

SEMINAR IN HYDROLOGY – ZHYDRO SEMINAR 2016

9 NOVEMBER 2016, ETH ZÜRICH, GEP-PAVILLON (MM C 78.1)

This year organized by ETH/USYS/ITES, Physics of Environmental Systems, contact: kirchner@ethz.ch

Time	Speaker	Title
09:00		Welcome and introduction
09:10	Jana von Freyberg (ETH Zürich, Physics of Environmental Systems)	A lab in the field: High-frequency analysis of water quality and stable isotopes in streamwater and precipitation
09:25	Márk Somogyvari (ETH Zürich, Engineering Geology)	Reconstruction of fracture network geometry using thermal tracer tomography
09:40	Manuela Brunner (Uni Zürich, Department of Geography)	Synthetic design hydrographs for Swiss catchments
10:10 – 10:45		Coffee break and posters
10:45	Siul Ruiz (ETH Zürich, Soil and Terrestrial Environmental Physics)	Modeling rates and energetics of soil bioturbation by earthworms and plant roots
11:00	Joaquin Jimenez-Martinez (ETH Zürich, Groundwater and Hydromechanics)	The unsaturated zone: water saturation impact on solute mixing and chemical reactions
11:15	Roberto Rusconi (ETH Zürich, Groundwater and Hydromechanics)	Effect of hydrodynamics on bacterial transport
11:30	Stan Schymanski (ETH Zürich, Soil and Terrestrial Environmental Physics)	Omissions in the Penman-Monteith equation affect leaf energy balance estimates and potential sensitivity to climate change
11:45	Adam Winstral (WSL, Mountain Hydrology and Mass Movements)	A multi-model approach to forecasting snowmelt during rain-on-snow events
12:15 – 13:30		Lunch and posters
13:30	Vincent Humphrey (ETH Zürich, IAC Land-Climate Dynamics)	Water storage from satellite gravimetry: recent advances and future challenges
13:45	Federica Remondi (ETH Zürich, Institute of Environmental Engineering)	Water transit time variability in time and space by fully distributed hydrology-transport modelling
14:15	Dirk Radny (Eawag, Dept. of Water Resources and Drinking Water)	Where does the water come from? Insights from a long-term pumping test in Basel
14:45 – 15:15		Coffee break and posters
15:15	Clément Roques (ETH Zürich, Engineering Geology)	Low flows in alpine systems: New insights from a year without snow in the Cascade Mountains of Oregon, USA
15:30	Sebastian Wolf (ETH Zürich, Physics of Environmental Systems)	Carbon-water interactions during warm spring and summer drought
15:45	Nadine Nicolai-Shaw (ETH Zürich, IAC Land-Climate Dynamics)	A satellite remote-sensing based analysis of soil moisture drought
16:00	Linda Schlemmer (ETH Zürich, Institute for Atmospheric and Climate Science)	A modified formulation for groundwater runoff in a regional climate model
16:30		Closure

SHORT TEASERS OF THE ORAL PRESENTATIONS:

09:10 Jana von Freyberg (*ETH Zürich, Physics of Environmental Systems*): **A lab in the field: High-frequency analysis of water quality and stable isotopes in streamwater and precipitation**

A newly developed instrument package enables on-line analysis of water isotopes and major ion chemistry at 30-minute frequency in the field. The resulting data streams are providing an unprecedented view of hydrochemical dynamics at the catchment scale.

9:25 Márk Somogyvári (*ETH Zürich, Engineering Geology*): **Reconstruction of fracture network geometry using thermal tracer tomography**

A novel inversion methodology has been developed to characterize the fracture geometry in hard rocks. Tracer tomography experiments are interpreted using the transdimensional reversible-jump Markov Chain Monte Carlo algorithm. The available statistical information (e.g. fracture intensity, fracture length distribution) on the fracture system is used within the inversion, to obtain more realistic results. The algorithm results in fracture probability maps, showing the most possible fracture locations where transport takes place.

09:40 Manuela Brunner (*Uni Zürich, Department of Geography*): **Synthetic design hydrographs for Swiss catchments**

Design floods for a given return period are required for the design of hydraulic structures and flood risk management. We present an approach which not only quantifies the peak discharge of the design flood, as it has been done traditionally, but also its flood volume and its hydrograph shape. We show how the uncertainty of such design floods can be assessed and how they can be regionalized to ungauged catchments.

10:45 Siul Ruiz (*ETH Zürich, Soil and Terrestrial Environmental Physics*): **Modeling rates and energetics of soil bioturbation by earthworms and plant roots**

Earthworms burrow into the soil at much higher rates than growing plant roots of similar geometry. We developed an analytic model based on cone-like penetration into a visco-elastic soil to test the energetic ramifications of these rates. The model was tested using cone penetrometers operating at rates of plant roots and earthworms (1 to 200 $\mu\text{m s}^{-1}$). Results suggest that earthworms spend up to three times the mechanical energy used by plant root for burrowing under similar soil conditions.

11:00 Joaquin Jimenez-Martinez (*ETH Zürich, Groundwater and Hydromechanics*): **The unsaturated zone: water saturation impact on solute mixing and chemical reactions**

In the unsaturated zone, water and air coexist in the pore space, which adds heterogeneity to the flow dynamics with respect to the fully saturated counterpart (aquifers) and can markedly affect transport processes. I will present recently developed microfluidics experiments and theoretical models used to identify and upscale pore-scale processes controlling solute mixing and chemical reactions in multiphase conditions.

11:15 Roberto Rusconi (*ETH Zürich, Groundwater and Hydromechanics*): **Effect of hydrodynamics on bacterial transport**

The vast majority of microorganisms experience fluid flow, whether turbulent flow in aquatic and industrial systems, or laminar flow in the human body and medical devices. In the absence of flow, motile bacteria explore their environment with random-walk swimming patterns, resulting in diffusive transport, but little is known about the effects of fluid motion on their navigation and spatial distribution. In this talk, I will present a novel phenomenon by which the coupling of flow with bacterial motility and morphology creates strong heterogeneity in the spatial distribution of bacteria by “trapping” them near the walls of a channel, thus increasing the likelihood of colonizing those areas. In addition, the topography of the surface can enhance bacterial attachment in specific regions, as shown by microfluidic experiments and numerical modelling of bacterial transport over regular and randomly corrugated boundaries. These results underscore the importance of fluid flow in bacterial transport under common environmental conditions, with significant consequences in a broad range of ecological, industrial, and medical problems.

11:30 Stan Schymanski (*ETH Zürich, Soil and Terrestrial Environmental Physics*): **Omissions in the Penman-Monteith equation affect leaf energy balance estimates and potential sensitivity to climate change**

Canopy gas and energy exchange is commonly represented by the Penman-Monteith (PM) equation. Experiments with artificial leaves in an insulated wind tunnel revealed omissions in the PM equation such as the neglect of two-sided exchange of sensible heat. We will explain the omissions and their correction, present supporting experimental results and discuss implications for climate projections.

11:45 Adam Winstral (*WSL, Mountain Hydrology and Mass Movements*): **A multi-model approach to forecasting snowmelt during rain-on-snow events**

Rain-on-snow events are capable of causing extensive damage and are expected to increase in prevalence, especially at higher elevations, as the climate warms. Timely and accurate forecasts, particularly those that also account for potential errors in the modeling system (i.e. ensemble forecasts), are imperative for ensuring human safety and preparing for future changes.

13:30 Vincent Humphrey (*ETH Zürich, IAC Land-Climate Dynamics*): **Water storage from satellite gravimetry: recent advances and future challenges**

This presentation will give an overview of recent progress in hydro-climatic applications of satellite gravimetry. These advances relate to new processing techniques, the contributions of ice melt and terrestrial water storage to sea level rise, the identification of large-scale droughts, and the assimilation of gravity observations in global hydrological models.

13:45 Federica Remondi (*ETH Zürich, Institute of Environmental Engineering*): **Water transit time variability in time and space by fully distributed hydrology-transport modelling**

A new fully distributed hydrochemical model allows to track the flow of multiple water parcels in their singular path towards the catchment outlet. This highlights major controls on the spatio-temporal variability of water transit time distributions.

14:15 Dirk Radny (*Eawag, Dept. of Water Resources and Drinking Water*): **Where does the water come from? Insights from a long-term pumping test in Basel**

Drinking water production in urban areas is highly vulnerable due to the variety of potential contamination pathways. Knowledge of the origin of the extracted groundwater is crucial. In the presentation we show results from a long term pumping test that was combined with a dye tracer test. The measures were conducted at a site, where artificial groundwater recharge is combined with drinking water production.

15:15 Clément Roques (*ETH Zürich, Engineering Geology*): **Low flows in alpine systems: New insights from a year without snow in the Cascade Mountains of Oregon, USA**

We examine stream flow recession in the Cascade Mountains of Oregon. A new method to compute the recession parameters is presented. The characteristic drainage timescales of the young volcanic systems were found to be 5x longer than the older watersheds. We demonstrate how the “maturity” of the landscape and its river network control such different hydrological behavior.

15:30 Sebastian Wolf (*ETH Zürich, Physics of Environmental Systems*): **Carbon-water interactions during warm spring and summer drought**

Warmer temperatures during spring and drought during summer are expected with climate change. In 2012, the United States experienced the most severe drought since the Dust Bowl period, along with the warmest spring on record. This talk presents the coupled impact of this climate anomaly on the biosphere–atmosphere exchange of carbon and water.

15:45 Nadine Nicolai-Shaw (*ETH Zürich, IAC Land-climate dynamics*): **A satellite remote-sensing based analysis of soil moisture drought**

Periods of extreme dry soil moisture conditions are first defined using remote-sensing based soil moisture. Next, anomalies in temperature, precipitation, evapotranspiration and vegetation activity surrounding these periods are quantified through composite analysis, helping us to understand drought development and drought impacts.

16:00 Linda Schlemmer (*ETH Zürich, Institute for Atmospheric and Climate Science*): **A modified formulation for groundwater runoff in a regional climate model**

We present a modified formulation for the groundwater runoff formation in the regional climate model COSMO-CLM (multi-layer soil model TERRA_ML). It is based on Darcy’s law, allows for saturated aquifers and includes a slope-dependent discharge. An implementation of this formulation into TERRA_ML is tested and validated both in idealized and real-case simulations and displays a physically meaningful recharge and discharge of the saturated zone. Decade-long climate simulations over Europe show an improved annual cycle of surface latent heat fluxes and as a consequence reductions of the long-standing bias in near-surface temperatures in semi-arid regions.