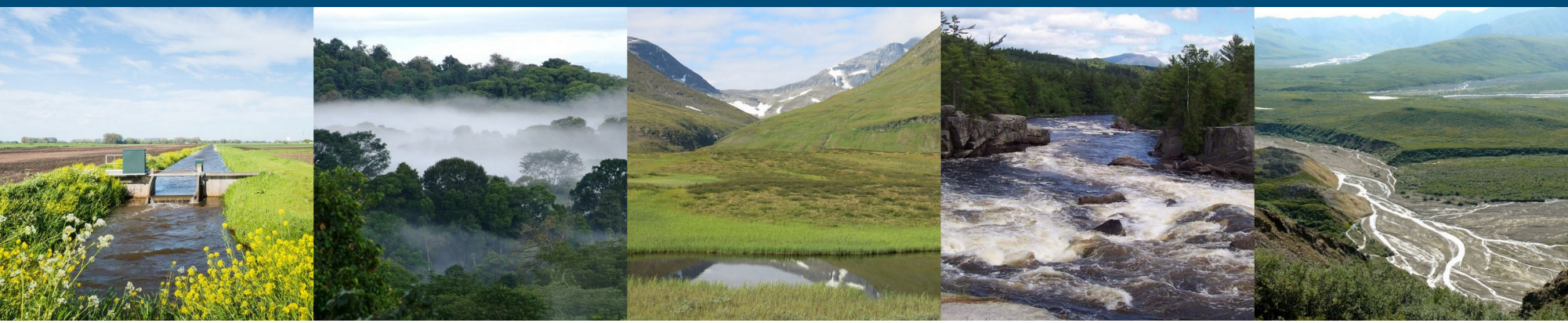
Hydrology and Water Resources Specialization
MSc programme Earth and Environment

Hydrology and Quantitative Water Management Group
Soil Physics and Land Management Group

Wageningen University, The Netherlands

Claudia Brauer



WAGENINGEN
UNIVERSITY & RESEARCH

Questions in water management

How can water productivity be increased?

How does stream restoration affect the hydrology upstream?

How fast do flood waves move downstream?

Where do erosion and deposition occur?

Questions in water research

How variable is rainfall in space and time?

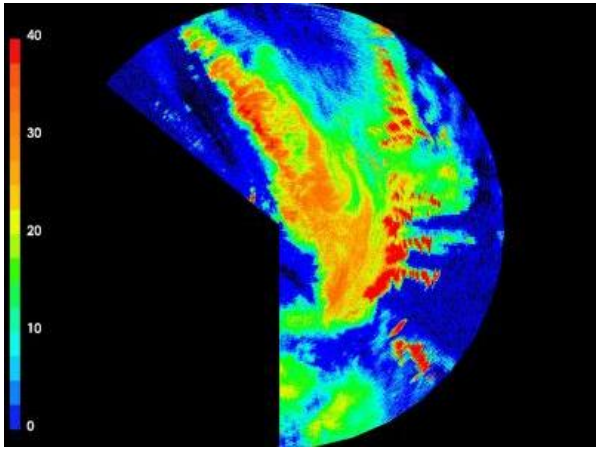
How do snow and ice affect runoff processes?

How does water availability determine vegetation cover?

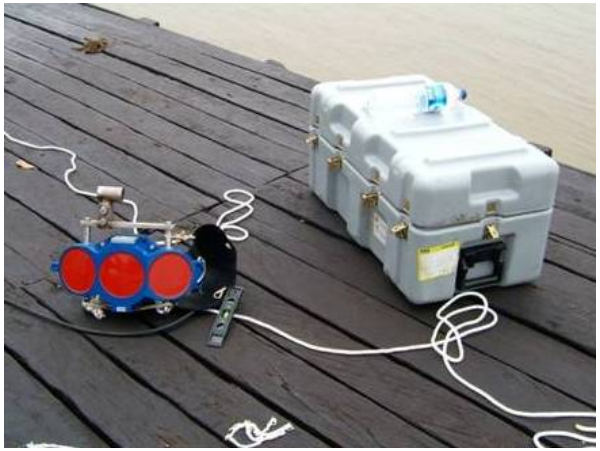
What happens hydrologically during drought and heat waves?

Improving observation methods for ...

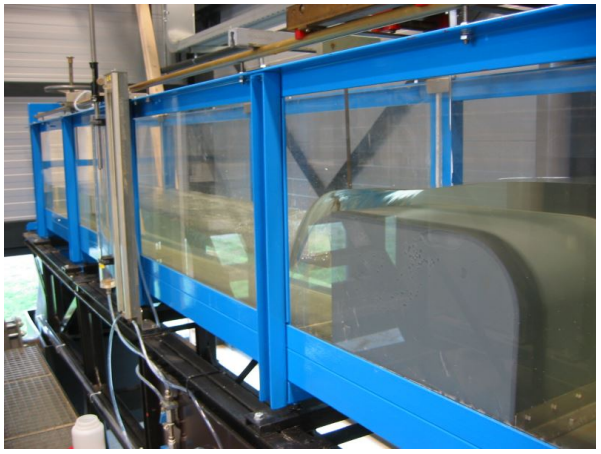
soil moisture (in situ and satellite).



rainfall (radar, satellite and microwave links).

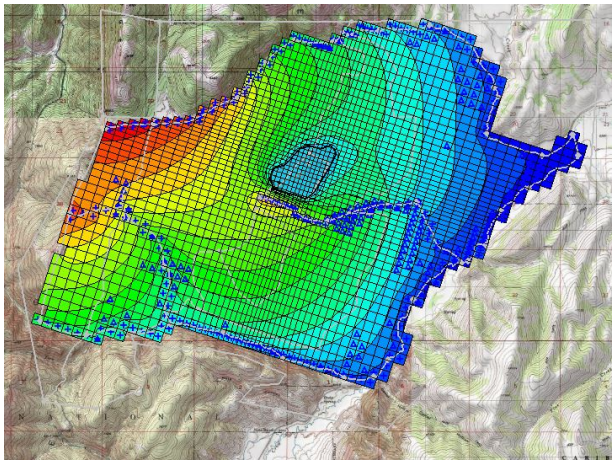


river discharge and sediment transport.

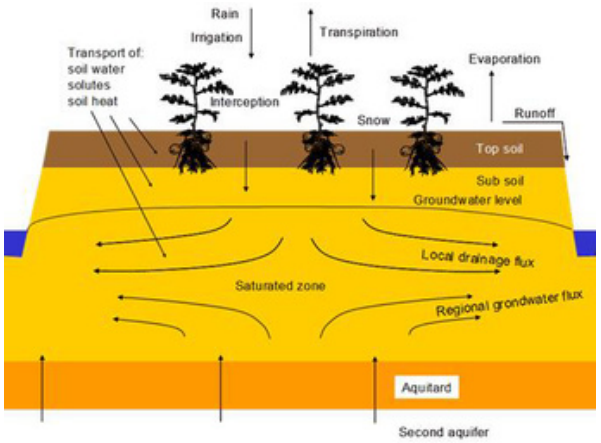


water flow in the Laboratory for Water and Sediment Dynamics.

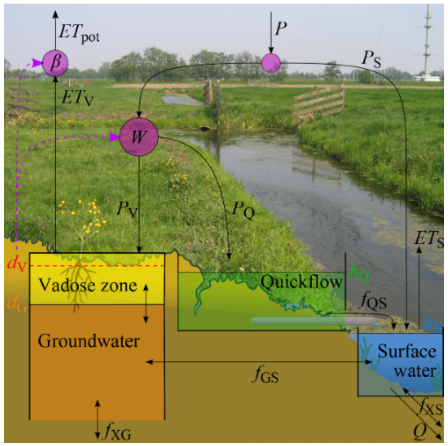
Improving models for...



groundwater flow and solute transport.



flow and transport in saturated and unsaturated zone.



catchment-scale rainfall-runoff processes.

river discharges during flood events.

Using observations and models to understand...

which feedbacks are present between plants and evaporation.

when irrigation leads to salinization.

how vegetation alters the response of discharge to rainfall.

which rainfall events and initial conditions lead to flash floods.

Courses

Compulsory:

- Interdisciplinary Topics in Earth and Environment
- Environmental Data Collection and Analysis
- Water and Air Flow: Numerical Techniques

Choose 2:

- Hydrology and Geology of Deltas
- Ecohydrology
- Urban Hydrometeorology
- Catchment Hydrology
- River Flow and Morphology
- Advanced Hydrological Systems Analysis

1	2	3	4	5	6
ITEE	HGD	WANT	UHM	CH	AHSA
EDCA	EH			RFM	

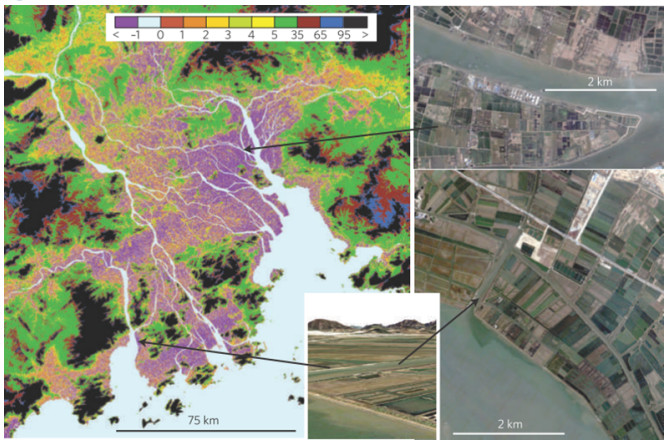
Hydrology and Geology of Deltas

questions

What happens to sediment at the mouth of a river?

How are fresh water plumes generated?

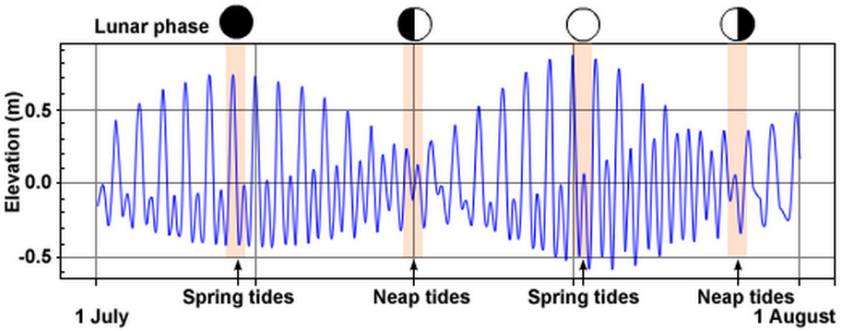
Where do tides cause large water level fluctuations?



How far does salt intrude in an estuary?

Hydrology and Geology of Deltas

activities



Recognising the influence of tide and river on delta morphology.

Using harmonic analyses to decompose sea level variations.

Computing sedimentation with a delta evolution model.

Excursion to the sand engine.

▸ video

Ecohydrology

questions

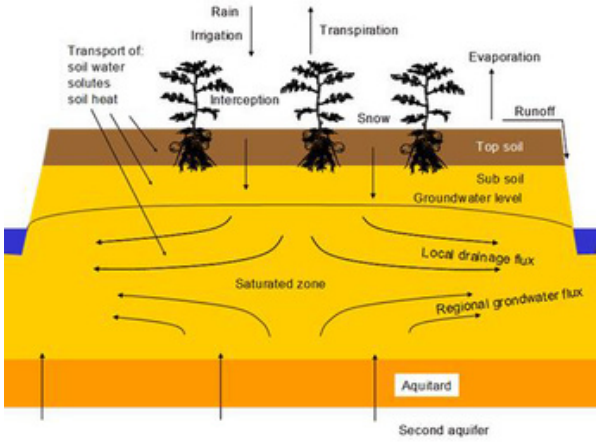
How does water availability determine vegetation cover?

How can water productivity be increased?

Which feedbacks are present between plants and evaporation?

When does irrigation lead to salinisation?

Ecohydrology activities



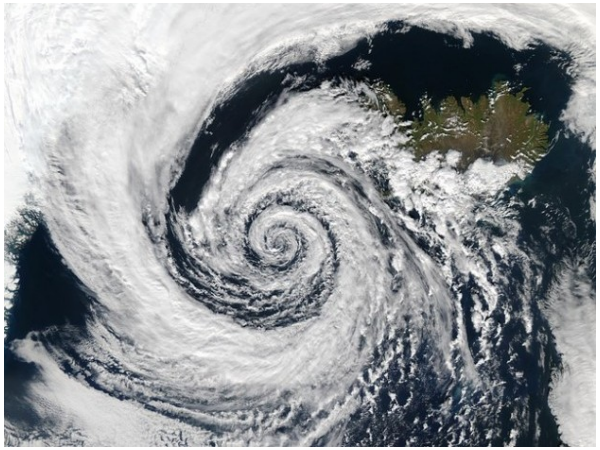
Modelling flow and transport in saturated and unsaturated zone.

Comparing soil moisture measurement techniques.

Linking vegetation type to soil wetness.

Recognising vegetation patterns and their causes. ▸ link

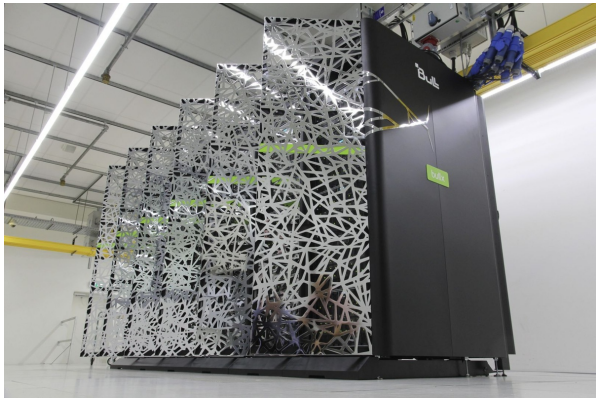
Water and Air Flow: Numerical Techniques



What do water and air flow equations have in common?

How do you translate reality into differential flow equations?

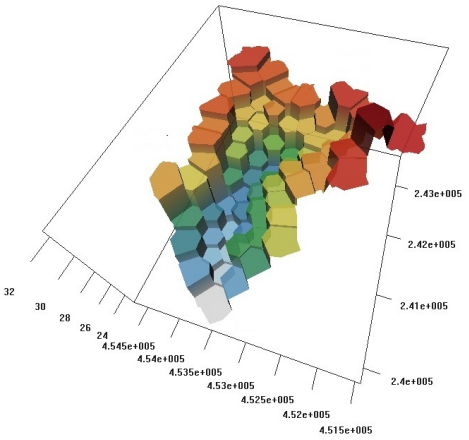
Which boundary conditions apply in rivers and groundwater?



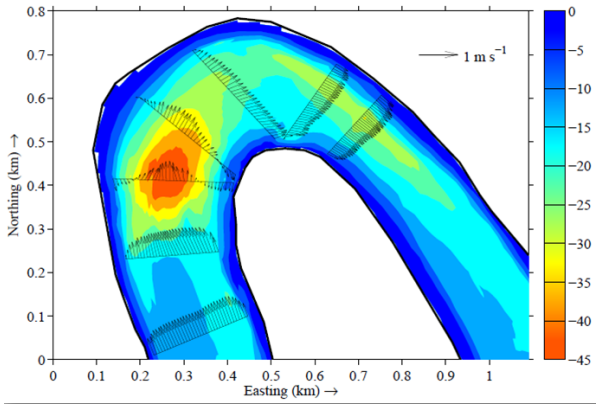
How does KNMI's supercomputer solve flow equations numerically?

Water and Air Flow: Numerical Techniques

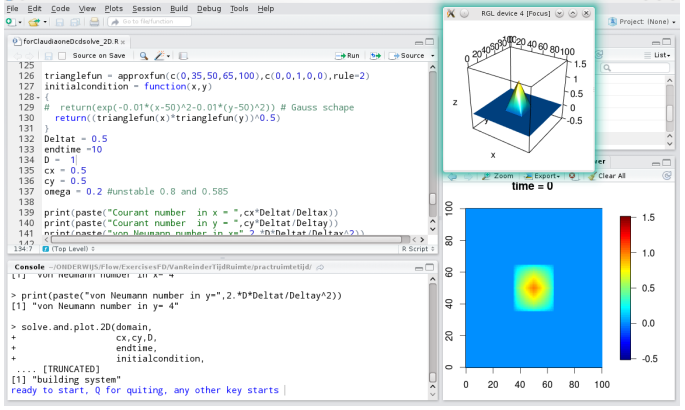
Computing backwaters caused by structures.



Building a groundwater model with finite volumes.



Dividing a continuous medium into discrete elements.



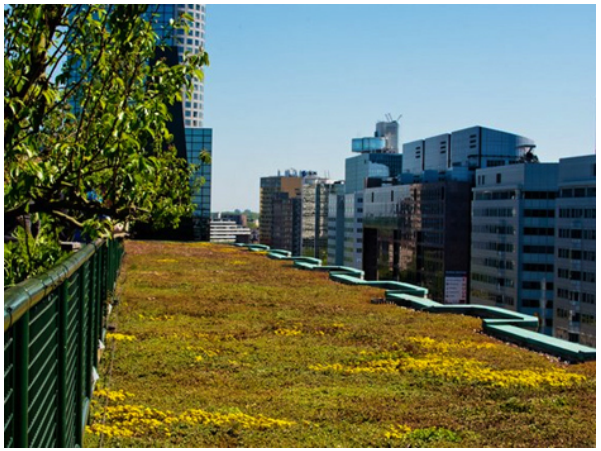
Programming diffusion equations for atmospheric applications.

questions

How variable in space and time is rainfall in cities?

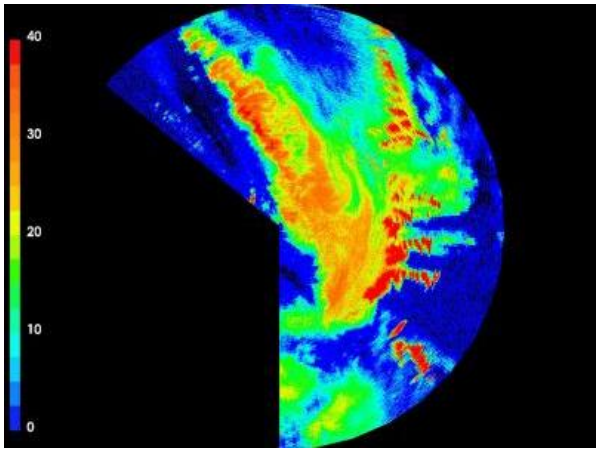
Why is the urban heat island effect relevant?

How are urban drainage systems designed?



What do inhabitants do to improve the urban microclimate?

Urban Hydrometeorology activities



Using advanced rainfall measurement techniques.

Excursion to cities to view urban challenges and solutions.

Analysing data from the green roof on the NIOO building.

Reviewing urban water management projects.

Catchment Hydrology

questions

How does vegetation alter the response of discharge to rainfall?

How do snow and ice affect runoff processes?

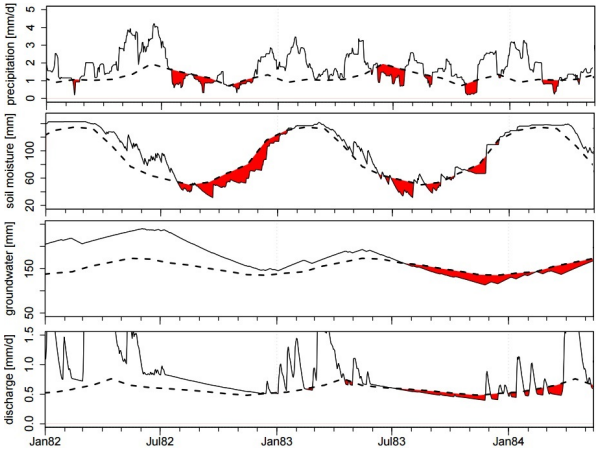
What causes flash floods?

▸ video

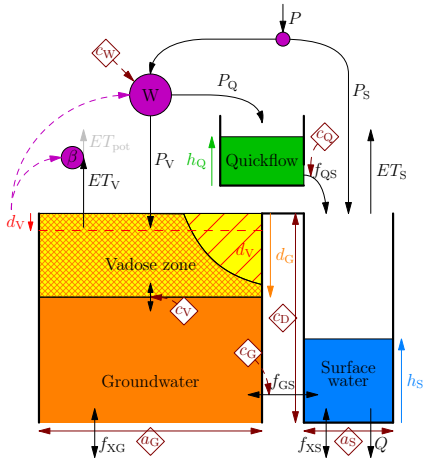
What is the relation between water scarcity and drought? ▸ link

Catchment Hydrology

activities



Analysing drought propagation through the hydrological cycle.



Flood forecasting using rainfall-runoff models.

Literature review and poster presentations

Excursion to Iceland.

▸ video

River Flow and Morphology

questions

What is the effect of bed shape on river flow?

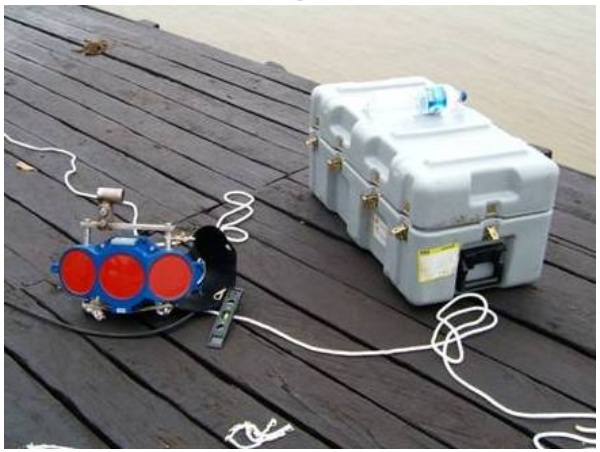
Why and how do sediment particles jump or roll? ▸ video

How fast do flood waves move downstream?

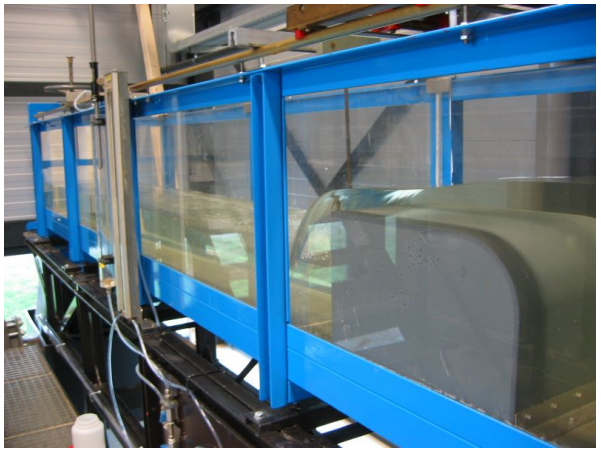
Where do erosion and deposition occur?

River Flow and Morphology activities

Computing rise and fall of water levels during flood peaks.



Analysing data from advanced flow velocity measurements.



Lab practicals.

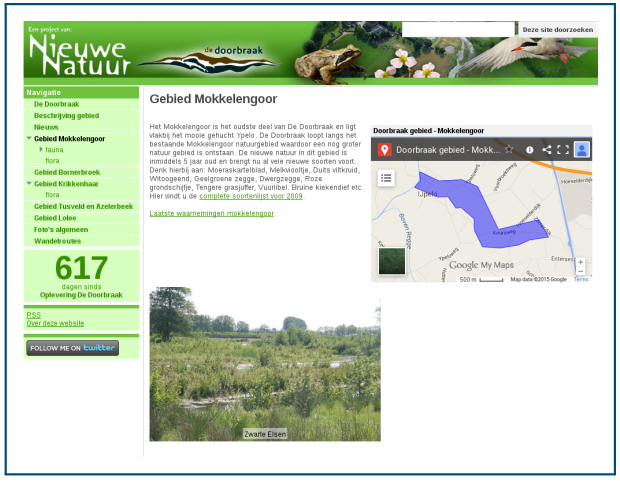
video

Predicting which bed structures appear under given conditions.

Which groundwater-surface water feedbacks occur along streams?

How does stream restoration affect the hydrology upstream?

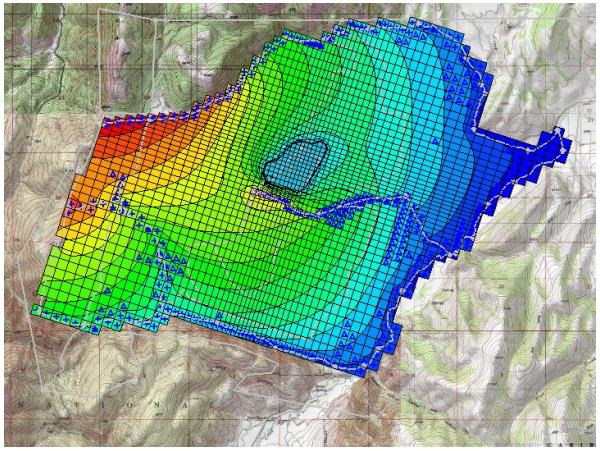
How do people change groundwater flow patterns?



On what information do water managers base decisions?

Advanced Hydrological Systems Analysis

Processing GIS datasets for modelling purposes.



Modelling groundwater flow in MODFLOW. ▸ link

Computing groundwater table drop caused by pumping.

Designing management strategies for water level control.

Other courses

- MSc courses from other MEE specializations
- BSc courses from Soil, Water and Atmosphere
  - Hydrogeology (1mo)
  - Geophysical Fluid Mechanics (2af)
  - Subsurface Solute Transport (5mo)
  - Field Practical Hydrology, Water Quality and Meteorology (6-1)
- MSc courses from other programmes
  - Geo-Information Science
  - Climate Studies
  - International Land and Water Management
  - Environmental Sciences
- Other universities
  - Netherlands (e.g. oceanography courses at Utrecht Univ., environmental fluid mechanics courses at TU Delft)
  - Abroad (Erasmus)

For inquisitive students

- Attend presentations at HWM and SLM
  (staff, visiting researchers, thesis colloquia,
  internship colloquia, thesis proposal presentations)
- Massive Open Online Courses
  - Coursera
  - Edx
  - Datacamp
- Capita Selecta for individual study or small research project
- "Further reading" after courses
  (search literature yourself or ask lecturer)
- Help teaching courses (student assistant)

What to do in June?

- Additional MEE courses
  - Field Training Land-Atmosphere Interactions
  - Field Training Geosciences
  - Practical Aquatic Ecology and Water Quality
  - Plant, Vegetation and Systems Ecology
- Start with thesis / internship
- Capita Selecta (Runoff Prediction in Ungauged Basins)

1	2	3	4	5	6
ITEE	HGD	WANT	UHM	CH	AHSA
EDCA	EH			RFM	

Tricks to increase flexibility in scheduling

- Start with thesis and, during one period, divide your time between a course (for example ACT) and thesis
- Move summer holidays to work on thesis / internship
- Consider Research Master Cluster instead of Academic Consultancy Training

1	2	3	4	5	6
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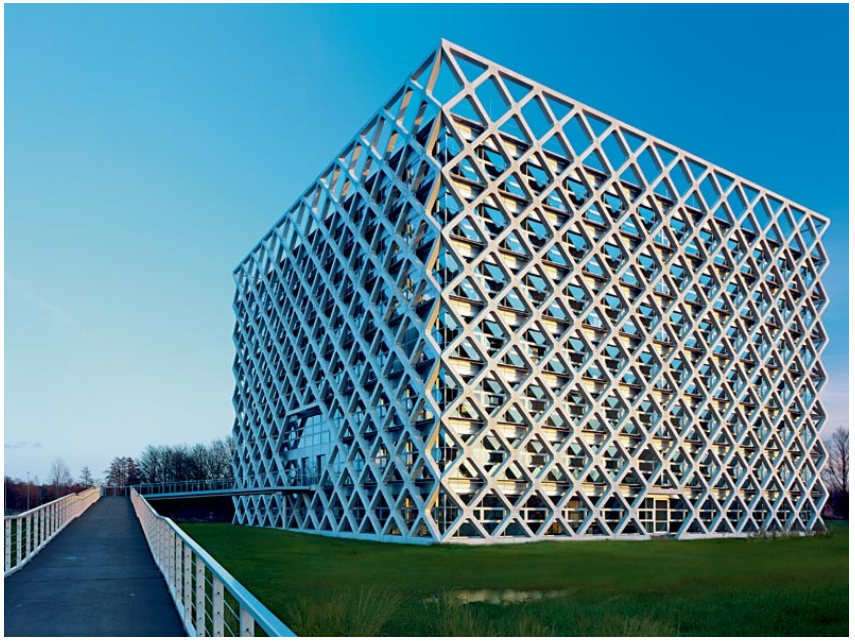
Chair groups in specialization A

Hydrology and Quantitative Water Management Group (HWM)

Lumen, 1st floor

▸ www.hwm.wur.nl

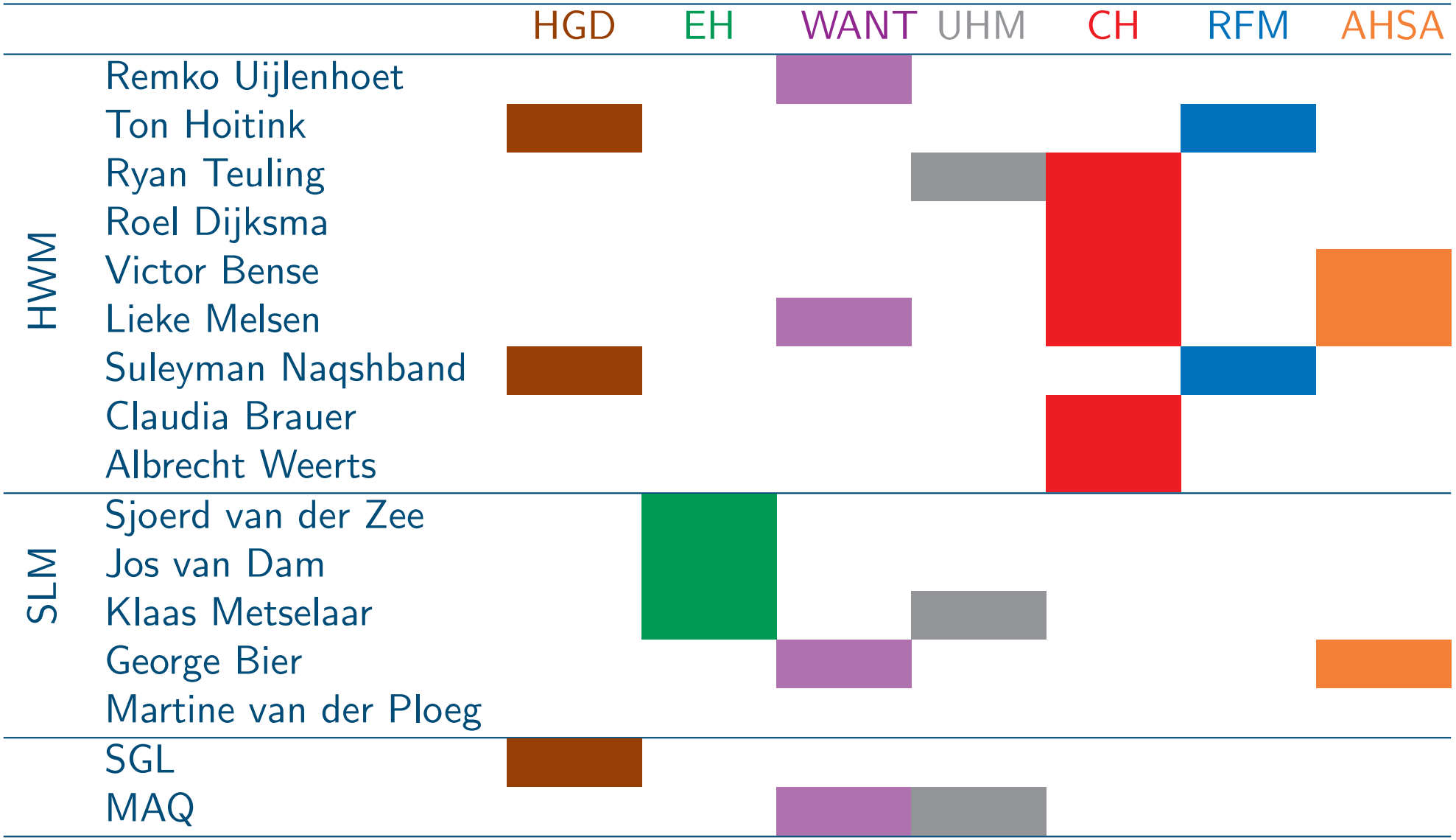
Soil Physics and Land Management Group (SLM)



Atlas, 4th floor

▸ www.slm.wur.nl

Who teaches which MEE specialization course?



Thesis vs. internship

	Thesis	Internship
Duration	6 months	4 months
Topic	Linked to current research at chair group	Linked to projects of internship provider
Location	In principle at HWM/SLM	At internship provider
Activities	Scientific research project	Assignment at academic level
Supervisors	• HWM or/and SLM • HWM/SLM + other group (SGL/MAQ/NCP/AEW) • HWM/SLM + research institute (KNMI, Deltares) • HWM/SLM + foreign university	• Engineering and consultancy firm • Water board • Government and research institute (Alterra, Deltares, KNMI, KWR, RIVM, NIOZ, Rijkswaterstaat) • Foreign university and research institute

Arranging theses and internships

		SLM	HWM
Coordinators:	thesis	Klaas Metselaar	Roel Dijksma
	internship	Jos van Dam	Victor Bense

Prerequisites:

- SLM thesis: depends on topic
- HWM thesis: at least Catchment Hydrology or Hydrogeology or Geophysical Fluid Mechanics, and depending on topic.

Choices:

- Which chair group?
- Thesis or internship first?
- Going abroad?
- Research or engineering oriented?

All procedures for HWM are described in the information document ▸ download

Summary

Some characteristics of the Hydrology and Water Resources specialization:

- Topics: interactions between surface water, groundwater, vegetation, soil and atmosphere.
- Skills: focus on quantitative analyses, in the field and behind the computer.
- Future: good connections to (inter)national research communities or water management practice.