

Summer School

Principles and application of flow and transport modelling in the subsurface

27 - 30th August 2013

The aim of the summer school is to introduce the principles of subsurface flow and transport modelling and demonstrate the practical application of commonly-used advanced numerical modelling tools, for the investigation and management of contaminated soil and groundwater from the site-scale to the regional-scale. The lectures and exercises will focus primarily on the development of real, full-scale practical examples dealing with groundwater contamination, starting from data and observations in the field to running and calibration of advanced numerical models. Participants will be introduced to modelling applications using computer-based simulations developed with environmental data from research cases studies.

The summer school is presented by the ADVOCATE Marie Curie Initial Training Network (www.theadvocateproject.eu/). After attending this summer school, participants will be able to:

1. Understand the principles and limitations of subsurface flow and transport modelling.
2. Develop an adequate conceptual site model related to real cases of soil and groundwater contamination for the purpose of using a numerical model.
3. Understand key components used for model development and the analysis of results, such as inverse modelling and automatic calibration or model sensitivity analysis.
4. Apply the specific modelling tools to investigate and interpret the subsurface fate and transport of contaminants in relevant and realistic scenarios.

The summer school will be presented by experienced training facilitators from the University of Liège (Belgium), VITO (Belgium), SCK-CEN Mol (Belgium), University of Mons (Belgium) and Université Laval in Québec (Canada).

The summer school is organised into three modules which run in parallel, linked by common elements. The three modules are designed to provide training on specific modelling tools. Participants must choose **ONE** of the three following modules when registering for the summer school, which they will work with for the duration of the school:

Module 1 focuses on a local-scale (1-D) modelling application with the HP-1 (combined Hydrus1D-PHREEQC) model. The case study is a chlorinated aliphatic hydrocarbon groundwater plume travelling to a river and focuses on the aquifer and groundwater-surface water interface.

Module 2 focuses on a site-scale (2-D) application with the Modflow - MT3D model. The case study investigated consists of a BTEX groundwater contamination problem in an alluvial aquifer.

Module 3 focuses on a regional (groundwater body-scale) application with the control volume finite element code HydroGeoSphere. The case study investigated consists of a regional (chalk) aquifer contaminated with nitrate.



Technical programme

Tuesday 27th August: Subsurface flow and transport modelling - an overview (plenary session)

- Basic and advanced concepts for subsurface flow and transport modelling
- Description of the modelling suites used during the course and tutorials
- Description of the three case studies used as a support to the training, considering case history, general context (geology, hydrogeology, hydrochemistry, etc), available data, observations and experiments

Wednesday 28th August: From the problem description to the development of the conceptual model (by modules)

- Brainstorming on the development of the conceptual site model (by modules)
- Feedback to the participants (plenary)
- Navigating through the model input files (by modules)
- First run of numerical models (possibly overnight!)

Thursday 29th: Model calibration and sensitivity analysis

- Lectures on model calibration, inverse modelling, sensitivity analysis
- Continued work on case studies

Friday 30th August (morning): Posters and case studies of participants

- Opportunity for the participants to present posters on their modelling results or the case study for which they expect to apply numerical models

The summer school will start at 09.00 on Tuesday 27th August and end at 12.00 on Friday 30th August. A detailed programme of the summer school is provided overleaf.

What is provided

A hardcopy copy of the lecture and tutorial notes for each session will be provided to participants. Refreshments will be provided on each day, but participants are expected to pay for their own meals and accommodation during the summer school.

Computer exercises and expected level of understanding of participants

The summer school will include computer-based exercises using the modelling codes indicated. The exercises will be organised in a computer room in the university (Building B52). The software used will be installed on these computers and be available for the participants during the summer school. Participants will receive a temporary user ID and password to log on the computers.

The summer school will focus on the practical and efficient application of numerical modelling tools and more particularly on the development of conceptual site models which support their use. The course is designed to provide advanced training to researchers and professionals with some experience in the use of numerical models for contaminated land and groundwater problems.



Expanded technical programme for summer school

Day 1: Subsurface flow and transport modelling - an overview

- 8:30 Arrival and registration of participants, software and license arrangements
- 9:00 Welcome and roundtable introductions
- 9:15 Basic and advanced concepts for subsurface flow and transport modelling : mathematical and numerical aspects
- 10:30 Refreshment break
- 11:00 Basic and advanced concepts for subsurface flow and transport modelling : the conceptual site model
- 12:30 Lunch break
- 14:00 Description of the modelling suites used during the course and tutorials (1/2h each)
- 15:30 Refreshment break
- 16:00 Description of the three case studies used as a support to the training (1/2h each)
- 17:30 End of Day 1

Day 2: Development of the conceptual model

- 8:30 Brainstorming on the development of the conceptual site model
- 10:00 Refreshment break
- 10:30 Brainstorming on the development of the conceptual site model
- 12:00 Lunch break
- 13:20 Debriefing of conceptual site models to all participants (plenary, 20 min each)
- 14:20 Navigating through the model input files
- 15:30 Refreshment break
- 16:00 First run of models
- 17:00 End of Day 2

Day 3: Model calibration and sensitivity analysis

- 8:30 Run of models
- 10:30 Refreshment break
- 11:00 Introduction to inverse modelling and sensitivity analysis tools (P.Goderniaux)
- 12:00 Lunch break
- 13:30 Run of models
- 15:30 Refreshment break
- 16:00 Lecture: Assessing the effect of spatial discretization on model performance and prediction uncertainty (S.Wildemeersch)
- 17:00 End of Day 3

Day 4: Posters and case studies of participants

- 8:30 Session 1
- 10:00 Refreshment break
- 10:30 Session 2
- 12:00 End of summer school and barbecue



Registration and further information

The registration fee for the summer school is 300 euros for the four days. Registration is limited to 20 participants (max 8 per module). **The deadline for registration is Monday 5th August 2013.**

To book a place, send the registration form included in the last page of the flyer to:

Juan Angel Pena Hernandez

Département ArGEnCo

Université de Liège

Mobile: +32474305062

Work: +3243662358

Fax: +3243669520

E-Mail: jahernandez@ulg.ac.be

Payment of the registration fee must be made in advance at the time of registration. Details of the payment options are provided below. Substitution of participants is possible in the event that participants are unable to attend after registering for the summer school. Details of substitute participants should be sent to the contact person above. No refund of the registration payment can be made in the event of cancellation of registration after 16th August 2013.

ULg banking details:

Account owner: Université de Liège

Address: Place du 20 Août, 7

4000 Liège

Belgium

IBAN: BE3334 015580 2246

BIC: BBRUBEBB

Communication: Advocate Summer School Nr1 + surname, first name

Venue Information

The summer school will be organized in the *Institut de Mécanique et Génie Civil* (Building 52 in Figures 1 and 2) on the campus of the University of Liège. The meeting room (-1/631) is located in level -1 in front of the entrance located at the back of the building. You can use the entrance at level -1 located on the south side of the building.

Access to Liège and to the Sart-Tilman campus

Liège is situated at the entrance of the Ardennes; at an altitude of 68 metres, its geographical location makes it an exceptional gateway for Europe. Extensive motorway and railway networks reinforce this international vocation. Be careful when you travel in Belgium: Liège may be written in French: Liège, in Dutch: Luik or in German: Lüttich.



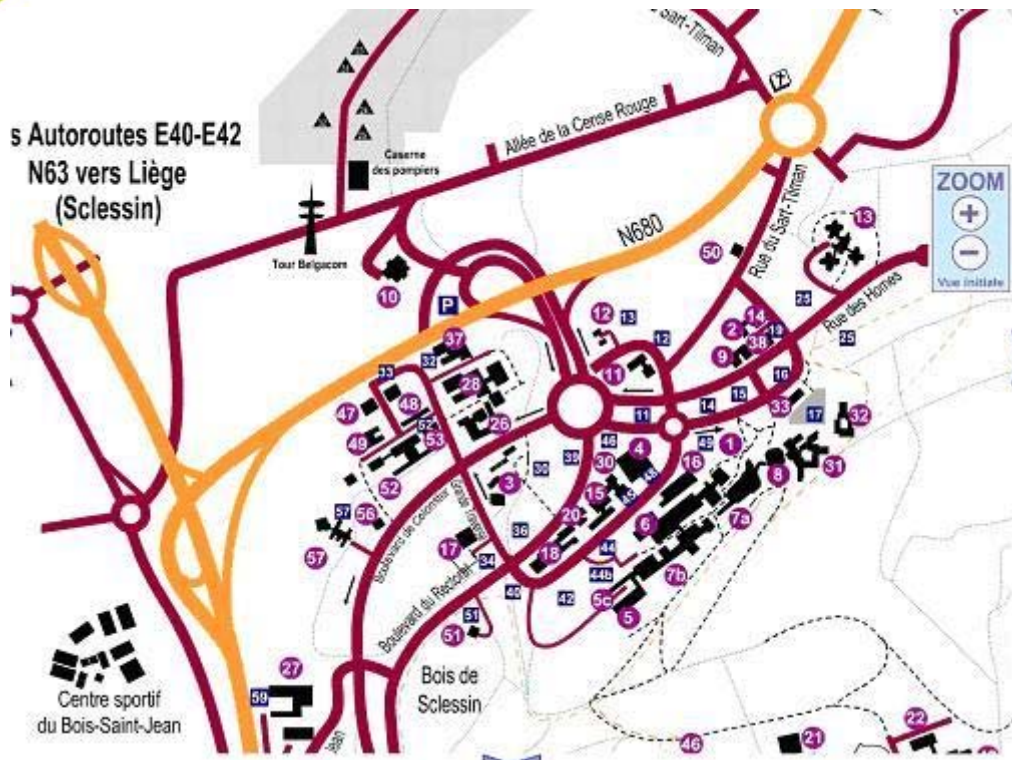


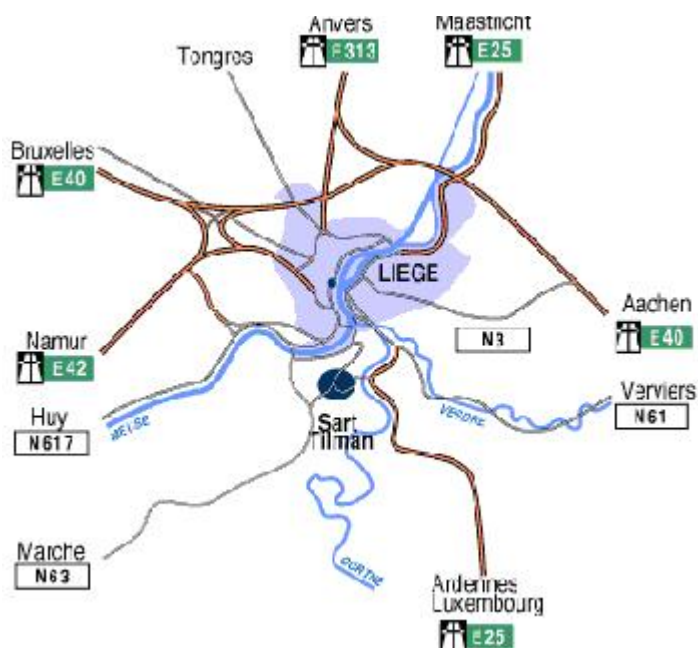
Figure 1. University of Liège North Campus map (red circles = buildings, blue squares = parkings)



Figure 2. Institut de Mécanique et du Génie civil (view of the building and detailed map)

Travel to Liège by car

The road and motorway network (E40, E25, E42, E313) makes getting to Liège and the Sart Tilman easy by car. The map below provides details.



Travel to Liège by train

Trains to Liège arrive at the Liège Guillemins railway station in Liège. For further information on this option tel : +3225282828 or check <http://www.belgianrail.be/en/Default.aspx>

There is a regular bus service from the railway station to the city centre (nb 1 and 4) and to Sart Tilman (nb 48).

Travel to Liège by plane

The main airport in Belgium is **Brussels National Airport** located near Brussels.
<http://www.brusselsairport.be/en/>

From this airport you can reach Liège by car or by train. By car, there are car rental desks in the arrival hall.
Itinerary: follow "RO - Ring" / E40-Luik / once on the E40 to Liège, the journey lasts approximately 1 hour.

By train, Brussels National Airport is less than twenty minutes from the city centre of Brussels. From 05:30 until nearly midnight, the Airport City Express links the airport with Brussels Midi, Central and North four times an hour. The airport train station is located in the basement (level -1) of the terminal building. There is no direct train to Liège; you will always have a change at Brussels North Station or at Leuven Station.



You can also travel by plane to **Brussels South Charleroi Airport**.

<http://www.charleroi-airport.com/en/brussels-south-charleroi-airport/index.html>

From this airport you can reach Liège by car or by train. By car, there is a car rental desk in the airport.

Itinerary: follow E42-Liège/ once on the E42 to Liège, the journey lasts approximately 45 minutes.

By train, first take a bus (bus A) to Charleroi-Sud railway station. The journey lasts around 20 minutes. Outside the airport, near Door 2, there are two ticket dispensers where you can buy a single or a return ticket (return on the same day) valid for "any Belgian destination". This ticket covers a journey in a TEC bus (from the airport to Charleroi-Sud railway station) and a train journey (from Charleroi-Sud to any railway station in Belgium). At Charleroi-Sud railway station, you have 1 train per hour to Liège and the journey lasts around 1 hour.

Travel to the Sart-Tilman campus by bus

The Sart Tilman campus is serviced by two TEC bus lines (nb 48 and nb 58). Line 48 starts from the city centre (Opera and Pont d'Avroy), stops at the railway station "Gare des Guillemins" and several other places in town, before reaching your destination. The journey lasts about 30 minutes. Line 58 starts from the railway station (Liège Guillemins), takes the motorway, with a journey time of about 20 minutes. For both lines, you have to get off the bus at the bus-stop called "Les Ateliers".

Travel to the Sart Tilman campus by car

From motorway E40 (Brussels or Aachen) or motorway E25 (Maastricht), see map below:

- Follow "E25-Liège", then "E25-Spa-Luxembourg-Ardenne-Bastogne"
- Take the exit Nr 40 "Sart Tilman-Ulg-CHU-Embourg"
- Turn right and cross the river
- Then turn left to the Sart Tilman

Follow the main road and you will arrive on the campus. Once you are there, follow the direction Parking 52 (P52).

Accommodation

A range of accommodation to suit all budgets is available in Liège. Participants should make their own arrangements for accommodation and contact specific providers directly with enquiries. The following websites provide examples of the options available: <http://www.liege.be/tourisme/lhebergement-1/hotels/liste-hotels>

Reduced prices are available in some hotels for researchers visiting the University of Liège. Information on this option will be provided to eligible participants after registration.



Registration Form

REGISTRATION FORM to be sent by e-mail to Juan Angel Pena Hernandez (jahernandez@ulg.ac.be)

Surname:

Name:

Affiliation and address:

E-Mail:

Tel:

Fax:

Selected module:

- (1) Local scale - Hydrus-PHREEQc
- (2) Site scale - Modflow-MT3DMS
- (3) Regional scale - HGS

I plan to present a case study for which I have to develop a modelling application: Yes - No

Case study brief description (more details to be provided prior to the summer school)

I plan to present a poster: Yes - No

Title of the poster:

