



# INXCES

Tone M. Muthanna (NTNU)  
NGU  
LTU  
HANZE  
UTCB

Water JPI  
WaterWorks2015 Cofunded Call  
8 May 2018, Larnaca

# Where are we going?

“The overall objectives of INXCES are to develop new innovative technological methods for risk assessment and mitigation of extreme hydroclimatic events. Further INXCES aims to optimize the urban water-dependent ecosystem services at the catchment level, for a spectrum of rainfall events. It is widely acknowledged that extreme events such as floods and droughts are an increasing challenge, particularly in urban areas.”

# The Inxces Team

- Guri Vennevik, Geological Survey of Norway (NGU)
- Floris Boogaard, Hanze University of Applied Science
- Maria Viklander, Luleå University of Technology
- Radu Gogu Constantin, the Technical University of Civil Engineering Bucharest
- Tone M. Muthanna, Norwegian University of Science and Technology



GEOLOGICAL  
SURVEY OF  
NORWAY  
- NGU -



TECHNICAL UNIVERSITY OF  
CIVIL ENGINEERING BUCHAREST



# INnovations for eXtreme Climatic eventS”

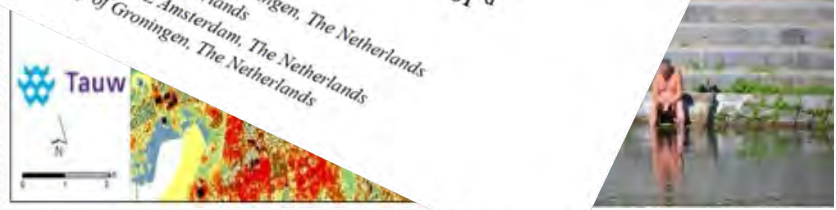
- -Scientific and technological progress
- -Collaboration, coordination and mobility
- -Stakeholder/industry engagement
- -Dissemination of the results
- -Identified problems or specific risks

# Scientific and technological progress

- (TS-1) Apply Quick-Scan selected urban areas in Bucharest, Romania.



ELSEVIER CrossMark Available online at [www.sciencedirect.com](http://www.sciencedirect.com)  
ScienceDirect  
Procedia Engineering 209 (2017) 56–60  
Urban Subsurface Planning and Management Week, SUB-URBAN 2017, 13-16 March 2017, Bucharest, Romania  
Procedia Engineering  
[www.elsevier.com/locate/procedia](http://www.elsevier.com/locate/procedia)  
Flood model Bergen Norway and the need for (sub-)surface Innovations for eXtreme Climatic Events (INXCES)  
Floris Boogaard<sup>a,b,\*</sup>, Jeroen Kluck<sup>b,c</sup>, Michael Bosscher<sup>a</sup>, Govert Schoof<sup>d</sup>  
<sup>a</sup>Hanze University of Applied Sciences Groningen, Zernikeplein 7, P.O. Box 30030, Groningen, The Netherlands  
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<sup>c</sup>Amsterdam University of Applied Sciences, Weesperzijde 190, 1097 DZ Amsterdam, The Netherlands  
<sup>d</sup>Geodienst, Nettelbosje 1, 9747 AJ Groningen, University of Groningen, The Netherlands



# Scientific and technological progress

- (TS-2) Improve identification, characterization and valuation of benefits of urban ecosystem services (ESS) offered by subsurface and nature-based water management in urban catchments.



Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

**ScienceDirect**  
Procedia Engineering 209 (2017) 127-134

**Procedia Engineering**  
[www.elsevier.com/locate/procedia](http://www.elsevier.com/locate/procedia)

Urban Subsurface Planning and Management Week, SUB-URBAN 2017, 13-16 March 2017, Bucharest, Romania

**Snowmelt modelling aspects in urban areas**  
Roxana-Gabriela Dobre<sup>a,b</sup>, Dragos Stefan Gaitanaru<sup>a,\*</sup>, Constantin Radu Gogu<sup>a</sup>

<sup>a</sup>Groundwater Engineering Research Center, Technical University of Civil Engineering of Bucharest, Lacul Tei Blvd, no. 122 - 124  
RO 020396, Romania

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RO 020396, Romania

# Scientific and technological progress

- (TS-3) Link multiple time series of satellite observations (InSAR) to hydroclimatic events and calibrate these with innovative on-site hydrological monitoring.



Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

**ScienceDirect**

Procedia Engineering 209 (2017) 119–126

**Procedia  
Engineering**

[www.elsevier.com/locate/procedia](http://www.elsevier.com/locate/procedia)

Urban Subsurface Planning and Management Week, SUB-URBAN 2017, 13-16 March 2017,  
Bucharest, Romania

An overview of ground surface displacements generated by  
groundwater dynamics, revealed by InSAR techniques

A. Radutu<sup>a,b\*</sup>, I. Nedelcu<sup>a,b</sup>, C.R.Gogu<sup>a</sup>

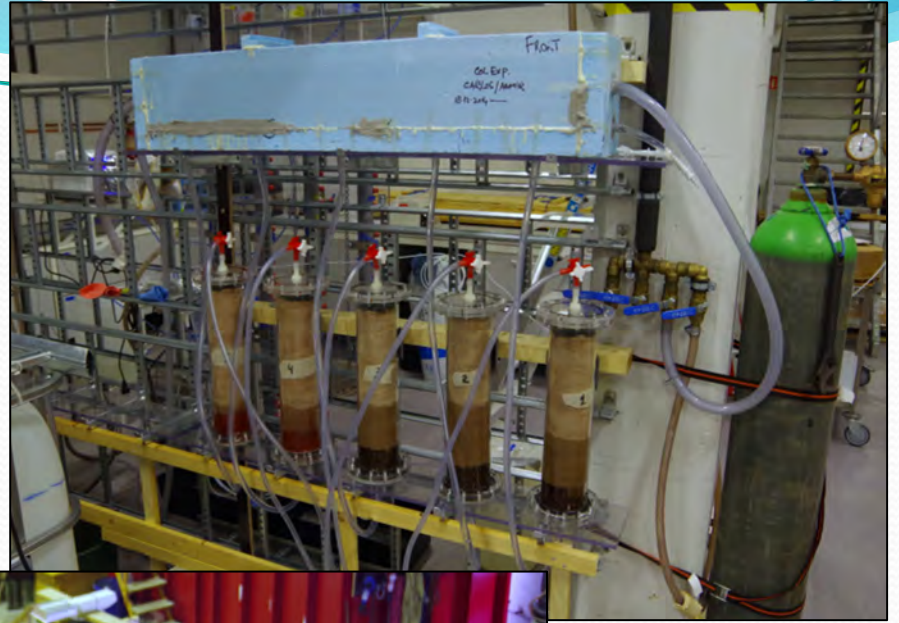
<sup>a</sup>Technical University of Civil Engineering Bucharest, Blvd. Lacul Tei nr.122-124, Bucharest-020383, Romania

<sup>b</sup>Romanian Space Agency, Mendeleev Str. 21-25, Bucharest-010362, Romania

# Scientific and technological progress

- (TS-4) Develop improved resilience in multifunctional stormwater treatment operations with processes for water treatment, flow peak attenuation and focus on water balance to protect aquatic ecosystems.







## Effects of extreme drought on

Journal of Environmental Science and Health - Part A Toxic/Hazardous Substances and Environmental Engineering  
Volume 52, Issue 14, 6 December 2017, Pages 1330-1340

### Henrik Metal removal efficiency, operational life and secondary environmental impacts of a stormwater filter developed from iron-oxide-amended bottom ash (Article)

Ilyas, A.  Muthanna, T.M. 

Department of Civil and Environmental Engineering, Norwegian University of Science and Technology, Trondheim, Norway

#### Abstract

[View references \(42\)](#)

The aim of this paper was to conduct pilot-scale column tests on an alternative treatment filter designed for the treatment of highway stormwater in cold climates. The study evaluated adsorption performance of the filter with regard to the four most commonly found metals (Cu, Ni, Pb, and Zn) in highway stormwater. An alternative method was used to estimate the operational life of the filter from the adsorption test data without a breakthrough under high hydraulic loads. The potential environmental impact of the filter was assessed by comparing desorption test data with four different environmental quality standards. The proposed filter achieved high adsorption (over 90%) of the target metals. The comparisons of desorption and leaching data with the environmental standards indicated that iron-oxide/bottom ash was non-hazardous, reusable and without serious environmental risks. The operational life and filter dimensions were highly dependent on rainfall depth, which indicated that the filter design would have to be adapted to suit the climate. To fully appreciate the performance and environmental aspects, the filter unit should be tested in the field and the testing should explicitly include ecotoxicological and life cycle impacts. © 2017 Taylor & Francis Group, LLC.

- Using Large  
incineration

Master's Thesis  
Submission date: June 2017  
Supervisor: Tone Merete  
Co-supervisor: Aamir Ilyas, I

Norwegian University of Science and Technology  
Department of Civil and Environmental Engineering

JU  
ir2  
Supervisor: Tone Merete Muthanna, IBM  
Aamir Ilyas, IBM  
Norwegian University of Science and Technology  
Department of Civil and Environmental Engineering

# Scientific and technological progress

- (TS-5) Coupling the surface and subsurface waters in the risk assessment and mitigation of the effects exerted by extreme hydroclimatic events.





# Coordination and mobility



Coupled LTU and NTNU PhD students



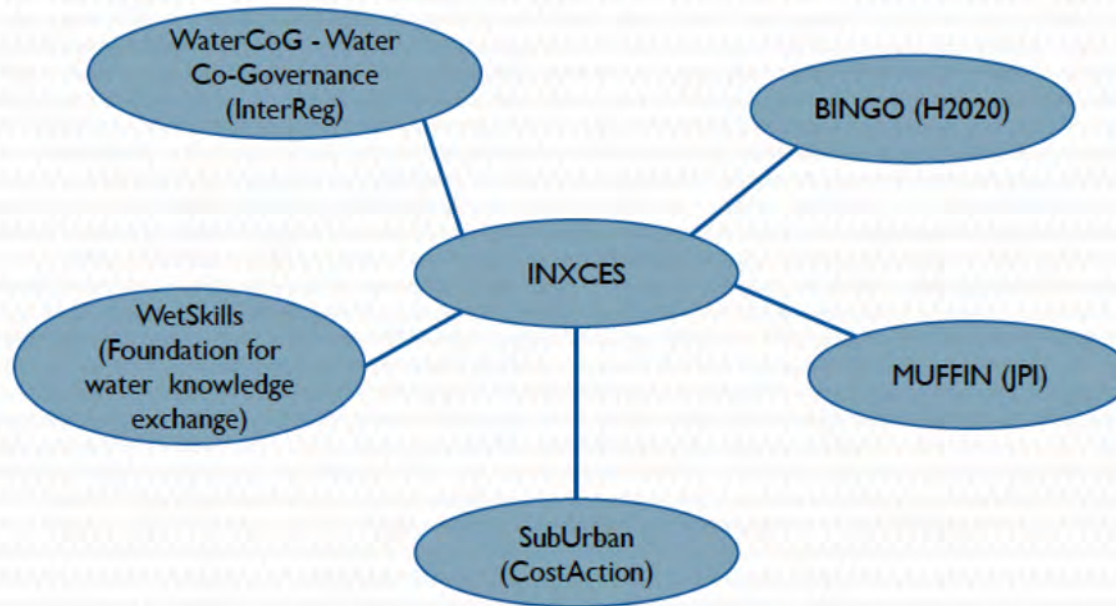
Dragos spent 2 weeks in Norway



Floris went to Norway and Romania

# Collaboration and networking

## Networking



# Stakeholder/industry engagement

- Collaboration with the WetSkills foundation in the summer 2017 (WetSkills Romania May 2017)
- City of Bergen and Groningen involved as stakeholders (owners of green infrastructure)



## **'Heat stress' Wins Romania Wetskills Water Challenge**

POSTED ON 20 JUNE 2017 BY MICHAEL BOSSCHER

The 25th Wetskills Water Challenge recently took place in Bucharest. It is an event for Dutch and Romanian students and... [READ MORE](#)



# Stakeholder/industry engagement



## Monitoring the rain garden at Bryggen

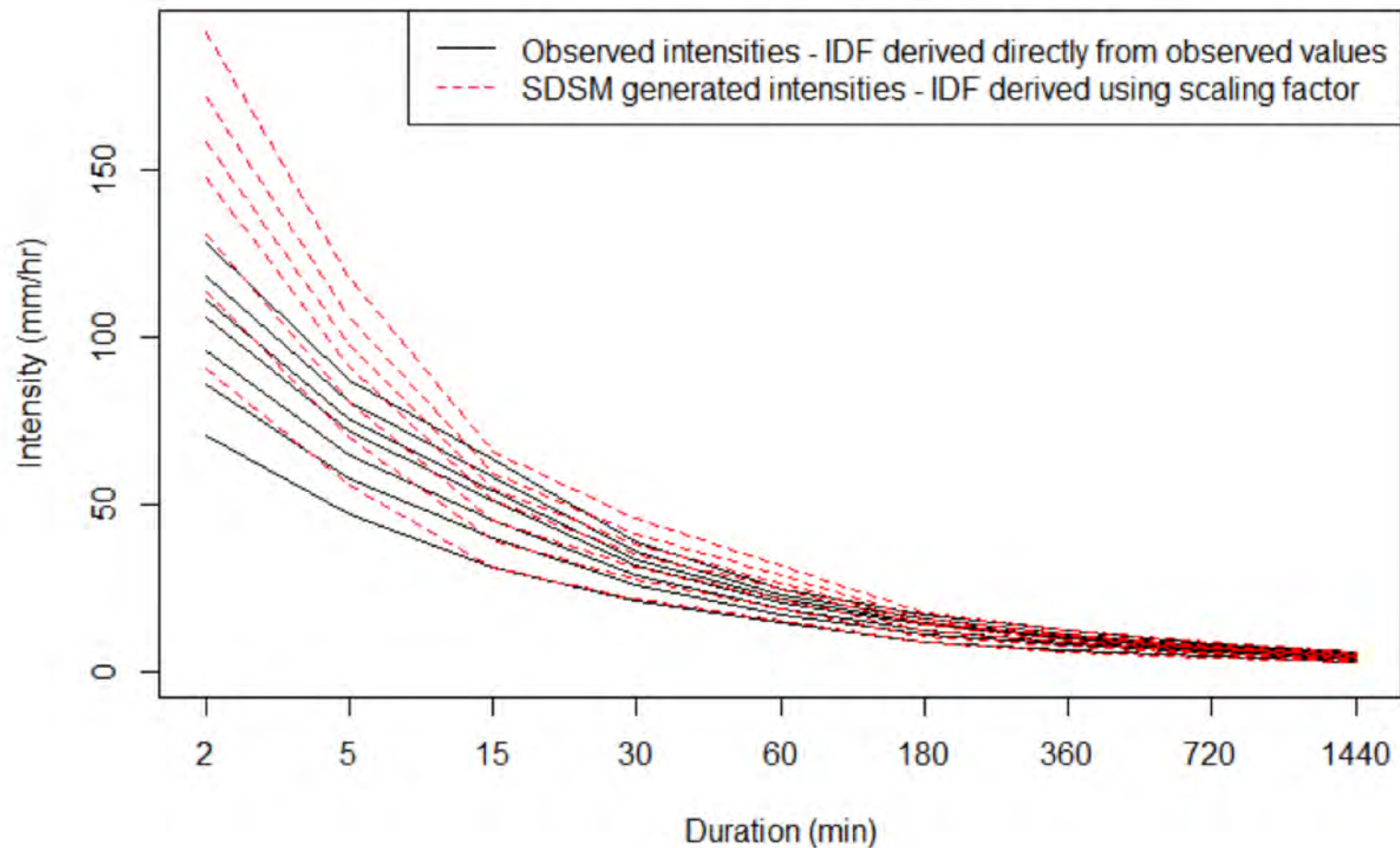
Bergen 16-17. November

Norwegian University of Science and Technology





# Stakeholder/industry engagement



Water Air Soil Pollut (2017) 228: 263  
DOI 10.1007/s11270-017-3438-x



**Procedia**  
**Engineering**

www.elsevier.com/locate/procedia

## Mineral and Anthropogenic Indicator Inorganics in Urban Stormwater and Snowmelt Runoff: Sources and Mobility Patterns

H. Galfi · H. Österlund · J. Marsalek · M. Viklander

Received: 30 December 2016 / Accepted: 15 June 2017 / Published online: 5 July 2017  
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**Abstract** Inorganic chemicals in urban stormwater and snowmelt runoff originate from catchment geology and anthropogenic activities. The occurrence, partitioning and mobility of six minerals and six trace metal (TM) indicators of anthropogenic activities were studied in stormwater, snowmelt and baseflow in four urban catchments, and the sampling of inorganics was supplemented by measurements of electrical conductivity (EC), pH and total suspended solids (TSSs). Minerals occurred at concentrations several orders of magnitude higher ( $1\text{--}10^2$  mg/L) than those of TMs ( $10^{-2}\text{--}10^2$  µg/L) and reflected the composition of local groundwater seeping

snowmelt and stormwater. Recognizing the *good* ecological status of the study area receiving water, Lake Storsjön, some protection against polluted runoff and snowmelt may be needed and could be achieved by implementing stormwater management measures controlling TSS and TMs.

**Keywords** Snowmelt · Stormwater · Trace metal

### 1 Introduction

2017, 13-16 March 2017,

areas

Constantin Radu Gogu<sup>a</sup>

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*rest, Lacul Tei Bvd., no. 122 - 124*

# Dissemination of the results



## **INXCES Dissemination Plans: The Nordic Hydrological Conference in August 2018**

POSTED ON 23 JANUARY 2018 BY MICHAEL BOSSCHER

The INXCES team is planning to have a strong presence at The Nordic Hydrological Conference <http://nhc2018.org/> taking place from August 15... **READ MORE**

# Dissemination of the results

- ICUD in Prague (posters and presentations)
- Presented at Sponge City Seminar in Shanghai, China
- Presented at ISCEE 2016 in Melaka, Malaysia
- Presented at COST SUB URBAN Final Conference in Bucharest, Romania
- Shared on [Climatescan.nl](http://Climatescan.nl) and Twitter
- Represented at Wetskills Water Challenge in Bucharest, Romania
- Represented at International Hanseatic Days in Kampen, The Netherlands
- Represented at closing event for 'The Green Quest' at Hanze UAS in Groningen, The Netherlands



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