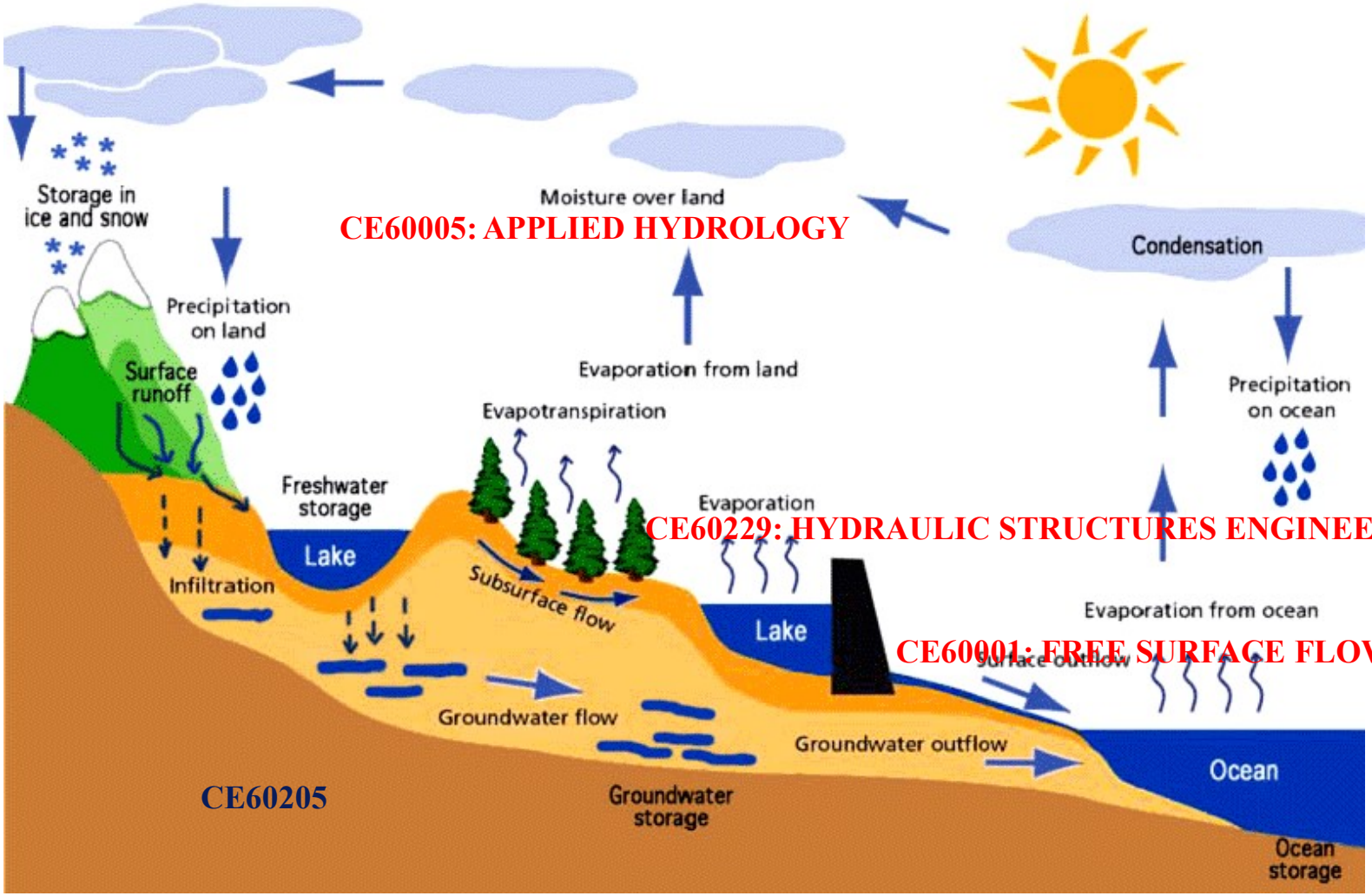
Overview

Groundwater Engineering| CE60205 Lecture:00

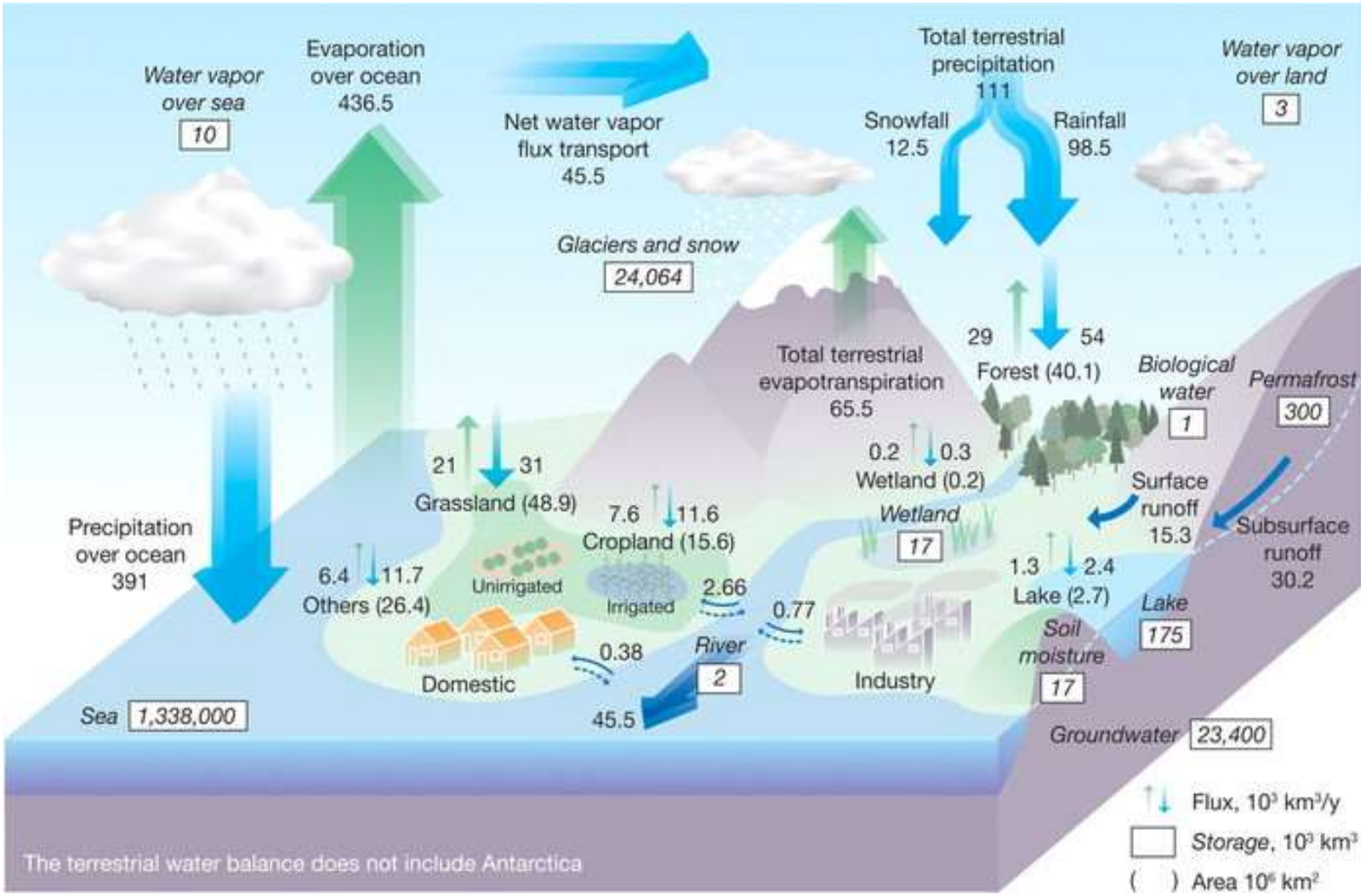
Learning Objective

To understand the importance of groundwater

The Hydrologic Cycle



Residence Time



Global Hydrological Cycles and World Water Resources, Volume: 313, Issue: 5790, Pages: 1068-1072, DOI: (10.1126/science.1128845)

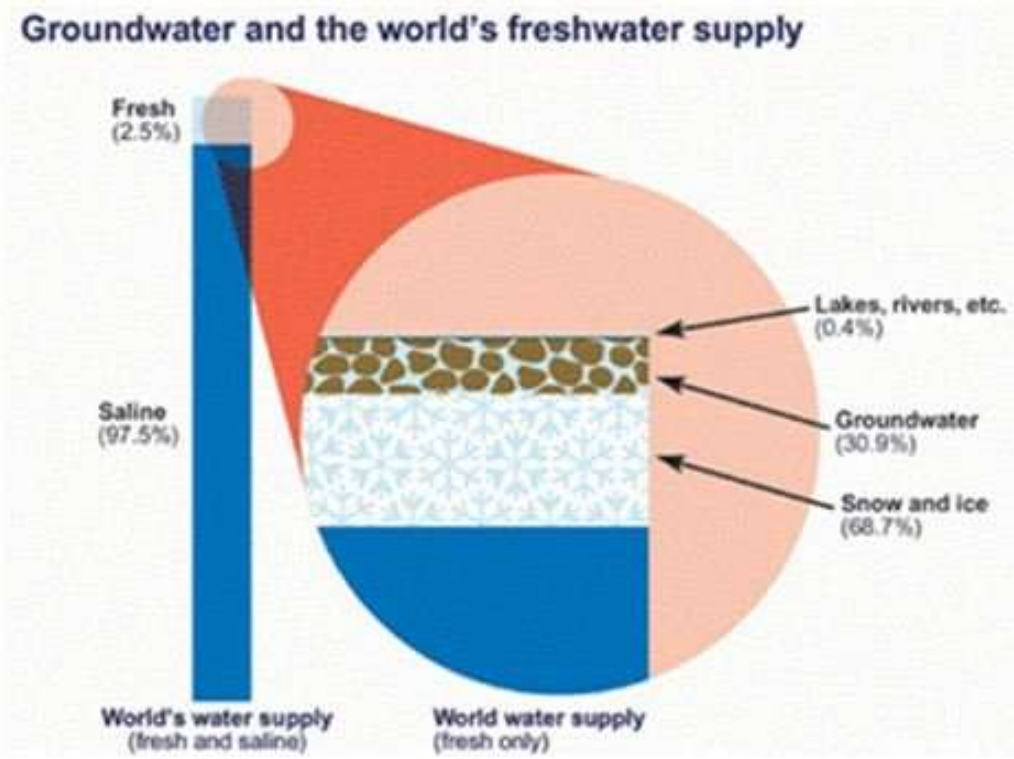
Basics

- Geology:

- Hydraulics & Hydrology:

Groundwater Hydraulics

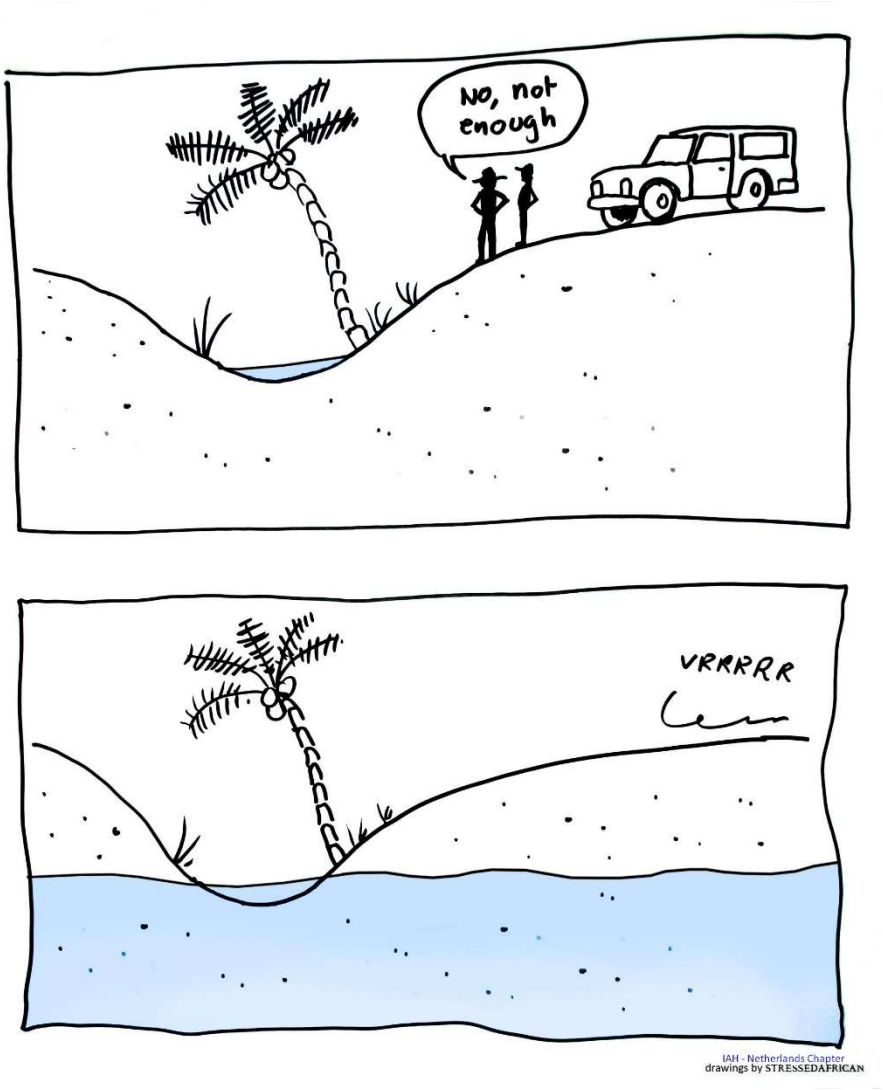
- ***Groundwater Hydraulics*** *is the part of hydraulics that deals with the occurrence, movement and quality of* ***water beneath the Earth's surface****.*
- Provide tools to deal with groundwater flow problems.
- Provides mathematical statement of the flow problem



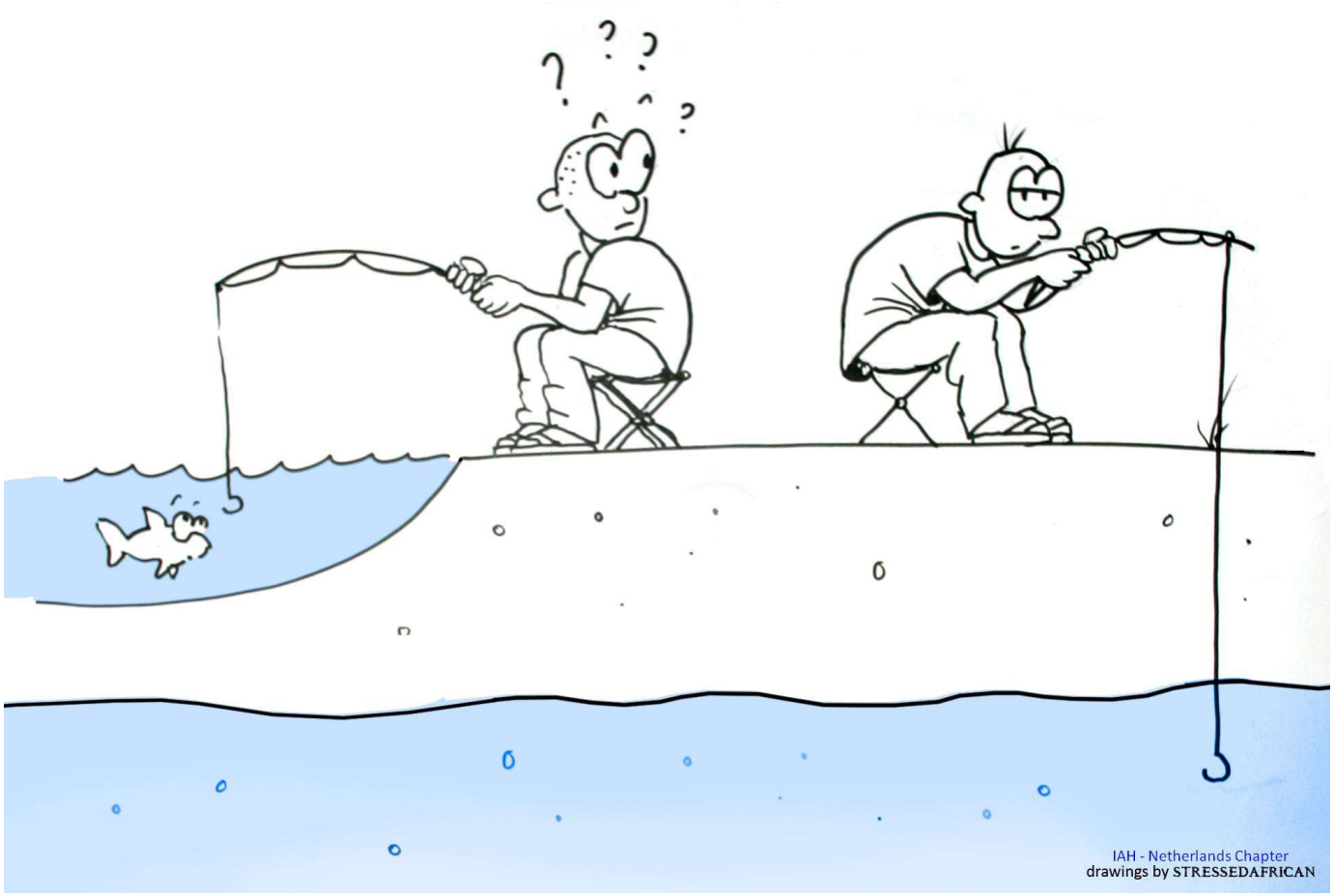
Differences between Groundwater Engineering and

- Groundwater Hydraulics
- Groundwater Hydrology
- Hydrogeology
- Geohydrology
- Geological Fluid Dynamics

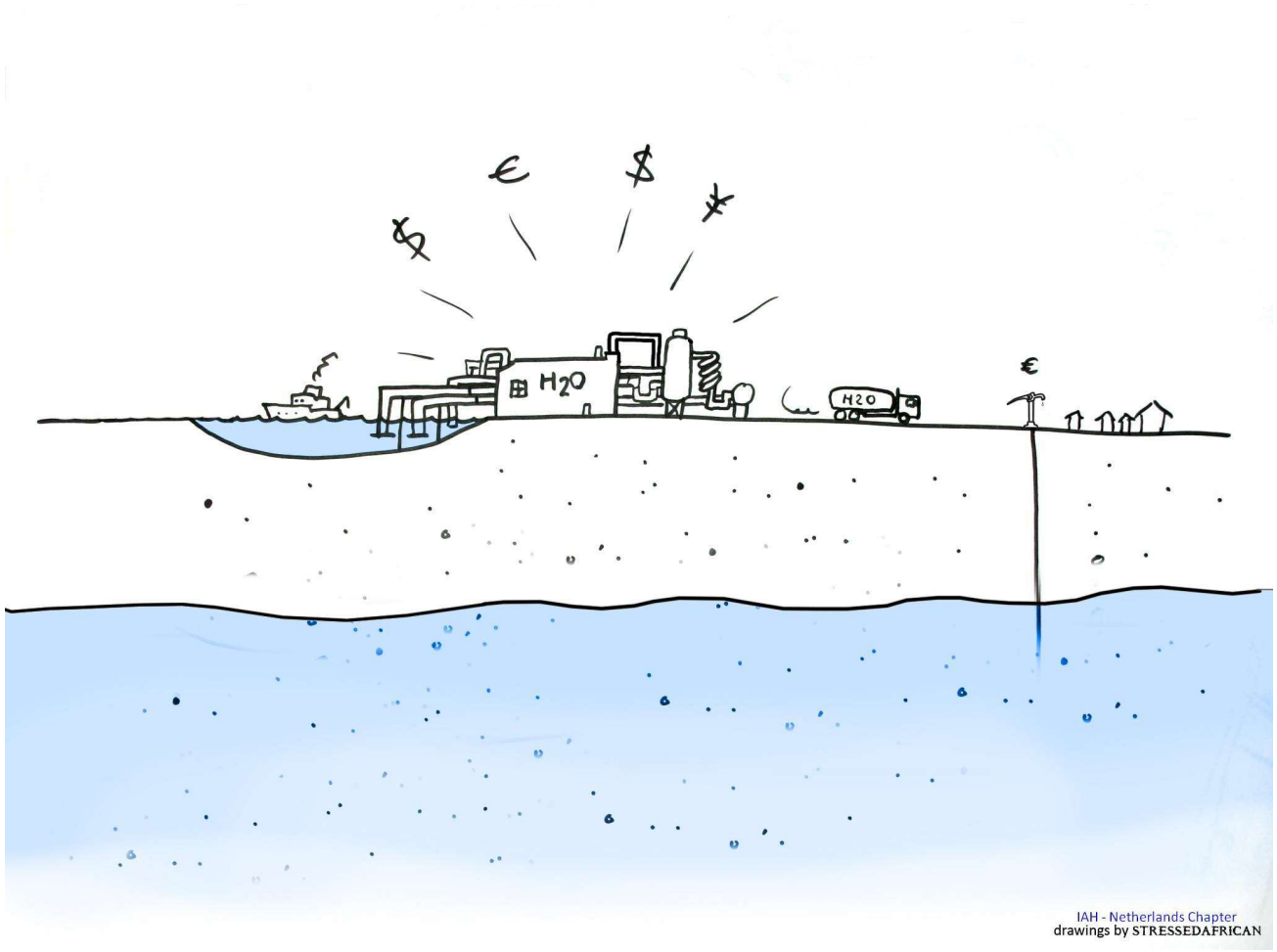
Groundwater: the hidden resource



Groundwater: not a lake under the ground

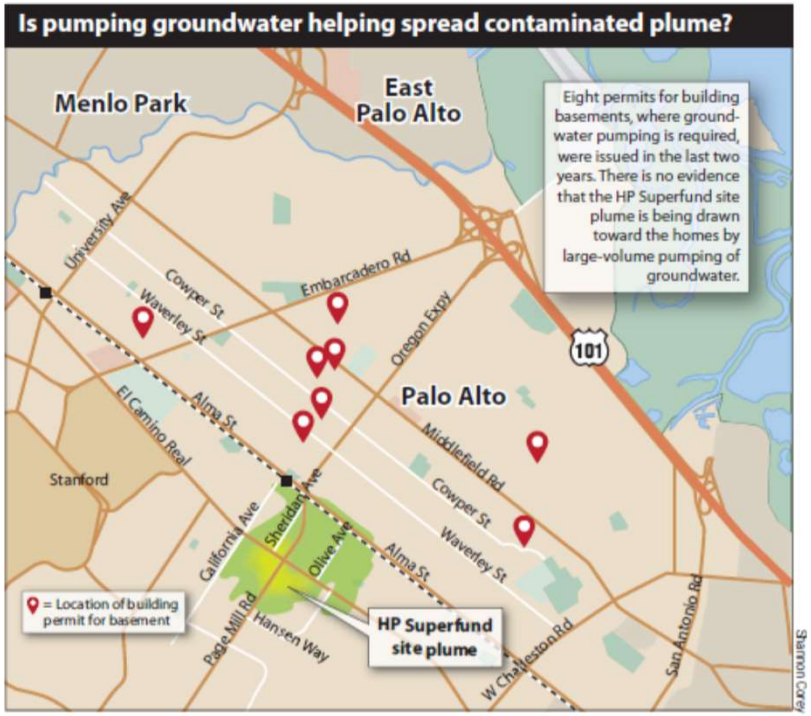


Groundwater: a inexpensive source of reliable water



Groundwater Engineering deals with

- Consumption (water for domestic and industrial use, irrigation ….)
- Pollution - Contamination - Remediation
- Geotechnical Applications
- Energy: Hydro-Geothermal Applications
- Mining



Questions

- **Where can I find groundwater in sufficient quantity and quality?** (groundwater exploration, groundwater development)
- **How much groundwater can be extracted at a certain location or from a certain aquifer?** (aquifer analysis, catchment deliniation, well head protection, sustainability)
- **How fast moves groundwater?** (water protection areas - well head protection)

Question (contd.)

- **How old is it?** (recharge, flow / seepage velocity, sustainabilty …)
- **Where does it go?** (contaminated site ⇒ affected area)
- **Where does it come from?** (drinking water supply, water protection area)
- **How is the quality of groundwater?** (drinking water, irrigation ..)

Business of Groundwater Engineering

- Groundwater supply
- Groundwater contamination

Syllabus

- Water in Subsurface Environment,
- Darcy's Law: Saturated Flow & Unsaturated Flow,
- Groundwater Flow Equation,
- Flow Equations and Analytical Solutions,
- Well Hydraulics,
- Mechanisms of Contaminant Transport in Aquifers,
- Mass Transport Equations,
- Transport Equations and Analytical Solutions,
- Transport of Immiscible Fluids,
- Groundwater Flow under a Temperature Gradient,
- Groundwater Surface Water Interaction Model,

Syllabus (contd.)

- Introduction to Modeling Fundamentals, Modelling Objectives and Conceptualization
- Mathematical Methods and Code Development: Finite Difference, Control Volume Finite Difference and Finite Volume,
- Design of Numerical Model: Model Dimensionality, Initial Condition and Boundary Conditions
- Design of Numerical Model: Spatial Discretization, Time Discretization, Hydrogeological Parameters, Hydrological Stresses (Sources and Sinks), Geostatistics,
- Data Requirement, Model Calibration, Validation and Testing (Prediction): Steady vs. Unsteady, Calibration Procedures,
- Standard Model Selection Criteria, Scenario Generation, Uncertainty Analysis, Capture Zone Analysis,
- Applied Flow Modeling,
- Applied Contaminant Transport Modeling,
- Particle Tracking,
- Regional Scale Flow and Transport,
- Groundwater Management

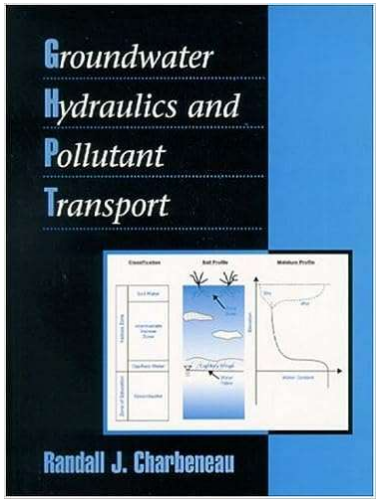
Evaluation Policy

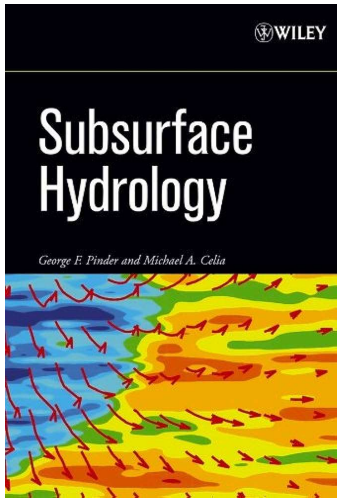
- **MID SEMESTER EXAMINATION: 30%**
- **END SEMESTER EXAMINATION: 50%**
- **CLASS PROJECT: 20%**

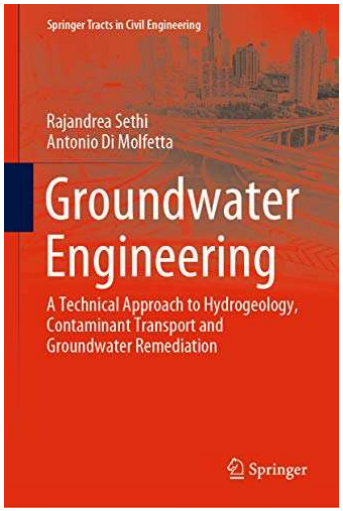
CLASS Website

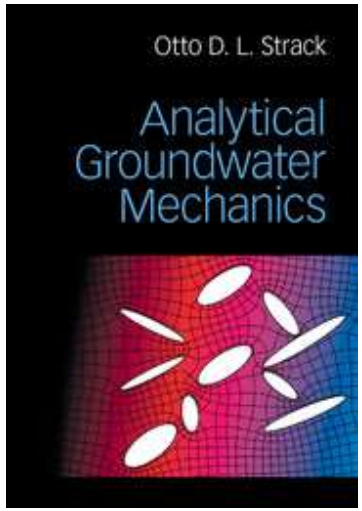
- Institute Moodle Server
- URL: http://kgpmoodlenew.iitkgp.ac.in/

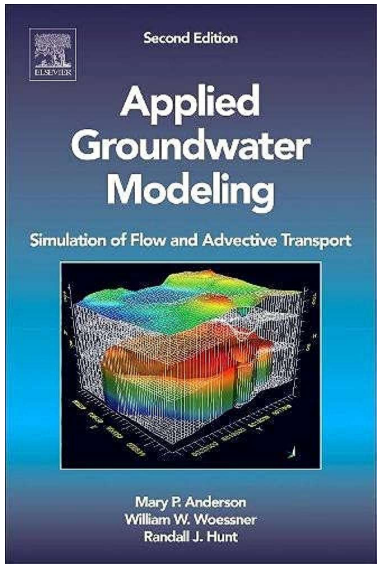
Text Books

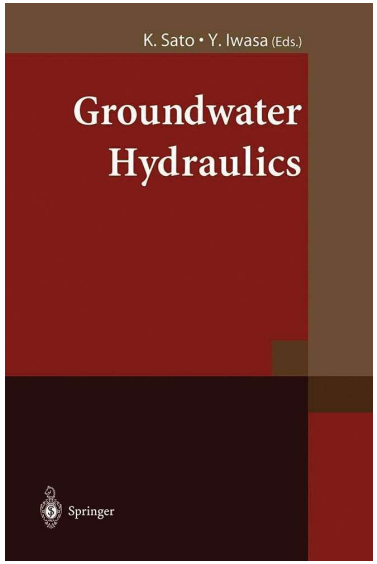

Groundwater
Hydraulics and
Pollutant
Transport
Randall J. Charbeneau

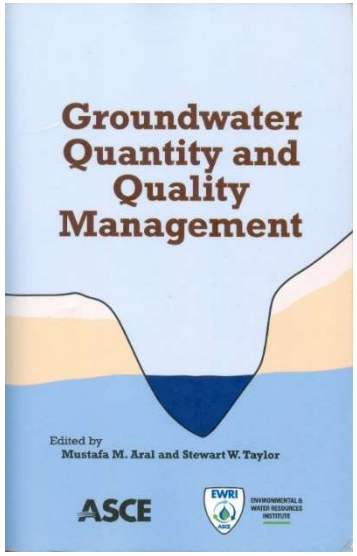

WILEY
Subsurface
Hydrology
George F. Pinder and Michael A. Celia

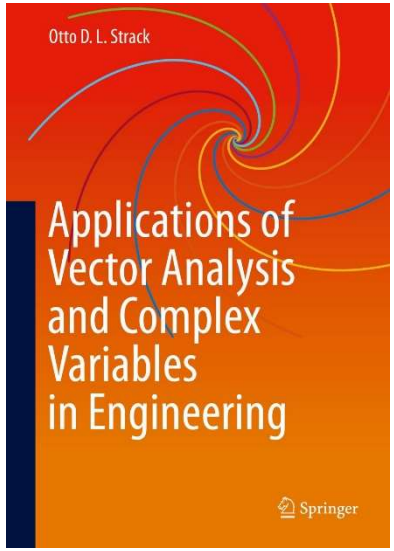

Springer Tracts in Civil Engineering
Rajandrea Sethi
Antonio Di Molfetta
Groundwater
Engineering
A Technical Approach to Hydrogeology,
Contaminant Transport and
Groundwater Remediation
Springer


Otto D. L. Strack
Analytical
Groundwater
Mechanics

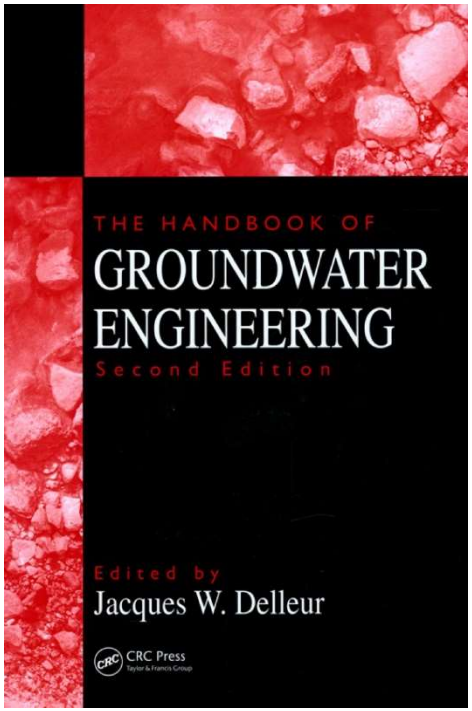

Second Edition
Applied
Groundwater
Modeling
Simulation of Flow and Advective Transport
Mary P. Anderson
William W. Woessner
Randall J. Hunt


K. Sato • Y. Iwasa (Eds.)
Groundwater
Hydraulics
Springer

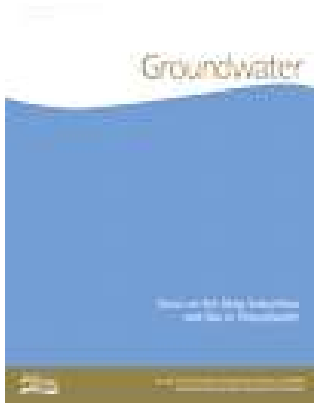

Groundwater
Quantity and
Quality
Management
Edited by
Mustafa M. Aral and Stewart W. Taylor
ASCE
EWRI

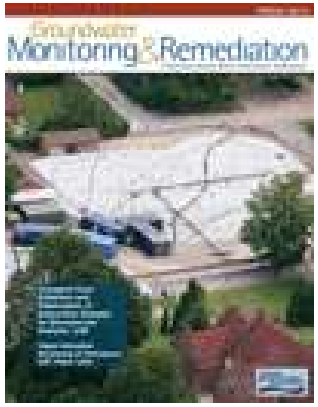

Otto D. L. Strack
Applications of
Vector Analysis
and Complex
Variables
in Engineering
Springer

Reference Book



Journals


Groundwater

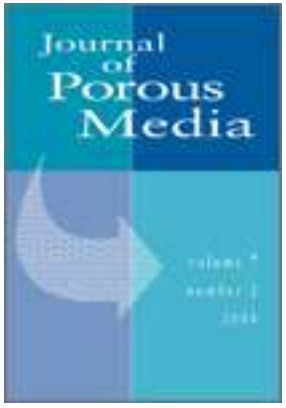

Groundwater
Monitoring & Remediation


CONTAMINANT
HYDROLOGY

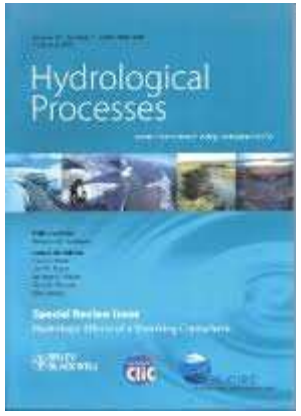

Advances
in Water
Resources


TRANSPORT IN
POROUS MEDIA
TIPM


ASCE
Journal of
Water Resources
Planning and
Management


Journal
of
Porous
Media

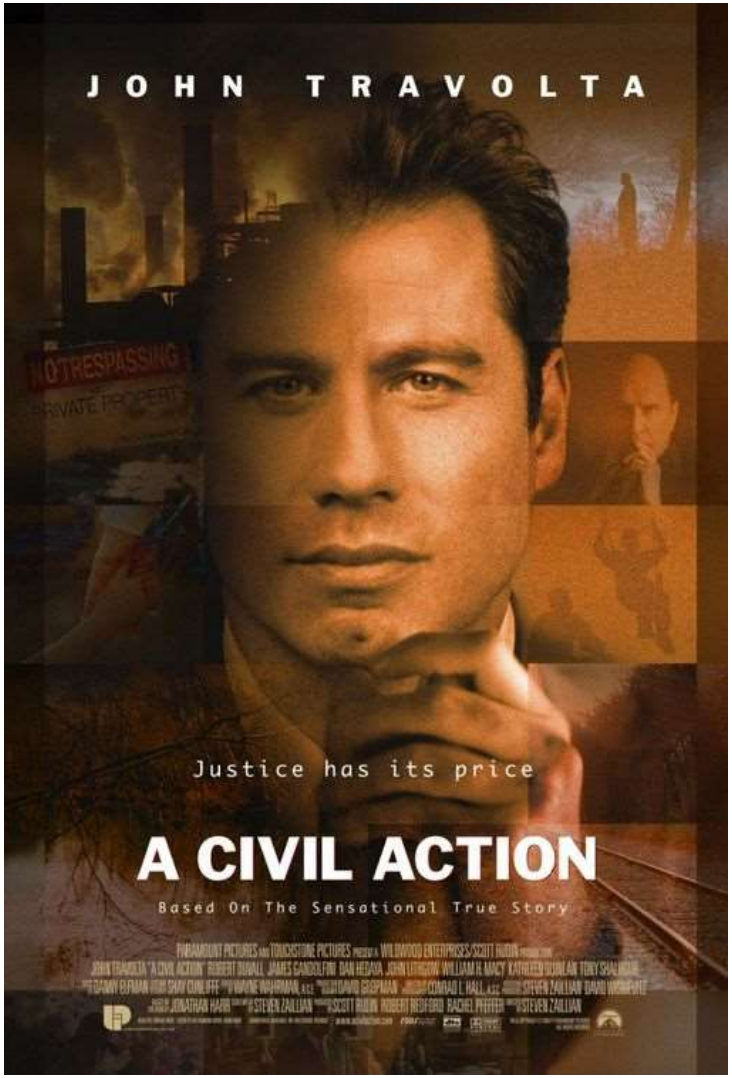

JOURNAL OF
HYDROLOGY


Hydrological
Processes

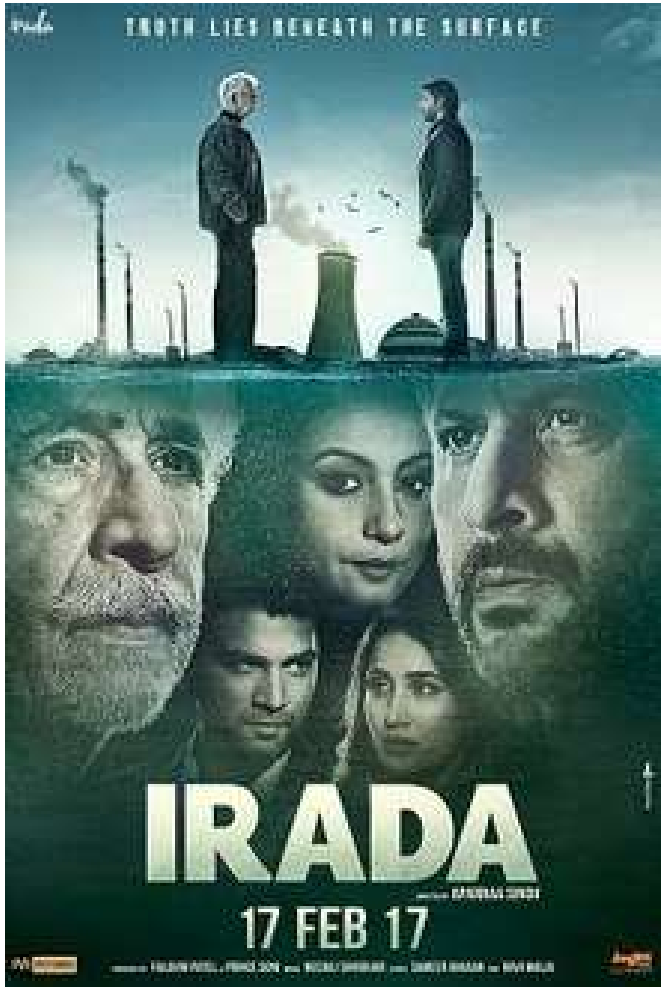

ASCE
Journal of
Hydrologic
Engineering

Movies


She brought a
small town to its feet
and a huge company
to its knees.
Julia Roberts is Erin Brockovich
Based on a true story.


JOHN TRAVOLTA
NO TRESPASSING
Justice has its price
A CIVIL ACTION
Based On The Sensational True Story

Movies


TRUTH LIES BENEATH THE SURFACE
IRADA
17 FEB 17


DARI STUDIO YANG MENGHADIRKAN
GREEN BOOK & SPOTLIGHT
A TODD HAYNES FILM
DARK WATERS
MARK RUFFALO
ANNE HATHAWAY
TIM ROBBINS
BILL CAMP
VICTOR GARBER
AND BILL PULLMAN
NOVEMBER
SCREENPLAY BY MARIO CORREA AND MATTHEW MICHAEL CARNAHAN DIRECTED BY TODD HAYNES

Thank you