



VIU
Graduate
Seminar
**HYDROGEOPHYSICAL
Inversion and Data
assimilation For
THE CHARACTERIZATION
and MONITORING
OF COASTAL aquifers**

**Hydrogeophysical inversion and data assimilation
for the characterization and monitoring of coastal aquifers**

July 1-5, 2019

**Venice International University
Isola di San Servolo, Venice**

VIU Graduate Seminar

Hydrogeophysical inversion and data assimilation for the characterization and monitoring of coastal aquifers.

July 1 – 5, 2019

Venice International University

Scientific coordinator:
Prof. Erwan Gloaguen, INRS,
Canada

This program is a
VIU Global Challenges
Initiative

Program

Sustainable management, characterization, protection and rehabilitation of aquifers rely on our capability to predict groundwater flow and transport over time. This is only possible if we are able to represent the hydraulic properties of aquifers (e.g. hydraulic conductivity), and to numerically predict their fluxes of water and solutes, also considering external factors and constraints such as extraction, recharge and boundary conditions. This is particularly important in the case of coastal aquifers, which are threatened by rising sea levels due to climate change and increasing demand for potable water driven by population increase and associated anthropogenic activities (e.g. golf courses, manufacturing, restaurants, agriculture) along the shores. Consequently, authorities are seeking better tools to forecast and manage coastal aquifers in such environments. This implies a need for building efficient methodologies to characterize, model, and compute flow and transport, and to update the model parameters over time using data from adapted monitoring tools. This series of lectures aims at teaching the participants the state-of-the-art of in situ hydrogeophysical characterization techniques, geophysical and hydrogeological numerical modeling, geostatistical modeling and data inversion and assimilation.

This Graduate Seminar will be led by:

- Institut National de la Recherche Scientifique, Canada
- University of Lausanne, Switzerland
- Università degli Studi di Padova, Italy

In cooperation with

- Laval University, Canada
- University of Neuchâtel, Switzerland

Methodology

The seminar is divided into a four-day training session followed by a one-day field trip to the Adige-Euganeo Reclamation Authority district (South of the Venice Lagoon), with a visit to the Ca' Bianca pumping station, and a presentation of land management problems in coastal areas. The graduate seminar will have the form of formal lectures followed by practical examples with real data.

Topics

Back to basics: review of the physics of groundwater flow, role of density in heads, how to represent seawater intrusion

Hydrogeological modeling: how to solve numerically those equations, boundary & initial conditions, what are the different techniques, advantages and disadvantages, accuracy criteria & numerical error, what are the codes and tools available, key issues

Important knowledge about these systems gained by numerical modeling: the Henry problem and its variants, demonstration, effect of 3D geometry of the aquifer base, effect of the heterogeneity of the aquifer in 2D, or in 3D.

Uncertainty and geostatistics: basic concepts of geostatistics to represent uncertainty and model spatial and temporal heterogeneity, variogram, kriging, simulation

The limits of the multigaussian model: concept of connectivity, impact on flow and transport, overview of alternative geostatistical models: objects, plurigaussian and MPS

Geophysical methods (electrical resistivity tomography, time-domain and frequency-domain electromagnetics, seismic reflection and refraction): basic underlying physics, experimental setup (including monitoring), modeling

Conventional and advanced inversion topics: Coupled hydrogeophysical inversion, joint inversion and multimethod surveys, outstanding challenges;

Introduction to data assimilation. Theory and assumptions of the Kalman filter. Extension to nonlinear models: the ensemble Kalman filter (EnKF) and its variants.

Learning outcomes for participants:

Participants will learn basic and advanced theoretical and practical concepts of the different disciplines involved in aquifer characterization (AC). All the theoretical aspects will be demonstrated with real examples giving the students a perspective of the best practices in the different disciplines in AC.

Level of students and suitable fields of study

This Graduate seminar is offered to both Master's students and young researchers early in their PhD; open to candidates from all the VIU Member Institutions. Excellent candidates from non-member institutions will be also considered and evaluated, although these candidates will pay fees and are not eligible for financial support.

Fees & Grant Support

Students from the VIU member universities will pay no participation fees. Grant support is also available to support, partially or fully, the costs of international travel and accommodation.

The participation fee for students of non-member universities is Euro 1,100 VAT incl. The fee is inclusive of tuition, course materials, accommodation, lunches, social events and taxes. Students from non-member institutions are not eligible for VIU grant support.

Credits

Participation in the Graduate Seminar is considered equivalent to 2 ECTS.

The final program will be available on the VIU website

Applications

February 21 – March 20, 2019

via the VIU website.

Applicants must submit the application form, a letter of motivation – which should include a brief description of the candidate's research project, a curriculum vitae and a photo.

PhD Students in EU universities may be eligible for Erasmus+ funding. Refer to international offices in home universities or contact VIU Erasmus office: erasmus@univiu.org.

Global Challenges Initiatives

The Graduate Seminar is part of the VIU Global Challenges Initiatives, a coordinated stream of activities, inspired by similar ambitions to contribute to the creation of knowledge, understanding, and skills, responding to current and future major societal challenges faced by humankind today: environmental, social, cultural and technological phenomena and their local impacts.

Knowledge creation across the disciplines - the humanities, social sciences, and the sciences - can play a fundamental role in coping with these challenges. Within an evolving and unconstrained ensemble of topics addressed by VIU member institutions, the Initiatives identify core interests of global and local relevance with the aim to make VIU an innovator.

Through these Initiatives VIU is committed to a critical exploration of what it means to envision a sustainable future. The Initiatives acknowledge the interconnected and intertwined relationships between human and natural systems and aim to be multidisciplinary and transdisciplinary.

Location



Venice International University

Isola di San Servolo

30133 Venice

Italy

T +39 041 2719511

F +39 041 2719510

E summerschools@univiu.org