Title: Professional Revival: Water Quality and Geologic Research and Skill-based Certifications

Abstract/Executive Summary: I aim to leverage this sabbatical leave to accelerate my incremental progress in areas of active research, professional development, and instructional innovation. The application comprises three key components: advancing knowledge in the fields of water quality of freshwater lakes and the potential of rare earth elements in our region; enriching my professional expertise in geospatial science and technology; and modernizing GIS curriculum to keep pace with rapidly developing AI technology. The proposed application, if approved, would allow me to propel an active research agenda and to complete two manuscripts, benefit students in our degree programs through research participation and immersive learning, and help grow me professionally through GIS-based skill certifications. Together, these projects will contribute to the LSSU's mission by equipping graduates with knowledge of water quality and rare earth elements and skills in GIS; and by serving communities with the development of HAB prediction tool in our freshwater lakes.

***Opening*:** By utilizing the proposed sabbatical leave period, I will pursue my professional goals that have been in progress or in pending for last few years. Various project components that constitute this application are:

1. **Research on Harmful Algal Blooms in Freshwater Lakes**:

   Introduction: Harmful algal blooms (HABs) have become increasingly common in freshwater bodies of broader Great Lakes region. Studies and public awareness indicate frequent occurrences of algal blooms in southern Great Lakes and inland lakes of adjoining watersheds. Lakes with warmer water temperatures and those that drain watersheds with more anthropogenic land covers have experienced algal blooms as prominent ecological and environmental problem for quite some time. Alarmingly, over the recent years, localized, and infrequent blooms have emerged in water bodies in the northern Great Lakes region including Saginaw Bay of Lake Huron, Green Bay of Lake Michigan, parts of Lake Superior, and a few inland lakes in the Upper Peninsula, Michigan. Consequently, the HAB issue has received considerable attention because of their known concerns on aquatic and public health. This study aims to explore the status of HABs and examine their primary drivers in inland lakes of northern Michigan.

   Background: Freshwater lakes in Michigan have experienced growing concerns of harmful algal blooms endangering the ecosystem services they provide. In summer of 2025 alone, more than 50% of the examined inland lakes in Michigan have shown visible signs of cyanobacteria with a few showing an elevated concentration (>150 ppb) of microcystin (Michigan EGLE, 2025). Microcystin, an EPA-recognized contaminant commonly associated with HABs, has been such a prevalent toxin that it is detected in 50% of the US lakes; with 2% of those exceeding EPA recreational criterion (USEPA, 2022). Studies on cyanobacterial blooms show that human-induced nutrient pollution, mainly due to increased nitrogen and phosphorus loading from agricultural, urban, and industrial sources, favor the onset and proliferation of such blooms (Mancuso et al., 2021, Glibert 2017, Paerl and Otten 2013, Anderson et al., 2002). Besides nutrients, warmer and sunlit layers of lakes are shown to be more conducive for HABs. A study that examined relationship between temperature and cyanobacterial percentage in

phytoplankton community showed a sharp increase in cyanobacterial mass with a rise in temperature (Kosten et al., 2012). The same study also showed that shallow lakes are more susceptible to developing cyanobacterial bloom in response to warming climate. In their study focusing on agricultural watersheds, Xie et al. (2003) demonstrated total phosphorus as the primary limiting factor for the growth of HABs which was supported by a correlation between cyanobacterial volume and total nitrogen (TN)/total phosphorus (TP) ratio. They also showed pH and light penetration conditions as the two other explanatory variables that account for changes in cyanobacterial percentage. In a similar study that looked at relative proportion of cyanobacteria in phytoplankton of upper, warm mixed-layer of lakes, the lakes with TN:TP ratio less than 29 showed cyanobacterial dominance (Smith, 1983). Moreover, Rigosi et al. (2014) reported cyanobacteria being adapted well in warming climate, and shallow, turbid, and stratified lakes. It is thus reasonable assumption that shorter winters and warmer summers in the northern latitudes attributable to global warming and consequent expansion of anthropogenic lands may result into an increase in nutrient exports and exacerbation of HABs in these regions. While recommendations have been made for limiting phosphorus in Michigan's cropland in response to the growing threats of such cyanobacterial blooms (Hird and Baden, 2023), a comprehensive analysis of watershed characteristics affecting nutrients' exports and water's physicochemical parameters are essential for an enhanced understanding of cyanobacterial blooms.

HABs are known to cause aquatic hypoxia and produce toxins thus making water hazardous to human and aquatic health for both drinking and recreational purposes (Carmichael, 2001; Chatterjee and More, 2023). Growth of urban land covers around major cities and cropland and pasture land expansions in more rural watersheds are two of the most likely land cover changes in the upper Great Lakes states due to climate warming (Eimers et al., 2020, Bartolai et al., 2015, Mao 2009, Tayyebi et al., 2017). These surface-level changes coupled with atmospheric warming will introduce more frequent and extreme precipitations and substantial increase in surface runoff thus allowing more nutrients' exports from watersheds.

Remote sensing approach is a tested technique for identifying the presence of cyanobacterial blooms (Coffer et al., 2020; Wayne et al., 2008), despite its limitations in detecting toxins (Stumpf et al., 2016). Referencing a local study of Chl-a estimation, a random tree regression model applied to red/red edge band ratio of Sentinel-2 data for Little Glen Lake in Michigan's Lower Peninsula produced an R^2 value of 0.72 (Kandel, 2025). While existing literature has established the potential of remote sensing data and spatial modeling to study HABs in freshwater lakes, the geographic region of northern Michigan, especially the small inland lakes, have not been covered adequately by previous research.

Research Questions and Objectives: In light of the above-mentioned research gap, a number of open questions related to HABs in freshwater lakes of northern Great Lakes region remain to be answered. Core questions to begin with include what factors are the most effective determinants for onset and growth of HABs in our fresh waters; and at what level of change in nutrient exports and related proportion of agricultural lands, change in air and water temperatures, and length of growing seasons become critical to induce HABs growth. Additionally, questions such as what morphometric characteristics of lakes and watersheds and physical quality of water tend to make lakes more vulnerable

for HAB growths need further research. These questions necessitate large-scale geographic and temporal analysis to move beyond the constraints of direct observational studies in the field. Therefore, I plan to approach the topic by integrating remote sensing imagery and geospatial modeling with in-situ observations focusing on freshwater lakes in northern Lower Peninsula and Upper Peninsula of Michigan as a continuation of my prior work that I started with CFRE affiliate faculty seed grant in 2023.

Outcome*:* Through this project, I plan to execute research tasks that range from lake selection to final research outcome dissemination. The proposed research questions are informed by the theoretical and empirical findings from previous studies on HABs in freshwater lakes. To further refine my questions and selection of study sites, I will use findings from my prior research, Michigan's EGLE's harmful algal bloom reports, result from a student's senior thesis that is being conducted currently, and historical Chlorophyll-a (Chl-a) data from Michigan Clean Water Corps' Cooperative Lake Monitoring Program (CLMP). Using these empirical data and a preliminary exploratory analysis based on application of band indices on Landsat 8-9 and Sentinel-2 imageries, five to six inland lakes representing geographic and watersheds' variability will be selected. For the selected lakes, a reconnaissance visit will be conducted to ensure the accessibility and feasibility of the in-situ measurements and sampling. Once confirmed, analysis-ready imageries of Landsat 8-9 and Sentinel-2 will be downloaded, and the band-arithmetic Chl-a models will be tested. Concurrently, field collection of in-situ data on physico-chemical water quality parameters using YSI field sensors (or Hydrolab sensors) will be conducted. Water samples will also be collected from the field to further analyze the cyanotoxins, Chl-a, and nutrients from respective lakes. Minimum of 30 in-situ data and water samples will be collected from each water body to support exploratory or multi-variate spatial regressions using geostatistical toolbox in ArcGIS Pro. Model parameters from band-arithmetic-based Chl-a will be calibrated using in-situ and lab-results. Various different multi-variable regressions, such as ordinary least square (OLS), geographically weighted regression (GWR), random-forest based regression, and presence-only prediction will be tested to examine, model, and predict data relationship. The lake morphometry, proportion of land cover types in watershed, water temperature, air temperature, nutrients in water, and number of point-discharge locations in watershed will be taken as explanatory variables and the concentration of Chl-a will be used as dependent variable. Model residuals and regression statistics (R^2 and p value) will be used to validate the model.

I expect that the outcome from this model will be a Chl-a prediction tool for a defined spatial and temporal domain. We strive to acquire grant money to cover the field and laboratory costs for the project. A research proposal for the same purpose is under preparation, for which a notice of intent has already been submitted in response to the NASA's Water Quality Application solicitation. As a backup, environmental sensors for the in-situ data and analytical facilities in water quality analysis lab in LSSU's CFRE (with existing and future small funding) will be considered as resources for this project.

This project will determine the status and future vulnerability of the inland lakes to harmful algal blooms in upper Great Lakes region and point out underlying causes and drivers for such impact. The interpreted results on the effect of hydrological variability on HABs and challenges to public and ecological health associated with the HABs' severity will be very important information that adds to our current knowledge of HABs. More

importantly, I plan to recruit 1-2 undergraduate students from the Natural Resources and/or Environmental Science programs to make this inquiry as their senior thesis research project for the enhanced student engagement and retention.

To summarize, this project not only contributes to our understanding of the various aspects of HABs in our region, but also enhances the hands-on learning experience and research capacity of our LSSU students. Eventually, students will present the outcomes of this project in state, regional, and/ or national/international scientific conferences potentially in Michigan Lakes and Stream Association's Annual Meeting, Annual Meeting of International Association of Great Lakes' Research, and/or Fall Meetings of American Geophysical Union to help achieve their professional development goals.

2. **Study of Rare Earth Elements' Potential in the Region**:
Introduction: Rare earth elements (REE), a group of 17 chemically similar elements located in the bottom two rows of the periodic table, have gained global attention due to their importance in high-tech electronic and military applications. Even though geologic occurrences of REE are relatively common in earth crust, their economic concentrations are found in uncommon deposit types. Typically, economic deposits of REES are found in fluorocarbonates (e.g., bastnasite), phosphates (e.g., monazite), complex oxides (e.g., loparite) and lateritic clays (Joseph, 2024). Since we have the instruments that support more in-depth analysis under very high-resolution (portable XRF, SEM/EDS, and bench-top μ-XRF) available in our geology, environmental science, and chemistry labs, it would be an important undertaking to capitalize this resource and continue geologic research. These research-grade instruments were procured from the funding sources such as NSF's-Major Research Instrumentation Grants (award numbers: 2215270, 2320397) that I have been the part of, and from donated research fund in geology. With this research and outcomes, I also aim to further the LSSU's credibility with the donors.
Background: The amphibole-bearing granitoids in northern complex greenstone-granitoid terrane located in the southern edge of superior province west of Marquette were reported as REE-bearing rocks by Wilkin and Bornhorst (1993). In their study, the authors indicated that the REEs are found mainly in zircon, monazite, and apatite. We carried out an exploratory study taking the rock samples of Compeau Creek Gneiss using scanning electron microscope (SEM) and have identified two REE elements: cerium, lanthanum (Obringer and Kandel, 2024). This project will extend these findings with the analysis of more samples covering rocks from neighboring formations.
Outcomes: The research involves rock sample collection, sample preparation, and analysis leveraging the techniques that LSSU already has. Rock samples containing zircon and monazite minerals will be collected from Compeau Creek Gneiss and the Ishpeming Greenstone of Northern Complex. I will recruit a geology student and we will also collect mineralized quartz-pebble conglomerate of Elliot Lake region in Ontario, Canada, given the potentials of uranium and REEs in these rocks. The findings of our analysis will be presented in university symposium, and regional meetings of Geological Society of America.

3. **Receiving Training and Certifications to Enrich Professional Development and Curriculum Update Goals**:

a) **Geospatial Training and Certifications**: Following the momentum of the approval of LSSU's Geospatial Technology associate degree as a new program for Perkins V funding

in 2025, I have submitted course change proposal for one of the courses of geospatial program to include GeoAI component in it. This change was driven by the motivation to embrace the emergence of AI in spatial data analysis and to address the calls for a readiness to modernize GIS curricula aiming at grasping the rapid evolution of AI. Although we are planning to offer the first version of this revamped course in the spring of 2026, it is critical that we make some deliberate efforts and investments to create the course in which students can fully immerse themselves. In order to keep pace with evolving technology rendering a path to self-update in the future, I plan to receive more invested trainings on AI and data science using online resources such as the ones from DeepLearning.AI and ESRI's resources. Besides, our aim to enhance our geospatial technology curriculum by integrating Unmanned Aerial System (UAS) needs to come into fruition through the instructor's completion of the UAS pilot license, which also is my another plan during this leave time. Another area of update under consideration for my geospatial expertise is obtaining the GIS Professional license.

b) Training in Partner Institutions/Labs: I am in contact with the personnel in the University of Maryland Center for Environmental Science to schedule a visit in their research centers focused on water, environmental chemistry and toxicology programs. The intent is to visit these centers at some point during their field season (awaiting confirmation). Likewise, I also aim to utilize Technology Transfer Program of NASA's Kennedy Space Center in Florida (under consideration for approval) to use their analysis facilities including water quality monitoring lab and investigative chemistry lab.

***Timeline**:*

Sabbatical Leave Project Timeline- Hari P Kandel

TASK	START	END	TASK	START	END
Project Initiation, Planning and Design			**Model Validation, Result Preparation, and Dissemination**		
Set up team (for design, field, lab, and analysis)	1/15/26	4/30/26	Modeling, and validate RS-based model for Chl-a + Geochemical Analyssi	11/16/26	11/27/26
Define goals, identify sites, tasks, and deliverables	2/2/26	3/27/26	Prepare results and presentations	11/30/26	12/4/26
Refine schedule, develop budget	3/2/26	7/27/26	Attend conference (AGU 26) and present	12/7/26	12/11/26
Identify risks/uncertainties, perform reconnaisance site visits, collect rock samples	4/6/26	8/15/26	Post conference reflection and updates	12/14/26	12/18/26
Project Execution			**Evaluation, Training, Writing**		
Update project design & literature review	8/1/26	8/14/26	Evaluate the project and write manuscript draft	1/4/27	1/29/27
Collect summer stratification lake data, prepare rock samples	8/17/26	8/29/26	Participate self-paced online trainings and certifications	1/29/27	4/3/27
Collect remote sensing data and perform preliminary modeling, and laboratory analysis, model calibration	9/1/26	10/26/26	Participate in partner institutions' field/lab	1/12/27	7/14/27
Collect fall turnover lake data	10/26/26	11/6/26	Final modeling/lab analysis, and model calibration	5/18/27	6/25/27
Lab-analysis (REE and HAB)	10/26/26	11/13/26	Final results preparation and project wrap-up	7/12/27	8/20/27

References:

Anderson, D. M., Glibert, P. M., & Burkholder, J. M. (2002). Harmful algal blooms and eutrophication: nutrient sources, composition, and consequences. *Estuaries*, *25*(4), 704-726.

Bartolai, A. M., He, L., Hurst, A. E., Mortsch, L., Paehlke, R., & Scavia, D. (2015). Climate change as a driver of change in the Great Lakes St. Lawrence River basin. *Journal of Great Lakes Research*, *41*, 45-58.

Carmichael, W. W. (2001). Health effects of toxin-producing cyanobacteria: "The CyanoHABs". *Human and ecological risk assessment: An International Journal*, *7*(5), 1393-1407.

Chatterjee, S., & More, M. (2023). Cyanobacterial harmful algal bloom toxin microcystin and increased vibrio occurrence as climate-change-induced biological co-stressors: exposure and disease outcomes via their interaction with gut–liver–brain axis. *Toxins*, *15*(4), 289.

Coffer, M. M., Schaeffer, B. A., Darling, J. A., Urquhart, E. A., & Salls, W. B. (2020). Quantifying national and regional cyanobacterial occurrence in US lakes using satellite remote sensing. *Ecological Indicators*, *111*, 105976.

Eimers, M. C., Liu, F., & Bontje, J. (2020). Land use, land cover, and climate change in southern Ontario: implications for nutrient delivery to the lower Great Lakes. In *Contaminants of the Great Lakes* (pp. 235-249). Cham: Springer International Publishing.

Glibert, P. M. (2017). Eutrophication, harmful algae and biodiversity—Challenging paradigms in a world of complex nutrient changes. *Marine pollution bulletin*, *124*(2), 591-606.

Hird, K., & Baden, E. (2023). Reducing harmful algal blooms in Michigan and the great lakes. *Journal of Science Policy & Governance*, *23*(1).

Joseph, S. (2024). *Anomaly mapping of heavy and light rare earth elements in central upper peninsula of michigan using geostatistics and fractal analysis*. [Master's thesis, Michigan Technological University].https://digitalcommons.mtu.edu/etdr/1760/

Kandel (2025, April 25-26). *Harmful algal bloom study in small inland lakes: chlorpophyll-a and microcystin* [Conference Presentation]. Michigan Lakes and Streams Association 64th Annual Conference, Muskegon, Michigan, USA.

Kosten, S., Huszar, V. L., Bécares, E., Costa, L. S., van Donk, E., Hansson, L. A., ... & Scheffer, M. (2012). Warmer climates boost cyanobacterial dominance in shallow lakes. *Global Change Biology*, *18*(1), 118-126.

Mancuso, J. L., Weinke, A. D., Stone, I. P., Hamsher, S. E., Woller-Skar, M. M., Snyder, E. B., & Biddanda, B. A. (2021). Bloom and bust: Historical trends of harmful algal blooms

in Muskegon Lake, Michigan, a Great Lakes estuary. *Freshwater Science*, 40(3), 463-477.

Mao, D., & Cherkauer, K. A. (2009). Impacts of land-use change on hydrologic responses in the Great Lakes region. *Journal of Hydrology, 374*(1-2), 71-82.

Michigan Department of Environment, Great Lakes and Energy. (2025, September 04). *Harmful Algal Blooms: Michigan harmful algal bloom reports web map*. https://mdhhs.maps.arcgis.com/apps/webappviewer/index.html?id=b05d6b7498ca4ce29a586f1f2b9cefeb

Obringer, W., & Kandel, H. (2024, May 15-17). *Exploring rare earth element concentrations in the northern complex of marquette, Michigan: insights into geochemical patterns and geological significance* [Abstract: 26-29] Joint 120th Annual Cordilleran/74th Annual Rocky Mountain Section Meeting. Geological Society of America, Spokane, Washington, USA.

Paerl, H. W., & Otten, T. G. (2013). Harmful cyanobacterial blooms: causes, consequences, and controls. *Microbial ecology*, *65*(4), 995-1010.

Rigosi, A., Carey, C. C., Ibelings, B. W., & Brookes, J. D. (2014). The interaction between climate warming and eutrophication to promote cyanobacteria is dependent on trophic state and varies among taxa. *Limnology and Oceanography*, *59*(1), 99-114.

Smith, V. H. (1983). Low nitrogen to phosphorus ratios favor dominance by blue-green algae in lake phytoplankton. *Science, 221*(4611), 669-671.

Stumpf, R. P., Davis, T. W., Wynne, T. T., Graham, J. L., Loftin, K. A., Johengen, T. H., ... & Burtner, A. (2016). Challenges for mapping cyanotoxin patterns from remote sensing of cyanobacteria. *Harmful algae*, *54*, 160-173.

Tayyebi, A., Smidt, S. J., & Pijanowski, B. C. (2017). Long-term land cover data for the lower Peninsula of Michigan, 2010–2050. *Data*, *2*(2), 16.

U.S. Environmental Protection Agency. (September 2025). *National Lakes Assessment 2022 key findings*. In *EPA.gov*. Retrieved September 7, 2025, from https://www.epa.gov/national-aquatic-resource-surveys/national-lakes-assessment-2022-key-findings

Wynne, T. T., Stumpf, R. P., Tomlinson, M. C., Fahnenstiel, G. L., Dyble, J., Schwab, D. J., & Joshi, S. J. (2013). Evolution of a cyanobacterial bloom forecast system in western Lake Erie: Development and initial evaluation. *Journal of Great Lakes Research*, *39*, 90-99.

Wilkin, R. T., & Bornhorst, T. J. (1993). Archean appinites from the northern complex, Michigan. *The Journal of Geology*, *101*(1), 107-114.

Xie, L., Xie, P., Li, S., Tang, H., & Liu, H. (2003). The low TN: TP ratio, a cause or a result of Microcystis blooms?. *Water Research*, *37*(9), 2073-2080.

Hari P Kandel

email: hkandel@lssu.edu, LinkedIn

EDUCATION

Ph.D., Geosciences (Geospatial Application and Hydrologic Modeling Lab), Florida International University, Miami, FL, USA, 2015.
M.S., Geology with Graduate Certificate in Geospatial Technology, Bowling Green State University, Bowling Green, Ohio, USA, 2010.
M.Sc., Geology (Track: Natural Resource Studies), Tribhuvan University, Kathmandu, Nepal, 2007.
B.Sc., Major-Geology (Stream: Geology, Botany, Zoology**)**, Tribhuvan University, Kathmandu, Nepal, 2003.

PROFESSIONAL EXPERIENCES: Academic Positions

1. **Associate Professor**: School of Natural Resources/School of Chemistry, Environmental, and Geosciences, **Lake Superior State University**, Sault Ste Marie, Michigan (August 2024-
2. **Assistant Professor**: School of Natural Resources/School of Chemistry, Environmental and Geological Sciences, **Lake Superior State University**, Sault Ste. Marie Michigan, (August 2017 – 2024)

2.1 Courses Taught at LSSU:

EVRN 131:	Introduction to GIS	EVRN 341:	Environmental Chemistry
EVRN 225:	Intermediate GIS	EVRN 313:	Solid/Hazardous Waste
EVRN 325:	Geospatial Analysis	GEOG 108:	Meteorology/Climatology
EVRN 355:	GIS Programming and App.	NRES 399:	Research Project Design
EVRN 445:	Remote Sensing and Spatial Stats.	NRES 495:	Senior Research Project
GEOL 315:	Geo-environmental Systems	NRES 499:	Senior Capstone
GEOL 334:	Hydrologic Systems	EVRN 490:	Independent Study Env.
GEOL 322:	Geochemical Systems	NSCI 104:	Environmental Sc. Lab
GEOL 490:	Research Topics in Geology	NSCI 102:	Great Lakes Geology Lab

2.2 Significant Accomplishments

i) Research Scholarship: Several peer-review publications, dozens of conference presentations (about half of those have students first authors), PI and Co-PI for 6+ grants including two from NSF and one from international agency: Natural Resources' Canada

ii) Services/Committees:

- **University Committees:**
  - University assessment committee (since 2024...)
  - General Education Committee (since 2020),
  - Retention, Promotion and Tenure Committee (since 2024…)

- **College/School Committees**:
  - Faculty search committees (tenure track assistant professor- geology, GIS, and natural resources)
  - Curriculum update: lead role- Geospatial Technology associate, GIS- minor, and certificates, subcommittee member in geology-major, environmental science-major, and marine and freshwater science-minor, sustainability-minor,
  - New degree proposal: member for accelerated MS in Fisheries and Wildlife,
  - School's Retention, promotion, and tenure committee

iii) **Mentoring and Students' Achievements**:
- Senior thesis research and students' career success mentor for the students in GIS, Geology, Fisheries & Wildlife, Conservation Biology
- Undergraduate research grant (internal and external), scholarships, students' conference presentations, graduate school applications, and jobs

iv) **Advising**: GIS, Geology, Environmental Science, Fisheries and Wildlife, Conservation Biology

v) **Coordinator** –A year-long university-wide Faculty Learning Community on Online Learning (launched the program as a coordinator- 2020)

vi) **Program Success Leader**: for the application and approval of Geospatial Tech Associate degree for Perkins V funding (2025)

3. **Lecturer:** Department of Earth and Atmospheric Sciences, **State University of New York College at Oneonta, Oneonta**, NY, August 2015 - July 2017

3.1. <u>Courses Taught</u>

GEOL 282: Intro to Hydrogeology: Fall 2015, 2016
GEOL 386: Geochemistry of Natural Waters: Fall 2015, 2016
GEOL 384: Watershed Management: Spring 2016
GEOL 394: Sp. Topic- Geospatial Hydrology: Spring 2016
GEOL 388: Applied Hydrogeology: Spring 2017
GEOL 389: Groundwater Modeling: Spring 2017

3.2 <u>Other Accomplishments</u>

- Update and acquisition of lab equipment and supplies.
- Design and offer special topics course
- Supervision of student research activities
- Student support (jobs/internships applications and recommendation letters)
- Involvement in departmental businesses

4. **Graduate Teaching Assistant**: Department of Earth and Environment, **Florida International University, Miami, FL**, August 2010–July 2015

<u>Key Roles</u>

- **Teaching**: Lab teaching (Intro to Earth Sciences (GLY 1010L), Environmental Geology (GLY 3039L), and Earth Resources (GEO 3510L)
- Head TA in the department for the year 2013-2014
- Environmental Geology Lab creation and modification
- Students' field work coordination
- Tutor, grade, and proctor for Intro and Environmental Geology lecture classes
- Cover lecture classes for Water Resources

5. **Graduate Teaching & Research Assistant**: **Bowling Green State University**, Department of Geology, TA; Physical Geology (lab) teaching August 2008–May 2009, **GIS RA:** Center for Regional Development, August 2009-May 2010.

RESEARCH

Grants (active and succeeded)

- **Co-PI** of Multi-Partner Research Initiative (MPRI) of Natural Resources Canada: Monitoring and Detection of Oil in Our Waters of the North (MONDE-OWN) Network's project "evaluation and pilot application of low-cost in-situ oil sensors". (Ashley Moerke-PI) ($1,466, 695)
- **Co-PI** in NSF MRI (Acquisition of a low vacuum scanning electron microscope (SEM) with EDS detector and STEM capability to advance research and undergraduate research training, 2022-2025, $ 197,808.
- **Senior Personnel** in NSF MRI Consortium: Track 1 Acquisition of a Micro X-ray Fluorescence Spectrometer to Support Multidisciplinary Research and Education in the Upper Midwest, 2023-2026, $384,660.
- **Co-PI** in Wilderness Shores Mitigation and Enhancement Fund. Evaluation of freshwater mussel survey strategies to inform relocation efforts associated with hydropower drawdowns. PIs: A. Moerke (lead) and **H. Kandel**; 2021-2023, $138,438.
- **Co-PI**: NOAA B-WET. Increasing freshwater and data literacy among high school students through real-time stream monitoring with MiWaterNet. 2021-2022, $79,619.
- **PI** in CFRE Affiliate Seed Grant. Mapping Chlorophyll-a and Microcystin in Selected Inland Lake of Michigan ($5,000), 2023
- **PI** in AGU Sharing Science, Plainspoken scientist, 2021, $1000.
- Further experience in proposal submission to NSF & NASA as a PI, details available upon request.

Publications

- Bill, M., Eide, J. D., Fugate, K. K., Bolton, M. D., **Kandel, H. P**., & Kandel, S. L. (2024). Continental-scale insights into the sugarbeet diffusion juice microbiomes. *Microbiology Spectrum*, e01093-24.
- **Kandel, H.,** Melesse, A., and Whitman D. (2016) An analysis on the urban heat island effect using radiosonde profiles and Landsat imagery with ground meteorological data in South Florida, *International Journal of Remote Sensing*, 37 (10): 2313-2337.
- Cristobal C., Melesse, A., Price, R., Dessu, S., **and Kandel, H.** (2015) Operational Actual Wetland Evapotranspiration Estimation for South Florida Using MODIS Imagery, *Remote Sensing*, 7: 3613-3632.
- **Kandel, H.** and Aryal, A. (2020) Impact of COVID-19 Pandemic on Air Pollution in Kathmandu and Pokhara Valleys. In *Sharma, B. & Adhikari, A. (2020). COVID-19 Pandemic and Nepal: Issues and Perspectives*. Asta-Ja RDC, Kathmandu, Nepal.
- Cervato, C., Charlevoix, D., Gold, A., **Kandel, H.** (2018) Research on Students' Conceptual Understanding of Environmental, Oceanic, Atmospheric, and Climate Science Content, *A Community Framework for Geoscience Education Research*, National Association of Geoscience Teachers.
- Mis, W., Kendrik, D., Coyte, R., **Kandel, H.** and Hall, C. (2021) *Understanding the Prevalence of Uranium in Groundwater Wells in Glastonbury, CT*, Published by Department of Health of the Town of Glastonbury, CT, https://www.glastonburyct.gov/home/showpublisheddocument/34754/637600331633770000
- **Kandel, H.P**., Wright, D., Doubek, J.P., Southwell, B. (2025) Uranium Geochemistry in Drinking Water Wells in Sugar Island, Michigan, Geochemistry, soon to be submitted.

- **Kandel, H.,** Melesse, A., Sukop, M. and Tachiev, G. Land Use/Land Cover Driven Alterations in the Surface Energy Balance in South Florida (under preparation to submit)

Conference Abstracts/presentations (*student author)

- **Kandel, H.** and Karner, R. (2025) Harmful Algal Bloom Study in Small Inland Lakes: Chlorophyll-a and Microcystin, In 64th Annual Conference of Michigan Lakes and Streams Association, April 26, 2025, Muskegon, Michigan
- **Kandel, H**., Kelso, P., Ranasinghage, N., *Strader, N. (2024) Relict Shoreline Delineation of Ancient Lake Algonquin in Northern Michigan Synthesizing Geomorphologic, Sedimentological, and Geochemical Analysis, Abstract (ID:1755552), American Geophysical Union's Fall Meeting, 9-13 December 2024, Washington, D.C.
- Shelton, S., Guldmann, J.M., **Kandel, H**., Dreyer, Z., Parker, M. (2024) Predicting urban heat from land-use data and building attributes: A collaboration between local government and scientists to understand community impacts and management opportunities, Abstract ID: 1675769), A Thriving Earth Exchange -Community Science Project of AGU, American Geophysical Union's Fall Meeting, 9-13 December 2024, Washington, D.C.
- **Kandel, H**., McMillian, S., Karner, R., & *Patterson B (2024) Integrating Landsat 9 and Sentinel-2 Imageries with In-situ Data to Model Chlorophyll-a in Small Inland Water Bodies in Michigan, Abstract ID: 223-226), presented at 2024 American Geophysical Union's Water Science Conference, 24-27 June, St Paul, MN
- *Sawle, M., **Kandel, H.**, Moerke, A. (2024), Deriving Water Depths of Hydropower Reservoir using Sentinel-2 and Worldview-3 Imagery Combined with Field-collected Depth Data, Abstract (319-245), presented at 2024 American Geophysical Union's Water Science Conference, 24-27 June, St Paul, MN
- *Gilpatrick, M., Kandel, H., Southwell, B., Wright, D. (2024), Studying the Presence of Polycyclic Aromatic Hydrocarbons in Small Inland Lakes – Exploring Links with Motorized Boats and Human Impact, Abstract (416-271) presented at 2024 American Geophysical Union's Water Science Conference, 24-27 June, St. Paul, MN
- *Beaudoin, H., Gordon, N., **Kandel, H. P**., Kelso, P. R., & Wright, D. D. (2023). Applications of Laser Direct Infrared (LDIR) Spectroscopy in Mineralogy: A Comparative Study to Conventional Methods. AGU Fall Meeting 2023, San Francisco, CA
- *Kelley, K., Wright, D. D., & **Kandel, H. P.** (2023). Effects of Firework Displays on Air Quality and Metal Deposition Fluxes. AGU Fall Meeting-2023, San Francisco, CA
- Moerke, A., **Kandel, H**., Hillary, M., and *Sawle, M. (2023) Evaluation of freshwater mussel survey strategies to inform relocation efforts associated with hydropower reservoir drawdowns, in Society for Freshwater Science, June 3-7, Brisbane, Australia
- ***Cox, N., **Kandel, H.** (2023) Analyzing Provenance of Jacobsville Sandstone of The Eastern Upper Peninsula of Michigan using Uranium Bearing Minerals, presented in Geological Society of America-23 North Central Section Meeting, May 5, 2023, Grand Rapids, MI. Abstract: https://gsa.confex.com/gsa/2023NC/meetingapp.cgi/Paper/386948
- *Sawle, M., **Kandel, H.**, and Moerke, A. (2023) Using Remote Sensing Data to Identify Freshwater Mussel Habitat and Inform Mussel Relocation Efforts, presented in the Wildlife Society/American Fisheries Society Michigan Chapter's Joint Annual Meeting, March 23-24, Bellaire, Michigan.

- **Kandel, H.P**., Wright, D.D., Doubek, J. and Southwell B (2022) Uranium in Groundwater Wells in Sugar Island, Michigan: A Water Supply and Public Health Concern, presented in American Geophysical Union Fall Meeting, 13 December 2022, Chicago, US.
- **Kandel, H.P**., Shah, S., Adhikari, P., Thakuri, N.S. (2022) Landsat Based Analysis of Anthropogenic Land Cover Change and Implied Hydrologic Impacts in Bharatpur Metropolitan City, Nepal, presented in American Geophysical Union Fall Meeting, 14 December 2022, Chicago, US.
- **Kandel, H.** and Moerke, A. (2021) Satellite Derived Bathymetry of Shallow Water Reservoirs using WorldView-3 Imageries to Facilitate Mussel Surveys, American Geophysical Union-Fall Meeting, 13-17 December, New Orleans, Louisiana, USA
- **Kandel, H.** (2021) Time Series Analysis of Snow Loss from the Glaciated High Mountain Area of Kaligandaki River Watershed using Global Scale Modeling and Reanalysis Products. In *10th Nepal Geological Congress*, Organized virtually on 7-8 March 2021, Kathmandu, Nepal.
- **Kandel, H.P.**, Aryal, A., & Kandel, P.P. (2020) COVID-19 and Environment: Analyzing stability and environmental impact of SARS-CoV-2 using theoretical study and observational approach. In *International Virtual Symposium (2020) Climatological, Meteorological, and Environmental factors in the COVID-19 pandemic, AGU.*
- **Kandel, H.** (2020) The Effect of Climate Change on Water Depletion Over Nepal Himalaya: A Remote Sensing Analysis. In *Environment and Climate Change Symposium, National Knowledge Convention 2020*, Non-Resident Nepalese Association- National Coordination Council, USA, July 04, 2020.
- **Kandel, H.** and Melesse, A. (2017) Do Surface Energy Fluxes Reveal Land Use Land Cover Change in South Florida? A Remote Sensing Perspective, American Geophysical Union Fall Meeting, 11-15 December, New Orleans, Louisiana, USA
- **Kandel, H.** and Melesse, A. (2016) A Remote Sensing Analysis on the Spatiotemporal Variation of Land Surface Albedo and Emissivity in South Florida: An Implication for Land-Atmosphere Energy and Water Transfer, American Geophysical Union Fall Meeting, 12-16 December, San Francisco, California, USA
- **Kandel, H.** and Melesse, A. (2014) Alteration of surface energy balance in South Florida driven by land use land cover change, American Water Resource Association, Annual Water Resources Conference, November 3-6, 2014, Session-54, Tysons Corner, Virginia, USA.
- **Kandel, H.** and Melesse, A. (2013) Human induced changes on land surface temperature and convective rainfall in South Florida, American Water Resource Association, Annual Water Resources Conference, November 4-7, 2013, Portland, Oregon, USA.
- **Kandel, H.** and Melesse, A. (2013) Effect of land use /land cover change on radar reflectivity based convective precipitation in South Florida, Geological Society of America, 125th Anniversary Annual Meeting and Expo, October 27-30, Denver, Colorado, USA.
- **Kandel, H.** and Melesse, A. (2012) Change in minimum temperature as a response to land cover change in South Florida, American Geophysical Union, Fall Meeting, December 3- 7, 2012, San Francisco, California, USA.

- **Kandel, H.** and Melesse, A. (2013) Land cover change and its hydro-climatic impact in South Florida, American Water Resource Association, 22nd Annual Southwest Florida Water Resource Conference, January 25, 2013. Fort Myers, Florida.
- **Kandel, H.** and Melesse, A. (2012) Pre- and Post-drainage South Florida: land cover change and temperature response, Rookery Bay National Estuarine Research Reserve, GIS Symposium 2012: Discovering Technology-Based Solutions, October 17, 2012, Naples, Florida.
- **Kandel, H.** and Gomezdelcampo, E. (2010) Spatial Variability of Sediment Delivery in the Sandusky Watershed, Ohio, 53rd Annual Conferences on Great Lake Research, International Association for Great Lake Research, May 17-21, 2010, Toronto, Ontario, Canada.

OUTREACH

WORKSHOPS OFFERED

- **Kandel, H.** (2025) A Conceptual Overview of Geologic and Hydrologic Aspects of Slope Stability, Workshop: Mathematical Tools and Geospatial Applications in Natural Disaster Management, In World Conference on Natural Resource Modeling, Resource Modeling Association, June 8, 2025, Kathmandu, Nepal. https://resourcemodeling.org/wcnrm2025-workshop/
- AGU Sharing Science Grants for Science Communication and Outreach, Environmental Degradation Awareness Dialogue Among High School Teachers /Students from Rural Nepal and Environmental Science Experts, 2021, $1,000 (https://blogs.agu.org/sciencecommunication/2021/11/15/sharing-science-grantrecipients/), Outcomes: https://www.youtube.com/watch?v=YgnAN0oQ_VI, https://www.youtube.com/watch?v=EI36h1h8ATM
- Watershed Mapping using GIS: MiWaterNet Professional Development Workshop: In 2021 NOAA BWET MiWaterNet for high school science teachers from Eastern Upper Peninsula Michigan, August 16, 2021

PROFESSIONAL SERVICES VOLUNTEERED

- Serving as a reviewer for the international peer-reviewed journals: *Remote Sensing, International Journal of Environmental Research and Public Health, Applied Science, Climate, Land, Forest, and Sustainability* since 2020
- NSF Panelist 2022
- Community Scientist, AGU- Thriving Exchange, Analyze Urban Heat: Relating it to Community Impacts, Community Resources, and tree Canopy Cover for Montgomery County, MD (continuing): https://thrivingearthexchange.org/project/montgomery-county-md/
- Community Scientist, AGU-Thriving Earth Exchange, a request from Environmental Protection Network for Flood Risk Analysis in Tuscon, Arizona, findings presented
- Community Scientist, AGU- Thriving Exchange, Uranium in Groundwater Wells, Glastonbury, Connecticut (2020-20220. Published reports/stories:
  i) https://thrivingearthexchange.org/project/glastonbury-ct/
  ii) https://thrivingearthexchange.org/a-dedicated-team-and-a-deep-well-ofdatauncovering-the-mystery-of-uranium-in-glastonbury-connecticut/
- Student Travel Grant Reviewer, AGU Section- Global Environmental Change, 2018-2020

- Judge, Outstanding Student Paper Award, AGU Fall Meeting, 2016, 2017, 2022.

PHILANTHROPIC SERVICES

- Fundraiser for Rescue and Recovery Effort for the Victims of 2015 Gorkha Earthquakes Nepal as a leading member of Nepalese Student Association @FIU, amount raised $10,000 (https://commencement.fiu.edu/real-triumphs-graduates/people/harikandel.html)
- President, Nepalese Student Association, FIU, 2014-2015.

PROFESSIONAL DEVELOPMENT

Workshops /Trainings Received

- Continuing Education Units for Faculty Development for Online Teaching from University of Illinois Springfield in the Illinois Online Network Professional eLearning Programs, completed overview of online teaching, course design in Spring 2019
- ESRI Web-based course trainings certificates (Spatial Data Science, Cartography, Spatial Analysis, Data Visualizations, Spatial Statistics, Python for GIS……)
- Coursera Courses: Data Science (completed: supervised machine learning: regression and classification, DeepLearning.AI, Stanford University, Writing in Science (under progress)
- Professional Development Trainings offered on PD Days at LSSU, since 2017
- Workshop on "Geoscience Education Research Grand Challenges and Strategies" in Earth Educators' Rendezvous, July 17-19, 2017, Albuquerque, NM
- A Grant Writing Workshop "Why Grants? Benefits, Broader Impacts and Strategies" sponsored by the Grant Development Office of SUNY Oneonta for College Faculty, March 6-7, 2017, SUNY College at Oneonta, NY.
- Establishing and Sustaining an Undergraduate Research Program Sponsored by the Council of Undergraduate Research, December 12, 2016, AGU Fall Meeting, San Francisco, California.
- State University of New York-wide workshop on Conversations in the Disciplines: External Factors Influencing SUNY Geoscience in the 21st Century, October 29, 2016. SUNY Oneonta, NY
- Upper Susquehanna Watershed Forum on State of the Watershed, BMP Success, and Restoration Resources, Alliance for the Chesapeake Bay, November 3rd, 2016, SUNY Oneonta, NY.

Professional Development Grants

- Travel Stipend to attend Early Career Geoscience Faculty Workshop: Teaching, Research and Managing your Career, 2019. National Association of Geoscience Teachers, Sponsored by NSF grant, July-August 2019.
- Stipend for Workshop participation in Teaching Quantitative Reasoning with Data Workshop through Environmental Data-Driven Inquiry and Exploration, supported from NSF funding, Science Education Resource Center, June 2019.
- Science Education Resource Center for Geoscience Education Research Workshop in Earth Educators' Rendezvous sponsored by NSF grant, 2017.
- Department of Earth and Atmospheric Sciences, SUNY Oneonta, 2016
- Graduate and Professional Student Committee, FIU, 2012 & 2013
- College of Arts and Sciences, FIU, 2012, 2013, and 2014

- Department of Earth and Environment, FIU, 2012, 2013, and 2014
- Geological Society of America, Travel Grant, 2013
- American Water Resources Association-Florida Chapter, Travel Grant, 2013 & 2014

Scholarships, Awards, and Recognition

- Worlds Ahead Graduates of FIU, Summer Graduation Ceremony, 2015 https://commencement.fiu.edu/real-triumphs-graduates/people/hari-kandel.html
- Ralph- Sanchez Grand Prix University Wide Scholarship, Florida International University, Miami, Florida, 2014.
- Naomura Foundation Student Scholarship, Tri-Chandra Campus, Tribhuvan University, Nepal, 2002.

Professional Affiliations

- American Geophysical Union, Member, 2010-present
- Nepal Geological Society, Life Member, since 2007
- International Association of Great Lakes Research, 2018
- Geological Society of America, Member, 2013
- American Water Resource Association, Florida Chapter, Member 2013-2015
- Member, AWRA-FIU Student Chapter, 2013-2014