



ALERT Geomaterials
The alliance of Laboratories in
Europe for Education,
Research and Technology



University of Strathclyde
Department of Civil and
Environmental Engineering



**Universitat Politècnica de
Catalunya - BarcelonaTech**
Department of Geotechnical
Engineering & Geosciences
**International Centre for
Numerical Methods in
Engineering**



TERRE
Training Engineers and Researchers to
Rethink geotechnical Engineering for a
low carbon future

12th ALERT Olek Zienkiewicz School 2021

Looking into the rhizosphere: the interface between plant science and soil mechanics

13 & 20 April 2021

18-20 May 2021

*Online platform
(Zoom)*

Organised by

The Alliance of Laboratories in Europe for Education, Research and Technology (ALERT Geomaterials)

University of Strathclyde (Department of Civil and Environmental Engineering)

Universitat Politècnica de Catalunya (Department of Geotechnical Engineering & Geosciences) &
CIMNE (Geomechanics Group)

TERRE Network

Coordinated by

Alessandro Tarantino (University of Strathclyde)

Enrique Romero (Universitat Politècnica de Catalunya / CIMNE)



ORGANISATION OF THE COURSE

The course will be held online on 18-20 May 2021. It is organised in five sessions

- Root-soil mechanical interactions
- Hydrological soil-plant interactions
- Effect of rhizosphere on soil hydraulic properties
- Short research presentations
- Case studies: mock-up tests, artificial slopes, and natural slopes

The course will be preceded by preparatory lectures organised in four sessions over two days

- Session: Mechanics and hydraulics of saturated soils
Target audience: researchers and practitioners with non-civil engineering background
- Session: Mechanics and hydraulics of unsaturated soils
Target audience: researchers and practitioners with no-unsaturated soil background
- Session: Plant physiology
Target audience: researchers and practitioners with non-plant science background
- Session: Plant hydraulics
Target audience: researchers and practitioners with non-plant science background



LECTURERS

PRE-COURSE

Maria Marin, University of Aberdeen, Scotland, UK
David Boldrin, University of Dundee, Scotland, UK
Alexia Stokes, INRAE – UMR AMAP, Montpellier, France
Mohsen Zarebanadkouki, University of Bayreuth, Germany
Scott McAdam, Purdue University, USA
Sylvain Delzon, INRAE - University of Bordeaux, UMR BIOGECO, Bordeaux, France
Bruna Lopes, University of Strathclyde, Glasgow, Scotland, UK
Alessandro Tarantino, University of Strathclyde, Glasgow, Scotland, UK

COURSE

18 May 2021

Evelyne Kolb, Sorbonne Université, France
Jean-Yves Delenne, French National Institute for Agriculture, Food, and Environment (INRAE), France
Jonathan Knappett, University of Dundee, Scotland, UK
Gerrit Meijer, University of Bath, UK
Barbara Switala, Institute of Hydro-Engineering, Polish Academy of Sciences, Gdańsk, Poland

19 May 2021

Thierry Fourcaud, CIRAD - UMR AMAP, France
A. Glyn Bengough, University of Dundee, Scotland, UK
Andrea Carminati, ETH Zürich, Switzerland
Louise Egerton-Warburton, Chicago Botanic Garden, USA
Anthony Leung, Hong Kong University of Science and Technology, Hong Kong, China
Katerina Tsiampousi, Imperial College London, UK

20 May 2021

Tiina Roose, University of Southampton, UK
Enrique Romero, Universitat Politècnica de Catalunya / CIMNE, Spain
Luca Pagano, Università di Napoli Federico II, Italy
Joel Smethurst, University of Southampton, UK
Dominika Krzeminska, NIBIO Norwegian Institute of Bioeconomy Research, Norway
Alessandro Fraccica, CIMNE / Universitat Politècnica de Catalunya, Spain
Marianna Pirone & Gianfranco Urciuoli, Università di Napoli Federico II, Italy
Federica Cotecchia & Vito Tagarelli, Politecnico di Bari, Italy
Slobodan B. Mickovski & Alejandro Gonzalez-Ollauri, Glasgow Caledonian University, Scotland, UK
Alessandro Tarantino, University of Strathclyde, Scotland, UK

SHORT RESEARCH PRESENTATION

20 May 2021

Floriana Anselmucci, Université Grenoble Alpes, France
Alessandro Fraccica, CIMNE, Spain
Ana Sofia Dias, Durham University, UK
Roberta Dainese, University of Strathclyde, Scotland, UK
Vittoria Capobianco, NGI Norwegian Geotechnical Institute, Norway



REGISTRATION

The course is free for participants affiliated to institutions member of ALERT Geomaterials (<http://alertgeomaterials.eu/alert-geomaterials/members/>). If you wish to attend the course, please send an email to alessandro.tarantino@strath.ac.uk and bruna.lopes@strath.ac.uk with subject '*OZC 2021 – Registration ALERT Participant*'.

If you are not affiliated to an institution member of ALERT Geomaterials, the fee is **£100** paid at registration. This will give you access to the material and lectures (both live and recorded).



PRE-COURSE

Please note that times are displayed in Central European Time (CET)

PLANT PHYSIOLOGY & HYDRAULICS

13 April 2021

Session: Plant physiology

Target audience: researchers and practitioners with non-plant science background

09:00 – 10:00 How plants function and grow - a brief introduction to what you need to know as an engineer
Maria Marin, University of Aberdeen, Scotland, UK

10:00 – 11:00 Understanding plant ecology, and why biodiversity is important for soils and bioengineering
David Boldrin, University of Dundee, Scotland, UK

11:00 – 11:30 Break

11:30 – 12:30 The why and how of tree biomechanics - or what makes trees fall over?
Alexia Stokes, INRAE – UMR AMAP, Montpellier, France

12:30 – 13:30 Lunch

Session: Plant hydraulics

Target audience: researchers and practitioners with non-plant science background

13:30 – 14:30 Quantification of root water uptake and hydraulic conductivities from root to the cellular scale
Mohsen Zarebanadkouki, University of Bayreuth, Germany

14:30– 15:30 How stomata respond to water: metabolism vs biophysics
Scott McAdam, Purdue University, USA

15:30 – 16:00 Break

16:00 – 17:00 The ascent of sap and xylem vessel (dis)content: 4 centuries of debate
Sylvain Delzon, INRAE - University of Bordeaux, UMR BIOGECO, Bordeaux, France

MECHANICS AND HYDRAULICS OF SATURATED & UNSATURATED SOILS

20 April 2021

Session: Hydraulics of saturated and unsaturated soils

Target audience: researchers and practitioners with non-civil engineering & no-unsaturated soil background

09:00 – 10:00 Water flow in rigid and deformable saturated soils
Bruna Lopes, University of Strathclyde, Glasgow, Scotland, UK

10:00 – 11:00 Water retention behaviour of unsaturated soils
Bruna Lopes, University of Strathclyde, Glasgow, Scotland, UK

11:00 – 11:30 Break

11:30 – 12:30 Hydraulic conductivity and water flow in unsaturated soils
Bruna Lopes, University of Strathclyde, Glasgow, Scotland, UK

12:30 – 13:30 Lunch

Session: Mechanics of saturated and unsaturated soils

Target audience: researchers and practitioners with non-civil engineering & no-unsaturated soil background

13:30 – 14:30 Compressibility and shear strength of saturated soils
Alessandro Tarantino, University of Strathclyde, Glasgow, Scotland, UK

14:30– 15:30 Compressibility and shear strength of unsaturated soils
Alessandro Tarantino, University of Strathclyde, Glasgow, Scotland, UK

15:30 – 16:00 Break

16:00 – 17:00 Stability analysis of infinite slope
Alessandro Tarantino, University of Strathclyde, Glasgow, Scotland, UK



12TH ALERT OLEK ZIENKIEWICZ SCHOOL 2021

Looking into the rhizosphere: the interface between plant science and soil mechanics

PROGRAMME

Please note that times are displayed in Central European Time (CET)

DAY 1 – 18 May 2021	
09:30 – 10:00	Welcome address <i>Alessandro Tarantino, Alert School Coordinator (University of Strathclyde, Glasgow, Scotland)</i> <i>Enrique Romero, Alert School Coordinator (Universitat Politècnica de Catalunya / CIMNE, Spain)</i> <i>Frédéric Collin, Director ALERT Geomaterials (Université de Liège, Belgium)</i>
ROOT-SOIL MECHANICAL INTERACTIONS	
10:00 – 11:00	Physical modelling of root-soil interactions <i>Evelyne Kolb, Sorbonne Université, France</i>
11:00 – 12:00	Root growth and force chains in granular soil <i>Jean-Yves Delenne, French National Institute for Agriculture, Food, and Environment (INRAE), France</i>
12:00 – 13:00	Lunch
13:00 – 14:00	From root-soil interactions to stability assessment of vegetated slopes <i>Jonathan Knappett, University of Dundee, Scotland, UK</i>
14:00 – 15:00	No strain, no gain: serviceability aspects of mechanical root-reinforcement <i>Gerrit Meijer, University of Bath, UK</i>
15:00 – 15:30	Break
15:30 – 16:30	Implementation of models for root-reinforced soils into finite element codes <i>Barbara Switala, Institute of Hydro-Engineering, Polish Academy of Sciences, Gdańsk, Poland</i>



DAY 2 - 19 May 2021

HYDROLOGICAL SOIL-PLANT INTERACTIONS

09:00 – 10:00	Modelling growth and development of plant root systems <i>Thierry Fourcaud, CIRAD - UMR AMAP, France</i>
10:00 – 11:00	Rhizosphere biophysics and its control on soil hydrology <i>Glyn A. Bengough, University of Dundee, Scotland, UK</i>
11:00 – 11:30	Break
11:30 – 12:30	Role of mucilage in shaping rhizosphere hydraulic properties and regulating root water uptake <i>Andrea Carminati, ETH Zürich, Switzerland</i>
12:30 – 13:30	Role of root hairs in regulating root water uptake <i>Andrea Carminati, ETH Zürich, Switzerland</i>
13:30 – 14:30	Lunch
14:30 – 15:30	Role of arbuscular mycorrhizas and ectomycorrhizas in regulating root water uptake <i>Louise Egerton-Warburton, Chicago Botanic Garden, USA</i>
15:30 – 16:30	Hydrological reinforcement to soil: insights from plant-water relation <i>Anthony Leung, Hong Kong University of Science and Technology, Hong Kong, China</i>
16:30 – 17:00	Break
17:00 – 18:00	Numerical modelling of vegetation-mediated ground atmosphere interaction <i>Katerina Tsiampousi, Imperial College London, UK</i>



DAY 3 - 20 May 2021

SHORT RESEARCH PRESENTATIONS

9:00 – 10:30	<p>Sand deformation around growing maize roots: an investigation with x-ray tomography <i>Floriana Anselmucci, Université Grenoble Alpes, France</i></p> <p>Tensile strength of a vegetated and partially saturated soil <i>Alessandro Fraccica, CIMNE / Universitat Politècnica de Catalunya, Spain</i></p> <p>The water retention properties of root-permeated pyroclastic soil <i>Ana Sofia Dias, Durham University, UK</i></p> <p>High-Capacity Tensiometer: measuring xylem water pressure to investigate soil-plant hydraulics <i>Roberta Dainese, University of Strathclyde, Scotland, UK</i></p> <p>The influence of long-root grass on hydro-mechanical behaviour of volcanic soils: an experimental study at lab scale <i>Vittoria Capobianco, NGI Norwegian Geotechnical Institute, Norway</i></p>
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10:30 – 11:00	Break
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EFFECT OF RHIZOSPHERE ON SOIL HYDRAULIC PROPERTIES

11:00 – 12:00	<p>Hydraulic behaviour of compacted vegetated soils <i>Enrique Romero, Universitat Politècnica de Catalunya / CIMNE, Spain</i></p>
12:00 – 13:00	<p>Multiscale Image Based Modelling of the Rhizosphere <i>Tiina Roose, University of Southampton, UK</i></p>

13:00 – 13:50	Lunch
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CASE STUDIES: MOCK-UP TESTS AND ARTIFICIAL SLOPES

13:50 – 14:10	<p>The effects of bare and vegetated conditions on the hydrological response of a silty volcanic layer tested by a lysimeter <i>Luca Pagano, Università di Napoli Federico II, Italy</i></p>
14.10 – 14:30	<p>Seasonal variations in soil water content and pore water pressure in a vegetated clay highway cut slope <i>Joel Smethurst, University of Southampton, UK</i></p>

CASE STUDIES: NATURAL SLOPES

14:30 – 14:50	<p>Effect of riparian vegetation on stream bank stability <i>Dominika Krzeminska, NIBIO Norwegian Institute of Bioeconomy Research, Norway</i></p>
15.10 – 15:30	<p>Fallow and vegetated slopes under heavy rainfalls in Costa Rica <i>Enrique Romero & Alessandro Fraccica, Universitat Politècnica de Catalunya / CIMNE, Spain</i></p>
15:30 – 15:50	<p>Effects of vegetation on hydro-mechanical behaviour of unsaturated pyroclastic slopes: two case studies in Campania (Southern Italy) <i>Marianna Pirone & Gianfranco Urciuoli, Università di Napoli Federico II, Italy</i></p>

15:50 – 16:10	Break
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16:10 – 16:30	<p>Effects of different crop types on the state of soils at depth and their impact on the stability of slopes: the real scale model set up at Pisciole <i>Federica Cotecchia & Vito Tagarelli, Politecnico di Bari, Italy</i></p>
16:30 – 16:50	<p>Hydrological effect of vegetation against rainfall-induced landslides: case study of Catterline Bay <i>Alejandro Gonzalez-Ollauri & Slobodan B. Mickovski, Glasgow Caledonian University, Scotland, UK</i></p>
16:50 – 17:10	<p>A case study on the hydraulic control of the rhizosphere on rainfall-induced shallow landslides <i>Alessandro Tarantino, University of Strathclyde, Scotland, UK</i></p>

17:10 – 17:30	<p>Closure <i>Alessandro Tarantino, Alert School Coordinator (University of Strathclyde, Glasgow, Scotland)</i> <i>Enrique Romero, Alert School Coordinator (Universitat Politècnica de Catalunya / CIMNE, Spain)</i> <i>Cino Viggiani, President ALERT Geomaterials (Université Grenoble Alpes, Laboratoire 3SR, France)</i></p>
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