School of hydrogeological modelling & Project-related strategies

Syllabus

November 2021 – May 2023

Fully blended: on-line, on-site, live, recorded

Rev.1

02/08/2021

The initiative is under the auspice of the

International Association of Hydrogeologists – Italian Chapter

Italian Chapter

Index

1. Basic School information

SYMPLE proposes an applied **School of Hydrogeological Modelling** divided into **6 Modules**:

MODULES

1) Basics
2) Hydrogeology
3) Groundwater Numerical Modelling
4) Project-Related Strategies
5) Workshop with field activities
6) Decision-Makers Course

Topics are deployed through different **integrated approaches**, including:

HOW

a) Recorded lessons (Module 1, 2, 3)
b) Exercises live sessions (Module 1, 2, 3)
c) Reading/study material (all modules)
d) Optional assignments (all modules)
e) Q&A/discussion on-line live sessions (all modules)
f) Participants moderated forum about "hot" topics (all modules)
g) Individual assistance (all modules)
h) On-line interactive courses (Module 4)
i) On-site courses (Module 5, 6)

Each activity is recorded, organized and accessible from the Moodle e-learning platform. Registered participants are provided with credentials to login from November 2021 to May 2023.

2. Languages of the School

The School is thought to be fruitfully attended by Italian and English speakers. Next editions might include Russian, Spanish and Chinese subtitles, as well as sessions dealing with local regulations and local hydrogeological contexts.


- Reading/study material is provided in English
- Slides are written in English
- Lessons are performed in English or Italian, with subtitles in both languages
- Support is provided in Italian, English, Spanish, Russian, Chinese on request

The only exceptions are the Risk Analysis course (HGCON-ADR) fully in Italian, and the Python section (GMPYL) which is fully in English.

3. Instructors information

The Teaching Staff includes about 40 prestigious experts from Universities, Companies, Professional Orders, Public Agencies from different countries.

Name	Surname	Company/Job/Institution
Alessio	Barbagli	CGT - Università di Siena
Gabriele	Bernagozzi	Geologist
Tullia	Bonomi	Università di Milano Bicocca
Iacopo	Borsi	TEA Sistemi SPA
Giovanna	De Filippis	AECOM URS Italia S.p.A.
Antonio	Di Gennaro	Engineer - Ministry of the Environment
Lucio	Di Matteo	Università di Perugia
John	Doherty	Watermark Numerical Computing Australia
Walter	Dragoni	Università di Perugia
Daniela	Ducci	Università degli Studi Federico II di Napoli
Marco	Falconi	ISPRA
Daniel	Feinstein	Wisconsin University Milwaukee, USA
Michael	Fienen	USGS
Giovanni	Formentin	Tethys srl
Vincenzo	Francani	Politecnico di Milano
Enrico	Guastaldi	CGT – Università di Siena
Randall	Hunt	USGS
Rui	Hugman	GMDSI/Ambidialogo Lda
Luigi	Lana	Kataclima/SYMPLE
Sara	Leggio	Economist/SYMPLE
Francesca	Lotti	Kataclima/SYMPLE
Lucia	Mastrolillo	Università di Roma 3
Mara	Meggiorin	Sinergeo srl
Antonio	Menghini	Emergo
Gani	Nesipbekov	Eurasian Resources Group, Kazakhstan
Oleksandra	Pedchenko	INRS Canada
Marco	Petitta	Università di Roma Sapienza
Marco	Petrangeli Papini	Università di Roma Sapienza
Vincenzo	Piscopo	Università della Tuscia
Vincent	Post	BRG Germany
Martin	Preene	Preene Groundwater Consulting USA
Patrizia	Pretto	EU JRC
Viviana	Re	Università di Pisa
Rudy	Rossetto	Scuola Superiore S. Anna
Manuel	Sapiano	Energy and Water Agency Malta
Luca	Vettorello	Sinergeo
Stefano	Viaroli	Università di Roma 3
Jeremy	White	INTERA

4. Expectations for interaction

It is possible to directly interact with the trainers in the dedicated Q&A sessions and/or asking for an individual discussion. We absolutely encourage interaction, being a fundamental component of the knowledge sharing.

5. SYMPLE's philosophy about teaching and learning

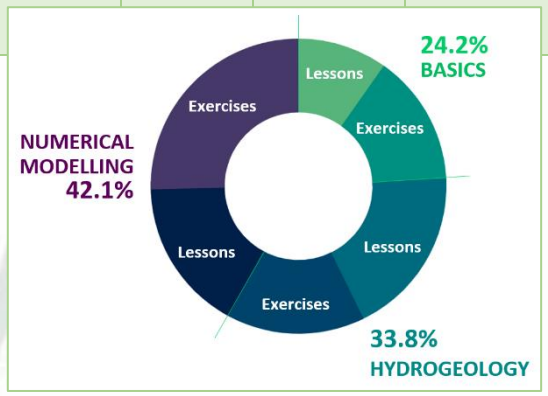
SYMPLE is a School made up of courses, but differently from other courses, the attempt here is not only to "teach", but to transfer as much experience as possible to the participants. They say that it takes 10 years to become a real modeller; well, we try to do that in just one year. We selected all the tools a modeller needs, focusing on what she/he really needs, all explained in a modelling-targeted way and applied to real cases, much more difficult to "solve" than exercises where everything works fine. Trainers have been asked to think at the school participants not as "students", but as "colleagues" that they have to train to work and solve problems together.

6. Description of the School content

Topics are divided into 6 Modules. The tables below give an idea of the *quantitative* content of the School in terms of number of lessons, number of trainers, hours of recorded lessons and estimated hours needed to execute the practical part.

Module	Name	ID	Description	Lessons	Trainers	Rec. hours	Ex. hours
1	Basics	B	Overview of the basic knowledge	18	12	58	85
2	Hydrogeology	HG	Theory and practice of hydrogeology in different contexts of application	54	18	110	90
3	Groundwater Numerical Modelling	GM	Building of models, calibrating and performing uncertainty analysis	47	9	99	150

MODULES 1, 2, 3



Module	Name	ID	Description	Lenght	Hours of practical activities
4	Project-Related Strategies	PR	Strategic application of modelling to specific hydrogeological problems	Stand-alone courses, 4 days over 4 weeks	32
5	Workshop	WS	Residential experience with field activities, team-building exercises and discussions	7 days	56

Module	Name	ID	Description	Lenght	Talks and discussion
6	Decision-Makers Course	DM	Numerical modelling explained to non-modellers	1 day	8

The approach of the School is described in this webpage, while the covered topics are listed in the Programme. The full list of the lessons is reported in APPENDIX 1, where details are provided about the single lesson status, trainer, spoken and subtitles languages presently available.

7. School goals and objectives

As reported on the website, SYMPLE intends to promote and facilitate the understanding, use and evaluation of hydrogeological numerical models through a multidisciplinary program (Module 1, 2, 3) associated with the use of strategies aimed at solving specific problems (project-related strategy, Module 4).

SYMPLE intends to teach an emerging paradigm, supported by latest available ideas and software for data assimilation, of "*starting from the problem and working backwards*". This workflow consists of firstly identifying the type of data that has the greatest capacity to reduce the uncertainties associated with decision-critical predictions of system behaviour, and then designing a numerical simulation strategy that serves the decision-support imperative of actually quantifying and reducing those uncertainties.

Development of better strategies to address existing and pressing problems just requires the same data and software mostly already available (PEST and PEST++ suites), but a new mindset. And in many cases the modelling will be quicker and less expensive because it is:

- management targeted;
- no more complex than it needs to be to serve the decision-support demands;
- supported by project-related strategies with associated specific software.

That is, modelling will be complex enough to assimilate data and reduce uncertainty, but strategically simple because it is decision-focused.

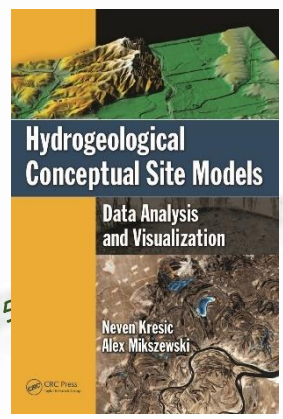
8. Purchases associated to the School

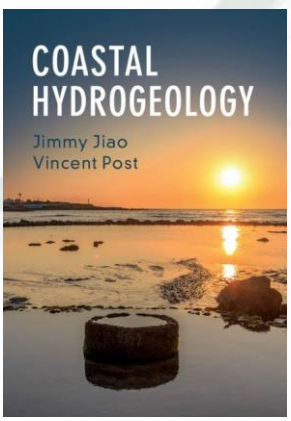
Most of the School makes use of public domain software. Anyway an important part of the course is performed with the commercial GUI Groundwater Vistas (ESI) the one which better supports PEST(++) at present. Participants can purchase the licences with 20% discount, as agreed with the software developers.

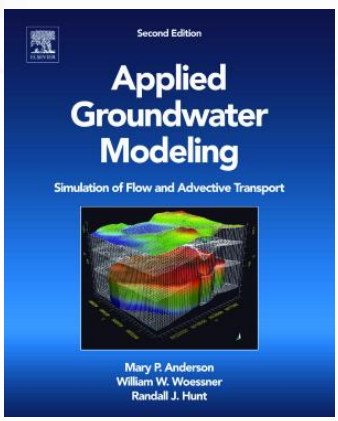
Alternatively, ModelMuse (USGS) is explained and supported for assistance. PEST is going to be implemented in the next official release of the GUI and most of the exercises will be also set up to be executed with ModelMuse.

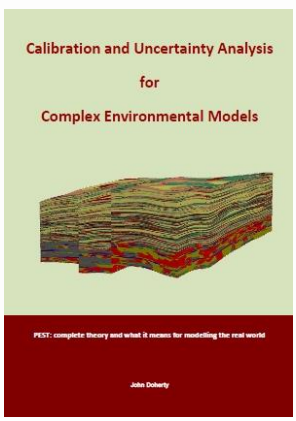
A section on request is dedicated to FEFLOW. The interested participants can purchase the licences with 20% discount as agreed with DHI-Italy.

Most of the School makes use of public domain papers or written on purpose study material, nevertheless high-quality books are recommended even if not necessary to attend the School.



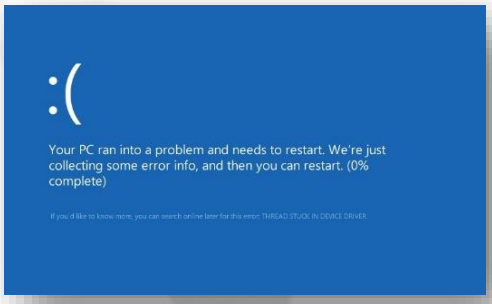






9. Pre- and co-requisites for the course

SYMPLE starts from zero. The only pre-requisite is the will to learn and a technical-scientific background. The co-requisites are the same needed to be a numerical modeller: patience, investigative approach, IT propension. If it happens to you to get nervous when your computer crashes, you are not eligible to attend!



10. Estimate of participants workload

Module 1 + 2 + 3

Since the aim of SYMPLE is to make you an "expert hydrogeological modeller", attending the School implies to spent time "working" with real cases, besides exercises. The number of hours is highly subjective and depends on the personal background. Assuming that you have no preliminary knowledge about data processing and modelling, and you decide to follow every single lesson proposed in Module 1, 2 and 3 and execute all the exercises (also the optional ones), hereafter you can find two possible monthly schedules.

Schedule 1: 267 hours of lessons + 325 hours of exercises in 11 months would require 56 hours/month. See the example of January 2022 according to 4 different weekly distributions.

SUN	MON	TUE	WED	THU	FRI	SAT
26	27	28	29	30	31	1 Jan
2	3	4	5	6	7 • 9:15am SYMPLE (8 hours)	8 • 10am SYMPLE (6 hours)
9	10 • 6pm SYMPLE (2 hours)	11 • 6pm SYMPLE (2 hours)	12 • 6pm SYMPLE (2 hours)	13 • 6pm SYMPLE (2 hours)	14 • 5pm Exercises (3 hours)	15 • 10am SYMPLE (2 hours)
16	17	18 • 3pm SYMPLE (4 hours)	19	20 • 3pm SYMPLE (4 hours)	21 • 2pm SYMPLE (6 hours)	22
23	24	25	26	27	28 • 10am SYMPLE (7 hours)	29 • 10am SYMPLE (7 hours)
30	31	1 Feb	2	3	4	5

Schedule 2: 267 hours of lessons + 325 hours of exercises over the full length of the School (18 months) would require 33 hours/month. See the example of February 2022 according to 4 different weekly distributions.

SUN	MON	TUE	WED	THU	FRI	SAT
30	31	1 Feb	2	3	4 10am SYMPLE (8 hours)	5
6	7	8	9	10	11	12 10am SYMPLE (8 hours)
13	14 6pm SYMPLE (2 hours)	15 6pm SYMPLE (2 hours)	16 6pm SYMPLE (2 hours)	17 6pm SYMPLE (2 hours)	18	19
20	21	22	23	24	25 4pm SYMPLE (4 hours)	26 9am SYMPLE (4 hours)
27	28	1 Mar	2	3	4	5

There is the chance to request **an extension** of the access to the School, in case something goes wrong. Extensions are free of charge up to 3 months or, alternatively, an extra year of access can be purchased at 25% of the cost.

Module 4

Courses of Module 4 will be activated from March 2022 based on a minimum number of participants. The single course will take 4 days (32 hours) distributed over 4 weeks. This setting is flexible and can be changed according to the participants needs.

Module 5

The on-site Workshop is concentrated in 7 days and will be held in October 2022.

Module 6

The Decision-Maker Course is concentrated in 1 day scheduled in 2022 in Italy, dates will be communicated by February 2022. Similar experiences can be repeated in different counties on request.

11. Policy for participants from low- and middle-income countries

Scholarships are available thanks to the entrustment of the SYMPLE Supporters. To be eligible, applicants must:

- be resident in and national of, low- and middle-income countries (see the list below);
- be 35 years old or younger, as documented by a valid document.

The final selection of candidates will be done in conjunction with the Supporters and will be based on qualifications and interview. Priority will be given to candidates with programming skills.

To apply, fill the form with required information and CV.

Deadline for application is September 30, 2021.

LOW-INCOME ECONOMIES (World Bank, 2021) – Priority 1

Afghanistan	Guinea-Bissau	Sierra Leone
Burkina Faso	Haiti	Somalia
Burundi	Korea, Dem. People's Rep.	South Sudan
Central African Republic	Liberia	Sudan
Chad	Madagascar	Syrian Arab Republic
Congo, Dem. Rep	Malawi	Tajikistan
Eritrea	Mali	Togo
Ethiopia	Mozambique	Uganda
Gambia	Niger	Yemen, Rep.
Guinea	Rwanda	

LOWER-MIDDLE INCOME ECONOMIES (World Bank, 2021) – Priority 2

Angola	Honduras	Papua New Guinea
Algeria	India	Philippines
Bangladesh	Kenya	São Tomé and Principe
Benin	Kiribati	Senegal
Bhutan	Kyrgyz Republic	Solomon Islands
Bolivia	Lao PDR	Sri Lanka
Cabo Verde	Lesotho	Tanzania
Cambodia	Mauritania	Timor-Leste
Cameroon	Micronesia, Fed. Sts.	Tunisia
Comoros	Moldova	Ukraine
Congo, Rep.	Mongolia	Uzbekistan
Côte d'Ivoire	Morocco	Vanuatu
Djibouti	Myanmar	Vietnam
Egypt, Arab Rep.	Nepal	West Bank and Gaza
El Salvador	Nicaragua	Zambia
Eswatini	Nigeria	Zimbabwe
Ghana	Pakistan	

02/08/2021

APPENDIX 1

Module	Module Name	Section	ID	Title	Recording (min)	Trainer	Spoken	Slides/material	Subtitles
1	BASICS	Essentials	BE-ICT	Basics of Information Technologies	In progress	Lotti	ENG	ENG	
1	BASICS	Essentials	BE-LA	Linear algebra	158	De Filippis	IT/ENG	ENG	
1	BASICS	Essentials	BE-HPS	Hydraulic properties of soils	96	Di Matteo	IT	ENG	IT/ENG
1	BASICS	Essentials	BE-HC	Hydrogeochemistry	332	Barbagli	IT	ENG	IT/ENG
1	BASICS	Essentials	BE-IH	Isotope hydrology	131	Petitta	IT	ENG	IT/ENG
1	BASICS	Essentials	BE-GMB	Groundwater Microbiology	In progress	Pretto	ENG	ENG	
1	BASICS	Essentials	BE-GP	Geophysics	222	Menghini	IT	ENG	IT/ENG
1	BASICS	Essentials	BE-GTI	Geotechnical Investigation	104	Di Matteo	IT	ENG	IT/ENG
1	BASICS	Essentials	BE-SG	Structural Geology	122	Guastaldi	IT	ENG	IT/ENG
1	BASICS	Essentials	BE-EE	Environmental Economics	In progress	Leggio	ENG	ENG	
1	BASICS	Essentials	BE-RF	Regulatory framework (EU)	132	Sapiano	ENG	ENG	ENG
1	BASICS	Data analysis	BD-ST	Statistics	487	Guastaldi	IT/ENG	ENG	
1	BASICS	Data analysis	BD-GST	Geostatistics	464	Guastaldi	IT/ENG	ENG	
1	BASICS	Data analysis	BD-GIS	GIS	374	De Filippis	IT/ENG	ENG	
1	BASICS	Data analysis	BD-RD	Relational databases	342	Barbagli	IT/ENG	ENG	
1	BASICS	Data analysis	BD-TSA	Time series analysis	54	Borsi	ENG	ENG	
1	BASICS	Data analysis	BD-AST	Examples of statistical application	117	Meggiorin	ENG	ENG	
2	HYDROGEOLOGY	Essentials	HGE-HH	History of Hydrogeology	In progress	Ducci	IT	ENG	IT/ENG
2	HYDROGEOLOGY	Essentials	HGE-HB	Introduction and hydrological balance	In progress	Dragoni	ENG	ENG	
2	HYDROGEOLOGY	Essentials	HGE-GW	Groundwater	In progress	Dragoni	ENG	ENG	
2	HYDROGEOLOGY	Essentials	HGE-FE	Applications of the Darcy equation	In progress	Dragoni	ENG	ENG	
2	HYDROGEOLOGY	Essentials	HGE-AQI	Aquifers I – Carbonate aquifers	In progress	Petitta	IT	ENG	IT/ENG
2	HYDROGEOLOGY	Essentials	HGE-AQII	Aquifers II – Alluvial aquifers	152	Bonomi	IT	ENG	IT/ENG

Module	Module Name	Section	ID	Title	Recording (min)	Trainer	Spoken	Slides/material	Subtitles
2	HYDROGEOLOGY	Essentials	HGE-AQIII	Aquifers III - Volcanic aquifers	75	Piscopo	IT	ENG	IT/ENG
2	HYDROGEOLOGY	Essentials	HGE-SR	Springs and rivers	236	Petitta	IT	ENG	IT/ENG
2	HYDROGEOLOGY	Essentials	HGE-HD	Hydrogeological Investigations - hydrologic data	80	Mastrorillo	IT	ENG	IT/ENG
2	HYDROGEOLOGY	Essentials	HGE-CD	Hydrogeological Investigations - climate data	80	Mastrorillo	IT	ENG	IT/ENG
2	HYDROGEOLOGY	Essentials	HGE-WI	Wells I - Construction	115	Piscopo	IT	ENG	IT/ENG
2	HYDROGEOLOGY	Essentials	HGE-WII	Wells II - Aquifer tests	166	Piscopo	IT	ENG	IT/ENG
2	HYDROGEOLOGY	Essentials	HGE-HYP	From the conceptual model to the numerical model	113	Bonomi	IT	ENG	IT/ENG
2	HYDROGEOLOGY	Contamination	HGCON-CN	Contesto normativo (IT)	In progress	Di Gennaro	IT	IT	
2	HYDROGEOLOGY	Contamination	HGCON-COP	Contaminants origin and properties (fate and transport)	180	Petrangeli Papini	IT	ENG	IT/ENG
2	HYDROGEOLOGY	Contamination	HGCON-ADE	Advection Dispersion Equations	96	Borsi	IT	ENG	IT/ENG
2	HYDROGEOLOGY	Contamination	HGCON-UT	Unsaturated transport	92	Borsi	IT	ENG	IT/ENG
2	HYDROGEOLOGY	Contamination	HGCON-REM	Sustainable aquifer and groundwater remediation	156	Petrangeli Papini	IT	ENG	IT/ENG
2	HYDROGEOLOGY	Contamination	HGCON-ADR1	Modello concettuale	58	Falconi	IT	IT	
2	HYDROGEOLOGY	Contamination	HGCON-ADR2	Sorgenti di contaminazione	60	Falconi	IT	IT	
2	HYDROGEOLOGY	Contamination	HGCON-ADR3	Fattori di trasporto	50	Falconi	IT	IT	
2	HYDROGEOLOGY	Contamination	HGCON-ADR4	Parametri sito-specifici	69	Falconi	IT	IT	
2	HYDROGEOLOGY	Contamination	HGCON-ADR5	Portata effettiva di esposizione	30	Falconi	IT	IT	
2	HYDROGEOLOGY	Contamination	HGCON-ADR6	Calcolo del rischio e delle CSR	46	Falconi	IT	IT	
2	HYDROGEOLOGY	Contamination	HGCON-ADR7	Applicazione a punti carburante	58	Falconi	IT	IT	
2	HYDROGEOLOGY	Contamination	HGCON-ADR8	Matrici aeriformi	84	Falconi	IT	IT	
2	HYDROGEOLOGY	Contamination	HGCON-ADR9	Software per AdR	30	Falconi	IT	IT	

Module	Module Name	Section	ID	Title	Recording (min)	Trainer	Spoken	Slides/material	Subtitles
2	HYDROGEOLOGY	Coastal hydrogeology	HGCOA-CA	Coastal groundwater systems	55	Post	ENG	ENG	
2	HYDROGEOLOGY	Coastal hydrogeology	HGCOA-FL	GW flow in coastal aquifers	69	Post	ENG	ENG	
2	HYDROGEOLOGY	Coastal hydrogeology	HGCOA-EX	GW exploration in coastal regions	54	Post	ENG	ENG	
2	HYDROGEOLOGY	Coastal hydrogeology	HGCOA-HC	Hydrochemistry	54	Post	ENG	ENG	
2	HYDROGEOLOGY	Coastal hydrogeology	HGCOA-MOD	Introduction to modelling	69	Post	ENG	ENG	
2	HYDROGEOLOGY	Coastal hydrogeology	HGCOA-MNG	Management issues	55	Post	ENG	ENG	
2	HYDROGEOLOGY	Geothermal systems	HGGT-TR	Heat transfer mechanisms	In progress	Pedchenko	ENG	ENG	
2	HYDROGEOLOGY	Geothermal systems	HGGT-EN	Geothermal energy	In progress	Pedchenko	ENG	ENG	
2	HYDROGEOLOGY	Geothermal systems	HGGT-CL	Low-enthalpy geothermal plants (close loop)	In progress	Pedchenko	ENG	ENG	
2	HYDROGEOLOGY	Geothermal systems	HGGT-OP	Low-enthalpy geothermal plants (open loop)	108	Vettorello	ENG	ENG	
2	HYDROGEOLOGY	Geothermal systems	HGGT-TW	Thermal aquifers	In progress	Piscopo	IT	ENG	
2	HYDROGEOLOGY	Mineral waters	HGMW-1	Italian regulation on mineral waters production. The case of a mineralized aquifer	130	Viaroli	IT	IT/ENG	IT/ENG
2	HYDROGEOLOGY	Mining hydrogeology	HGMIN-DA	Relevant data collection and processing	In progress	Nesipbekov	ENG	ENG	
2	HYDROGEOLOGY	Mining hydrogeology	HGMIN-DEW	Dewatering and groundwater control	In progress	Nesipbekov	ENG	ENG	

Module	Module Name	Section	ID	Title	Recording (min)	Trainer	Spoken	Slides/material	Subtitles
2	HYDROGEOLOGY	Mining hydrogeology	HGMIN-CON	Quality issue connected to mining operations	In progress	Nesipbekov	ENG	ENG	
2	HYDROGEOLOGY	Civil-engineering constructions	HGCIV-CC	Groundwater control for construction	54	Preene	ENG	ENG	ENG
2	HYDROGEOLOGY	Civil-engineering constructions	HGCIV-RO	Roads	62	Francani	IT	IT	IT/ENG
2	HYDROGEOLOGY	Civil-engineering constructions	HGCIV-TU	Tunnels	59	Francani	IT	IT	IT/ENG
2	HYDROGEOLOGY	Civil-engineering constructions	HGCIV-DA	Dams	35	Francani	IT	IT	IT/ENG
2	HYDROGEOLOGY	Gw resources management	HGRES-AGR	Groundwater use in river basin management	In progress	Rossetto	ENG	ENG	
2	HYDROGEOLOGY	Gw resources management	HGRES-MAR	Rural water management	In progress	Rossetto	ENG	ENG	
2	HYDROGEOLOGY	Gw resources management	HGRES-RBM	Measures for adapting to climate change: managed aquifer recharge	In progress	Rossetto	ENG	ENG	
2	HYDROGEOLOGY	Gw resources management	HGRES-DW	Potable water supply	83	Vettorello	ENG	ENG	
2	HYDROGEOLOGY	Socio-Hydrogeology	HGSOC-1	Introduction	74	Re	ENG	ENG	
2	HYDROGEOLOGY	Socio-Hydrogeology	HGSOC-2	Tools and techniques	70	Re	ENG	ENG	
2	HYDROGEOLOGY	Socio-Hydrogeology	HGSOC-3	Practical applications and case studies	66	Re	ENG	ENG	
3	GROUNDWATER MODELLING	Introduction	GMI-AN	From analytical to numerical solutions	In progress	Bernagozzi	IT	ENG	IT/ENG

Module	Module Name	Section	ID	Title	Recording (min)	Trainer	Spoken	Slides/material	Subtitles
3	GROUNDWATER MODELLING	Introduction	GMI-DM	Modelling support in the decision-making process	In progress	Doherty	ENG	ENG	
3	GROUNDWATER MODELLING	Model building in ModelMuse	GMM-1	Flow numerical modelling	In progress	Bernagozzi	IT	ENG	IT/ENG
3	GROUNDWATER MODELLING	Model building in ModelMuse	GMM-2	Mass transport numerical modelling	In progress	Bernagozzi	IT	ENG	IT/ENG
3	GROUNDWATER MODELLING	Model building in ModelMuse	GMM-3	Heat transport numerical modelling	In progress	Bernagozzi	IT	ENG	IT/ENG
3	GROUNDWATER MODELLING	Model building in GW Vistas	GMV-1	Course presentation + MODFLOW history and and Modelling guides	124	Feinstein	IT	ENG	IT/ENG
3	GROUNDWATER MODELLING	Model building in GW Vistas	GMV-2	GW Vistas 7/8 introduction	147	Feinstein	ENG	ENG	
3	GROUNDWATER MODELLING	Model building in GW Vistas	GMV-3	MODFLOW-NWT	60	Feinstein	ENG	ENG	
3	GROUNDWATER MODELLING	Model building in GW Vistas	GMV-4	Multi-node Wells and MNW package	53	Feinstein	ENG	ENG	
3	GROUNDWATER MODELLING	Model building in GW Vistas	GMV-5	Groundwater-superficial water exchanges	124	Feinstein	ENG	ENG	
3	GROUNDWATER MODELLING	Model building in GW Vistas	GMV-6	MODPATH5 and MODPATH7	128	Feinstein	ENG	ENG	
3	GROUNDWATER MODELLING	Model building in GW Vistas	GMV-7	MT3DMS and MT3D-USGS	336	Feinstein	ENG	ENG	
3	GROUNDWATER MODELLING	Model building in GW Vistas	GMV-8	Seawater intrusion with SEAWAT	45	Feinstein	ENG	ENG	
3	GROUNDWATER MODELLING	Model building in GW Vistas	GMV-9	Heat transport and variable-density flow with SEAWAT2005	79	Feinstein	ENG	ENG	
3	GROUNDWATER MODELLING	Model building in GW Vistas	GMV-10	MODFLOW6: new strategies + course conclusions	109	Feinstein	ENG	ENG	
3	GROUNDWATER MODELLING	Calibration and UA with PEST	GMCUA-1	Introduction of the case study	In progress	Lotti	ENG	ENG	

Module	Module Name	Section	ID	Title	Recording (min)	Trainer	Spoken	Slides/material	Subtitles
3	GROUNDWATER MODELLING	Calibration and UA with PEST	GMCUA-2	PEST introduction	In progress	Lotti	ENG	ENG	
3	GROUNDWATER MODELLING	Calibration and UA with PEST	GMCUA-3	Structure of files	In progress	Formentin	ENG	ENG	
3	GROUNDWATER MODELLING	Calibration and UA with PEST	GMCUA-4	Traditional parameter estimation	In progress	Doherty/Formentin/Lotti	ENG	ENG	
3	GROUNDWATER MODELLING	Calibration and UA with PEST	GMCUA-5	Highly parameterized inversion with pilot points	In progress	Doherty/Formentin/Lotti	ENG	ENG	
3	GROUNDWATER MODELLING	Calibration and UA with PEST	GMCUA-6	Uncertainty analysis	In progress	Doherty/Formentin/Lotti	ENG	ENG	
3	GROUNDWATER MODELLING	Calibration and UA with PEST	GMCUA-7	Decision and modelling	In progress	Doherty	ENG	ENG	
3	GROUNDWATER MODELLING	Calibration and UA with PEST	GMCUA-8	PEST++ overview	In progress	White	ENG	ENG	
3	GROUNDWATER MODELLING	Calibration and UA with PEST	GMCUA-9	Overview of model-partner-software	In progress	Doherty	ENG	ENG	
3	GROUNDWATER MODELLING	Calibration and UA with PEST	GMCUA-10	Case histories	In progress	Doherty	ENG	ENG	
3	GROUNDWATER MODELLING	Language basics	GMPYL-1	Intro on Python as programming language	52	Borsi	ENG	ENG	
3	GROUNDWATER MODELLING	Language basics	GMPYL-2	Fundamentals and advanced features	56	Borsi	ENG	ENG	
3	GROUNDWATER MODELLING	Language basics	GMPYL-3	Analysis of drawdown due to a pumping well and computation of evapotranspiration	24	Borsi	ENG	ENG	
3	GROUNDWATER MODELLING	Language basics	GMPYL-4	Using Python/Pandas to manage hydrological timeseries	54	Borsi	ENG	ENG	
3	GROUNDWATER MODELLING	Model building with FloPy	GMFLO-1	Before getting started	In progress	Hugman	ENG	ENG	

Module	Module Name	Section	ID	Title	Recording (min)	Trainer	Spoken	Slides/material	Subtitles
3	GROUNDWATER MODELLING	Model building with FloPy	GMFLO-2	A very simple model (steady state)	In progress	Hugman	ENG	ENG	
3	GROUNDWATER MODELLING	Model building with FloPy	GMFLO-3	A more complex model (transient)	In progress	Hugman	ENG	ENG	
3	GROUNDWATER MODELLING	Model building with FloPy	GMFLO-4	Advanced topic demonstration	In progress	Hugman	ENG	ENG	
3	GROUNDWATER MODELLING	Model building with FloPy	GMFLO-5	Geoprocessing and setting up for modflow setup	In progress	Fienen	ENG	ENG	
3	GROUNDWATER MODELLING	Model building with FloPy	GMFLO-6	Making a telescopic mesh refinement model within in existing model	In progress	Fienen	ENG	ENG	
3	GROUNDWATER MODELLING	Model building with FloPy	GMFLO-7	Building a streamflow routing network package	In progress	Fienen	ENG	ENG	
3	GROUNDWATER MODELLING	Calibration and UA with PEST(++)	GMPP-1	Editing a PEST(++) control file using PyEMU	In progress	White/Fienen	ENG	ENG	
3	GROUNDWATER MODELLING	Calibration and UA with PEST(++)	GMPP-2	Connecting a model to PEST(++) using PstFrom in PyEMU	In progress	White/Fienen	ENG	ENG	
3	GROUNDWATER MODELLING	Calibration and UA with PEST(++)	GMPP-3	Post-processing PEST(++) results with PyEMU	In progress	White/Fienen	ENG	ENG	
3	GROUNDWATER MODELLING	Calibration and UA with PEST(++)	GMPP-4	Uncertainty analysis with PESTPP-IES	In progress	White	ENG	ENG	