sYmple

School of hydrogeological modelling & Project-related strategies

Info & Programme

2027 Edition: January 8th – October 29th

Online courses (live and recorded lessons)
with **unlimited access** to the e-learning platform

Ente di Formazione Accreditato

11/06/2026

The initiative is under the auspice of the

International Association of Hydrogeologists – Italian Chapter

website @info@hydrosymple.com telegram +39.0761.481622 LinkedIn

School Outlook

OUR MISSION

SYMPLE is an international school for applied hydrogeological modelling aimed to **promote and facilitate the understanding, use and evaluation of hydrogeological numerical models through a multidisciplinary programme associated with the use of strategies to solve real-world problems**.

Launched in 2021, SYMPLE is a comprehensive, applied, internet-based School of Hydrogeological Modelling built around an emerging paradigm: "*starting from the problem and working backwards*". Supported by the latest ideas and cutting-edge software for data assimilation, this workflow begins by identifying the data with the greatest potential to reduce the uncertainties affecting decision-critical predictions, and then designs a numerical simulation strategy that serves the core imperative of actually quantifying and reducing those uncertainties.

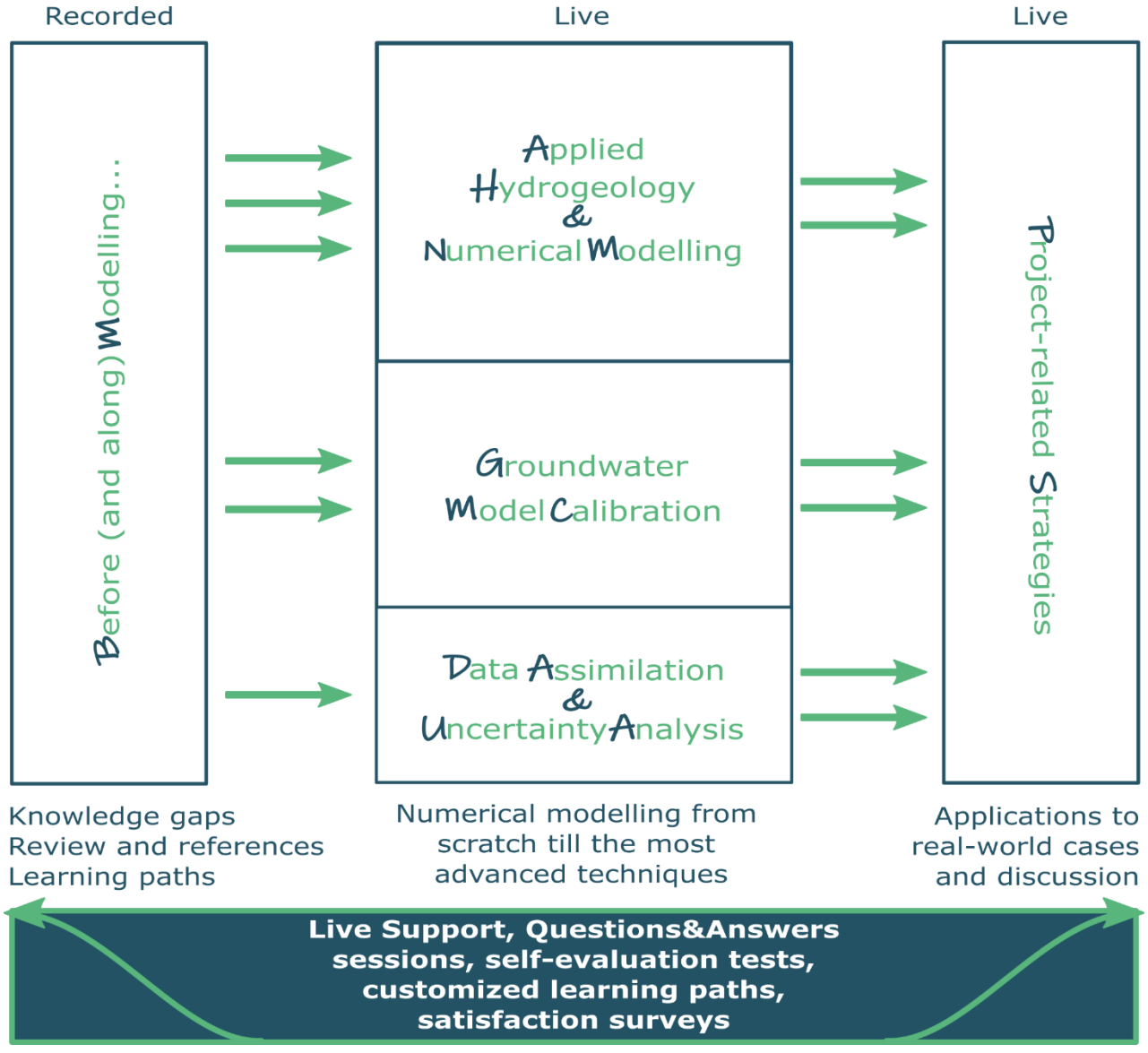
Increasingly, SYMPLE extends its scope beyond modelling alone to embrace data management and processing as well as field hydrogeology, recognizing these as foundational to any modelling effort. A model holds no validity unless it is grounded in robust field data and informed by the appropriate extraction of information from that data through processing. By covering the full chain (from the field, through the data, to the model) participants gain the practical knowledge needed to deploy models effectively across a range of decision-making contexts.

School Contents

The programme is organized into three Live Modules, optional Recorded Courses and the Project-related Strategies meetings, which conclude the School by applying the whole modelling process to real-world problems presented by the attendees.

Live lessons are mostly held by Francesca Lotti, Thomas Reimann, Daniel Feinstein and John Doherty, with the participation of other experts according to the subject. All live lessons are held in English, **recorded and uploaded** on the E-learning platform for later **never-ending access**.

Most exercises use public-domain software, such as QGIS, Python scripts and the MODFLOW graphical user interface (GUI) ModelMuse. The commercial GUI Groundwater Vistas is also applied since it is the one that better supports the automated calibration process through PEST.



Before (and along) Modelling (recorded)

The School offers a kind of "hydrogeologist's toolbox" that is intended to provide the necessary "bricks" needed to approach hydrogeological problems. The importance of getting back to the pillars of geology, hydrogeology, physics, and maths is surely clear, nevertheless it will become clearer during the School. This section includes hundreds of hours of recorded courses: thanks to self-assessment tests, attendees of the School will be able to detect their main gaps and get back to the pertinent courses. Whether or not to take advantage of this opportunity is up to each participant, according to his/her own interests and personal background.

Contents

Module 1 – Hydrogeology Basics and Modelling (live)

The module begins with a review of key topics such as groundwater flow equations, aquifer properties, boundary conditions and transport dynamics. Participants then move into data processing, where they are introduced to geostatistics and hydrogeological data analysis, especially pumping tests interpretation. The module continues with sessions on hydrogeological modelling of flow and transport, covering analytical and numerical methods. Real-world data coming from a landfill site are then used to build a numerical model using MODELMUSE. The Landfill numerical model will be at the basis of the calibration exercises in Module 2.

The first module includes related stand-alone courses that complement the topic of the Module and offer different points of view from international experts.

Preliminary programme

Module 2 – Groundwater Model Calibration (live)

The module introduces the basic concepts of model calibration with the **PEST** suite. Live sessions adopt a "learning by doing" approach, focusing on hands-on workshops. Theoretical concepts are presented in a simplified manner, aiming to provide a comprehensive overview of parameter estimation and data assimilation techniques. Most of the practical exercises are carried out using the graphical user interface (GUI) ModelMuse to support learning.

Preliminary programme

Module 3 – Parameter estimation and uncertainty analysis using PEST/PEST++ (live)

The module deepens the theory behind modern-day inversion and uncertainty analysis as these are applied to groundwater modelling. Just as importantly, practical sessions demonstrate how theory can be turned into workflows using a graphical user interface such as ModelMuse in conjunction with utility software from the PEST suite. This utility software allows a modeler to undertake calibration and uncertainty analysis in innovative ways that are not supported by off-the-shelf modelling interfaces.

Assignment of site-specific parameters to models that must be used to support expensive decisions provides important insights into issues such as appropriate structural and parameterization complexity. A particularly exciting topic is that of non-stationary geostatistics, and how these can be used to parameterize models that possess both structured and unstructured grids.

Data space inversion is another new technology explained in the module. It enables data assimilation and predictive uncertainty analysis to proceed without the need to actually adjust model parameters. This has profound implications for the speed with which sophisticated numerical models can be built and deployed to support operational and regulatory decision-making.

The module will also be offered as a blended stand-alone course, delivered in person in Vetralla.

Preliminary programme

Project related strategies (live on request)

The scientific background of the operational project-related strategies is provided by the concept of "problem decomposition", described in Doherty & Moore, 2023. The term "problem decomposition" characterises an approach to environmental management that renders it amenable to the type of quantitative assistance that numerical modelling can provide. It requires that modelling goals be carefully defined, and that modelling workflows be then designed to serve these goals. As the term "decomposition" implies, it often involves the development of a number of conceptual simplifications, which may invoke concepts such as "impact pathways". These provide a focus for model-based processing of environmental data in ways that improve the likelihood of a management decision being "good" according to the values that system management serves. These concepts and approaches were the driving motive behind the existence of SYMPLE.

A unique feature of the session is the inclusion of participant case studies through a series of interactive live sessions organized on request. Participants would engage describing their hydrogeological problems, relevant datasets, and the broader management context. Discussion with key experts would explore alternative approaches, assist in identifying key actions to address the problem.

Module 1 (T. Reimann, F. Lotti) – 45 h

Live Sessions	Contents	CET/CEST	Days
Presentations	Introduction & Overview	3-6pm	2027-01-08
M1-A Review of key topics	Fundamental concepts of groundwater flow: flow equations, aquifer properties, water balance, and transport equations.	3-6pm 10am-1pm 3-6pm	2027-01-15 2027-01-22 2027-01-29
M1-B Data processing	Introduction to applied statistics and geostatistics. Case Study introduction. Analysis and processing of hydrogeological datasets, semivariogram modelling, field data regionalization, uncertainty of spatial distributions. Aquifers and Wells. Flow to wells, capture zone, aquifer investigation and pumping tests evaluation.	10am-1pm 3-6pm 10am-1pm 3-6pm 10am-1pm	2027-02-05 2027-02-12 2027-02-19 2027-02-26 2027-03-05
M1-C Numerical Modelling of flow with MODFLOW	Analytical and numerical methods in groundwater: solution of flow equation through finite differences and finite elements, numerical methods, grid and mesh construction, boundary conditions, model assumptions.	3-6pm 10am-1pm 3-6pm 10am-1pm	2027-03-12 2027-03-19 2027-03-26 2027-04-02
M1-D Model building of the Case Study	Demonstration of model design. Exercise/tutorials with MODELMUSE. Case Study model building, evaluation of aquifer geometry, properties and boundary conditions from previously processed data (M1-B).	3-6pm 10am-1pm	2027-04-09 2027-04-16 2027-04-23
M1-E Numerical Modelling of basic transport	Euler / Lagrange approaches, Numerical schemes (FD, TVD, MOC, MMOC, HMOC) and different applications. Uncertainty due to solution method and parameters. Exercise/tutorials with MODELMUSE.		Recorded

Module 2 (F. Lotti) – 15 h

Live Sessions	Contents	CET/CEST	Days
M2-A General Overlook about Model Calibration	Principle of Parsimony and highly parametrized methods Is model calibration really worth? Traditional calibration approach based on uniform "zones" Sensitivity analysis, parameter correlation and troubles associated Exercise/tutorials with MODELMUSE	3-6pm 10am-1pm 3-6pm	2027-05-07 2027-05-14 2027-05-21
M2-B Basics of PEST	Pilot points, strategies and brief review of geostatistics needed to understand them. Regularization, why do we need it? Exercise/tutorials with MODELMUSE Case study calibration	10am-1pm 3-6pm	2027-05-28 2027-06-04

Module 3 (J. Doherty) – 32 h

The course is included in the school programme but also available as a stand-alone course.

Live Sessions	Contents	CET/CEST
Day 1 2027-11-13	Metrics for decision-support modelling Brief review of linear algebra and geostatistics What does "calibration" really mean? Bayes theorem, and how it is applied in groundwater modelling Predictive uncertainty and predictive error Old style calibration based on parameter parsimony	9 am-1 pm 2-6 pm
Day 2 2027-11-14	The costs and benefits of parameter uniqueness Highly parameterized inversion and regularization Subspace methods including singular value decomposition Tikhonov regularization Pilot points as a parameterization device Construction of covariance matrices for parameter regularization and uncertainty analysis	9 am-1 pm 2-6 pm
Day 3 2027-11-15	Principles of uncertainty analysis Nonstationary geostatistics Generating random hydraulic property fields for structured and unstructured grids Linear uncertainty analysis Ensemble smoothers: theory and practice Direct predictive hypothesis-testing	9 am-1 pm 2-6 pm
Day 4 2027-11-16	Uncertainty in uncertainty: parameterizing the prior Data space inversion Ensemble space inversion Hierarchical inversion How history-matching can do more harm than good	9 am-1 pm 2-6 pm
Day 5 2027-11-17	Optimization under uncertainty Data worth analysis Some considerations for contaminant transport modelling, low enthalpy geothermal modelling, well protection zones. Course lunch and "Group therapy": participants discuss their own problems	9 am-3 pm

Dates subject to adjustments

Recorded courses

Basics		Hours	Trainer	Lang.
Basic Hydrogeology 25 h	Introduction to Hydrogeology	2:30	*Dragoni, Ducci*	*ENG/IT*
	Types of Aquifers, Springs and Rivers	11:00	*Petitta, Bonomi, Piscopo*	*IT*
	Properties of soil. Geotechnical Investigations	3:30	*Di Matteo*	*IT*
	Hydrogeological investigations and Isotopes	2:30	*Mastrorillo, Petitta*	*IT*
	Structural Geology	2:00	*Guastaldi*	*IT/ENG*
	Geophysics	3:30	*Menghini*	*IT*
Basic Contaminant Hydrogeology 20 h	Hydrogeochemistry	5:30	*Barbagli*	*IT/ENG*
	Solute transport	3:00	*Borsi*	*IT/ENG*
	Contaminants origin and properties (fate and transport). Sustainable aquifer and groundwater remediation	5:30	*Petrangeli Papini*	*IT*
	Groundwater Monitoring	3:30	*Preziosi*	*IT/ENG*
	Regulatory context in Italy	3:00	*Di Gennaro*	*IT*
Basic methods 33 h	Linear algebra	2:30	*De Filippis*	*IT/ENG*
	Statistics and Geostatistics	16:00	*Guastaldi*	*IT/ENG*
	GIS	6:00	*De Filippis*	*IT/ENG*
	Relational databases	6:00	*Barbagli*	*IT/ENG*
	Time series analysis and examples of statistical application	3:00	*Borsi, Meggiorin*	*ENG*
Groundwater Engineering 8 h	Wells construction and Aquifer tests	4:30	*Piscopo*	*IT*
	Groundwater control for construction	1:00	*Preene*	*ENG*
	Roads, Tunnels and Dams	2:30	*Francani*	*IT*
MODFLOW Conduit Flow Process (CFP) 10 h	The conceptual and numerical model for karst. Theory and application of MODFLOW-CFP, set up with ModelMuse and text editor. Advanced features in CFPv2. Primer and outlook of CFPy (Scripting CFP with Python). Primer and outlook to transport computation.	10:00	*T. Reimann, S. Birk*	*ENG*
FloPy and PyEMU 11 h	Before getting started. A first simple steady state and transient model. Flow and transport model building and predictive use. Model building with FloPy Pre-processing of data and building the model from YML notebook Overview of the modflow-setup tool Pre-processing of data and building the model from YML notebook Introduction to PEST++ and PyEMU Set up and run PESTPP-IES	11:00	*R. Hugman, M. Fienen, J. White*	*ENG*

Other recorded courses will be made accessible on request

Registration

Ente di Formazione CONSIGLIO NAZIONALE GEOLOGI Accreditato

Contact us

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Siamo presenti sul MEPA

acquistinretepa

Il portale degli acquisti della pubblica amministrazione

CARTA del DOCENTE

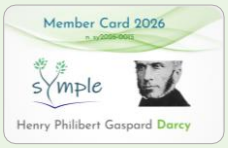
SPENDI QUI IL TUO BUONO

Students – ECHN	SGI – IAH members	Regular
1600 €	**2500 €**	**2700 €**
before July 30: 1300 € enter the Coupon Code **School_EB_2027**	**before July 30: 2200 €** enter the Coupon Code **School_EB_2027**	**before July 30: 2400 €** enter the Coupon Code **School_EB_2027**

Scholarship eligibility:

- Must be a national of, and reside in, a low- or middle-income country (refer to the list provided in the application form).
- Preferably under the age of 35.

Professional credits (50 APC) for **Italian Geologists**



Become a **SYMPLE Member** read more about the memberships benefits

Register here - Apply for Scholarship