



Northern areas are facing rapid warming due to climate change, which is leading to complex changes in the natural environment and societies. Shift in thermal regime has drastic impacts in cold climate hydrological cycle changing water availability and quality. These changes are important to understand as they assign boundary conditions for social and economic development. In addition to direct human impacts, expected changes in hydrological processes will affect carbon and nitrate cycles, ecological communities, geochemistry and microbiological activity in Northern natural environment.

Northern hydrology – research methods and foreseen changes is a PhD short course arranged in collaboration between the universities of Oulu, Aalto, Turku and Helsinki, Finnish Environment institute (SYKE) and Northern research institute (NORUT), Norway.

Short course will be held in University of Oulu, Finland 1 – 3 December, 2015. Course will link multidisciplinary Northern and Arctic research and cover hydrological processes in the North. The processes strongly relate to the fields of hydrogeology, geochemistry, agricultural sciences, forest sciences, geography, remote sensing, ecology and civil engineering.

Target audience for course is multidisciplinary doctoral students in environmental sciences, whose research activities are related to Northern latitudes. Students will be introduced the key hydrological processes in cold climates. The course will tie the gap between theoretical concepts and practical applications by introducing state-of-the-art research methods and demonstrate use of available databases. Building on these learning outcomes, students will have the tools to understand expected hydrological changes in the future, which are relevant for their individual research topic.

The course is free and open for all PhD-students. The course includes field excursion/site visit.

Course capacity: Maximum of 30 students.

Send in your registration to the course to hannu.marttila@oulu.fi no later than **October 1, 2015**.

Organization committee:
Dr. Hannu Marttila (coordinator)
Prof. Bjørn Kløve
Dr. Anna-Kaisa Ronkanen
Dr. Pekka M. Rossi



OULUN YLIOPISTO
UNIVERSITY of OULU

PRELIMINARY CONTENT OF THE COURSE

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| Tuesday 1 Dec 2015 | DAY 1: FIELD EXCURSION TO ROKUA OR SYÖTE |
| bus transportation (8-10) | Organizers and students give a 1 min introduction who they are and why are they on the bus |
| morning (10-12) NORTHERN HYDROLOGY (UOULU, UTU, UHEL) | Introducing the special concepts of northern hydrology (snow, ice, soil freeze/thaw) and related measurement techniques. Lecture topics are already covered by pre-assignments. |
| Lunch | |
| afternoon (13-17) FIELD WORK (UOULU, UTU) | Applying field methods in practice in groups of 4-5 students. Each group gets a task (water sampling, snow sampling, SWE measurement, streamflow measurement, soil frost depth measurement, etc.) |
| Course Dinner | |
| evening (19-20) MINISEMINAR | each group of (4-5) students presents a method in northern hydrology they applied in the field |
| Ride home (at Oulu ~22) | |
| Wednesday 2 Dec 2015 | DAY 2: UPCOMING METHODOLOGIES |
| morning (9-12) REMOTE SENSING (UHEL, SYKE, NORUT) | <ul style="list-style-type: none"> - Hydrologically relevant data that can be acquired using remote sensing <ul style="list-style-type: none"> o Airborne techniques (drones and manned aircraft) to acquire hydrological data (UHEL) o Optical remote sensing techniques to map snow coverage and snow water equivalent (SYKE) o Microwave remote sensing techniques to map soil frost, soil moisture (NORUT) - All lectures include demonstrations of available remote sensing databases and means to process the data |
| Lunch | |
| afternoon (13-15) ISOTOPE HYDROLOGY (UOULU, UHEL) | <ul style="list-style-type: none"> - Theory of applying environmental isotopes - Examples on applications |
| afternoon (15-17) ISOTOPE HYDROLOGY (UOULU, UHEL) | <ul style="list-style-type: none"> - Demonstration on how to use PICARRO isotope analyser - HANDS-ON EXERCISE using isotope data |
| Thursday 3 Dec 2015 | DAY 3: HYDROLOGICAL MODELLING |
| morning (9-12) HYDROLOGICAL MODELING (UOULU, UAALTO) | <ul style="list-style-type: none"> - Basic concepts of hydrological modelling - Modelling of Northern hydrological processes <ul style="list-style-type: none"> o Simulating snow and soil freeze/thaw processes o Land drainage modelling o Modelling of hydrological response of different land- |
| Lunch | |
| afternoon (13-15) HYDROLOGICAL MODELING (UOULU, UAALTO) | <ul style="list-style-type: none"> - HANDS ON EXERCISE <ul style="list-style-type: none"> o familiarize students to hydrological modelling with computational software o different models and different datasets applied |
| afternoon (15-17) STUDENT PRESENTATIONS | <ul style="list-style-type: none"> - 3-5 students present their research topic and how it is related to Northern hydrology - other students are perform as opponents |

Course teachers:

University of Oulu (UOulu): Prof. Bjørn Kløve, Dr. Hannu Marttila, Dr. Anna-Kaisa Ronkanen, Dr. Pekka M. Rossi

Aalto University (UAALTO): Prof. Harri Koivusalo

University of Turku (UTU): Prof. Petteri Alho, Dr. Elina Kasvi

University of Helsinki (UHEL): Prof. Juha Karhu, Dr. Kirsti Korkka-Niemi

Finnish Environment Institute (SYKE): Dr. Sari Metsämäki

Northern research institute, Norway (NORUT): Dr. Corine Davis