

Research Interest

Reduced-order models. Response surface methods; Data-driven approaches; Machine learning techniques.
Flow and transport in porous media. Transport of contaminants in porous media; Multi-phase flow.
Water resources. Groundwater hydrology; Sustainability of freshwater withdrawals; Water saving in agriculture; Reduction of water losses in the water supply network; Satellite data for water resources management.
Biomedical applications. Prediction of cardiovascular diseases for clinical practice via surrogate models.

Professional Experience

Jun 2020 - present **Expert Member for the State Exam for the Habilitation to Engineering Profession** - University of Bologna, Italy.
Jan 2022 **Teacher in a Training Course** on predictive maintenance for water losses organized by UtilitEnergy – IKN Italy.

Academic Employment

Feb 2024 - present **Research Fellow** - Research Project: *Predictive forecasting of flow and transport processes under uncertainty via meta-modeling techniques*. Research contract partially funded by the Italian Ministry of University and Research (MUR) - PRIN 2022 Programme - *Predictive forecasting and risk assessment for CO₂ transport in pipelines* (Principal Investigator: Prof. Valentina Ciriello) and by the EU project MAR2PROTECT *Preventing groundwater contamination related to global and climate change through a holistic approach on managed aquifer recharge* (Horizon Europe Framework Programme). Affiliation: Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna, Italy.
Feb 2024 - present **Adjunct Professor** - Affiliation: Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna, Italy. (Total contracted hours: 82)
Nov 2023 - Jan 2024 **Research Fellow** - Research Project: *Uncertainty quantification and model reduction techniques to protect water resources from pollution*. Research contract partially funded by the EU Project StopUP *Protecting the aquatic environment from urban runoff pollution* (Horizon Europe Framework Programme). Affiliation: Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna, Italy.
Sep 2022 - present **Teaching Assistant** - Affiliation: Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna, Italy. (Tot. hours: 170)
May 2019 - Oct 2020 **Research Fellow** - Research Project: *Impact of climatic conditions on pipe breaks in water supply networks*. Research contract funded by the multiutility Hera SpA. Affiliation: Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna, Italy.

Education

Mar 2024 **PhD in Civil, Chemical, Environmental and Material Engineering**, (final exam: March 15, 2024; Excellent), University of Bologna, Italy. Thesis: *Decoding complex flow phenomena via Dynamic Mode Decomposition*. Advisors: Prof. V. Ciriello (University of Bologna, Italy), Prof. D. M. Tartakovsky (Stanford University, California, USA).
Feb 2019 **MSc in Environmental Engineering**, 110/110 with honors, University of Bologna, Italy.
Jul 2016 **BSc in Environmental Engineering**, 110/110 with honors, University of Bologna, Italy.

Visiting Positions

Mar 2022 - June 2022 **Visiting Student Researcher** at Stanford University - Department of Energy Resources Engineering, California USA. (invited by Prof. D.M. Tartakovsky, duration of stay: 4 months)

Awards

2021 **Marco Polo Grant** of the University of Bologna (mobility scholarship for research) [4050 €].

Conference Presentations and Talks

- Nov 2025 *Baseflow Identification via Explainable AI with Kolmogorov–Arnold Networks.*, TOP10 nelle scienze tecniche - Selezione dei migliori prodotti scientifici dell'anno, Accademia delle Scienze dell'Istituto di Bologna, 6 Nov 2025, Bologna. - **invited oral presentation**
- Sep 2025 *Reconstructing spatiotemporal dynamics of Total Water Storage Anomalies using DMD.*, Session 1: Koopman Theory Applications: Climate & Environmental Sciences, Koopman Operator Theory: Fundamentals, Approximations and Applications 2, 10-12 Sep 2025, Cres. - **invited oral presentation**
- May 2025 *Decoding spatiotemporal patterns in global-scale data via Dynamic Mode Decomposition.*, IS024: Data Driven, Physics Informed and Operator Learning Methods for Complex Dynamical Systems, XI International Conference on Coupled Problems in Science and Engineering (COUPLED25), 25-28 May 2025, Villasimius. - **oral presentation**
- Oct 2024 *Data-informed reconstruction of reactive contaminant release scenarios.*, Session 3: Data driven and physics based machine learning methods for forecasting and knowledge discovery of subsurface hydrology, XXV Conference on Computation Methods in Water Resources (CMWR24), Sep 30-Oct 3 2024, Tucson. - **oral presentation**
- Sep 2024 *Data-driven order reduction of contaminant transport models.*, Sessione 12: Processi di trasporto nei domini acquatici attraverso le diverse scale di osservazione, XXXIX Convegno Nazionale di Idraulica e Costruzioni Idrauliche (IDRA24), 15-18 Sep 2024, Parma. - **oral presentation**
- April 2024 *Dynamic Mode Decomposition enables decoding dominant spatiotemporal structures in global scale hydrological datasets*, Poster Session: Large-scale hydrology and groundwater, European Geosciences Union General Assembly 2024 (EGU24), 14-19 April 2024, Vienna. - **poster presentation**
- Feb 2024 *Dynamic Mode Decomposition for source identification.*, Minisymposium: Quantifying Parameter Uncertainty in Random Differential Equations, SIAM Conference on Uncertainty Quantification (UQ24), 27 Feb-1 Mar 2024, Trieste. - **invited oral presentation**
- Dec 2023 *Dynamic Mode Decomposition of GRACE and GRACE-FO data.*, Poster Session: Advancing Terrestrial Hydrology Through GRACE Missions and Integrated Observations, American Geophysical Union Fall Meeting 2023 (AGU23), 11-15 Dec 2023, San Francisco. - **poster presentation**
- June 2023 *Dynamic Mode Decompositions for Inhomogeneous Transport Problems.*, Minisymposium: Advanced Methods for Data-Driven Modeling in Porous Media Applications, SIAM Conference on Mathematical and Computational Issues in the Geosciences 2023 (GS23), 19-22 June 2023, Bergen. - **invited oral presentation**
- May 2023 *Dynamic Mode Decomposition to reconstruct and extrapolate hydrological time series.*, Minisymposium: Machine Learning and Big Data in Porous Media, 15th Annual International Conference on Porous Media (InterPore2023), 22-25 May 2023, Edinburgh. - **oral presentation**
- April 2023 *Interpolation of hydrological time series via Dynamic Mode Decomposition*, Poster Session: Hydroinformatics: data analytics, machine learning, hybrid modelling, optimisation, European Geosciences Union General Assembly 2023 (EGU23), 23-28 April 2023. - **poster presentation**
- Jan 2023 *Modeling Complex Dynamical Systems Via Dynamic Mode Decomposition*, Poster Session, Physics-based hydrology: From the heterogeneous subsurface to dynamic catchments, 10-12 Jan 2023, Tel Aviv University. - **invited poster presentation**
- May 2022 *Dynamic Mode Decomposition applied to GRACE data*, Stanford University, Stanford, California, USA, Talk Invited by Prof. D. M. Tartakovsky. - **invited talk**
- Dec 2020 *Irrigation channels-groundwater interaction: a meta-modeling framework to support water saving in agriculture*, Session: Data centric simulation and modeling, Computation Methods in Water Resources 2020 (CMWR20), 14-17 Dec 2020. - **poster presentation**

Professional Activities

2020-present **Referee:** Water Resources Research (Wiley), Stochastic Environmental Research and Risk Assessment (Springer), Computational Geosciences (Springer), Journal of Computational Physics (Springer), Journal of Hydrology (Elsevier), Frontiers in Water (Frontiers), Physical Review Fluids (American Physical Society), Hydrology and Earth System Sciences (Copernicus Publications), Journal of Computing in Civil Engineering (ASCE).

Teaching Activity

A.Y. **Adjunct Professor** - University of Bologna, Italy.
2025/2026

- Course: *Hydraulics*, Teaching contract: 30 hours, B.Sc. in Civil Engineering

Teaching Assistant - University of Bologna, Italy.

- Course: *Environmental Hydraulics*, Teaching Tutor contract: 20 hours, M.Sc. in Civil Engineering
- Course: *Advanced Models and Methods for Water Security*, Teaching Tutor contract: 20 hours, M.Sc. in Environmental Engineering (international curriculum)

A.Y. **Adjunct Professor** - University of Bologna, Italy.
2024/2025

- Course: *Environmental Hydraulics*, Teaching contract: 26 hours, M.Sc. in Civil Engineering

Teaching Assistant - University of Bologna, Italy.

- Course: *Modeling and Management of Natural Hydraulic Systems*, Teaching Tutor contract: 20 hours, M.Sc. in Environmental Engineering (international curriculum)

A.Y. **Adjunct Professor** - University of Bologna, Italy.
2023/2024

- Course: *Environmental Hydraulics*, Teaching contract: 26 hours, M.Sc. in Civil Engineering

Teaching Assistant - University of Bologna, Italy.

- Course: *Modeling and Management of Natural Hydraulic Systems*, Teaching Tutor contract: 30 hours, M.Sc. in Environmental Engineering (international curriculum)
- Course: *Hydraulics*, Teaching Tutor contract: 30 hours, B.Sc. in Civil Engineering

A.Y. **Teaching Assistant** - University of Bologna, Italy.
2022/2023

- Course: *Modeling and Management of Natural Hydraulic Systems*, Teaching Tutor contract: 30 hours, M.Sc. in Environmental Engineering (international curriculum)
- Course: *Groundwater and Contamination Processes*, Teaching Tutor contract: 20 hours, International M.Sc. in Civil Engineering

2020-present **Co-supervisor** of 9 theses of B.Sc. students and 4 theses of M.Sc. students in Civil Engineering.

Membership in Professional Societies

- Italian Group of Hydraulics (GII)

Research Projects

- MAR2PROTECT *Preventing groundwater contamination related to global and climate change through a holistic approach on managed aquifer recharge*, 48 months [Dec 1, 2022 - Nov 30, 2026], funded by EU Horizon Programme, GA n.101082048. [Research Fellow, University of Bologna]
- PRIN 2022 *Predictive forecasting and risk assessment for CO₂ transport in pipelines*, 24 months [Sep 28, 2023 - Sep 28, 2025], Research Projects of National Interest funded by the Italian Ministry of University and Research (MUR). [Research Fellow, University of Bologna]
- StopUP *Protecting the aquatic environment from urban runoff pollution*, 36 months [Sep 1, 2022 - Aug 31, 2025], funded by EU Horizon Programme, GA n.101060428. [Research Fellow, University of Bologna]

- PRIN 2017 *Fluid dynamics of hearts at risk of failure: towards methods for the prediction of disease progression*, 48 months [Sep 15, 2019 - Sep 15, 2023], Research Projects of National Interest funded by the Italian Ministry of Education, Universities and Research (MIUR). [Research Unit Member, University of Bologna]
- FALDA *Monitoring network management of the hypodermic aquifer*, 36 months [Apr 1, 2016 - Mar 31, 2019], funded by EU Rural Development Programme (PSR Emilia-Romagna 2014-2020). [Master Student, University of Bologna]

Scientific Production

Papers in Refereed International Journals

1. Ciriello V., Libero G., Tartakovsky D. M. *Short-Term Forecasting from GRACE Data via Dynamic Mode Decomposition with Sequential Update*. Journal of Hydrology. - under review
2. Libero G., Bonazzi A., de Barros F. P. J. (2026) *Reconstructing contaminant plume dynamics from sparse well data using Dynamic Mode Decomposition: Effects of sampling density and support scale*. Advances in Water Resources, 216, 105436, DOI: 10.1016/j.advwatres.2026.105436.
3. Daprà I., Libero G., Scarpi G.(2026). *Analysis of pipe flow of a Giesekus fluid including the effect of Newtonian solvent viscosity*. Journal of Engineering Mathematics, 157,3,DOI:10.1007/s10665-025-10508-w
4. Bicelli G., Libero G., Picchi D., Ciriello V. (2026). *Fracture susceptibility and depressurization dynamics in CO₂ pipelines under uncertainty*. Energy, 344, 140013, DOI:10.1016/j.energy.2026.140013
5. Libero G., Ciriello V. (2025). *Dominant spatiotemporal structures in total water storage anomalies*. Advances in Water Resources, 203, 105015, DOI:10.1016/j.advwatres.2025.105015
6. Girometti E., Frascari D., Pinelli D., Di Federico V., Libero G., Ciriello V. (2025). *Polyphenol adsorption and recovery from olive mill wastewater: a model reduction-based optimization and economic assessment*. Journal of Environmental Chemical Engineering, 116370, DOI:10.1016/j.jece.2025.116370
7. Libero G., Tartakovsky D. M., Ciriello V. (2024). *Dynamic mode decomposition of GRACE satellite data*. Advances in Water Resources, 193, 104834, DOI:10.1016/j.advwatres.2024.104834
8. Libero G., Chiofalo A., Ciriello V., Tartakovsky D. M.(2024). *Extended dynamic mode decomposition for model reduction in fluid dynamics simulations*. Physics of Fluids, 36 (6), 061911, DOI:10.1063/5.0207957
9. Libero G., Tartakovsky D. M., Ciriello V. (2024). *Polynomial chaos enhanced by dynamic mode decomposition for order-reduction of dynamic models*. Advances in Water Resources, 186, 104677, DOI:10.1016/j.advwatres.2024.104677
10. Collia D., Libero G., Pedrizzetti G., Ciriello V. (2022). *Surrogate models provide new insights on metrics based on blood flow for the assessment of left ventricular function*. Scientific Reports, 12, 8695, DOI:10.1038/s41598-022-12560-3.

International Conference Proceedings

1. Libero G., Ciriello V. (2026). *Basin-Scale Interpretation of Low-Frequency Terrestrial Water Storage Dynamics Using Dynamic Mode Decomposition*. In: XXVI Conference on Computation Methods in Water Resources 2026 (CMWR26), Bologna, June 28-July 2, 2026.
2. Libero G., Ciriello V., Tartakovsky D. (2026). *Basin-Scale Sequentially Updated Dynamic Mode Decomposition for Short-Term Forecasting of GRACE Signals*. In: XXVI Conference on Computation Methods in Water Resources 2026 (CMWR26), Bologna, June 28-July 2, 2026.
3. Libero G., Ciriello V., Tartakovsky D. (2025). *Reconstructing spatiotemporal dynamics of Total Water Storage Anomalies using DMD*. In: Koopman Operator Theory: Fundamentals, Approximations and Applications 2, Cres, Croatia, Sep 10-12, 2025.
4. Ciriello V., Libero G., Tartakovsky D. (2025). *Decoding spatiotemporal patterns in global-scale data via Dynamic Mode Decomposition*. In: XI International Conference on Computational Methods for Coupled Problems in Science and Engineering (COUPLED2025), Villasimius, Italy, May 25-28, 2025.
5. Libero G., Tartakovsky D., Ciriello V.(2024). *Data-informed reconstruction of reactive contaminant release scenarios*. In: XXV Computation Methods in Water Resources (CMWR24), Tucson, Sep30-Oct3, 2024.

6. Ciriello V., Libero G., Tartakovsky D. (2024). *Polynomial Chaos Expansion for uncertainty quantification in subsurface processes*. In: XXV Computation Methods in Water Resources (CMWR24), Tucson, Sep 30-Oct 3, 2024.
7. Libero G., Ciriello V. (2024). *Data-driven order reduction of contaminant transport models*. In: XXXIX Convegno Nazionale di Idraulica e Costruzioni Idrauliche (IDRA24), Parma, Sep 15-18, 2024.
8. Libero G., Tartakovsky D., Ciriello V. (2024). *Dynamic Mode Decomposition enables decoding dominant spatiotemporal structures in global scale hydrological datasets*. In: European Geosciences Union General Assembly 2024 (EGU24), Vienna, Apr 14-19, 2024.
9. Ciriello V., Libero G., Tartakovsky D. (2024). *Use of Dynamic Mode Decomposition for the reconstruction of contaminant release history*. In: European Geosciences Union General Assembly 2024 (EGU24), Vienna, Apr 14-19, 2024.
10. Libero G., Tartakovsky D., Ciriello V. (2024). *Dynamic Mode Decomposition for source identification*. In: SIAM Conference on Uncertainty Quantification (UQ24), Trieste, Feb 27-Mar 1, 2024.
11. Ciriello V., Libero G., Tartakovsky D. (2024). *Dynamic Mode Decomposition accelerates uncertainty quantification via Polynomial Chaos Expansion*. In: SIAM Conference on Uncertainty Quantification (UQ24), Trieste, Feb 27-Mar 1, 2024.
12. Libero G., Tartakovsky D., Ciriello V. (2023). *Dynamic Mode Decomposition of GRACE and GRACE-FO data*. In: American Geophysical Union Fall Meeting 2023 (AGU23), San Francisco, Dec 11-15, 2023.
13. Ciriello V., Libero G., Tartakovsky D. (2023). *Combining Polynomial Chaos Expansion and Dynamic Mode Decomposition for the reduction of models with time-variant response*. In: American Geophysical Union Fall Meeting 2023 (AGU23), San Francisco, Dec 11-15, 2023.
14. Libero G., Chiofalo A., Ciriello V., Tartakovsky D. (2023). *Dynamic Mode Decompositions for Inhomogeneous Transport Problems*. In: SIAM Conference on Mathematical and Computational Issues in the Geosciences 2023 (GS23), Bergen, June 19-22, 2023.
15. Libero G., Tartakovsky D., Ciriello V. (2023). *Dynamic Mode Decomposition to reconstruct and extrapolate hydrological time series*. In: 15th Annual International Conference on Porous Media (InterPore2023), Edinburgh, May 22-25, 2023.
16. Ciriello V., Libero G., Tartakovsky D. (2023). *Dynamic Mode Decomposition for model reduction of flow and transport in porous media*. In: 15th Annual International Conference on Porous Media (InterPore2023), Edinburgh, May 22-25, 2023.
17. Libero G., Ciriello V. (2023). *Interpolation of hydrological time series via Dynamic Mode Decomposition*. In: European Geosciences Union General Assembly 2023 (EGU23), Vienna, Apr 23-28, 2023.
18. Libero G., Letterio T., Raimondi S., Genovesi R., Di Federico V., Ciriello V. (2020). *Irrigation channels-groundwater interaction: a meta-modeling framework to support water saving in agriculture*. In: XXIII Computation Methods in Water Resources (CMWR20), Stanford, June 22-25, 2020.

Additional Skills

Languages: Italian (mother tongue), English (B2); French (A2)

Programming Languages: Matlab, Python and R.

Applications and programs: Excellent skills in Excel, PowerPoint and Word. Extensive experience with QGIS, including Python plugin programming. Good abilities in modeling with MODFLOW (Flopy and GroundwaterVistas). Familiarity with VS2DI, Gretl, ParaView, KNIME.

I give the authorization on my personal information to be treated according to the art. 13 of D. Lgs. 196/2003 and UE Regulation n. 2016/679.

Ph.D. Giulia Libero, Bologna, August 17, 2026