Course outline, VVRN05 Advanced Hydrology 2013

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Objectives: The student should obtain an understanding of the physics behind the hydrological processes, be able to use theoretical approaches on real data, read scientific literature and put it into a context.

Requirements: For a pass the student should be able with deep understanding to explain how water is stored and moves in nature. The student should be able to approach hydrological problems of complex character and critically analyze them relying on findings from the literature and on theoretical evaluations. The problem analysis should be presented in a clear scientific way orally and in writing.

To pass the course, one assignment (including an oral presentation) and a written examination have to be passed, see details below.

Contents: Cold climate hydrology, climatology, evapotranspiration, soil moisture, hillslope and basin runoff processes, urban hydrology, extreme events.

Literature: Journal papers (from the web or protected homepage for the course), handouts, W. Brutsaert: Hydrology, An Introduction, Cambridge Press 2005 (handouts and journal papers are sufficient). Exercises are found on the home page.

Teachers
MP Magnus Persson       JS Johanna Sörensen
LB Lars Bengtsson       KF Kean Foster
CU Cintia Uvo          LZ Linus Zhang

Deadlines: The assignment should be handed in December 3. The assignments will be graded (3-5). Assignments handed in after the deadline cannot get a higher grade than 3.

Examination 17 Dec 8.00-13.00 (V:N1, N2)

The exam and the assignment are graded (3-5). The final grade is calculated as; written exam, 75 %, and assignment (including oral presentation) 25 % of the final grade.

Exam examples are found on the home page of the course
Individual essays (you can choose other topic yourself) (contact suggested supervisor to discuss and email MP when topic has been chosen)

Two options, literature review or critical analysis of news article

1. Literature review (maximum 5 pages (strict!) excluding the required cover page, table of contents and scientific references, oral presentation)

   Suggested topics:
   1. Glaciers of the world and climate change (CU).
   2. Glacier dynamics (LB)
   3. Climate variability and its effect in different parts of the world (CU).
   4. Proxim for determining pre-historic climate (CU).
   5. Ongoing rising of the land in northern Sweden and Finland and consequences on bays and the living near the coast (LB).
   6. Increasing of snow and ice melt (LB).
   7. Snow distribution and melt in/from large river basins (LB).
   8. Trends of ice covered period and ice thickness (LB).
   10. Albedo of snow, ice, water and vegetation and its variation in time and with solar angle (LB).
   11. Permafrost and hydrology (LB):
   12. Irrigation methods (MP).
   13. The Dead Sea in a historical perspective (LB).
   14. Major flood events in Europe in a 1000 year perspective (LB).
   15. Different types of wetlands (LB).
   16. Lake classification based on origin, water balance, nutrients (LB)
   17. Terminal lakes (LB).
   18. Agricultural rain water harvesting (MP).
   19. Antarctic lakes (LB).
   20. The Yellow river – hydrology, utilization, problems (LZ).
   22. Real time river flow forecasting (LB).
   23. Comparison of different evaporation models (MP)
   24. Long term trends in evaporation (global dimming) (MP)
   25. Factors that influence the resistance to transpiration (MP)
   26. Groundwater recharge in arid areas (MP)
   27. Macroporosity and agriculture (MP)
   28. Flood protection (Magnus Larson)

2. Critical analysis of news article (maximum 5 pages (strict!), oral presentation)

   Find a news article (in a newspaper or on the internet) about hydrology. Write a critical review, putting the article in the correct context. Include calculations to show that the figures in the article are correct (or incorrect). The article needs to be in an appendix, if the original article is written in another language, an English translation should also be provided.
Schedule

Lecture 1  O2, 29 Oct 13-15  Evapotranspiration (MP)
Course introduction. Energy balance, potential and actual evaporation, transpiration, different
equations, Monin-Obukov theory, stomata resistance, evapotranspiration from different kinds of
vegetation, influence of interception.
Lit: lecture notes, Brutsaert.

Lecture 2  O2, 30 Oct 8-10  Subsurface hydrology 1 (MP)
Soil physics, pF and Richards equation.
Lit: lecture notes, Tindal and Kunkel.

Lecture 3  O2, 31 Oct 10-12  Subsurface hydrology 2 (MP)
Preferential flow, solute transport.

Lecture 4  E1147,1149, 5 Nov 13-15  Subsurface hydrology 3 (MP)
Soil water measurement techniques, modeling.

Lecture 5  O2, 6 Nov 8-10  Tutorial
Soil and evaporation examples

Lecture 6  O2, 7 Nov 10-12  Cold climate 1 (MP)
Importance of snow on the hydrology, snow properties, metamorphism, snow distribution, energy
balance, simple snow modeling.
Lit: Lecture notes, Journal papers on Energy balance (Snow NH76), and scales (Snowscale
NH2000).

Lecture 7  P2, 12 Nov 13-15  Cold climate 2 (MP)
Water movement through snow, thermal properties, melt water refreezing in snow.
Lit: UnescoSnow 1 and 2.

Lecture 8  O2, 14 Nov 10-12  Runoff processes (MP)
Hillslope processes, hillslope – river basin relation, origin of stream water, kinematic wave
approach, particle movement age of water.
Lit: Lecture notes

Lecture 9  O2, 19 Nov 13-15  River basin management (LZ)
River basin management
Lit: IntRiverBasinMan.
Lecture 10  O2, 20 Nov 8-10   Tutorial
Cold climate and runoff examples

Lecture 11  O2, 21 Nov 10-12   Lakes 1 (LB)
River routing, series of reservoirs, flooded areas, lake water balance.
Lit: see below.

Lecture 12  O2, 26 Nov 13-15   Lakes 2 (LB)
Energy balance lakes, water temperature, ice growth, real time forecasting.
Lit: Lakes (Bengtsson course on Lake Hydrology), Lakes (EncycI text book Circulation, Thermal regime, Water balance, Thermal bar) Lake heat balance (example hand written), Lake Poopo (journal paper terminal lake), Lake water balance (excel lake routing, but water balance better on Lakes), Ice covered lakes (journal paper mixing), Ice(EncycI; two parts Ice formation and general about Ice covered lakes), ThermalIceLake (Enc. Text book heat balance under ice)

Lecture 13  O2, 27 Nov 8-10   Elements of meteorology (CU)
Climate of the world, circulation pattern, NAO, ENSO.
Lit: lecture notes, Brutsaert.

Lecture 14  O2, 28 Nov 10-12   Extreme events (CU)
Flood risk and mitigation, extreme value analysis

Lecture 15  R1, 3 Dec 13-15   Urban hydrology (JS)
Alternative storm handling methods, green roofs, rain water harvesting.
Lit: lecture notes

Lecture 16  O2, 4 Dec 8-10   Essay presentations (6 * 15 min incl discussion)

Lecture 17  O2, 5 Dec 10-12   Linking climatology to hydrology (KF)
Lit: lecture notes

Lecture 18  O2, 9 Dec 8-10   Essay presentations (6 * 15 min incl discussion)

Lecture 19  O2, 10 Dec 13-15   Essay presentations (6 * 15 min incl discussion)

Lecture 20  O2, 11 Dec 8-10   Tutorial
Examples from old exams, lakes, urban hydrology

Lecture 21  O2, 12 Dec 10-12   Essay presentations (6 * 15 min incl discussion)

Exam   V:N1, N2, 17 Dec 8-13   Exam