

# 夏基洋



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## 自我简介

本人现为曼彻斯特大学人工智能与城市气候科学交叉领域博士研究生。NeurIPS 2025 第一作者 (Scholar Award), 发表了城市气候仿真领域在 AI 顶会的首篇突破性成果, 具备从 0 到 1 定义复杂科学问题并实现 SOTA 模型的能力。深耕时空 AI (Spatial-Temporal Modeling)、物理增强深度学习 (Physics-informed DL) 及生成式扩散模型 (diffusion)。擅长处理高维、异构、多尺度的海量时空数据预测与生成。曾主导/核心参与 NVIDIA、上海人工智能实验室、微软等顶尖机构联合研发项目。具备跨洲际多团队协作经验, 能够胜任高强度、结果导向的产学研落地任务。

## 教育背景

曼彻斯特大学 (The University of Manchester, QS 34), 人工智能与环境科学, 博士在读 2024.01 - 2027.03

- 研究方向: AI for Science (AI4S)、气候时空仿真、物理增强深度学习。
- 学术突破: 以第一作者身份在 NeurIPS 2025 发表该领域首篇突破性论文。
- 荣誉奖励: 荣获 NeurIPS 2025 Scholar Award (学术资助)、曼彻斯特大学博士研究奖学金。

浙江大学, 城乡规划 (空间大数据分析方向), 硕士 2020.09 - 2023.06

- 成绩排名: GPA 3.88/4, 年级排名前 1%。
- 荣誉奖励: 浙江省优秀毕业生、浙江大学优秀毕业生、杨咏曼奖学金、三好学生。
- 核心能力: 主攻大规模城市空间数据建模, 具备扎实的数学建模与跨学科研究能力。

西南交通大学, 城乡规划, 学士 2015.06 - 2020.06

- 基础背景: 五年的城乡规划专业训练, 打下深厚的城市空间逻辑与地理信息数据基础。

## 专业技能

深度学习与大模型 (DL & LLM): PyTorch, Diffusion Models (DDPM, EDM), RAG, LangChain, Transformer, U-Net, PINNs, AutoML

时空数据与科学计算: Python, Xarray, NetCDF4, NumPy, Pandas, Scipy, Bash, GDAL, Rasterio, Tensorboard, Wandb

数值模式与工程工具: WRF, CESM, ERA5, Google Earth Engine (GEE), HPC Cluster (Slurm), Git, Docker, Linux, LaTeX, Markdown

语言能力: 英语托福 (TOEFL) 103, 大学英语六级 (CET-6)

## 实习经历

上海人工智能研究所, 实习生 2024.3 - 2024.9

- 负责城市气候 AI 仿真项目的全生命周期研发, 包括需求定义、多源异构数据清洗 Pipeline 构建、模型架构设计及实验验证; 最终研究成果以第一作者身份发表于 NeurIPS 2025。
- 参与 AI4S LLM-agent 的深度调研, 为团队的 agent 研究任务确定提供了核心决策依据。

## 主要项目

预测城市气候的高效能机器学习仿真器 (NeurIPS 2025) 2024

- 核心创新与效率提升: 构建了城市尺度气候仿真器, 通过物理归纳算子替代昂贵的偏微分方程数值解, 实现 **422x** 模拟加速 (从 2h 缩短至 17s)。与城市气候相关 baseline 相比, 实现了“更高精度、更小体积、更快速度”的仿真。
- 模型架构与表现: 设计基于 Transformer 的多任务学习框架, 通过联合建模温度、湿度等多物理场耦合关系, 将关键预测指标提升 **10.2%**。并使模型在未见城市 (OOD) 上的泛化能力提升 **7.4%**。
- 工程价值与应用前景: 突破性地实现了基于真实观测数据的**模型微调 (Fine-tuning)**, 成功弥合了“模拟器-真实世界”的领域鸿沟 (Domain Gap)。其模拟精度已超越部分传统数值模型, 为城市规划与气候研究提供了兼具高精度与高效率的全新工具。该工作的后续课题已获得 **NVIDIA 学术资助**。

## 面向城市气候的 AI 驱动生成式适应模型 (Preparing for Science)

2025

- 核心技术突破: 开发了具有物理感知的城市气候生成模型 (Physics-aware diffusion model)。通过在生成过程中锚定物理条件约束, 实现了对城市热岛效应等复杂现象的高保真模拟, 将模拟精度误差控制在  $0.2^{\circ}\text{C}$  以内, 且推理速度较传统数值模型实现 **800x** 速度飞跃 (从 20 小时到 80 秒)。该性能提升支持了大规模蒙特卡洛敏感度分析 (以往不可触达), 使得在现有计算资源下进行全城市尺度的气候适应性方案**全量搜索**成为可能。
- 定义中立评估基准: 构建了领域首个**空间中立评估基准 (Spatial-neutral benchmark)**: 为消除领域研究中常见的空间偏见。通过在  $1\text{km}$  分辨率网格中进行百万级随机采样重建了无偏样本空间。该 Benchmark 旨在提供一个该领域场景的中立评价协议, 为后续的空间解耦提供基石。
- AI4S 范式创新: 提出“生成发现-数学验证”协同范式, 利用扩散模型挖掘城市气候的潜在演化模式, 并配合数学解析模型完成物理一致性校准。该路径通过空间中立基准 (Benchmark) 的跨场景严谨验证, 实现了 AI 模型从“关联性发现”到“因果规律验证”的本质跨越, 极大提升了模型在复杂场景下的决策可信度。
- 多模态融合工程: 架构了统一的表征学习框架, 实现了 2D 遥感图像、气象时序与社会经济指标在扩散模型 Denoising 过程中的**多模态对齐**, 解决了异构数据在超高分辨率下信息融合难、噪声干扰大的技术挑战。

## 城市气候 RAG 知识库系统构建

2026

- 端到端容器化部署: 基于 Docker & NVIDIA Container Toolkit 构建了高性能本地 LLM 推理环境, 利用 Ollama 实现了 Qwen 系列模型 (含 Thinking/Embedding) 的私有化部署, 并封装 FastAPI 接口支持调用。以及实现 Open WebUI 的多容器协同网络架构, 通过 Docker Network 优化了内部通信。
- 证据驱动生成 (Evidence-Grounded Generation): 打破传统“聊天式 RAG”模式, 利用 system prompt 开启证据溯源机制。通过对检索 Chunk 进行 ID 映射与归因, 确保模型输出严格基于原文证据, 实现了“回答即引用”的**科研级生产力工具**标准。
- 针对向量库在专业知识查询下召回噪声大的问题, 实现了 **Two-stage Retrieval** 架构。通过在召回阶段后引入 Cross-Encoder 重排序 (Reranker), 利用 Attention 机制强化 Query 与文档块之间的语义对齐, 显著提升了 RAG 系统在特定领域 (如城市气候学) 下的回答准确度, 解决了‘定义 vs 机制’等细粒度辨析难题。”

## AI4S 模型研发与基准 (benchmark) 构建 (与 NVIDIA & Microsoft 合作项目)

2024 – 2025

- 英国空气质量基准 (Microsoft)**: 协同定义评测协议与多维评价指标, 参与设计了针对英国全境空气质量的科学评测场景, 确保了该 Benchmark 涵盖了从城市中心到郊区等异构地理特征的代表性。负责基准模型的性能对齐与鲁棒性验证: 独立完成了包括 Transformer 模型在内的多种基准架构的训练与调优, 确立了该领域的 **Performance Ceiling** (性能天花板), 为后续大模型的增量改进提供了核心参照指标。
- 生成式 AI 降尺度模型 (NVIDIA)**: 深度参与 NVIDIA 与曼彻斯特大学合作项目——生成式模型 (CorrDiff) 在英国空气质量数据集的部署以及 pipeline 搭建, 重点负责了数据加载模块的构建, 参与训练策略的讨论与超参调优。

## 会议报告与发表论文

- Jiang Fei, Jiyang Xia, et al. CAAL: Confidence-Aware Active Learning for Heteroscedastic Atmospheric Regression. *submit to KDD 2026 AI4S track*
- Jiyang Xia, et al. Learning Urban Climate Dynamics via Physics-Guided Urban Surface-Atmosphere Interactions. 39th Conference on Neural Information Processing Systems (NeurIPS 2025), 2025, 10
- the 12th International Conference on Urban Climate (Session S1: Digital Twins, AI/ML, and Open Data Science for Urban Climate), Rotterdam, Netherlands, 2025, 07
- 2024.08, NERC's Digital Gathering 2024, Manchester, UK
- Jiyang Xia, Yue Zhang\*. Where Are Potential Areas for Transit-Oriented Development (TOD)—Exploring the Demands for Built Environment for TOD Planning. Sustainability. 2022, 14, 8364.
- Jiyang Xia, Yue Zhang\*. Research on Spatial Spillover Effect of Highly Educated Migrants in Yangtze River Delta Urban Agglomerations Based on Urban Innovation. Areal Research and Development. 2022, 1, 162-168.

## 荣誉奖项

- NeurIPS 2025 Scholar Award 2025
- Doctoral Training and Development Support Fund by The University of Manchester 2025
- SoNS Research Training Support Grant by The University of Manchester 2024
- 浙江省优秀硕士研究生 **Top 1%** 2023
- 浙江大学杨咏曼奖学金 **Top 1%** 2022
- 浙江大学三好研究生 2022
- 浙江大学研究生奖学金 2020

# Jiyang (Kian) Xia

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[linkedin.com/in/jiyang-xia](https://linkedin.com/in/jiyang-xia) | [github.com/Jiyang-Xia](https://github.com/Jiyang-Xia) | Age: 28

## Short Bio

PhD researcher in **AI and Urban Climate Science (AI4S)** at the University of Manchester. Published the **first** breakthrough paper in the urban climate simulation field at a top-tier AI venue (**NeurIPS 2025**, First Author) and awarded the **NeurIPS 2025 Scholar Award**. Specializes in Spatial-Temporal Modeling, Physics-informed Deep Learning, and Diffusion Models. Possesses strong capability to define complex scientific problems from 0 to 1 and implement SOTA models. Core participant in joint R&D projects with NVIDIA, Shanghai AI Laboratory, and Microsoft.

## Education

**The University of Manchester, UK**, PhD in AI and Environmental Science Jan 2024 – Mar 2027  
(Expected)

- Research themes: AI for Science (AI4S), Climate Spatial-Temporal Simulation, Physics-informed DL.
- Honors: NeurIPS 2025 Scholar Award, University of Manchester Doctoral Research Scholarship.

**Zhejiang University, China**, MSc in Urban Planning (Spatial Big Data Analysis) Sep 2020 – Jun 2023

- GPA: 3.88/4.0, **Ranked Top 1%**.
- Honors: Outstanding Graduate of Zhejiang Province, Sophia Yang Scholarship.

**Southwest Jiaotong University, China**, BEng in Urban and Rural Planning Jun 2015 – Jun 2020

## Skills & Expertise

- **Deep Learning & LLM**: PyTorch, Diffusion Models (DDPM, EDM), RAG, LangChain, Transformer, U-Net, PINNs, AutoML.
- **Spatial Data & Scientific Computing**: Python, Xarray, NetCDF4, NumPy, Pandas, Scipy, Bash, GDAL, Rasterio, Tensorboard, Wandb.
- **Numerical Models & Engineering Tools**: WRF, CESM, ERA5, Google Earth Engine (GEE), HPC Cluster (Slurm), Git, Docker, Linux, LaTeX, Markdown.
- **Languages**: TOEFL 103, CET-6.

## Experience

**Research Intern**, Shanghai AI Laboratory, China Mar 2024 – Sep 2024

- Responsible for the full lifecycle R&D of the urban climate AI simulation project, including demand definition, multi-source heterogeneous data cleaning pipelines, model architecture design, and experimental verification.
- Research results published as First Author in **NeurIPS 2025**.
- Conducted in-depth research on AI4S LLM-agents to support core decision-making for the team's agent research tasks.

## Selected Projects

**Machine Learning Emulator for Urban Climate (NeurIPS 2025)** 2024

- **Efficiency**: Built a city-scale climate emulator replacing expensive PDE solvers with physics-inductive operators, achieving **422x acceleration** (2h → 17s). Faster and lighter than SOTA baselines.
- **Performance**: Designed a Transformer-based multi-task framework modeling coupled physical fields (e.g., Temperature, Humidity), improving key metrics by **10.2%** and OOD generalization by **7.4%**.
- **Value**: Achieved breakthrough **fine-tuning** on real observational data, bridging the "Sim-to-Real" domain gap. Follow-up work funded by **NVIDIA Academic Grant**.

**AI-Driven Generative Adaptation of Urban Climate (Preparing for Science)** 2025

- **Physics-Aware Diffusion**: Developed a generative model with physical constraints, achieving high-fidelity

simulation of heat islands (error < 0.2°C) with an **800x speedup** (20h → 80s).

- **Spatial-Neutral Benchmark:** Constructed the domain's first unbiased benchmark via million-level random sampling at 1km resolution to eliminate spatial bias.
- **New Paradigm:** Proposed "Generative Discovery – Math Verification", using diffusion models to mine patterns and analytical models for calibration.
- **Multimodal Fusion:** Aligned 2D remote sensing, meteorological time-series, and socio-economic data within the denoising process.

### Urban Climate RAG Knowledge System Construction

2026

- **Containerized Deployment:** Built a local LLM environment using Docker & NVIDIA Container Toolkit; deployed Qwen series via Ollama with FastAPI encapsulation.
- **Evidence-Grounded Generation:** Implemented a "system prompt" trace-back mechanism to ensure outputs are strictly evidence-based, meeting research-grade standards.
- **Two-stage Retrieval:** Implemented Cross-Encoder Reranking to align Query-Document semantics, solving fine-grained definition/mechanism distinction problems.

### AI4S Benchmarking & Development (Collaboration with NVIDIA & Microsoft)

2024 – 2025

- **UK Air Quality Benchmark (Microsoft):** Co-defined protocols and designed evaluation scenarios covering diverse geographies. Trained baseline models (Transformer, etc.) to establish the field's **Performance Ceiling**.
- **Generative Downscaling (NVIDIA):** Deployed CorrDiff (Generative AI) on UK datasets; built data loading pipelines and optimized training strategies.

## Publications

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- Jiang Fei, **Jiyang Xia**, et al. CAAL: Confidence-Aware Active Learning for Heteroscedastic Atmospheric Regression. *Submitted to KDD 2026 AI4S track*.
- **Jiyang Xia**, et al. Learning Urban Climate Dynamics via Physics-Guided Urban Surface–Atmosphere Interactions. *39th Conference on Neural Information Processing Systems (NeurIPS 2025)*, 2025.
- **Jiyang Xia**, Yue Zhang. Where Are Potential Areas for Transit-Oriented Development (TOD). *Sustainability*, 2022, 14, 8364.
- **Jiyang Xia**, Yue Zhang. Research on Spatial Spillover Effect of Highly Educated Migrants... *Areal Research and Development*, 2022.

## Awards (selecteed)

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NeurIPS 2025 Scholar Award	Oct 2025
Doctoral Training and Development Support Fund (UoM)	May 2025
SoNS Research Training Support Grant (UoM)	Feb 2024
Outstanding Graduate of Zhejiang Province (Top 1%)	Mar 2023
Sophia Yang Scholarship of ZJU (Top 1%)	Nov 2022

## Invited Talks

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- 12th International Conference on Urban Climate (ICUC 12), Rotterdam, Netherlands Jul 2025
- NERC's Digital Gathering 2024, Manchester, UK Aug 2024
- 16th International Association for China Planning (IACP) Annual Conference, Wuhan, China Jul 2022