CHUNYANG GAO

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EDUCATION

ETH Zürich **Zürich, Switzerland**
Master of Science in Geomatics Engineering ***Sep 2022 – Present***

- Language of Instruction: English
- Selected courses: Computational Methods for Geospatial Analysis, Introduction to Machine Learning, Image Analysis and Computer Vision, Advanced GIS
- Thesis: Leveraging Diffusion Models for Urban Change Detection and Classification from Historical Map

Wuhan University **Wuhan, China**
Bachelor of Science in Geographical Information Science ***Sep 2018 – Jun 2022***

- Honors: National Scholarship, Outstanding Graduate
- Thesis: The Impact of Different Built Environment Variables on Traffic Congestion in Wuhan

RESEARCH EXPERIENCE

Leveraging Diffusion Models for Urban Change Detection and Classification from Historical Maps
Master thesis *Sep 2024 – Mar 2025*
Advisors: Prof. Lorenz Hurni, Dr. Sidi Wu, Dr. Yizi Chen (ETH Zürich)

- Collected three types of historical map sheets (Swisstopo, Old National and Siegfried), along with the associated vector data. Symbolized the vector map in QGIS to ensure the best alignment with the corresponding raster map and used optical character recognition model keras-ocr to mask map labels.
- Utilized ControlNet to control spatial composition and semantic layout for generating different types of historical maps (Swisstopo, Old National and Siegfried) automatically, with vector map images serving as control while raster map images serving as ground truth.
- Defined urban change scenarios in a large time span and automatically modified vectors to simulate the urban change types. Utilized trained ControlNet to generate plausible pre-change and post-change maps.
- Trained change detection algorithms (ChangeFormer and MambaBCD) using simulated pre-change and post-change data. Evaluation of trained models on real-world datasets showed the comprehensiveness of defined urban change types.

ICESat-2 Spaceborne LiDAR as Complementary Data Source for Biomass Mapping **ETH Zürich**
Group project *Mar 2024 - Jul 2023*
Advisors: Prof. Konrad Schindler, Ghjulia Sialelli, Arno Rüegg

- Aligned ICESat-2 data with Sentinel-2 tiles. Developed a pipeline to generate 150x150 meter patches centered on the GEDI footprints from Sentinel-2 and ICESat-2 datasets for training models. Extracted relevant features such as spectral bands, geographical coordinates, and biomass density values.
- Designed and trained a Fully Convolutional Neural Network (FCN) to estimate Above Ground Biomass Density (AGBD), using Sentinel-2 and ICESat-2 bands as input features and GEDI AGBD as target feature.
- Ran inference on the tiles with no biomass density ground truth. Created overlapping patches that are weighted to have less influence towards the edges, fused these, and visualized the results. Provided biomass mapping in sub-arctic region without GEDI data.

Modelling Integrated Water Vapour with Machine Learning and Meteorological Data **ETH Zürich**
Personal project *Sep 2023 - Dec 2023*
Advisors: Prof. Benedikt Soja, Laura Crocetti, Dr. Matthias Schartner

- Developed machine learning-based models (XGBoost and Lasso regression) to predict IWV from ERA5 meteorological variables, geographical location, and temporal data across global GNSS stations. Conducted both station-wise and time-wise prediction tasks to evaluate spatial and temporal generalization performance.
- Analyzed feature importance and identified specific humidity at lower atmospheric levels as the most influential variable for accurate IWV prediction.

Semantic Segmentation and Vectorization of Building Blocks from Historical Maps **ETH Zürich**
Group project (Research Topics in Cartography) *Mar 2024 - Jun 2024*
Advisor: Dr. Yizi Chen

- Implemented and evaluated three semantic segmentation models (U-Net, ResUnet, and SwinUnet) for building block segmentation, using pixel- and instance-based evaluation metrics such as F1-score and panoptic quality.

- Developed a data processing pipeline for model training, testing, and vectorization, including the use of image augmentation, mask generation, and post-processing techniques like the Douglas-Peucker algorithm for polygon generalization.

Geospatial Data Acquisition and Total Station Automation **ETH Zürich**
Group project (Geospatial Data Acquisition) *Sep 2024 - Dec 2024*
Advisors: Zhaoyi Wang, Lorenz Schmid

• Conducted manual and automatic point measurements (using GeoCOM interface) using a Leica TS60 total station, following the ISO 17123-3 standard. Investigated the impact of meteorological factors on slope distance measurements taken with a total station.

3D Data Acquisition, Modeling, and Visualization of Archaeological Sites **ETH Zürich**
Group project (Geodetic Project Course) *Jun 2024 - Jul 2024*
Advisors: Bingxin Ke, Julia Azumi Koch (ETH Zürich)

• Collaborated in a team of 5 students to reconstruct and visualize Steinsberg Castle and Fortezza Rohan, two archaeological sites in Switzerland, using GNSS, terrestrial laser scanners (TLS), drones, and cameras.
• Contributed to the data acquisition process. Processed and aligned point clouds and images using Cyclone Register 360, Reality Capture, and Bernese software for precise 3D modeling.
• Created high-fidelity 3D models for archaeological analysis and public demonstration, incorporating advanced techniques like Neural Radiance Fields (NeRF) for scene synthesis, and delivered fly-through visualizations and textured renders.

Analysis of the Built Environment and Spatiotemporal Traffic Congestion in Urban Areas
Bachelor thesis *Feb 2022-Jun 2022*
Advisors: Zhongliang Cai (Wuhan University)

• Analyzed temporal and spatial characteristics of urban traffic congestion in Wuhan. Calculated built environment variables. Applied a Geographically Weighted Regression model to identify key influencing factors.

SuperMap Cup Competition 2020: Created a map to visualize the spatial pattern and analyze the global effects of COVID-19 pandemic, Excellence Award

PROFESSIONAL EXPERIENCE

Research Intern | Hubei Provincial Academy of Eco-environmental Sciences *Mar 2022-May 2022*

• Collected, processed, and analyzed environmental monitoring data related to air and water quality across multiple sampling stations. Assisted in preparing technical reports for environmental impact assessments (EIAs) and pollution source investigations. Applied GIS tools to visualize pollution distribution patterns and supported spatial analysis for regulatory planning.

Machine Learning Intern - Weather Forecasting | Beijing Presky Technology Co., Ltd. *Sep 2025-Present*

• Developed a precipitation forecasting model integrating ERA5 reanalysis data (69 meteorological variables: 5 upper-air variables across 13 pressure levels + 4 surface variables) and lightning observations over China (0.125° resolution). Implemented three deep learning architectures (UNeXt, ConvNeXt V2, SwinUNet) with dual-head outputs (numerical regression + 21-class precipitation classification). Designed specialized loss functions (WeightedPrecip, SSIM, Seesaw Loss) to handle sample imbalance and extreme precipitation events.
• Implemented and tested deep learning architectures (e.g., CNN, Transformer-based models) for short-term precipitation and temperature forecasting.

SKILLS

• **Programming:** Python (PyTorch, TensorFlow, scikit-learn, NumPy, Pandas, SciPy, OpenCV), LATEX, R, SQL, HTML/CSS/Javscript
• **Software:** ArcGIS, QGIS, GEE, ENVI
• **Version Control:** Git

EXTRACURRICULAR ACTIVITIES & INTERESTS

Summer Practice Activity **Vancouver, Canada**
Team Leader *Jul 2019 - Aug 2019*

• Led a team to Vancouver to investigate the differences in environmental protection policies and culture between Canada and China and won the Second Prize of Summer Social Practice of Wuhan University.