

ZHANG MENGXUE

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PROFILE

Earth-system AI researcher working at the intersection of **physics-aware deep learning, probabilistic modeling, and uncertainty quantification**. I hold a Ph.D. in Remote Sensing from the University of Valencia, where I developed hybrid AI methods for uncertainty-aware drought modeling. My research integrates physical knowledge and probabilistic inference into deep learning to improve **model generalization, predictive reliability, and physical consistency**. I have published in Remote Sensing of Environment, IEEE Transactions on Geoscience and Remote Sensing, and NeurIPS, and contributed to the EU Horizon project and the open-source toolbox. My future research aims to develop **uncertainty-aware hybrid Earth-system models** for robust prediction of climate extremes under changing climate conditions.

RESEARCH INTERESTS

Earth-System AI: Hybrid and physics-aware machine learning for Earth-system modelling
Reliable AI: Probabilistic deep learning, uncertainty quantification, calibration, and robustness
Climate Extremes: Drought monitoring, prediction, and forecasting
Land-Atmosphere Processes: Land-atmosphere interactions, soil-moisture dynamics, and climate variability

EDUCATION

University of Valencia Valencia, Spain
Ph.D. in Remote Sensing Sep. 2021 - July 2026
Dissertation: *Hybrid Probabilistic Deep Learning for Drought Monitoring*
Academic advisor: *Gustau Camps-Valls, Miguel Ángel Fernández-Torres*
Committees: *Matteo Giulian, Maria Piles Guillem, Noelia Otero Felipe, Shijie Jiang, Laura María Cornejo Bueno, Marta Sapena Moll*

Hohai University NanJing, China
M.E. in Geographic Information Engineering (Excellent) Sep. 2018 - June 2021
Thesis: *Differential Pooling Network for Hyperspectral image Classification, supervised by Zhaohui Xue*
B.S. in Geomatics Engineering (Excellent) Sep. 2014 - June 2018
Thesis: *Semi-supervised Deep Learning Approach for SAR Ship Recognition*

RESEARCH EXPERIENCE

Dissertation Research University of Valencia
1. *Extreme Event Detection: Hybrid AI → Generalization* Sep. 2021 - July 2023
Developed a hybrid AI model for detecting low-likelihood, high-impact drought events across Europe.
Improved model transferability to unseen geographic locations.

2. *Reliable probabilistic prediction: Calibration → Uncertainty → Reliability* Sep. 2023 - July 2025
Developed a calibration algorithm and entropy-based uncertainty framework for drought prediction.
Improved the reliability and robustness of uncertainty estimates for decision-making.

3. *Long-term Soil Moisture Forecasting: Land-atmosphere Process → Physical consistency* Sep. 2025 - July 2026
Investigated how nonlinear land-atmosphere processes can be represented in deep learning models.
Improved reliability across climate variability and consistency with local soil-water budgets.

Lab Research University of Valencia
EU Horizon XAIDA — Advanced AI for Detecting and Understanding Extreme Events Sep. 2022 - July 2025
Contributed to the open-source toolbox through data-characterization modules and drought workflows.

Collaborated in a multidisciplinary EU research project and contributed to internal reports and peer-reviewed publications.

Research Assistant

Few-shot Hyperspectral Image Classification

Collaborated on the design of graph convolutional networks (GCNs) and attention mechanisms to optimize hyperspectral image classification.

Hohai University

Sep. 2018 - June 2021

PUBLICATIONS

First-author Publications

Zhang, M., Cohrs, K.H., Fernández-Torres, M.Á., Rodrigo-Bonet, E., Camps-Valls, G. 2026. The Risks of Imperfect Knowledge: Reliability Trade-Offs in Physics-Aware Neural Networks for Climate Projections. *International Conference on Artificial Neural Networks*. (accepted).

[Physics-aware AI | Climate projections]

Zhang, M., Fernández-Torres, M.Á., Cohrs, K.H. and Camps-Valls, G. 2025. Calibration and uncertainty quantification for deep learning-based drought detection. *International Journal of Applied Earth Observation and Geoinformation*. 311, p.114252.

[Probabilistic AI | Uncertainty quantification]

Zhang, M., Fernandez-Torres, M.A. and Camps-Valls, G. 2024. Domain knowledge-driven variational recurrent networks for drought monitoring. *Remote Sensing of Environment*. 140, p.104563.

[Hybrid AI | Drought monitoring]

Zhang, M., Fernández-Torres, M.Á. and Camps-Valls, G. 2022. Hybrid recurrent neural network for drought monitoring. *In Proc. NeurIPS*. pp.1-9.

[Domain knowledge | Drought monitoring]

Selected Collaborative Works

Gonzalez-Calabuig, M., Cortés-Andrés, J., Williams, T.K.E., **Zhang, M.**, Pellicer-Valero, O.J., Fernandez-Torres, M.A. and Camps-Valls, G. 2024. The AIDE toolbox: Artificial intelligence for disentangling extreme events [software and data sets]. *IEEE Geoscience and Remote Sensing Magazine*. pp.113-118.

Xue, Z., Liu, Z. and **Zhang, M.** 2023. DSR-GCN: Differentiated-scale restricted graph convolutional network for few-shot hyperspectral image classification. *IEEE Transactions on Geoscience and Remote Sensing*. 61, pp.1-18.

Cortés-Andrés, J., Gonzalez-Calabuig, M., **Zhang, M.**, Williams, T., Fernández-Torres, M.Á., Pellicer-Valero, O.J. and Camps-Valls, G. 2023. XAIDA4Detection: A Toolbox for the Detection and Characterization of Spatio-Temporal Extreme Events. *In EGU General Assembly Conference Abstracts*. EGU-4816.

Xue, Z., **Zhang, M.**, Liu, Y. and Du, P. 2021. Attention-based second-order pooling network for hyperspectral image classification. *IEEE Transactions on Geoscience and Remote Sensing*. pp.9600-9615.

In Preparation

Zhang, M. et al. Long-Term Agricultural Drought Monitoring Using a Robust Deep Learning Framework. Manuscript in preparation; intended for submission to *Journal of Hydrology*.

Zhang, M. et al. Toward Uncertainty-Aware Drought Modeling: Monitoring, Prediction, and Projection. Manuscript in preparation; intended for submission to *Earth's Future*.

ACADEMIC COMMUNICATIONS

Conference

EGU General Assembly — Poster presentation. No. EGU26-8630. Vienna, Austria.	May 2026
ELLIS Summer School: AI for Earth and Climate Sciences. Jena, Germany.	Sep. 2025
EGU General Assembly — Poster presentation. No. EGU23-4816. Vienna, Austria.	May 2023
NeurIPS Workshop on Tackling Climate Change with Machine Learning. Virtually.	Dec. 2022
The National Symposium on Earth Observation with Imaging Spectroscopy. China.	Sep. 2019

Academic Service

2021 - present

Review for *IEEE Geoscience and Remote Sensing Magazine*, *Information Fusion*, *Computers and Electronics in Agriculture*, *International Journal of Applied Earth Observation and Geoinformation*, *Natural Hazards and Earth System Sciences*, etc.

FELLOWSHIPS AND AWARDS

Chinese Government Scholarship — Competitive Doctoral Fellowship (€48,600)	2022 - 2026
Conference Travel Grant, ELSA Mobility (€1300)	Sep. 2025
Award for Academic Excellence Scholarship, Hohai University (¥10,000)	2018
Award for Chinese National Scholarship, Hohai University (¥10,000)	2015

TECHNICAL SKILLS

Earth-System Modelling: Physics-aware neural networks, hydrological modelling, climate variability;
 Machine Learning: Deep learning, probabilistic modelling, uncertainty quantification;
 Programming: Python (PyTorch, GPyTorch, scikit-learn), R;
 Earth Observation: MODIS, Landsat, ERA5, CMIP6, CRU-TS;
 Geospatial: Google Earth Engine, ArcGIS, ENVI.

REFERENCES

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