Zhenhua Zou

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POSITIONS

University of Maryland
- Assistant Research Professor 07/2021-Present
- Postdoc Associate Researcher 06/2019-06/2021

University of Oklahoma
- Graduate Research Assistant 08/2015-05/2019

Beijing Normal University
- Research Assistant 08/2012-07/2015

EDUCATIONS

University of Oklahoma
- Ph.D. in the interdisciplinary field of Remote Sensing and Ecology (Center for Earth Observation and Modeling) 05/2019

Beijing Normal University
- MEng. in Cartography & Geographic Information Engineering 07/2015

South China Normal University
- BSc. In Geographical Sciences 08/2012

RESEARCH GRANT EXPERIENCES

- **Zou**, Zhenhua (PI), 2024-2027: Estimating the Carbon Release from U.S. Tree Destruction in Extreme Climate Events. (**Proposal submitted** to NASA's Early Career Investigator Program in Earth Science, waiting for result)
- Huang, C. (PI), Zhenhua **Zou** (Co-I), 2020-2023: Development of Enhanced NWI Mapping Protocols for the U.S. Fish and Wildlife Service. Funding agency: U.S. Fish and Wildlife Service. The awarded amount is $383K. (**Funded**, F20AC11249)
- Xiao, X. (PI), Zhenhua **Zou** (Co-I), 2018-2019: 2018 Student Research Grant: Evaluating the potential of Sentinel-2 and Landsat images for mapping open surface water body areas and water quality in Oklahoma. Funding agency: USGS Oklahoma Water Resource Center. Award amount is $5k. (**Funded**). (Supervisor needs to have a match funding of 2:1)

PEER-REVIEWED PUBLICATIONS (ResearchGate, Google Scholar)(29 published + 2)

2023 Zou, Z., et al. Testing deep learning models in impervious surface detection for wetland loss assessment. (In preparation)

2023 **Zou, Z.**, Huang, C., Lang, M. W., Du, L., McCarty, G., Ingebritsen, J. C., Harner, J., Griffin, R., Gong, W., & Lu, J. Hotspots of wetlands loss to impervious surfaces in the conterminous United States (**Under review in Communications Earth & Environment**).

2023 **Zou, Z.,** Xiao, X., Huang, C., Dong, J., Du, L., Wang, X., Zhou, Y., and Qin, Y., Multidecadal trends in surface water areas at various scales across the globe (**Under review in Nature Communications**).

2023 **Zou, Z**., Huang, C., Lang, M. W., Du, L., McCarty, G., Ingebritsen, J. C., Herold, N., Griffin, R., Gong, W., Lu, J. (2023), "Use of high-resolution land cover maps to support the maintenance of the NWI geospatial dataset: a case study in a coastal New Orleans region" **Remote Sensing**, 15(16), p.4075.

2021 **Zou, Z.**, C., Huang, B., DeVries, M., Lang, S., Thielke, G., McCarty, A., Robertson, J., Knopf, A., Wells, J., Ju, J., Masek, L., Du (2021), "Characterizing Wetland Inundation and Vegetation Dynamics in the Arctic Coastal Plain Using Recent Satellite Data and Field Photos," **Remote Sensing**, 13(8), p.1492.

2018 **Zou, Z.**, X. Xiao, J. Dong, Y. Qin, R. B. Doughty, M. A. Menarguez, G. Zhang, J. Wang. (2018), "Divergent trends of open surface water body area in the contiguous US during 1984-2016," **Proceedings of the National Academy of Sciences**, 115, 3810-3815, https://doi.org/10.1073/pnas.1719275115.

2017 **Zou, Z.**, J. Dong, M. A. Menarguez, X. Xiao, Y. Qin, R. B. Doughty, K. V. Hooker, and K. David Hambright (2017), "Continued decrease of open surface water body area in Oklahoma during 1984-2015," **Science of the Total Environment**, 595, 451-460, doi: 10.1016/j.scitotenv.2017.03.259.

2023 Zhou, Y., Dong, J., Cui, Y., Zhao, M., Wang, X., Tang, Q., Zhang, Y., Zhou, S., Metternicht, G., **Zou, Z.**, Zhang, G., and Xiao, X. (2023), "Ecological restoration exacerbates the agriculture-induced water crisis in the North China Region," **Agricultural and Forest Meteorology**, 331, 109341.

2022 Zhou, Y., Dong, J., Cui, Y., Zhou, S., Li, Z., Wang, X., Deng, X., **Zou, Z.**, and Xiao, X. (2022), "Rapid surface water expansion due to increasing artificial reservoirs and aquaculture ponds in the North China Plain," **Journal of Hydrology**, 608, p.127637.

2022 Liu, F., Xiao, X., Qin, Y., Yan, H., Huang, J., Wu, X., Zhang, Y., **Zou, Z.**, and Doughty, R.B. (2022), "Large spatial variation and stagnation of cropland gross primary production increase the challenges of sustainable grain production and food security in China," **Science of the Total Environment**, 811, p.151408.

2021 Wang, X., Xiao, X., Xu, X., **Zou, Z.**, Chen, B., Qin, Y., Zhang, X., Dong, J., Liu, D., Pan, L., and Li, B. (2021), "Rebound in China's coastal wetlands following conservation and restoration," **Nature Sustainability**, 4(12), pp.1076-1083.

2021 Du, L., McCarty, G.W., Li, X., Rabenhorst, M.C., Wang, Q., Lee, S., Hinson, A.L., and **Zou, Z.** (2021). "Spatial extrapolation of topographic models for mapping soil organic carbon using local samples." **Geoderma**, 404, p.115290.

2020 Wang, X., Xiao, X., **Zou, Z.**, Dong, J., Qin, Y., Doughty, R.B., Menarguez, M.A., Chen, B., Wang, J., Ye, H., and Ma, J. (2020), "Gainers and losers of surface and terrestrial water resources in China during 1989–2016," **Nature Communications**, 11(1), pp.1-12.

2020 Wang, X., Xiao, X., **Zou, Z.**, Hou, L., Qin, Y., Dong, J., Doughty, R.B., Chen, B., Zhang, X., Chen, Y., and Ma, J. (2020). "Mapping coastal wetlands of China using time series Landsat images in 2018 and Google Earth Engine." **ISPRS Journal of Photogrammetry and Remote Sensing**, 163, pp.312-326.

2020 Wang, X., Xiao, X., **Zou, Z.**, Chen, B., Ma, J., Dong, J., Doughty, R.B., Zhong, Q., Qin, Y., Dai, S., and Li, X. (2020). "Tracking annual changes of coastal tidal flats in China during 1986–2016 through analyses of Landsat images with Google Earth Engine." **Remote Sensing of Environment**, 238, p.110987.

2020 Xin, F., Xiao, X., Dong, J., Zhang, G., Zhang, Y., Wu, X., Li, X., **Zou, Z.**, Ma, J., Du, G., and Doughty, R.B. (2020). "Large increases of paddy rice area, gross primary production, and grain production in Northeast China during 2000–2017." **Science of The Total Environment**, 711, p.135183.

2020 Du, L., McCarty, G.W., Zhang, X., Lang, M.W., Vanderhoof, M.K., Li, X., Huang, C., Lee, S., and **Zou, Z.** (2020). "Mapping Forested Wetland Inundation in the Delmarva Peninsula, USA Using Deep Convolutional Neural Networks." **Remote Sensing**, 12(4), p.644.

2019 Zhou, Y., Dong, J., Xiao, X., Liu, R., **Zou, Z.**, Zhao, G., and Ge, Q. (2019). "Continuous monitoring of lake dynamics on the Mongolian Plateau using all available Landsat imagery and Google Earth Engine." **Science of the Total Environment**, 689, pp.366-380.

2019 Chang, Q., Xiao, X., Jiao, W., Wu, X., Doughty, R., Wang, J., Du, L., **Zou, Z.**, and Qin, Y. (2019). "Assessing consistency of spring phenology of snow-covered forests as estimated by vegetation indices, gross primary production, and solar-induced chlorophyll fluorescence." **Agricultural and Forest Meteorology**, 275, pp.305-316.

2019 Niu, Q., Xiao, X., Zhang, Y., Qin, Y., Dang, X., Wang, J., **Zou, Z.**, Doughty, R.B., Brandt, M., Tong, X., and Horion, S. (2019). "Ecological engineering projects increased vegetation cover, production, and biomass in semiarid and subhumid Northern China." **Land Degradation & Development**, 30(13), pp.1620-1631.

2019 Qin, Y., Xiao, X., Dong, J., Zhang, Y., Wu, X., Shimabukuro, Y., Arai, E., Biradar, C., Wang, J., **Zou, Z.**, and Liu, F. (2019). "Improved estimates of forest cover and loss in the Brazilian Amazon in 2000–2017." **Nature Sustainability**, 2(8), pp.764-772.

2018 Wang, X., Xiao, X., **Zou, Z.**, Chen, B., Ma, J., Dong, J., and Li, X. (2018). "Tracking annual changes of coastal tidal flats in China during 1986–2016 through analyses of Landsat images with Google Earth Engine." **Remote Sensing of Environment**.

2018 Du, L., Mikle, N., **Zou, Z.**, Huang, Y., Shi, Z., Jiang, L., and Luo, Y. (2018). "Global patterns of extreme drought-induced loss in land primary production: Identifying ecological extremes from rain-use efficiency." **Science of the Total Environment**, 628, 611-620.

2018 Wang, J., Xiao, X., Qin, Y., Doughty, R.B., Dong, J., and **Zou, Z.** (2018). "Characterizing the encroachment of juniper forests into sub-humid and semi-arid prairies from 1984 to 2010 using PALSAR and Landsat data." **Remote Sensing of Environment**, 205, 166-179.

2018 Xu, W., Qin, Y., Xiao, X., Di, G., Doughty, R.B., Zhou, Y., **Zou, Z.**, Kong, L., Niu, Q., and Kou, W. (2018). "Quantifying spatial-temporal changes of tea plantations in complex landscapes through integrative analyses of optical and microwave imagery." International **Journal of Applied Earth Observation and Geoinformation**, 73, 697-711.

2018 Doughty, R., Xiao, X., Wu, X., Zhang, Y., Bajgain, R., Zhou, Y., Qin, Y., **Zou, Z.**, McCarthy, H., Friedman, J., Wagle, P., Basara, J., and Steiner, J. (2018). "Responses of gross primary production of grasslands and croplands under drought, pluvial, and irrigation conditions during 2010–2016, Oklahoma, USA." **Agricultural Water Management**, 204, 47-59.

2017 Qin, Y., Xiao, X., Dong, J., Zhou, Y., Wang, J., Doughty, R.B., Chen, Y., **Zou, Z.**, and Moore, B. (2017). "Annual dynamics of forest areas in South America during 2007–2010 at 50-m spatial resolution." **Remote Sensing of Environment**, 201, 73-87.

2017 Zhou, Y., J. Dong, X. Xiao, T. Xiao, Z. Yang, G. Zhao, Z. Zou, and Y. Qin (2017), Open Surface Water Mapping Algorithms: A Comparison of Water-Related Spectral Indices and Sensors, ***Water-Sui***, *9*(4), doi: 10.3390/w9040256.

2017 Lin, Q., **Zou, Z.**, Lin, L., Wang, Y. (2017). "Combining Spectral and Morphometric Properties of Landslides for Separating Individual Landslides Based on Object-Oriented Method. in Advancing Culture of Living with Landslides" (pp. 61-70). **Springer International Publishing**. http://dx.doi.org/10.1007/978-3-319-53498-5_8

2016 Qin, Y., X. Xiao, J. Dong, K. Ewing, B. Hoagland, D. Hough, T. Fagin, Z. Zou, G. Geissler, G. Xian, T. Loveland (2016), Mapping Annual Forest Cover in Sub-Humid and Semi-Arid Regions through Analysis of Landsat and PALSAR Imagery, **Remote Sensing**, *8*(11), doi: 10.3390/rs8110933.

2015 Li M., **Zou Z.**, Xu G., Shi P. (2015) "Mapping Earthquake Risk of the World. In: Shi P., Kasperson R. (eds) World Atlas of Natural Disaster Risk. IHDP/Future Earth-Integrated Risk Governance Project Series". pp. 25-39. **Springer**, Berlin, Heidelberg

2015 Wang, Y., **Zou, Z.**, & Li, J. (2015). Influencing factors of households disadvantaged in post-earthquake life recovery: a case study of the Wenchuan earthquake in China. **Natural Hazards**, 75(2), 1853-1869.

2014 Du, L., T. Zhou, Z. Zou, X. Zhao, K. Huang, and H. Wu (2014), Mapping Forest Biomass Using Remote Sensing and National Forest Inventory in China, **Forests**, *5*(6), 1267-1283, doi: 10.3390/f5061267.

2014 Wang, Y., Li, J., Chen, H., & **Zou, Z.** (2014). The time process of post-earthquake

recovery: the Yao'an earthquake in China. **Disasters**, 38(4), 774-789.

CONFERENCE PRESENTATIONS

2023 **Zou, Z.**, Huang, C., Lang, M., Ingebritsen, J. (2023). "Qualitative Assessment of New 1-m C-CAP Product over Tampa." Conference with U.S. Fish and Wildlife Service, U.S. National Oceanic and Atmospheric Administration, and Ducks Unlimited, June 2, 2023, College Park, Maryland. (Oral presentation, Online).

2023 **Z. Zou**, "Development of 1-m Difference Product to Support NWI Targeting and Maintenance, project presentation to scientists and researchers at Fish and Wildlife Service", College Park, Maryland. Mar. 15, 2023. (Oral presentation, Online).

2022 **Z. Zou**, "Hotspots of wetland loss to impervious surface in the conterminous United States, project presentation to scientists and researchers at Fish and Wildlife Service", College Park, Maryland. Nov. 02, 2022. (Oral presentation, Online).

2020 **Z. Zou**, B. DeVries, C. Huang, Introduction to Google Earth Engine (GEE) "Dynamic Surface Water Extent (DSWE), Workshop to scientists and researchers at Fish and Wildlife Service", Jun. 24, 2020. College Park, Maryland. (Workshop with hand-on training, Online)

2018 **Zou, Z.**, Xiao, X., Dong, J., Qin, Y., Doughty, R.B., Menarguez, M.A., Zhang, G., Wang, J. (2018). "Spatiotemporal Dynamics of Open Surface Water Body Area in the Contiguous United States (CONUS) from 1984 to 2016." 2018 AGU Fall Meeting, Dec 14, 2018, Washington DC. (Oral Presentation).

2018 **Zou, Z.**, Xiao, X. (2018). "Trends of Open Surface Water Body Area and GRACE Land Water Storage in Southern Great Plains." GrazingCAP project annual meeting, Aug 22, 2018, Stillwater, OK. (Oral presentation).

2018 **Zou, Z.**, Xiao, X., Dong, J., Qin, Y., Doughty, R.B., Menarguez, M.A., Zhang, G., Wang, J. (2018). "Divergent trends of open surface water body area in CONUS during 1984–2016." EPSCoR project annual meeting, Apr 24, 2018, OKC. (Poster).

2017 **Zou, Z.**, Xiao, X., Dong, J., Qin, Y., Doughty, R.B., Menarguez, M.A., Wang, J. "The spatial-temporal dynamics of open surface water bodies in CONUS during 1984-2016", 2017 AGU Fall Meeting, Dec 13, New Orleans, LA. (Poster).

2016 **Zou, Z.**, Xiao, X., Menarguez, M.A., Dong, J., Qin, Y. (2016). "Mapping inter-annual dynamics of open surface water bodies in Oklahoma from Landsat images in 1984 to 2015 at 30-m spatial resolution." 2016 AGU Fall Meeting, Dec 15, 2016, San Francisco, CA. (Poster).

2015 **Zou, Z.**, Xiao, X. "Assessment of Vegetation Destruction Due to Wenchuan Earthquake and Its Recovery Process Using MODIS Data." 2015 AGU Fall Meeting, Dec 15, San Francisco, CA. (Poster).

TECHNICAL REPORTS

2022 **Zou, Z.**, Huang, C., Lang, M., Griffin, R., Derivation of Wetland Difference Products by Comparing the NWI Geospatial Dataset with C-CAP (10-m) and NLCD (2019) Data. A technical report to U.S. Fish and Wildlife Service. Available at U.S. Fish and Wildlife Service Website: (This is a technical report for the multi-year grant project I received as a co-investigator)

RESEARCH EXPERIENCES

Change detection in wetland ecosystems across the U.S. (2/2021–now)

I received a multi-year research grant as a co-investigator to develop NWI update targeting tools. I compared the NWI data with the 30-meter National Land Cover Database (NLCD) and 10-meter C-CAP datasets across the entire U.S. to evaluate changes in NWI datasets. The targeting tools consisted of pixel level wetland change products at 10-meter and 30-meter resolutions, wetland loss conditions for 33 million wetland polygons of the entire NWI geospatial dataset, and statistics of wetland loss and gain at 83,334 HUC12 watersheds and 83,776 census tracts. The targeting tools were delivered to the U.S. Fish and Wildlife Service and its collaborators. The tools were used to prioritize regions (watersheds/census tracts) with the most wetland changes for updates and maintenance. This research found that approximately 2600 hectares of wetlands are lost to impervious surfaces annually across the U.S. Wetland loss concentrated in rapidly expanding suburban regions, forming hotspots in cities such as Houston, Chicago, Jacksonville, and Naples. Population growth and the associated demand for new housing are major drivers of wetland loss in these regions. Current wetland loss hotspots are expected to experience further loss due to projected population growth in future decades, with Houston projected to lose the most wetland area at 8915 hectares (manuscript under review).

Global surface water evaluation (1/2018–3/2023)

I generated 30-meter global annual water body maps from 1984 to 2017 using 3.8 million Landsat images, totaling 2.2 petabytes of data in Google Earth Engine cloud computing platform. I analyzed the time series variations and trends in surface water area at 0.01° grid cells, 5° tiles, and level-5 hydrological basins globally using the Python programing language and parallel processing techniques in high performance computers. Additionally, I compared these trends with those observed in terrestrial water storage. Globally, approximately 4.0 million 0.01° grid cells exhibited significant increasing trends over the past decades, while around 4.5 million cells showed significant decreasing trends. The total increasing and decreasing rates were estimated at 6190 km^2/year and 5954 km^2/year, respectively. The trends in 5° tiles revealed significant increases in water area in regions such as the Tibetan Plateau and the Prairie Pothole Region, while notable decreases were

observed in the Aral Sea region, western US, and southern Japan. Divergent trends between surface water area and terrestrial water storage were found in 5° tiles located in Greenland, China, the Indus Basin, and central Africa (Manuscript under review).

Classification of water and impervious layers using deep learning (2/2023-now)
I used deep learning models to extract water and impervious layers from very high-resolution (0.25m) aerial images across the entire state of Delaware. The deep learning algorithms successfully extracted water and impervious layers across various landscapes with high accuracy. The extracted water and impervious layers from recent aerial images, Sentinel-1/2, and Lidar point cloud data can be utilized to detect changes in the NWI dataset. I plan to build a wetland monitoring tool to detect wetland loss using deep learning models and multi-sensor observations, such as NAIP, Lidar point cloud data, Sentinel-1, Sentinel-2, Landsat, etc. (manuscript in preparation).

Research on changes in U.S. inland water resources (9/2016–3/2018)
I detected open-surface water bodies in 370,000 Landsat images (over 200 TB of data) and generated 30-meter annual water body frequency maps for the years 1984 to 2016 in Google Earth Engine using JavaScript and Python programming languages. I analyzed trends in water body area and examined the climatic and anthropogenic drivers using high-performance computers and parallel processing techniques with Python, GDAL, and over 300 CPUs. Generally, the western half of the United States is susceptible to water stress, with small water body areas and significant interannual variability. From 1984 to 2016, regions in the Southwest and Northwest with limited water resources experienced decreasing trends in water body area, while water-rich regions in the Southeast and far north Great Plains witnessed increasing trends. These divergent trends, primarily driven by climate, have widened water-resource gaps and are likely to persist according to climate projections. The shrinkage of surface water bodies during the prolonged drought of 2012 resulted in substantial groundwater depletion and a rapid decline in land water storage in California and the southern Great Plains (Published in the Proceedings of the National Academy of Sciences, PNAS).

Wetland difference product at 1-m resolution for NWI maintenance (9/2022–2/2023)
I explored the utilization of the 1-meter land cover map from the National Oceanic and Atmospheric Administration (NOAA) Coastal Change Analysis Program (C-CAP) to facilitate the update and maintenance of NWI datasets in New Orleans and Tampa Bay regions. Firstly, I generated 1-m difference products by comparing the NWI and C-CAP datasets. Secondly, I generated time series dynamic surface water extent datasets. Next, I calculated wetland change statistics for each NWI wetland polygon. Additionally, I derived new water polygons from the C-CAP dataset. The difference products and statistics provided precise

spatial details regarding the locations of wetland change and enabled the selection of NWI polygons with the most wetland loss and water regime changes. The algorithms and products developed in this study can support the update and maintenance of the NWI dataset, leading to enhanced efficiency and cost savings (manuscript submitted).

Alaska ANWR wetland ecosystem mapping and change analysis (7/2019-5/2020)
I generated sub-pixel water fraction maps of Arctic National Wildlife Refuge (ANWR) at a 10-meter resolution using Sentinel-2 data. I analyzed water regimes and their seasonal dynamics. Additionally, I classified vegetation types through the synergistic use of Sentinel-1 synthetic-aperture radar (SAR) data, water regimes, vegetation index, topographic data, and a random forest classifier. Based on this, I analyzed shrub expansion over the last three decades. The findings revealed that June exhibited the maximum inundation, while the least inundation was recorded in July. Areas such as riverbeds, edges of lakes and ponds, and wetlands in topographic depressions demonstrated higher hydrological dynamics, whereas pond centers were relatively more stable. Compared with the NWI data produced in the 1980s, shrub wetlands have increased from 91 km^2 to 258 km^2 over the last three decades, representing 182% change. These findings indicate significant changes in vegetation types across Artic wetlands due to global warming (Published in Remote Sensing).

Water quality estimation using satellite images (1/2019–6/2019)
I received a research grant from the USGS Oklahoma Water Resources Center to evaluate the potential of Sentinel-2 and Landsat images in estimating chlorophyll-a concentration. Multiple stepwise regression analysis was used to explore the relationships between approximately 10,000 chlorophyll-a measurements and their corresponding surface reflectance from satellite images. Regression models using Landsat data showed good performance in Eufaula Lake, Keystone Lake, Copan Lake, Hugo Lake, Foss Reservoir, and Atoka Reservoir. The brightness temperature band of Landsat images was selected in one-third of the chlorophyll-a estimation models, indicating that temperature is one of the most important factors influencing algal bloom in Oklahoma. The Red Edge 2 band of Sentinel-2 images also showed great potential in chlorophyll-a estimation across different water sampling sites and water bodies across Oklahoma. Estimating chlorophyll-a using Landsat 5/7/8 and Sentinel-2 satellite images can serve as a cost-effective supplement to expensive in-situ field measurements in some lakes and reservoirs in Oklahoma.

Oklahoma water resource and environment study (9/2015–9/2016)
I generated annual water body maps of Oklahoma for the period 1984-2015 at a spatial resolution of 30 meters. Based on this analysis, I analyzed the areas and numbers of four water body extents: maximum, year-long, seasonal, and average extents. These analyses

aimed to capture variations in water body area and number. Statistically significant downward trends were identified in the maximum, year-long, and annual average water body areas from 1984 through 2015. Additionally, both water body area and number exhibited positive relationships with precipitation and negative relationships with temperature. Surface water withdrawals primarily influenced the year-long water bodies. Moreover, it was observed that smaller water bodies face a higher risk of drying under drier climate conditions. This suggests that small water bodies are more vulnerable in climate-warming scenarios (Published in Science of the Total Environment).

Vegetation destruction and recovery assessment (2/2015–12/2015)
I evaluated the vegetation destruction caused by an 8.0 Ms. earthquake in 2008 and studied its subsequent recovery process using MODIS data. This study calculated the mean and standard deviation of the maximum NDVI for each MODIS pixel over the 8 years prior to the earthquake. If a pixel's maximum NDVI in 2008 was two standard deviations smaller than the mean maximum NDVI, it was classified as a vegetation-destructed pixel. For each vegetation-destructed pixel, adjacent non-destructed pixels of the same vegetation type were selected as reference pixels to assess the vegetation recovery process. The results revealed that the vegetation recovery in those destructed pixels was slow and fluctuating. (Poster presentation in 2015 AGU meeting).

Forest biomass mapping (5/2013–12/2013)
My work involved calibrating MODIS forest area data with the national forest inventory. I developed a program using MATLAB to determine the optimal thresholds for forest area calibration (Published in Forests, third author).

PRODUCTS AND DATASETS

- 1-m resolution difference product of the National Wetland Inventory (NWI) for Tampa Bay, Florida. The product has been delivered to the U.S. Fish and Wildlife Service (FWS). https://umd.box.com/s/9293os5ez4ct0ji2jq8hfym6vur8efyf
- NWI wetland monitoring tools. There tools are utilized by the U.S. Fish and Wildlife Service (FWS) to identify regions with the most wetland loss across the Contiguous United States (CONUS). https://umd.box.com/s/zzjqq819mxm7f5cde16julbpcnkurwox
- Sub-pixel water fraction dataset and vegetation type dataset of the Arctic National Wildlife Refuge (ANWR). These datasets are utilized by the GeoSpatial Services Group at Saint Mary's University for the generation of NWI standard-compliant products for ANWR. They are also used by the FWS Alaska field office for field survey. https://umd.box.com/s/uhwzthid0v299mkusdt8e2fgs476zu90

SERVICES

Guest/Associate Editors for Peer-review Journals

- Guest Editor of the Special Issue "Recent Advances in Water and Wetland Studies with Remote Sensing Techniques" for the peer-review journal Remote Sensing. (June 2022 - September 2023).
- Guest Editor of the Special Issue "Mapping and Change Analysis of Water and Wetland" for the peer-review journal Water. (May 2021 - April 2022).
- Associate editor for the peer-review journal Frontiers in Big Data (June 2023 - now)
- Member of the Volunteer Reviewer Board for MDPI journals (Remote Sensing, Sustainability, Water) (July 2023 - now)

Grant Proposal Technical Lead and Referee

- Technical lead for the Environmental Protection Agency (EPA) Chesapeake Bay Program (CBP) Goal Implementation Team (GIT, Zhenhua Zou and Megan Lang) for the grant named "Mapping Non-Tidal Vegetated Wetlands in Areas with Outdated Wetland Maps" ($90,000). (1/2023 - now). Additionally, I serve as a referee for this grant.

Journal Referee

- *Nature Communications*
- *Remote Sensing of Environment*
- *ISPRS Journal of Photogrammetry and Remote Sensing*
- *IEEEAccess*
- *IEEE Transactions on Geoscience and RS*
- *Hydrology*
- *Water*
- *Sustainability*
- *Sensor*
- *Drones*
- *Frontier in Earth Science*
- *Geo-spatial Information Science*
- *Open Geosciences*
- *Hydroinformatics*
- *Remote Sensing*
- *Watershed Ecology and the Environment*
- *Ecohydrology*
- *Acta Agriculturae Scandinavica*
- *Physics and Chemistry of the Earth*
- *International Journal of Digital Earth*
- *Journal of the American Water Resources Association*

RESEARCH MENTORSHIPS

Anteneh Sarbanes, Master student, Department of Geographical Sciences, UMD. GOEG797 Capstone Project "Multi-sensor, Water Index Flood Analysis: Ethiopia 2020". Spring, 2021.

Jennifer Kraus, Master student, Department of Geographical Sciences, UMD. GOEG797 Capstone Project "Using Satellite Imagery to Model Bathymetry and Create Environmental Predictors". Fall 2020.

Xinxin Wang, Ph.D. student, Center for Earth Observation and Modeling, University of Oklahoma. "Surface water and wetland mapping and change analysis". Spring 2018 - Fall 2021.

Publications of student Xinxin Wang:

Wang, X., Xiao, X., Xu, X., **Zou, Z.**, Chen, B., Qin, Y., Zhang, X., Dong, J., Liu, D., Pan, L., and Li, B. (2021), "Rebound in China's coastal wetlands following conservation and restoration," **Nature Sustainability**, 4(12), pp.1076-1083.

Wang, X., Xiao, X., **Zou, Z.**, Chen, B., Ma, J., Dong, J., Doughty, R.B., Zhong, Q., Qin, Y., Dai, S., and Li, X. (2020). "Tracking annual changes of coastal tidal flats in China during 1986–2016 through analyses of Landsat images with Google Earth Engine." **Remote Sensing of Environment**, 238, p.110987.

Wang, X., Xiao, X., **Zou, Z.**, Dong, J., Qin, Y., Doughty, R.B., Menarguez, M.A., Chen, B., Wang, J., Ye, H., and Ma, J. (2020), "Gainers and losers of surface and terrestrial water resources in China during 1989–2016," **Nature Communications**, 11(1), pp.1-12.

Wang, X., Xiao, X., **Zou, Z.**, Hou, L., Qin, Y., Dong, J., Doughty, R.B., Chen, B., Zhang, X., Chen, Y., and Ma, J. (2020). "Mapping coastal wetlands of China using time series Landsat images in 2018 and Google Earth Engine." **ISPRS Journal of Photogrammetry and Remote Sensing**, 163, pp.312-326.

Wang, X., Xiao, X., **Zou, Z.**, Chen, B., Ma, J., Dong, J., and Li, X. (2018). "Tracking annual changes of coastal tidal flats in China during 1986–2016 through analyses of Landsat images with Google Earth Engine." **Remote Sensing of Environment**.

PROFESSIONAL SKILLS

- Programming: Python, JavaScript, IDL, and MATLAB. Processing big geospatial datasets (e.g., dozens of global 30-m maps) in HPCs using Python, GDAL, and GeoPandas. Data processing in Google Earth Engine using JavaScript. Processing Lidar point cloud data in HPCs using Python. Running deep learning models using Python.
- Software: ArcGIS, ENVI, SPSS, etc.
- Field work instrument: FieldSpec-ASD, Spectroradiometer PSR 3500+, LAI - 2000/2200, Eddy covariance system (LI-7500, LI-7700), and Drone.
- Certificates: Chinese high school geography teacher certificate. Unmanned aircraft pilot certificate, Eddy Covariance Training Certificate

HONORS AND AWARDS

2018 Distinguished Publication Award, University of Oklahoma.

2018 First prize in the poster contest of the 2018 GIS Day, University of Oklahoma.

2018 Robberson Conference Presentation & Creative Exhibition Travel Grant.

2014 National Scholarship, Beijing Normal University.

2012 Excellent Thesis Paper award. South China Normal University.

2011 Second prize in the geography teaching contest, Beijing Normal University (considered the top teacher education university in China)

2010 National Endeavor Fellowship, South China Normal University

TEACHING EXPERIENCES

- 2019 Spring: GIS4733/5733 - Environmental Remote Sensing. I served as an instructor for 6 weeks, conducting lab lectures on Spectroradiometer PSR 3500+ and field lectures on FieldSpec-ASD, LAI 2000, and grass biomass measurement. I also taught Google Earth Engine data processing using Javascript. Additionally, I graded weekly textbook or article reading reports for 15 weeks and handled project and test design and grading.
- 2018 Spring: GIS4733/5733 - Environmental Remote Sensing. I served as an instructor for 6 weeks, conducting lab lectures on Spectroradiometer PSR 3500+ and field lectures on FieldSpec-ASD, LAI 2000, and grass biomass measurement. I also taught Google Earth Engine data processing using Javascript. Additionally, I graded weekly textbook or article reading reports for 15 weeks and handled project and test design and grading.
- 2017 Spring: GIS4733/5733 - Environmental Remote Sensing. I served as an instructor for 5 weeks, conducting lab lectures on Spectroradiometer PSR 3500+ and field lectures on FieldSpec-ASD, LAI 2000, and grass biomass measurement. Additionally, I graded weekly textbook or article reading reports for 15 weeks and handled project and test design and grading.
- 2011 Fall: I worked as a full-time substitute teacher at Guangzhou No. 86 High School, teaching natural geography in 6 classes, with 50 students in each class. I covered 2 new lessons per week, amounting to 12 lessons per week for 15 weeks.

MEMBERSHIPS IN PROFESSIONAL ASSOCIATIONS

American Geophysical Union (AGU)

American Meteorological Society (AMS)

European Geosciences Union (EGU)

Signature:  Date: 07/27/2023