# Enrico Balugani   *Birth place and date: Cesena (Italy), November 19, 1982* Italian Nationality

enricobalugani82@gmail.com   •   +39 3917634972   •   enrico.balugani *(Skype)*   •
via G.Pascoli n.24   •   Ravenna   •   RA   •   Italia

## Profile

I am an Environmental Scientist specialized in Modelling (statistical, numerical, system dynamics) and Hydrogeology, with experience in both academic research and consulting in various countries (Italy, The Netherlands, Spain, Colombia). My main interest is in soil physics, with a focus on soil exchange of energy and matter with the atmosphere, related with environmental problems. More in details, I worked on modelling of soil carbon dynamics, liquid and vapour water flow in soils and porous systems, soil erosion, and environmental impacts of the change in land use. My research has a strong focus on interdisciplinarity, modeling (of ecosystems, water resources, risk assessment, ecosystem services, soil physics, chemistry and biology), GIS, statistics and agriculture. My goals are to help to achieve sustainable development and create scientific knowledge by integrating various scientific disciplines on one hand and finding the connection between theory and practice on the other.

I worked both independently and in a team: independently while managing the monitoring network of the hydrogeology laboratory of Bologna University (about water fluxes and quality in a natural park) and as the hydrogeology consultant in a climate change impact study in Colombia; as part of a team during an interdisciplinary study about evapotranspiration in Spain (with a Dutch University); as leader of a team when organizing the yearly fieldwork program for Ph.D. students (in Italy) and M.Sc. students (in The Netherlands and Spain); and as a member of the EMRG research group of Environmental Sciences of CIRSA (Centre for research in Environmental Sciences, Ravenna, Bologna University). I have experience in scientific writing (and reviewing), scientific presentations, meeting preparation (I organized the Ph.D. monthly meeting for the hydrogeology department of Twente University), computer programming, teaching, student tutoring. I would gladly travel around for work.

## Education

Twente University (ITC) - Wageningen University          Enschede-Wageningen, The Netherlands

**Ph.D. candidate in Hydrogeology**          *2010 – 2021*

Thesis project: "Partitioning (and sourcing) of bare soil evaporation in semi-arid areas".

Acquired skills: fieldwork planning in foreigner areas, fieldwork planning for geographical characterization of soil properties, set-up and management of hydro-climatic stations, use of soil sensors (soil moisture, temperature, water pressure), construction of lysimeters, design of soil-column laboratory experiments, writing in LaTeX code, programming in MATLAB, programming in Python (generic code and scientific version - NumPy, SciPy packages), programming in R, programming in C++, modeling of fluid flux in porous materials (especially using DuMuX and Hydrus models), upscaling techniques for geographical mapping, interpolation techniques in hydrogeology, theory of vapor flow in porous media, statistical analysis focused of model calibration and validation, statistical analysis for geographical characterization of soil geo-physical properties, writing techniques for scientific articles, team-writing techniques for scientific articles, team management, presentation of results, preparation of meetings, teaching to university students.

Supervisor: Prof. Bob Su; Advisors: Prof. Sjoerd SEATM van der Zee, Dr. Klaas Metselaar, Dr. Maciek Lubczynski.

Bologna University          Bologna - Ravenna, Italy

**Environmental Sciences** (Master Degree)          *2005 – 2008*

Final grade: 110/110 cum laude

Thesis project: "Hydrogeological characterization of the dunal system between river Bevano and Lido di Classe".

Acquired skills (thesis only): Granulometric analysis, Electrical resistivity methods (V.E.S.), Use of G.I.S. software to order data and interpolate maps from them, Fourier Analysis of the transmission of tidal effect on superficial aquifers, computation of hydrogeological balance, influence of dunal system and pine forest on superficial aquifer, soil description.

Supervisor: Prof.Giovanni Gabbianelli; Mentor: Dr. Marco Antonellini.

Bologna University          Bologna - Ravenna, Italy

**Environmental Sciences** (Bachelor Degree)          *2001 – 2005*

Final grade: 107/110

Thesis project: "Primary production variations and their effect on sedimentation of layer rich in organic

carbon".

Acquired skills (thesis only): Primary production computation, mechanical properties of sediments, use of S.E.M., stratigraphic description.

Supervisor: Rossella Capozzi.

Liceo Scientifico "A.Righi"                                                                  CESENA, ITALY

(pre-university secondary education)                                                        *1996 – 2001*

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## Publications

[1] E. Balugani and M. Antonellini. Resolving the atmospheric pressure influence on watertable level fluctuations in the coastal aquifer south of Ravenna, Italy. In D. N. Arabelos and C. C. Tscherning, editors, *EGU General Assembly Conference Abstracts*, volume 11 of *EGU General Assembly Conference Abstracts*, pages –, April 2009.

[2] E. Balugani and M. Antonellini. Measuring salinity within shallow piezometers: Comparison of two field methods. *Journal of Water Resources and Protection*, 2(3):251–258, 2010.

[3] E. Balugani and M. Antonellini. Barometric pressure influence on water table fluctuations in coastal aquifers of partially enclosed seas: An example from the adriatic coast, italy. *Journal of Hydrology*, 400:176–186, 2011.

[4] E. Balugani, M.W. Lubczynski, and K. Metselaar. A framework for sourcing of evaporation between saturated and unsaturated zone in bare soil condition. *Hydrological Sciences Journal*, 61(11):1981–1995, 2016.

[5] E. Balugani, M.W. Lubczynski, and K. Metselaar. Evaporation through a dry soil layer: Column experiments. *Water Resources Research*, Accepted, 2021. Manuscript code 2020WR028286RRR.

[6] E. Balugani, M.W. Lubczynski, L. Reyes-Acosta, C. van der Tol, A.P. FrancÃǏs, and K. Metselaar. Groundwater and unsaturated zone evaporation and transpiration in a semi-arid open woodland. *Journal of Hydrology*, 547:54 – 66, 2017.

[7] E. Balugani, M.W. Lubczynski, C. van der Tol, and K. Metselaar. Testing three approaches to estimate soil evaporation through a dry soil layer in a semi-arid area. *Journal of Hydrology*, 567:405 – 419, 2018.

[8] E. Balugani, M. Maines, D. Zannoni, A. Buscaroli, and D. Marazza. Soil carbon sequestration through crops rotation in a Mediterranean Cambisols: measurement and modelling. In *EGU General Assembly*, EGU General Assembly, pages EGU21–6372, April 2021.

[9] E. Balugani, A. Rava, and D. Marazza. Variance based sensitivity analysis of the RUSLE model in the E.U. parameter space. In *EGU General Assembly*, EGU General Assembly, pages 9771EGU2020–9571, May 2020.

[10] E. Balugani, J.L. Reyes-Acosta, C. van der Tol, A.P. Francés, and M.W. Lubczynski. Partitioning and sourcing of dry season et fluxes at the footprint of the eddy covariance tower in sardon semi - arid location in spain, 2011.

[11] E. Balugani, J.L. Reyes-Acosta, C. van der Tol, and M.W. Lubczynski. Partitioning and sourcing of dry season subsurface water fluxes at the footprint of the eddy covariance tower - experimental approach, part 1. In *Proceedings of Confronting climate change : 39th IAH congres*, Niagara Falls, Canada., 2012.

[12] C. Carlini, A. Primante, N. Greggio, E. Balugani, A. Contin, and D. Marazza. PO4 recovery using mixtures of biochar and carbonate materials. In *EGU General Assembly*, EGU General Assembly, pages EGU21–2716, April 2021.

[13] Luca Compagnoni, Diego Marazza, Serena Righi, Enrico Balugani, and Eva Merloni. Land Use Change comprehensive framework in LCA for microalgae cultivation systems as emerging production option in the bio-economy. In *ABSTRACT BOOK SETAC Europe 28th Annual Meeting*, 2018.

[14] A.P. Francés, M.W. Lubczynski, J.L. Reyes-Acosta, E. Balugani, C. van der Tol, and T. Hassan. Partitioning and sourcing of subsurface water fluxes at the catchment scale : modeling approach, part 2. In *Proceedings of Confronting climate change : 39th IAH congres*, Niagara Falls, Canada., 2012.

[15] A.P. Francés, J.L. Reyes-Acosta, E. Balugani, C. van der Tol, and M.W. Lubczynski. Assessment of catchment water balance using distributed and transient coupled models of the unsaturated and saturated zones. In *ModelCare 2011 : models : repositories of knowledge*, Leibzig, Germany., 2011.

[16] A.P. Francés, J.L. Reyes-Acosta, E. Balugani, C. van der Tol, and M.W. Lubczynski. Towards an improved assessment of the water balance at the catchment scale : a coupled model approach. In N.S. Martin. J.M. FernÃąndez, editor, *Estudios en la zona no saturada del suelo*, volume X, Salamanca, 2011. Universidad de Salamanca.

[17] G. Gabbianelli, M. Antonellini, P. Mollema, A. Minchio, F. Stecchi, E. Balugani, and D. Savelli. Caratterizzazione idrologico-idrogeologica delle dune costiere. In REGIONE EMILIA ROMAGNA, editor, *BeachMed in Emilia- Romagna: i risultati*, pages 45–48. Regione Emilia Romagna, BOLOGNA, 2008.

[18] Nicolas Greggio, Enrico Balugani, Carlotta Carlini, Andrea Contin, Nicola Labartino, Roberto Porcelli, Marta Quaranta, Serena Righi, Luciano Vogli, and Diego Marazza. Theoretical and unused potential for residual biomasses in the emilia romagna region (italy) through a revised and portable framework for their categorization. *Renewable and Sustainable Energy Reviews*, 112:590–606, 2019.

[19] Nicolas Greggio, Beatrice M. S. Giambastiani, Enrico Balugani, Chiara Amaini, and Marco Antonellini. High-resolution electrical resistivity tomography (ert) to characterize the spatial extension of freshwater lenses in a salinized coastal aquifer. *Water*, 10(8), 2018.

[20] D. Marazza, E. Balugani, and E. Merloni. Indirect land use risk modelling with System Dynamics: the case of bioplastics. In *EGU General Assembly*, EGU General Assembly, pages 9771EGU2020–20951, May 2020.

[21] Diego Marazza, Enrico Balugani, Stefan Majer, and Vincent Rossi. A risk evaluation approach for indirect land use change associated to biobased products. In *LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (II)*, page 108, 2018.

[22] V. Marconi, M. Antonellini, E. Balugani, and E. Dinelli. Hydrogeochemical characterization of small coastal wetlands and forests in the southern po plain (northern italy). *Ecohydrology*, 4(4):597–607, 2011.

[23] V. Marconi, E. Dinelli, M. Antonellini, B. Capaccioni, E. Balugani, and G. Gabbianelli. Hydrogeochemical characterization of the phreatic system of the coastal wetland located between Fiumi Uniti and Bevano rivers in the southern Po plain (Northern Italy). In D. N. Arabelos and C. C. Tscherning, editors, *EGU General Assembly Conference Abstracts*, volume 11 of *EGU General Assembly Conference Abstracts*, page 9771, April 2009.

[24] S. Pesce, E. Balugani, J.M. De Paz, F. Visconti, C. Carlini, and D. Marazza. Modelling of soil carbon sequestration by use of rice-straw mulching in two citrus orchards in Valencia (Spain). In *EGU General Assembly*, EGU General Assembly, pages EGU21–6323, April 2021.

[25] Roberto Porcelli, Enrico Balugani, Andrea Contin, Serena Righi, and Diego Marazza. System dynamics as a tool to include time-dependent factors in environmental assessment modelling. In *SETAC EUROPE 24th LCA SYMPOSIUM 24âĂŞ26 September 2018 I Vienna, Austria - Abstract Book*, 2018.

[26] P. Roberta, E. Balugani, M. Ventura, N. Greggio, and D. Marazza. Modelling soil carbon sequestration with biochar using RothC. In *EGU General Assembly*, EGU General Assembly, pages EGU21–4741, April 2021.

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## Skills

**Field related:** Field study design and preparation for: (i) land cover check, (ii) soil hydraulic and physical properties, (iii) vegetation cover and characterization, (iv) hydrogeological monitoring, (v) water management monitoring, (vi) water quality monitoring, (vii) hydro-meteorological and agricultural monitoring.
Field team-work and leadership (with students).
Basic knowledge of electronics and programming of probes and data-loggers.
Set up and use of dataloggers and probes.

**Programming-Technical:** Programming in: R, Python, MATLAB, C++, SQL (data base language), Basic, Turbo Pascal plus a plethora of Data-Logger programming languages. Use of: RothC, Hydrus1D, $DuMu^x$, Linux, Jupyter Notebook, Windows Office package, LaTeX, ArcGIS, spatial databases, Spark, System Dynamic softwares (Simantics System Dynamics, Vensim, Stella). Use of S.E.M. Hydrogeological modeling, Machine learning, Big Data handling and analysis, Data Science.

**Theoretical:** Environmental sciences, environmental modeling, system dynamics, soil carbon dynamics, groundwater, geophysics, ecology, plant science, geochemistry, biology, biochemistry, physical chemistry, water management, water quality, climate change, evapotraspiration in water-limited environment, landslide analysis, hydrogeology, fluid dynamics (especially in porous media), meta-modeling, system dynamics, statistics, spatial analysis, stratigraphic description.
For a full description, please refer to the degree certificate issued by Bologna University.

**Generic:** Public presentation of studies and topics, academic writing, meeting preparations, team management, team work, independent work, research, teaching, support for Ph.D. and M.Sc. students, support/tutoring for "first and second level degree" students, supervisor for university students thesis preparation (6 students in total).

Driving: I drove in several countries (Italy, Spain, France, Belgium, The Netherland, UK, Germany, Denmark, Sweden, Norway, Austria, Switzerland, Colombia), in several conditions (big chaotic cities, mountain, deserts, forests, sand dunes, wetlands, snow, ice, stormy weather) and with several vehicles (4-wheels, vans, small-to-luxury cars) without having any accident. I own two driving licenses (Italian and Colombian).

**Languages:** Italian *(mother tongue)*, English *(professional proficiency)*, Spanish *(professional proficiency)*, French *(Upper Intermediate)*.

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## Experience

Bologna University                                                    RAVENNA, EMILIA-ROMAGNA, ITALY

**Student tutor**                                                                          *Nov '07 – Nov '08*
As a tutor, I helped students with (1) approving exams given in foreign universities; (2) finding the material to prepare particular exams; (3) find short-time jobs to finance their studies; (4) interact with professors. I also interviewed frequently the students and participated in the professors" committee in order to bring the student's point of view on the degree course. Scienze Ambientali Ravenna

**Intern Research help**                                                                   *Nov '08 – Nov '09*
As intern in the C.I.R.S.A. (Interdisciplinary Research Center for Environmental Sciences) laboratories, I: (1) monitored and maintained the network of hydrogeological measurements in the coastal pine forests of Ravenna province ("San Vitale", "Cervia", "Lido di Dante", "Lido di Savio"); (2) produced original research (with 2 articles published); (3) helped the Ph.D. students with their thesis; (4) managed the laboratory activity on the following projects: wetlands and pollution abatement, wetlands and salt water infiltration, water pollution modeling in coastal pine forests. Scienze Ambientali Ravenna

**Environmental modeling Research Fellow**                                                  *March '18 – May '20*
As a research fellow at C.I.R.S.A. (Interdisciplinary Research Center for Environmental Sciences) laboratories, I was part of the team working in WP7 of STAR-ProBio Horizon 2020 project (http://www.star-probio.eu/). I was the main modeler of the project, tasked with the design and implementation of the system dynamic SydILUC model used to inform the normative approach for ILUC assessment of bio-based products. As such, my main activities were to: (1) implement a system dynamic model to simulate policy effects for promotion of bio-based products on land use change, especially the indirect, global, market mediated effects; (2) present the results with reports and presentation within the project; and (3) write scientific articles related with the model work. I was also part of the "Environmental Management Research Group (EMRG)". As such, I: (1) supervised modeling-related M.Sc. thesis; (2) prepared the system dynamic modeling laboratory classes for the classes on "Environmental, Political and Economic Management Systems" as part of the Bologna University Environmental Sciences M.Sc. course ("Environmental Assessment and Management"); (3) helped bologna university students with issues related to environmental policy modeling; participated to the research group activities.

CENIGAA research center                                                       NEIVA, HUILA, COLOMBIA

**Hydrogeologist consultant**                                                              *Nov '15 – Nov '16*
As hydrogeologist consultant for CENIGAA in the project "AnÃąlisis de la vulnerabilidad y desarrollo e implementaciÃşn de medidas participativas de adaptaciÃşn del sector agropecuario ante impactos de Cambio ClimÃątico y Vulnerabilidad ClimÃątica Extrema en el departamento del Huila", I: (1) helped recover and organize the literature about hydrogeology and hydrology for the Huila region, preparing a literature review and preparing maps to show the data collected; (2) prepared maps of potential infiltration for the whole region, in order to focus environmental protection studies in areas of rain infiltration and aquifer recharge; (3) prepared 2D and 3D maps of "potential aquifers" in the region in order to estimate the resilience of the aquifer system to extended periods of drought (El NiÃśo-Southern Oscillation); (4) prepared a plan for fieldwork to improve the maps created (the sparse and heterogeneous nature of the sub-soil dataset affected the accuracy of the maps greatly) in order to create an hydrogeological model for the region; (5) prepared the literature review on flood, droughts, fire and landslide risk modeling in the region (the actual modeling was not the focus of the study).