

Wanshu Nie, Ph.D.

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SUMMARY

- Research scientist with 7+ years of experience in geospatial modeling, remote sensing, data assimilation, and integrating multi-sensor Earth observation datasets.
- Skilled at developing physical and ML/DL models (LSTM, Transformers, XGBoost) for global monitoring and forecasting of water and climate extremes.
- Experienced in large-scale computing and distributed workflows (Linux, SLURM, Dask).

SKILLS

- **ML/AI:** PyTorch, TensorFlow, Scikit-learn, XGBoost, LightGBM, Optuna, SHAP
- **Data Engineering:** Python (NumPy, Pandas, Xarray, Dask), R, FORTRAN, Git/GitHub
- **HPC/Remote Sensing:** Linux, SLURM, NetCDF, HDF5, GDAL, rasterio | Datasets: IMERG, MERRA-2, ERA5, CHIRPS, SMAP, GRACE/GRACE-FO, MODIS, ESA CCI, etc.
- **Domain Applications:** Geospatial ML, climate/earth data modeling, time-series forecasting

EMPLOYMENT

9/2025 – present	Assistant Research Scientist at JHU EPS (with SAIC, Sep 2025 – Mar 2026)
12/2023 – 9/2025	Research Scientist at NASA/GSFC, SAIC
7/2022 – 11/2023	Assistant Research Scientist at JHU EPS
12/2021 – 6/2022	Postdoctoral Researcher at JHU EPS
1/2020 – 11/2021	GESTAR-supported Postdoctoral Researcher JHU EPS and NASA GSFC Hydrological Sciences Lab, Greenbelt, MD

EDUCATION

Ph.D.: Department of Earth and Planetary Science, Johns Hopkins University	2015-2019
Dissertation: Irrigation and its response to climate: improving representation of human impacts in hydrological modeling and data assimilation systems.	
Advisor: Benjamin Zaitchik	
MS: Department of Hydraulic Engineering, Tsinghua University, Beijing, China	2013-2015
Thesis: Spatiotemporal characteristics of anthropogenic heat in an urban environment and impacts on hydrometeorology.	
Advisor: Guangheng Ni	
BS: Department of Hydraulic Engineering, Tsinghua University, Beijing, China	2009-2013

PUBLICATIONS

- [1] Nie, W., Kumar, S. V., Chen, J., Zhao, L., Skulovich, O., Yoo, J., ... & Konapala, G. (2025). Rethinking deep learning: linear regression remains a key benchmark in predicting terrestrial water storage. *Journal of Geophysical Research: Machine Learning and Computation* (under review).
- [2] Nie, W., Kumar, S. V., Getirana, A., Zhao, L., Wrzesien, M. L., Konapala, G., ... & Rodell, M. (2024). Nonstationarity in the global terrestrial water cycle and its interlinkages in the Anthropocene. *Proceedings of the National Academy of Sciences*, 121(45), e2403707121.
- [3] Nie, W., Kumar, S. V., Peters-Lidard, C. D., Zaitchik, B. F., Arsenault, K. R., Bindlish, R., & Liu, P. W. (2022). Assimilation of remotely sensed leaf area index enhances the estimation of anthropogenic irrigation water use. *Journal of Advances in Modeling Earth Systems*, 14(11), e2022MS003040.

- [4] Nie, W., Kumar, S. V., Bindlish, R., Liu, P. W., & Wang, S. (2022). Remote sensing-based vegetation and soil moisture constraints reduce irrigation estimation uncertainty. *Environmental Research Letters*, 17(8), 084010.
- [5] Nie, W., Kumar, S. V., Arsenault, K. R., Peters-Lidard, C. D., Mladenova, I. E., Bergaoui, K., ... & Navari, M. (2022). Towards Effective Drought Monitoring in the Middle East and North Africa (MENA) Region: Implications from Assimilating Leaf Area Index and Soil Moisture into the Noah-MP Land Surface Model for Morocco. *Hydrology and Earth System Sciences*, 26(9), 2365-2386.
- [6] Nie, W., Zaitchik, B. F., Rodell, M., Kumar, S. V., Arsenault, K. R., & Badr, H. S. (2021). Irrigation water demand sensitivity to climate variability across the contiguous United States. *Water Resources Research*, 57(3), 2020WR027738.
- [7] Nie, W., Zaitchik, B. F., Rodell, M., Kumar, S. V., Arsenault, K. R., Li, B., & Getirana, A. (2019). Assimilating GRACE into a land surface model in the presence of an irrigation-induced groundwater trend. *Water Resources Research*, 55(12), 11274-11294.
- [8] Nie, W.S., Zaitchik, B.F., Rodell, M., Kumar, S.V., Anderson, M.C., Hain, C.R., 2018. Groundwater withdrawals under drought: reconciling GRACE and land surface models in the United States High Plains Aquifer. *Water Resources Research*, 54(8), pp.5282-5299.
- [9] Nie, W.S., Zaitchik, B.F., Ni, G. and Sun, T., 2017. Impacts of Anthropogenic Heat on Summertime Rainfall in Beijing. *Journal of Hydrometeorology*, 18(3), pp.693-712.
- [10] Nie, W.S., Sun, T. and Ni, G.H., 2014. Spatiotemporal characteristics of anthropogenic heat in an urban environment: A case study of Tsinghua Campus. *Building and Environment*, 82, pp.675-686.
- [11] Springer, Anne, et al. "A review of current best practices and future directions in assimilating GRACE/-FO terrestrial water storage data into numerical models." *Hydrology and Earth System Sciences* 30.4 (2026): 985-1022.
- [12] Pflug, Justin M., et al. "Efficient and regionally transferable snow water equivalent estimation using a long short-term memory network." *Journal of Geophysical Research: Machine Learning and Computation* 2.4 (2025): e2025JH000593.
- [13] Getirana, Augusto, et al. "Deltaic freshwater scarcity driven by unsustainable groundwater-fed irrigation." *Nature Sustainability* 8.8 (2025): 914-924.
- [14] Ahmad, S. K., Holmes, T. R., Kumar, S. V., Lahmers, T. M., Liu, P. W., Nie, W., ... & Yang, Y. (2024). Droughts impede water balance recovery from fires in the Western United States. *Nature Ecology & Evolution*, 8(2), 229-238.
- [15] Khadim, F. K., Getirana, A., Bindlish, R., Kumar Biswas, N., Nie, W., Lahmers, T. M., & Kumar, S. V. (2024). Continental freshwater discharge influences sea surface salinity variability near world's megadeltas. *Proceedings of the National Academy of Sciences*, 121(49), e2412551121.
- [16] Zhang, Y., Sankaranarayanan, S., Nie, W., Zaitchik, B., & Siddiqui, S. (2024). Small-Scale Irrigation: Improving Food Security under Changing Climate and Water Resource Conditions in Ethiopia. *Journal of Water Resources Planning and Management*, 150(8), 04024028.
- [17] Bergaoui, K., Fraj, M. B., Fragaszy, S., Ghanim, A., Hamadin, O., Al-Karablieh, E., ... & McDonnell, R. (2024). Development of a composite drought indicator for operational drought monitoring in the MENA region. *Scientific reports*, 14(1), 5414.
- [18] Getirana, A., Kumar, S., Konapala, G., Nie, W., Locke, K., Loomis, B., ... & Simard, M. (2023). Climate and human impacts on hydrological processes and flood risk in southern Louisiana. *Water Resources Research*, 59(2), e2022WR033238.
- [19] Fu, J., Wang, W., Shao, Q., Xing, W., Cao, M., Wei, J., ... & Nie, W. (2022). Improved global evapotranspiration estimates using proportionality hypothesis-based water balance constraints. *Remote Sensing of Environment*, 279, 113140.
- [20] Fu, J., Wang, W., Zaitchik, B., Nie, W., Fei, E. X., Miller, S. M., & Harman, C. J. (2022). Critical role of irrigation efficiency for cropland expansion in western China arid agroecosystems. *Earth's Future*, 10(9), e2022EF002955.
- [21] Kumar, S. V., Holmes, T., Andela, N., Dharssi, I., Hain, C., Peters-Lidard, C., ... & Getirana, A. (2021). The 2019–2020 Australian drought and bushfires altered the partitioning of hydrological fluxes. *Geophysical Research Letters*, 48(1), e2020GL091411.

RESEARCH EXPERIENCES

Apr 2026 – NASA Hydrosphere program – Compound Hydrological Extremes and Water Security

Jan 2026 – Present NASA’s Advanced Information Systems Technology (AIST) Earth Systems Digital Twin (ESDT) Project on AI Climate Tipping Point Simulator

- Led the workflow of design, build, and calibrate the foundational box model for the Amazon monsoon system
- Coordinated a multi-team workflow, ensuring timely, high-quality implementation with AI agent system.

Sep 2024 – Present NASA Water Insight White Paper Project

- Led development of HydroGlobe, an ML and remote sensing-enhanced global water reanalysis, adopted in WMO 2022/2024 State of Global Water Resources report.
- Built ML pipelines for global TWS prediction using Linear, Random Forest, LightGBM, LSTM, and Temporal Fusion Transformer; results under review at JGR-MLC.
- Coordinated a multi-team workflow (20+ collaborators), ensuring timely, high-quality dataset delivery.

Mar 2021 – Sep 2024 NASA’s Earth Information System Project

- Built global drought monitoring frameworks integrating satellite + model data.
- Published findings in PNAS (2024) on water cycle nonstationarity; featured in NASA communications.
- Collaborated with NASA SVS to produce open science visualizations reaching broad audiences.

Oct 2021 – present NASA Advanced Information Systems Technology (AIST) – New Observing Strategies (NOS) project

- Help established workflow to generate real-time and medium-range streamflow forecasts at daily time scales and provided high-quality data sets for the team to monitor, target, and track flood events for regions that have suffered from wildfires for the Western United States.

Jan 2020 – Sep 2021 Improving Drought Monitoring and Forecasting for Middle East and North Africa

- As a technical lead of the project, Dr. Nie made significant progress in investigating and designing a customized modeling and data assimilation framework that contributes to the improvement of soil moisture related drought monitoring and forecasting skills.
- The outcome of this project, including the tools and datasets, was successfully delivered to governmental stakeholders in countries such as Morocco, Jordan, and Lebanon to support their drought risk management and decision making.

Mar 2019 – Dec 2019 Impact of Climate Variability on irrigation water demand in Continental US under climate change

- Implement satellite and in-situ observation derived irrigation parameters into NASA’s Land Information System (LIS) and the Land surface Data Toolkit (LDT).
- Perform simulations using Noah-MP Land Surface Model within LIS and evaluate the model performance using in-situ observations from USGS.
- Explore the impact of climate factors (precipitation and temperature) on irrigation water demand using various statistical metrics.

Dec 2018 – present Seasonal Forecast of Groundwater Storage Change in Continental US

- Implement irrigation fraction map into NASA’s Land Information System (LIS) and the Land surface Data Toolkit (LDT) to partition the irrigation water sources.
- Conduct seasonal forecast experiments using downscaled meteorological forecasts from the NASA Goddard Earth Observing model version 5 (GEOS5).

Dec 2017 – Dec 2018 GRACE data assimilation using NASA Land Information System (LIS)

- Implemented irrigation routine into the Noah-MP land surface model and GRACE data assimilation system within the framework of NASA’s Land Information System (LIS) and conducted case studies over regions in US.
- Performed GRACE data assimilation using Catchment Land Surface Model (CLSM) within LIS for South Asia, targeting at the Hindu Kush Himalayan region.

Sep 2017 – Dec 2017 Analyses of Terrestrial Hydrology Drought Characteristics over the Continental United States using GRACE-based Drought Indicators

- Conducted cross comparison of the frequency, intensity and duration of the drought in five climate divisions provided by the North American Regional Climate Change Assessment Program (NARCCAP).

Feb 2017 – May 2017 Analyses of the Vulnerability of Groundwater Aquifers Equipped with Well System to Contamination Migration using PFLOTRAN

- Conducted case studies of modeling contaminant transport for pumping and injection wells at different rate.

Mar 2014 – Jun 2015 Modeling Anthropogenic Heat Impact on Summertime Rainfall in Beijing Using WRF

- Incorporated spatiotemporally dynamic anthropogenic heat data estimated by BEP-BEM urban parameterization scheme into WRF.
- Generated up-to-date urban land cover categories as WRF input using MODIS NDVI and DMSP-OLS nighttime Light datasets.

Oct 2013 – Jan 2014 Heat Wave Pattern Simulation in Beijing Using WRF

- Used three different boundary layer schemes (MYJ, YSU and UM) to simulate hydrometeorological conditions during a heat wave in Beijing.
- Examined the impact of urbanization on the near surface temperature and wind speed using the Urban Canopy Module (UCM).

Oct 2012 – Jun 2014 Research on Spatiotemporal Characteristics of Anthropogenic Heat in Block Scale

- Conducted a detailed investigation of the characteristics of anthropogenic heat emitted from human metabolism, transportation and buildings using inventory and building energy modeling methods.

Sep 2010 – Aug 2011 Experimental Study on Green Roof Water Retention

- Designed an experimental apparatus including a sprinkler, a green roof container and a rain gauge.
- Conducted irrigation experiment and analyzed the water retention capacity of the green roof for different layers.

HONORS & AWARDS

2025 NASA Robert H. Goddard Award - Center Director's Award

2025 NASA HBG Best Paper Award

2024 NASA HBG Peer Award for Scientific Achievement

2019 AGU Chapman Conference Travel Grant

2019 Journal Club Presentation Award of EPS Department, Johns Hopkins University

2015 Earth and Planetary Science Fellowship, Johns Hopkins University

2015 Distinguished Master's Thesis Award, Tsinghua University

2015 Outstanding Graduate Student Award, Tsinghua University

2014 China National Scholarship

2012 The Wu Chaoyu Scholarship for Excellent Academic Performance

2011 The Comprehensive Scholarship of Tsinghua University

PRESENTATIONS

Conference Presentations

2023 AMS Annual Meeting, 2023, Two decades of global water cycle variability – nonstationarity assessed by land data assimilation

2022 AGU Fall Meeting, 2022, Two decades of global water cycle variability – nonstationarity assessed by land data assimilation

2022 AMS Annual Meeting, 2022, Irrigation estimation constrained by remotely sensed vegetation and soil moisture

- 2021 AGU Fall Meeting, 2021, Advancing the modeling of human footprint impact on water-energy-carbon cycles via land data assimilation (Invited)
- 2020 AGU Fall Meeting, 2020, Improving drought monitoring for the Middle East and North Africa region via data assimilation using the NASA Land Information System
- 2019 AGU Fall Meeting in San Francisco, California, 2019, Irrigation water use sensitivity to drought and heat across the Contiguous United States: a modeling study
- 2019 AGU Chapman Conference in Valencia, Spain, 2019, Assimilating GRACE into a Land Surface Model in the presence of an irrigation-induced groundwater trend. Poster Presentation
- 2018 AGU Fall Meeting in Washington DC, 2018, Assimilating GRACE into a Land Surface Model in the presence of an irrigation-induced groundwater trend. Oral Presentation
- 2017 AGU Fall Meeting in New Orleans, 2017, Groundwater withdrawals under drought: reconciling GRACE and land surface models in the United States High Plains Aquifer. Oral Presentation
- 2017 GRACE Science Team Meeting in Austin, Texas, 2017, Groundwater withdrawals under drought: reconciling GRACE and land surface models in the United States High Plains Aquifer. Oral Presentation
- 2016 AGU Fall Meeting in San Francisco, California, 2016, Impact of anthropogenic heat on summertime rainfall in Beijing. Oral Presentation
- 2016 GEWEX Convection-Permitting Climate Modeling Workshop in Denver, Colorado, 2016, Impact of anthropogenic heat on summertime rainfall in Beijing. Poster Presentation

Invited Seminars

Topic: Global terrestrial water storage nonstationarity and its application in drought

2025 Noah-MP monthly telecon, NOAA, 28 May 2025.

Topic: Enhancing global land water reanalysis through multivariate data assimilation: integrating leaf area index, soil moisture, and GRACE/GRACE-FO water storage anomalies into Noah-MP land surface model

2024 Technical workshop on assimilating GRACE/-FO data into land surface and hydrological models, Online, 18 Jan 2024.

Topic: Advancing the modeling of human footprint impact on water-energy-carbon cycles via land data assimilation using Noah-MP land surface model

2022 Noah-MP monthly telecon, NOAA, 30 Mar 2022.

Topic: Irrigation and its response to climate: improving representation of human impacts in hydrological modeling and data assimilation systems

2020 Tsinghua University, Dept of Hydraulic Engineering, Beijing, China, 22 Aug 2018.

Topic: Human-water interface in hydrological modeling: implications of GRACE observations for drought monitoring and forecasting

2018 International Center for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal, 23 Jul 2018.

2018 Tsinghua University, Dept of Hydraulic Engineering, Beijing, China, 22 Aug 2018.

2018 Chinese Academy of Sciences, Key Laboratory of Regional Climate-Environment for Temperate East Asia (RCE-TEA), Beijing, China, 23 Aug 2018.

2018 Capital Normal University, College of Resource Environment and Tourism, Beijing, China, 24 Aug 2018.

TEACHING EXPERIENCE

2020 The Johns Hopkins Teaching Institute Program (Certificated)

2019 Graduate Teaching Assistant, Johns Hopkins University

(AS.270.103 Introduction to Global Environmental Change)

SERVICE TO PROFESSION

Peer reviewer for the following journals:

Remote Sensing of Environment (RSE), Journal of Hydrometeorology (JHM), Water Resources Research (WRR), Journal of Hydrology (JOH), Journal of Applied and Meteorology and Climatology (JAMC), Hydrological Sciences Journal (HSJ), Geophysical Research Letters (GRL), Hydrology and Earth System Sciences (HESS), Earth's Future, Advances in Atmospheric Sciences, Geoscientific Model Development (GMD), NSF ad hoc reviewer for the CAREER proposals (2021), NASA FINESST panel reviewer (2023)

PROFESSIONAL MEMBERSHIPS

American Geophysical Union (2016 - present) | American Meteorological Society (2022- present)