

Mohamed Sultan

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Department of Geological and Environmental Sciences
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Education

Washington University, St. Louis, MO	Remote Sensing	Post Doc.	1985-1988
Washington University, St. Louis, MO	Geochemistry	Ph.D.	1984
Ain Shams University, Cairo, Egypt	Stratigraphy	M.Sc.	1978
Ain Shams University, Cairo, Egypt	Geology	B.Sc.	1974

Work History

August 2020- Professor – Dept. Geological and Environmental Sciences, Western Michigan University
2004-July 2020 Professor and Chair – Dept. Geological and Environmental Sciences, Western Michigan University
2004-present Director – Earth Sciences Remote Sensing facility, Western Michigan University
2011-July 2020 Chair – Michigan Geological Survey, Michigan, USA
2002-2004 Professor – Dept. Geology, University at Buffalo, Amherst, NY.
1996-2002 Project Manager, International Programs – Environmental Research Division, Argonne National Laboratory, Argonne, IL.
1988-1996 Senior Research Scientist – National Aeronautics and Space Administration (NASA) Earth and Planetary Remote Sensing Facility, Department of Earth and Planetary Sciences, McDonnell Center for the Space Sciences, Washington University, St. Louis, MO.
1984-1988 Research Associate – Department of Earth and Planetary Sciences, Washington University, St. Louis, MO.

Honors, Awards

Fellow Geological Society America, GSA Annual Meeting (2009- present)
Farouk El-Baz Award for Desert Research, Quaternary Geology and Geomorphology Division, Geological Society of America (1999)
Member of NASA GRACE Science Team (2009- present)
Associate Editor – Geological Society America, Bulletin (2004-2007)
Research Professor – Department of Geology, University at Buffalo, Amherst, NY (2004-2007).
Adjunct Associate Professor – Department of Earth and Environmental Sciences, University of Illinois, Chicago, IL (1997-2012)
Adjunct Full Professor – Department of Geophysics, Cairo University, Giza, Egypt (1996-2007)
Visiting Professor – Department of Geology, Ain Shams University, Cairo, Egypt (2022-present)
Fellow, McDonnell Center for the Space Sciences, Washington University, St. Louis, MO (1988-1996)

Current Support

Sultan, M., Co-Principal Investigator, Automated Country-wide Monitoring System for Natural and Anthropogenic Ground Deformation and Establishing the general frame for an Early Warning System for Ground Deformation over Qatar, Qatar Ministry of Municipality (MM) (2022-2024)
Sultan, M., Principal Investigator, EMIT for Lithologic Mapping, Mineral Exploration, and Tectonic Investigations in Arid Lands (NASA, GRACE) (2024-2027)

Sultan, M., Principal Investigator, Integrated Approach for Sustainable Utilization of the Groundwater

- Resources in the Western Desert (National Academy of Sciences) (2023-2026).
- Sultan, M., Principal Investigator, Consultation Study for Sabkhas and Sand Dunes in the Mecca and Riyadh Provinces, Kingdom of Saudi Arabia (Saudi Geological Survey) (2023-2025)
- Sultan, M., Co-Principal Investigator, Earth MRI Critical Minerals Mine Waste proposal, (USGS)(2023-2025)
- Sultan, M., Principal Investigator, Consultancy Services and Technical Assistance for the Study of Release Mechanisms of Radionuclides in Groundwater Aquifers in KSA (King Saud University)(2023-2025)

Pending Support

None

Previous Support

- Sultan, M., Principal Investigator Monitoring Deep Aquifer Response to Climatic Variability Using GRACE Data (NASA, GRACE) (2020-2024)
- Sultan, M., Principal Investigator, Natural discharge for agricultural development and a solution for reduced River Nile flow (National Academy of Sciences) (2019-2023).
- Sultan, M., Principal Investigator, Continues Monitoring of Land Deformation in Qatar: A Radar Interferometric Approach (Qatar Ministry of Municipality and Environment) (2019-2023)
- Sultan, M., Principal Investigator, Geophysical and Remote Sensing applications for a better understanding of the distribution and deformation associated with Salt domes in the Jazan City and surroundings, Saudi Arabia (Saudi Geological Survey) (2017-2022).
- Sultan, M., Principal Investigator, Training on Hyperspectral Remote Sensing for Geological Mapping, Mineral Exploration and Target Detection in the Arabian Shield (Saudi Geological Survey) (2019-2021)
- Sultan, M., Principal Investigator, An integrated approach for a better understanding of the hydrologic setting, longevity, and optimum utilization of the Nubian Sandstone Aquifer System in Egypt (National Academy of Sciences) (2016-2020).
- Sultan, M., Principal Investigator, Generation of a baseline database to support the NEOM Project (King Abdullah University of Science and Technology) (2019-2020)
- Sultan, M., Principal Investigator, GRACE: An effective tool for understanding aquifers', infiltration, recharge, mass transport, impediments, response, and sustainable utilization (NASA) (1/1/2019-12/31/2019)
- Sultan, M., Principal Investigator, Developing predictive models for algal bloom occurrence and identifying factors controlling their occurrence in the Charlotte County and surroundings (Western Michigan University & Charlotte County, Florida) (2017-2018)
- Sultan, M., Principal Investigator, Use of Grace, remote Sensing, and traditional data sets for modeling time-dependent water partitioning on continental scales: A case study from Africa, (NASA- GRACE) (2015-2018).
- Sultan, M., Assessment of the Spatial and Temporal Subsidence (Sinkholes) Patterns and Controlling Factors in Qatar: A Radar Interferometric Approach (Ministry of Municipality & Environment, Doha, State of Qatar) (2017-2018)
- Sultan, M., Principal Investigator, Integrated remote sensing studies on the natural discharge in the western desert of Egypt, (National Authority for Remote Sensing and Space Sciences (NARSS)(2017-2018)
- Sultan, M., Principal Investigator, Development of an early warning system for rainfall-induced debris flows (Saudi Geological Survey) (2015-2017).
- Sultan, M., Principal Investigator, Use of GRACE and Relevant Remote Sensing Data to Estimate Spatial and Temporal Changes in Terrestrial Water Storage over the Nubian Sandstone Aquifer System, (National Authority for Remote Sensing & Space Sciences; NARSS) (2016)
- Sultan, M., Principal Investigator, Evaluating subsidence in the Nile Delta using radar interferometry, (NSF)(2011-2015)
- Sultan, M., Principal Investigator– Towards a better understanding of the paleo-hydrologic setting of the Empty Quarter (Saudi Geological Survey) (2014)
- Sultan, M., Principal Investigator – Detailed Studies of Landslides in Jazan Area, Saudi Arabia (Saudi Geological Survey) (2010-2014)
- Sultan, M., Principal Investigator – Use of GRACE data to estimate temporal changes in terrestrial water storage (TWS) across the Empty Quarter and surroundings (Saudi Geological Survey) (2013)

Sultan, M., Co-Principal Investigator, Enhancing capacity for water-resource studies in Egypt and Morocco (State Department) (2011-2013)

Sultan, M., Principal Investigator - Assessment and development of alternative water resources in the Sinai Peninsula, Egypt (NATO Science for Peace and Security) (2007-2012)

Sultan, M., Principal Investigator – Integration of Grace Data with Inferences from Hydrologic Models, Geochemical Data, and Field Data for a Better Understanding of the Time-Dependent Water Storage Variability in Large-Scale Aquifers: Case Studies from North Africa (NASA Earth Science Division) (2008-2012)

Sultan, M., Principal Investigator – The hydrologic role of faults in the Mojave Desert: Fracture controlled mountain front groundwater flow, San Bernardino Mountains (Mojave Water Agency) (2009-2011)

Sultan, M., Principal Investigator - Assessment and development of renewable groundwater resources in the Quetta Valley, Pakistan (US State Department) (2007-2010)

Sultan, M. Co-Principal Investigator – A proposal to evaluate the Jet Propulsion Laboratory Mars Exploration Public Engagement Program and Mars Student Imaging Project, (NASA) (2007-2010)

Sultan, M., Principal Investigator, The Mesopotamian marshlands from disintegration to restoration (NSF) (2005-2010)

Sultan, M., Co-Principal Investigator - Establishment of the Michigan Geological Repository for Research and Education, (Congressional Earmark) (2006-2008)

Sultan, M., Co-Principal Investigator - Monitoring and event response for harmful algal blooms (NOAA) (2004-2008)

Sultan, M., Principal Investigator - Renewable groundwater resources in Sinai (NSF) (2005-2008)

Sultan, M., Co-Investigator - The Relation between 20th Century dune migration and wetland formation at Cape Cod National Sea Shore, MA. (National Park Service) (2006-2008)

Sultan, M., Project Director: Towards a better understanding of the hydrology of Lake Nasser, Egypt (NSF International Program) (2003-2007).

Sultan, M., Principal Investigator: Developing renewable ground water resources in arid lands: A Pilot Case – The Eastern Desert of Egypt (Global Environmental Facility; United Nations Development Program [UNDP]) (2003-2007).

Sultan, M., Principal Investigator: A Web-Based GIS for Egypt's geological datasets (NSF) (2003-2007).

Sultan, M., Project Director: REU support - Towards a Better understanding of the hydrology of Lake Nasser, Egypt (NSF) (2004-2007)

Sultan, M., Principal Investigator: REU support - A Web-Based GIS for Egypt's geological datasets (NSF) (2004-2007)

Sultan, M., Co- Investigator, Town of Amherst soil and structural stability study: Technical, planning, and engineering assistance (US Army Corps of Engineers) (2004-2005) (administered by UB)

Sultan, M., Principal Investigator: Integrated Hydrology of the Nubian Aquifer: Evidence from Radar and SRTM data (European Space Agency) (2004-2005)

Sultan, M., Co-Project Director: Collaborative Research: A GIS Database for Studying and Visualizing Tethyan Plate Collisions (National Science Foundation [NSF]) (2003-2006)

Sultan, M., Co-Investigator: Environmental Assessment of Natural Radioactivity and Heavy Metal Pollution in the El Fayoum Area, Egypt (U.S. Environmental Protection Agency) (2002-2005) (administered by UIC).

Sultan, M., Principal Investigator: Assessment, Monitoring, and Modeling of Changes in Land Use and Land Cover and Their Impacts on the Nubian Aquifer, Saharan Africa (NASA – Carbon Cycle Science and Related Opportunities in Biology and Biogeochemistry of Ecosystems and Applications) (2001-2005).

Sultan, M., Co-Principal Investigator: Training of Cairo University (CU) Faculty on Environmental Issues (U.S. Agency for International Development-CU) (2002-2003) (administered by UIC).

Sultan, M., Co-Investigator: Water Cycle Observations, Analysis, and Modeling (DOE) (2001-2002).

Sultan, M., Principal Investigator: Hydrogeologic and Environmental Impacts of the New Valley Project, U.S. Department of Agriculture (USDA)/Egyptian Ministry of International Cooperation. Project involved the development of the Center for Environmental Science and Technology (1999-2001).

Sultan, M., U.S. Principal Investigator: CU Center for Environmental Hazard Assessment. Funded by USDA (1995-2002).

Sultan, M., Principal Investigator: Application of Fundamental Science to Critical Environmental Issues. (Argonne LDRD Strategic Initiatives) (1998-2000).

- Sultan, M., Co-Principal Investigator: Paleoclimatic Studies of the Western Desert, Egypt. (NASA Geology Program) (1995-1997).
- Sultan, M., Principal Investigator: Tectono-Thermal History of Pre-Pan African Crust in NE Africa: Inferences from Field, Geochronologic, and Isotopic Data. (NSF) (1993-1997).
- Sultan, M., Co-Investigator: SIR-C Studies of the Precambrian Hamisana and Nakasib Structures, NE Sudan, in Arid Regions of Low Relief and in the Subsurface. (NASA Geology Program) (1988-1994).
- Sultan, M., Co-Principal Investigator: Paleoclimatic and Tectonic History of the Eastern Desert, Egypt, and Surroundings. (NASA Geology Program) (1991-1994)
- Sultan, M., Principal Investigator: Geologic Correlations across the Atlantic using Landsat and Gravity Data. (EOSAT) (1993-1994).
- Sultan, M., Co-Principal Investigator: Workshop on the Assembly of Gondwana. (NSF, Continental Dynamics Program) (1993-1994).
- Sultan, M., Co-Investigator; Arvidson, R.E., Principal Investigator: Toward Global Perspectives on Continental Tectonics. (NASA Geology Program) (1988-1991).
- Sultan, M., Co- Investigator: Integration of Landsat, Field, and Geochronological Data in Search for the Oldest Continental Crust within Accreted Terranes in the Eastern Desert, Egypt. (NASA Innovative Research Program) (1988-1990).
- Sultan, M., Principal Investigator: Production of Lithologic and Structural Maps from Digital Landsat Thematic Mapper Data over the Eastern Desert, Egypt. (NSF) (1989-1991).

Students Supervised (Degrees awarded)

- Mohamed Elhebiry, August 2023, Origin of the Mega-Streamlined Morphology in NE Africa and Arabia: Remote Sensing and Field-based Investigations, Ph.D., Western Michigan University,
- Guzalay Sataer, December 2022, Remote Sensing Application for Landslide Detection, Monitoring along Eastern Lake Michigan (Miami Park, MI), **PhD**, Western Michigan University
- Nathan Erber, 2022, Evidence for an Early Saginaw Lobe Ice Retreat and Drainage Adjustments Across Southern Michigan, **Ph.D.**, Western Michigan University
- Moein Izadi, 2022, A Remote Sensing and Machine Learning-Based Approach to Forecast the Onset of Harmful Algal Bloom, **PhD**, Western Michigan University
- Mustafa Emil 2021, Use of InSAR technologies for countrywide monitoring of ground deformation in Qatar and identification of controlling factors", **PhD**, Western Michigan University
- Abdulaziz Aljammaz, 2021, An integrated approach for the assessment and monitoring of land deformation in the Riyadh city and surroundings and for identifying the controlling factors, **PhD**, Western Michigan University
- Hannah Pankratz, 2020, Monitoring salt diapir related land deformation and distribution: A geophysical and remote sensing approach Jazan Province, Saudi Arabia, **PhD**, Western Michigan University.
- Karem Abdelmohsen, 2020, Response of deep aquifers to climate variability, **PhD**, Western Michigan University.
- Hossein Sahour, 2020, Statistical downscaling techniques to enhance the spatial resolution of the GRACE satellite data and to fill temporal gaps, **PhD**, Western Michigan University.
- Fahad Alshehri, 2020, An integrated approach (remote sensing, hydrogeology, GIS, and statistical modeling) to identify the distribution of shallow groundwater occurrences over southwest Saudi Arabia, **PhD**, Western Michigan University
- Sita Karki, 2019, Developing early warning systems for debris flows and harmful algal blooms, **PhD**, Western Michigan University.
- Esayas Gebremichael, 2018, Use of radar interferometry to assess land deformation in the Nile Delta region of Egypt and identifying the controlling factors using integrated research approaches, **PhD**, Western Michigan University.
- Abdullah Othman, 2017, An Integrated Approach (Remote sensing, Hydrogeology, Geotechnical, and Geoinformatics) to Assess and Monitor Fossil Aquifers and Associated Land Deformation over the Arabian Peninsula, **PhD**, Western Michigan University.
- Abotalib Farag, 2016, An integrated approach for a better understanding of the paleo-hydrology and landscape evolution in the Sahara during the previous wet climatic periods, **PhD**, Western Michigan University.

- Lamees Mohamed, 2015, Structural controls on the distribution of groundwater in southern Sinai, Egypt: Constraints from geophysical and remote sensing observations, **PhD**, Western Michigan University.
- Racha Elkadiri, 2014, An integrated approach (Remote Sensing, GIS, Engineering, Data Mining) for modelling, assessing and mitigating slope stability hazards in mountainous environments, **PhD**, Western Michigan University.
- Cameron Manche, 2014, A remote sensing based early warning system for algal blooms in Kuwait bay and coastal waters, **MS**, Western Michigan University.
- Talal Ghazi Alharbi, 2014, Integrated (remote sensing, GIS, and modeling) hydrological investigations and landslide susceptibility studies in the Arabian Shield. **PhD**, Western Michigan University.
- El Hachemi Yousef Bouali, 2013, Utilizing persistent scatterer interferometry to investigate the nature and factors controlling Nile Delta subsidence, **MS**, Western Michigan University.
- Abdou Abouelmagd, 2012, Paleoclimatic Regimes of the African Sahara Desert during Pleistocene and the Origin of Groundwater in the Nubian Sandstone Aquifer System. **PhD**, Western Michigan University
- Mohamed Ahmed, 2012, Integrated approach for hydrogeologic investigations in Africa: Inferences from space-borne and land-based gravity, aeromagnetic, GIS, and remote sensing data, **PhD**, Western Michigan University.
- Jinal B. Kothari, 2011, Remote Sensing-based inputs to rainfall runoff models: A case study from the Tigris-Euphrates, **MS**, Western Michigan University
- Dee Becker, 2011, A Web-based GIS Vehicle for the Assessment of Groundwater Potential in Arid Lands: A Case Study from Egypt, **MS**, Western Michigan University.
- Zhanay Sagintayev, 2010, Integrated Approach for the Assessment and Development of Groundwater Resources in Arid Lands: Applications in the Quetta Valley, Pakistan, **PhD**, Western Michigan University.
- Richard Becker, 2008, Remote Sensing Studies for the Assessment of Geohazards: Toxic Algal Blooms in the Lower Great Lakes, and Land Subsidence in the Nile Delta, **PhD**, Western Michigan University.
- Adam Milewski, 2008, Remote sensing solutions for estimating runoff and recharge in arid environments, **PhD**, Western Michigan University.
- Christopher Jones, 2007, Hydrologic impacts of engineering projects on the Tigris-Euphrates System and its marshlands, **MS**, Western Michigan University.
- Nakul Manocha, 2006, Development of a web-based GIS for groundwater exploration in arid lands, **MS**, Western Michigan University.

Post-doctoral scientists supervised

- Mustafa Emil (2021- present) Western Michigan University (PhD remote sensing)
- Karem Abdelmohsen (December 2020 – present) Western Michigan University (PhD geophysics)
- Hannah Pankratz (2021-2022) Western Michigan University (PhD geophysics)
- Abotalib Zaki (2019-present) Western Michigan University (PhD paleoclimate)
- Mehdi Vazifedan, 2020 (Nov 2020 – December 2021) Western Michigan University (PhD mathematics)
- Hossein Sahour, 2020 (August 2020- October 2020) Western Michigan University (PhD machine learning, data mining)
- Ahmed Korany Abdelaal (2018-2019) Western Michigan University (PhD environmental geology)
- Racha El Kadiri (2014- 2015) Western Michigan University (PhD geotechnical Engineering)
- Mohamed Ahmed (2012-present) Western Michigan University (PhD geophysics)
- Tamer El Bayoumi (2013- 2014) Western Michigan University (PhD Statistics)
- Abdou Abouelmagd (2012- 2013) Western Michigan University (PhD geochemistry)
- Adam Milewski (2008- 2011) Western Michigan University (PhD Hydrology)
- Richard Becker (2008) Western Michigan University (PhD Remote Sensing)
- Safei El Deen Metwally (2007-2008) Western Michigan University (PhD Geophysics)
- Khalid Essa (2006) Western Michigan University (PhD Geophysics)
- Jeongkon Kim (1999-2001) Argonne National Lab (PhD Civil Engineering)
- Hazem Gheith (1998-1990) Argonne National Lab (PhD Civil Engineering)

Manuscripts

1. Erber, N.R., Kehew, A.E., Schaetz, R.j., Gillespie, R., **Sultan, M.**, Esch, J., Yellich, J., Curry, B.B., Sebastien H., Abotalib, A.Z., 2023, Evidence for an early Saginaw lobe retreat and drainage adjustments across southern Michigan, USA, *Catena*, v. 233, p. 107510. <https://doi.org/10.1016/j.catena.2023.107510>
2. Abdelmohsen, K., **Sultan, M.**, Yan, E., Abotalib, A.Z., Save, H., Emil, M., Elhaddad, H., Abdelmalik, K., 2023, Watching the Grand Ethiopian Renaissance Dam from a Distance: Implications for Sustainable Water Management of the Nile Water, *Nature Sustainability* (in review).
3. Abdelaal, A., **Sultan, M.**, Abotalib, A.Z., Krishnamurthy, R.V., Bedair, M.M, and Elhebery, M., 2023, Emerging Mercury and Methylmercury contamination from new Artisanal and Small-scale Gold Mining along the Nile Valley, Egypt, *Environmental Science and pollution research*, <https://doi.org/10.1007/s11356-023-25895-9>
4. Abdelmohsen, K., **Sultan, M.**, Save, H., Abotalib, A., Yan, E., and Zahran, K., 2022, Buffering the impacts of extreme climate variability in the highly engineered Tigris Euphrates river system. *Nature Scientific Report*, 12, 4178, <https://doi.org/10.1038/s41598-022-07891-0>
5. Elhebiry, M.S., **Sultan, M.**, Abotalib, A.Z., Kehew, A.E., Voice. P.J., El-Leil, I.A., 2022, Red Sea tectonics unveil the largest known terrestrial ice stream: New constraints on Late Ordovician ice sheet dynamics, *EPSL, Earth and Planetary Science Letters* v. 587 p. 117531
6. Sahour, H., **Sultan, M.**, Abdellatif, B., Emil, M., Abotalib, A.Z., Abdelmohsen, K., Vazifedan, M., Mohammad, A.T., Hassan, S.M., Metwalli, M.R., El Bastawesy, M., 2022, Identification of shallow groundwater in arid lands using multi-sensor remote sensing data and machine learning algorithms, *J. Hydrology*, v. 614, <https://doi.org/10.1016/j.jhydrol.2022.128509>
7. Sataer, G., **Sultan, M.**, Emil, M.K., John A. Yellich, Monica Palaseanu-Lovejoy, Richard Becker, Esayas Gebremichael, Karem Abdelmohsen, 2022, Remote Sensing Application for Landslide Detection, Monitoring Along Eastern Lake Michigan (Miami Park, MI), *Remote Sensing*, *Remote Sens.* 2022, 14, 3474, <https://doi.org/10.3390/rs14143474>
8. Aljammaz, A., **Sultan, M.** Izadi, M. Abotalib, A.Z., Elhebiry, M.S., Emil, M.K., Abdelmohsen, K., Saleh, M., and Becker, R., 2021, Subsidence induced by rapid urbanization in arid environments: A remote sensing-based investigation, *Remote Sensing*, 13, 1109, <https://doi.org/10.3390/rs13061109>
9. Emil, M, Sultan, M., Alakhras, K., Sataer, G., Gozi, S., Al-Marri, M., and Gebremichael, E., 2021, Countrywide monitoring of ground deformation using InSAR time series: a case study from Qatar, *Remote Sensing*, 13, p. 702, <https://doi.org/10.3390/rs13040702>
10. Hassan, S., **Sultan, M.**, Sobh, M., Elhebiry, M.S., Zahran, K., Abdeldayem, A., Issawy, E., and Kamh, S., 2021, Crustal Structure of the Nile Delta: Interpretation of Seis-mic-Constrained Satellite-based Gravity Data, 2021, *Remote Sensing*, 13 (10), DOI: 10.3390/rs13101934.
11. Izadi, M., Sultan, M., El Kadiri, R., Ghannadi, A., Abdelmohsen, K., 2021, A Remote Sensing and Machine Learning-Based Approach to Forecast the Onset of Harmful Algal Bloom, *Remote Sensing*, v.13, p. 3863, <https://doi.org/10.3390/rs13193863>
12. Pankratz, H., Sultan, M., Abdelmohsen, K., Sauck, W., Alsefry, S., Alharbi, H., Emil, M.K., Gebremichael, E., Asaedi, A., Alshehri, F., Hisham, I.H., Al-Shamrani, H.A., El-Sahly, M., 2021, Use of Geophysical and Radar Interferometric Techniques to Monitor Land Deformation Associated with the Jazan Salt Diapir, Jazan city, Saudi Arabia, *Surveys in Geophysics*, <https://doi.org/10.1007/s10712-020-09623-3>
13. Abdelaal, A., Sultan, M., Elhebery, M., Krishnamurthy, RV, Sturchio, N. 2020, Site-specific Parameters for Environmentally Benign Mining Operations: A Case Study from the Sukari Gold Mine, Egypt, *Science of the Total Environment*, *Science of the Total Environment*, DOI: 10.1016/j.scitotenv.2020.141654
14. Abdelmohsen, K., Sultan, M., Save, H., Abotalib, A., Yan, E. 2020, What can the GRACE seasonal cycle tell us about lake-aquifer interactions? *Earth Science Reviews*, <https://doi.org/10.1016/j.earscirev.2020.103392>
15. Alshehri, F., Sultan, M., Karki, S., Alwagdani, E., Alsefry, S., Alharbi, H., Sahour H., Sturchio, N., 2020, Mapping the distribution of shallow groundwater occurrences using remote sensing-based statistical modeling over southwest Saudi Arabia, *Remote Sensing*, 12, 1361; doi:10.3390/rs1209136
16. El Bastawesy, M., Gebremichael, E., Sultan, M., Attwa, M., and Sahour, H., 2020, Tracing Holocene channels and landforms of the Nile Delta through integration of early elevation,

- geophysical, and sediment core data, 2020, Holocene, <https://doi.org/10.1177/0959683620913928>
17. Elhebiry, M.S., Sultan, M., Kehew, A.E., Abu El-Leil, I., Bekiet, M.H., Soliman, N.M.A., Abdel Shahid, I., 2020, Paleozoic glaciation in NE Africa: field and remote sensing-based evidence from the South Eastern Desert of Egypt, *International Geology Reviews*, 62:9, 1187-1204, DOI: 10.1080/00206814.2019.1636416
 18. Sahour, H., Sultan, M., Vazifedan, M., Abdelmohsen, K., Karki, S., Yellich, J., Gebremichael, S., Alshehri, F., Elbayoumi, T., 2020, Statistical Applications to Downscale GRACE- Derived Terrestrial Water Storage Data and to Fill Temporal Gaps, 2020, *Remote Sens.* 2020, 12(3), 533; <https://doi.org/10.3390/rs12030533>
 19. Sultan, M., Geith, H., Sturchio, N., El Alfy, Z., and Danishwar, S., 2003, Origin and recharge rates of alluvial ground waters, Eastern Desert, Egypt, In *Hydrology and Water Resources*, vol 5, International Conference on water Resources Management in Arid Regions, Editors: Sherif M.M., and Al-Rashed, M., 386 pp, <https://doi.org/10.1201/9781003078845>
 20. Abdelmohsen, K., Sultan, M., Ahmed, M., Save, H., Elkaliouby, B., Emil, M., Yan, E., Abotalib, A., Krishnamurthy, R.V., Abdelmalik, K., *Earth and Planetary Science Let.*, 2019, Response of deep aquifers to climate variability, *Science of the Total Environment*, <https://doi.org/10.1016/j.scitotenv.2019.04.316>
 21. Ahmed, M., Sultan, M., Elbayoumi, T., and Tissot, P., 2019, Forecasting GRACE data over African watersheds, *Remote Sensing*, 11, doi:10.3390/rs11151769 www.mdpi
 22. Sherif, M., Sultan, M., and Sturchio, N.C., 2019, Chlorine isotopes as tracers of solute origin and age of groundwaters from the Eastern Desert of Egypt, *Earth and Planetary Science Letters* 510:37-44, DOI: 10.1016/j.epsl.2018.12.035
 23. Sultan, M., Sturchio, N.C., Alsefry, S., Abdelmohsen, K., Abuabdullah, M.M., Yan, E., Save, H., Othman, Chouinard, K., 2019, Assessment of age, origin, and sustainability of fossil aquifers: A geochemical and remote sensing-based approach, *J. Hydrology*, DOI:10.1016/j.jhydrol.2019.06.017
 24. Karki, S., Sultan, M., Al-Sefry, S., Alharbi, H., Emil, M., Elkadiri, R., Alfadail, E., 2019, A remote sensing-based Intensity-Duration Curve, Faifa Mountains, Saudi Arabia, *NHESS*, DOI: 10.5194/nhess-2018-282
 25. Zaki, Abotalib, Sultan, M., Jimenez, G., Crossey, L.J., Karlstrom, K., Forman, S., Elkadiri, R., Polyak, V., 2019, Complexity of Saharan paleoclimate reconstruction and implications for modern human migration, *Earth and Planetary Science Letters* 508:74-84, DOI: 10.1016/j.epsl.2018.12.015
 26. Gebremichael, E., Sultan, M., Becker, R., El Bastawesy, M., Cherif, O., Emil, M., 2018, Assessing Land Deformation and Sea Encroachment in the Nile Delta: A Radar Interferometric and Inundation Modeling Approach, *J. Geophysical Research*, doi.org/10.1002/2017JB015084
 27. Karki, S. Sultan, M., Elkadiri, R., Elbayoumi, T., 2018, Mapping and Forecasting Onsets of Harmful Algal Blooms Using MODIS Data over coastal waters surrounding Charlotte County, Florida, *Remote Sensing*, doi.org/10.3390/rs10101656
 28. Othman, A., Sultan, M., Becker, R., Allsefry, S., Alharbi, T., Gebremichael, E., Alharbi, H., and Abdelmohsen, K., 2018, Use of Geophysical and Remote Sensing Data for Assessment of Aquifer Depletion and Related Land Deformation, *Surveys in Geophysics*, DOI10.1007/s10712-017-9458-7
 29. Sherif, M.I, Lin, J., poghosyan, A., Abouelmagd, A., Sultan, M., and Sturchio, N., 2017, Geological and hydrogeochemical controls on radium isotopes in groundwater of the Sinai Peninsula, Egypt, *Science of The Total Environment* v. 613-614C: pp. 877-885, DOI10.1016/j.scitotenv.2017.09.129
 30. Mohamed, A., Sultan, M., Ahmed, M., Yan, E., Ahmed, E., 2016, Aquifer recharge, depletion, and connectivity: Inferences from GRACE, land surface models, and geochemical and geophysical data, *GSA Bulletin*, DOI: 10.1130/B31460.1
 31. Abotalib A.Z., Sultan, M., Elkadiri, R., 2016, Groundwater processes in Saharan Africa: Implications for landscape evolution in arid environments, *Earth Science Reviews*, v. 156, p. 108-136.

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Abstracts for Presentations (talks/posters) at Professional Meetings

1. **Sultan, M.**, Abdelmohsen, K., Saleh, H., and Karimi, H., 2023, Recharge from Reservoirs, Groundwater Flow, and Response to Climate Variability in Arid Basins: Revelations from GRACE Observations, EGU, Vienna, Austria, April 23-28.
2. **Sultan, M.**, 2023, From limited placer outcrops to mapping the largest terrestrial ice stream: Alan Kehew's contributions to Late Ordovician glaciation in the Saharan-Arabian Desert, GSA North Central, Grand Rapids, May 4-5, 2023
3. Hassan, S, **Sultan, M.**, Abdelmohsen, K., Karimi, H., Emil, M.K., GRACE, and GRACE-FO unravel the impacts of tropical cyclones on Arabia's hydrology: Najd watershed as a case study, GSA North Central, Grand Rapids, May 4-5, 2023.
4. Gillespie, R., **Sultan, M.**, Caruthers, A.H., Voice, P., Petcovic, H., (2023) WMU dinosaur park: an update, GSA North Central, Grand Rapids, May 4-5, 2023.
5. Elhebiry, M., **Sultan, M.**, Yellich, J., 2023, Critical mineral exploration in Upper Peninsula of Michigan: Challenges and opportunities, GSA North Central, Grand Rapids, May 4-5, 2023.
6. Abdelmohsen, K., **Sultan, M.**, Save, H., Farag, A., and Zahran K.H., 2022, The role dams could play in modulating the impacts of climate change in shared river systems: insights from the Tigris Euphrates watershed, AGU Annual Meeting, Chicago, Dec 12-16
7. Mohammad, A.T., **Sultan, M.**, Farag, A.Z., 2022, Structural control on the inception and evolution of the Saharan depressions, AGU Annual Meeting, Chicago, Dec 12-16
8. Mohammad, A.T., **Sultan, M.**, Elhebiry, M., Emil, M., and Hassan, S., 2022, Did the late Miocene witness the failure of the Suez rift and the cessation of extension? AGU Annual Meeting, Chicago, Dec 12-16.
9. **Sultan, M.**, Abdelmohsen, K., and Save, H., 2022, Remote Sensing Applications for Assessment of Seepage from Artificial Reservoir: Case Studies from the Nile Basin, Africa, AGU Annual Meeting, Chicago, Dec 12-16.
10. Emil, M.K., **Sultan, M.**, Algahtani, B., Alsefry, S., 2022, Sinkhole formation in relation to nearby wastewater storage in abandoned quarries, southeastern Riyadh, Saudi Arabia, American Geophysical Union, Fall Meeting, Chicago, December 12-16
11. Sataer, G., **Sultan, M.**, Emil, M.K., Palaseanu, M., Becker, R., Yellich, J.A., Gebremichael, E., Abdelmohsen, K., Karimi, H., 2022, Remote Sensing Applications for Landslide Detection and Monitoring along Lake Michigan Eastern Coastline, Miami Park, MICHIGAN, American Geophysical Union, Fall Meeting, Chicago, December 12-16
12. Saleh, H., **Sultan, M.**, Abdelmohsen, K., Save, H., Karimi, H., Emil, M.K., 2022, Use of GRACE and GRACE-FO to Monitor the Impacts of Tropical Cyclones on Arabia's Hydrologic Systems, American Geophysical Union, Fall Meeting, Chicago, December 12-16
13. Pankratz, H.G., Alharbi, H., **Sultan, M.**, Abdelmohsen, K., Emil, M.K., Alamudi, M., Alsadi, N., Alzahrani, S., Aldahri, M., Al Amri, R., 2022, InSAR, Geophysical, and Field Investigations to Assess and Monitor Deformation Associated with a Rising Salt Diapir, Jazan City and Surroundings, Kingdom of Saudi Arabia, American Geophysical Union, Fall Meeting, Chicago, December 12-16

14. Elhebiry, M.S., **Sultan, M.**, Mohammad, A.T., 2022, Control of Sequent Crustal Collisions on the Distribution of Orogenic Gold Mineralization in the Arabian Nubian Shield, American Geophysical Union, Fall Meeting, Chicago, December 12-16
15. Karimi,H., **Sultan, M.**, Emil, M.K., Sahour, H., Abdelmohsen, K., Saleh, H., 2022, The Impact of Extreme Precipitation Events on The Terrestrial Water Storage in The Arabian Peninsula, American Geophysical Union, Fall Meeting, Chicago, December 12-16
16. Hegazy, D., Farag, A., Sultan, M., El Bastawesy, M., Abdelmalik, K., Attwa, M., Medany, S., 2022, An Integrated Remote Sensing, Geophysical and Stable Isotope Approach for Groundwater Assessment in the northern area of the Western Desert, Egypt. American Geophysical Union, Fall Meeting, Chicago, December 12-16
17. Sultan, M., Abdelmohsen, K., and Save, H., 2021, Satellite-based investigations of the Artificial Reservoirs in the Nile Basin, Grace-FO Science Team virtual Meeting, Oct. 12-20.
18. Abdelmohsen, K., Sultan, M., and Save, H., 2021, Highly Engineered River Systems, a Potential Adaptation to Climate Variability, Grace-FO Science Team virtual Meeting, Oct. 12-20.
19. Abdelmohsen, K., Sultan, M., Save, H., and Zahran, K.H., 2021, Watching the Grand Ethiopian Renaissance from a Distance, American Geophysical Union, Fall Meeting, New Orleans, December 13-17.
20. Emil, M.K., Pankratz, H.G., **Sultan, M.**, 2021, Rapid assessment of Surfside condo collapse using InSAR time series analysis and geospatial technologies, American Geophysical Union, Fall Meeting, New Orleans, December 13-17.
21. Emil, M.K., Pankratz, H.G., **Sultan, M.**, Al-Akhras, K., Abdelmohsen, K., Al-Marri, M., 2021, Continuous monitoring of ground motion using Sentinel-1 InSAR time series: A case study from Doha, Qatar, American Geophysical Union, Fall Meeting, New Orleans, December 13-17.
22. Badawy, A., **Sultan, M.**, Abdelmohsen, K., Save, H., 2021, Assessment of Extreme Precipitation Events over the Nile Basin and their Impact on Downstream Countries, American Geophysical Union, Fall Meeting, New Orleans, December 13-17.
23. Pankratz, H.G., Sultan,M., Emil, M.K., Harbi, H.A., and Abdelmohsen, K., 2021, Salt Diapir Hazard Monitoring in the Southwestern Arabian Peninsula, American Geophysical Union, Fall Meeting, New Orleans, December 13-17.
24. Sahour, H., **Sultan, M.**, Emil, M.K., Abdellatif, B., Farag, A.Z.A., Vazifedan, M., Abdelmohsen, K., Hassan, S.M., and Attwa, M., 2021, Use of Multi-sensor Remote Sensing Data and Machine Learning to Locate Shallow Groundwater in the Western Desert of Egypt, American Geophysical Union, Fall Meeting, New Orleans, December 13-17.
25. Sataer, G., **Sultan, M.**, Emil, M.K., Palaseanu, M., Becker, R., Yellich, J.A., Pankratz, H.G., 2021, Continuous monitoring of Eastern Lake Michigan bluffs using Sentinel -1 and Unmanned Aerial Vehicles (UAVs) data, 2021, American Geophysical Union, Fall Meeting, New Orleans, December 13-17.
26. **Sultan, M.**, Satellite-based investigations of the Artificial Reservoirs in the Nile Basin, October 11-14, 2021, 7th Arab Conference on Astronomy and Geophysics, Satellite-based investigations of the Artificial Reservoirs in the Nile Basin, October 11-14, 2021
27. **Sultan, M.**, Abdelmohsen, K., Save, H., Farag, A.Z.A., Yan, E., and Zahran, K.H., 2021, Assessment of the impacts of climate variability on highly engineered watersheds: A case study from the Tigris Euphrates watershed, American Geophysical Union, Fall Meeting, New Orleans, December 13-17.
28. Abdelmohsen, K. **Sultan, M.**, Save, H., Assessment of Signal Leakage on GRACE-Derived Seasonal Variations in Dakhla Subbasin, Egypt, 2020, American Geophysical Union, Fall Meeting, San Francisco, 1-17 December
29. Elhebiry, M., **Sultan, M.**, Farag, A.Z.A., Alan Kehew, A., 2020, Late Ordovician Arabian ice stream: The largest known terrestrial ice stream, American Geophysical Union, Fall Meeting, San Francisco, 1-17 December
30. Hassan, S.H., **Sultan, M.**, Sobh, M., Elhebiry, M.S., Zahran, K.H., Issawy, E., Abdelaziz, A., and Kamh, S., 2020, Crustal structure of the Nile Delta: Interpretation of seismic-constrained gravity inversion, American Geophysical Union, Fall Meeting, San Francisco, 1-17 December
31. Izadi, M., **Sultan, M.**, Elkadiri, R., Ghannadi, M.A., Nikraftar, Z., Namjoo, F., 2020, Remote sensing & Statistical learning approach to Harmful Algal Bloom Forecasting Using MODIS

- Ocean color parameters, American Geophysical Union, Fall Meeting, San Francisco, 1-17 December
32. Pankratz, H.G., Sultan, M., Abdelmohsen, K., Sauck, W.A., Al Sefry, S.A., Alharbi, H., Emil, M.K., Gebremichael, E., Asaeidi, A., Alshehri, F., Hashim, H., Al-Shamrani, H.A., and El Sahly, 2020, Monitoring of Salt Diapir-Related Land Deformation in an Urban Setting, American Geophysical Union, Fall Meeting, San Francisco, 1-17 December
 33. Sahour, H., **Sultan, M.**, Vazifedan, M., Emil, M.K., Farag, A.Z.A, Abdellatif, B., El Bastawesy, M., 2020, Use of machine learning algorithms and remote sensing data to identify shallow groundwater occurrences in the Western Desert of Egypt, American Geophysical Union, Fall Meeting, San Francisco, 1-17 December
 34. Sataer, G., **Sultan, M.**, Emil, M.K., Palaseanu, M., Becker, R., Yellich, J.A., 2020, Developing a Radar based Landslide Monitoring System (LMS) Along the Eastern Lake Michigan Bluffs, American Geophysical Union, Fall Meeting, San Francisco, 1-17 December
 35. Shaw, N., **Sultan, M.**, Emil, M., Tellich, J., Becker, R., Palaseanu, M., and Sataer, G., 2019, Investigating groundwater seepage control on bluff failure along Michigan coastline using UAVs, American Geophysical Union, Fall Meeting, San Francisco, 9-13 December
 36. Ahmed, M., Gyawali, B., and **Sultan, M.**, 2019, Bridging gravity field observations across GRACE and GRACE-FO missions over Africa, American Geophysical Union, Fall Meeting, San Francisco, 9-13 December
 37. Sahour, H., **Sultan, M.**, Yellich, J., Harrison, W., Emil, M., and Sataer, G., 2019, Use of Sentinel-1 and GRACE Data to Assess the Distribution, Nature, and Factors Causing Land Deformation in the Lower Peninsula of Michigan, 2019 American Geophysical Union, Fall Meeting, San Francisco, 9-13 December
 38. Hassan, S., **Sultan, M.**, Emil, M., Zahran, K.H., Issawy, Elsayed, Abdeldayem, A., Kamh, S., and Emam, E., 2019, Monitoring recent land subsidence in the Nile Delta of Egypt using Sentinel-1 InSAR time series, 2019, American Geophysical Union, Fall Meeting, San Francisco, 9-13 December
 39. Sataer, G., **Sultan, M.**, Emil, M., Becker, R., Kehew, A., Yellich, J., and Kincarwe, K., 2019, Visualizing and Monitoring Bluff Retreat Using Sentinel 1 Radar Interferometry and UAV Imagery, American Geophysical Union, Fall Meeting, San Francisco, 9-13 December
 40. Emil, M., **Sultan, M.**, Al-akhras, K., Sataer, G., Gozi, S., and Shaw, N., 2019, Continuous monitoring of ground deformation in Qatar, using Sentinel-1 InSAR time series, American Geophysical Union, Fall Meeting, San Francisco, 9-13 December
 41. Elhebeiry, M., **Sultan, M.**, Kehew, A., 2019, Late Ordovician ice stream in NE Africa and Arabia and its implication, American Geophysical Union, Fall Meeting, San Francisco, 9-13 December
 42. Pankratz, H. G., **Sultan, M.**, Sefry Saleh, Alharbi, H., Emil, M., and Gozi, S., Analyzing InSAR time series: Case study on salt diapir intrusions and sabkhas in Southwestern Saudi Arabia, American Geophysical Union, Fall Meeting, San Francisco, 9-13 December
 43. **Sultan, M.**, Abdelmohsen, K., Elkaliouby, B., Abdellatif, B., Emil, M., Ahmed, M., Save, H., Abotalib, A., and Abdelmalik, K., 2019, Use of GRACE solutions for a better understanding of aquifer recharge sources, connectivity, groundwater flow, sustainability, and response to climate variability, American Geophysical Union, Fall Meeting, San Francisco, 9-13 December
 44. Abdelmohsen, K., **Sultan, M.**, and Save, H., 2019 Use of GRACE_{TWS} to identify the nature and timing of recharge sources and groundwater flow directions and velocities in aquifers, American Geophysical Union, Fall Meeting, San Francisco, 9-13 December
 45. Elhebeiry, M. S., M. Sultan, A. E. Kehew, I. Abu El-Leil, M. H. Bekiet, and N. M. Soliman. 2018. Ordovician Glaciation in NE Africa: Field and Remote sensing-based evidences from the South Eastern Desert of Egypt. In Geological Society of America, Annual Meeting. Indianapolis, Indiana, USA. 10-14 December
 46. Sahour, H., **Sultan, M.**, Abdelmohsen, K., Karki, S., Yellich, J. A., & Elbayoumi, T. 2018. Statistical Down-scaling of GRACE Data Using Multivariate Regression Models and Artificial Neural Networks. In American Geophysical Union, Fall Meeting. Washington, D.C. USA. 10-14 December

47. **Sultan, M.**, Abdelmohsen, K., Emil, M., Elkaliouby, B., Save, H., Ahmed, M., & Abdelmalik, K. 2018. Fast Aquifer Response: GRACE, Geophysical, and Geochemical Evidence. In American Geophysical Union, Fall Meeting. Washington, D.C. USA. 10-14 December 2018
48. Aljammaz, A., **Sultan, M.**, Emil, M., Alharbi, T., AlHarbi, H., & Alshehri, F. 2018. Using remote sensing and GIS technologies to map progressive urbanization and to identify hazardous areas related to sinkholes in Riyadh city and surroundings, Saudi Arabia. In American Geophysical Union, Fall Meeting. Washington, D.C. USA. 10-14 December
49. Alshehri, F., **Sultan, M.**, Alharbi, H., Alwagdani, E., Emil, M. K., & Karki, S. 2018. Assessment of the Distribution and the Factors Controlling the Rise in Groundwater Levels in Mecca Region, Saudi Arabia. In American Geophysical Union, Fall Meeting. Washington, D.C. USA. 10-14 December
50. Sataer, G., **Sultan, M.**, Gebremichael, E., Emil, M. K., Kehew, A., Yellich, J. A., & Chase, R. 2018. Application of InSAR techniques for monitoring landslide and bluff recession along Lake Michigan's coastal bluff. In American Geophysical Union, Fall Meeting. Washington, D.C. USA. 10-14 December
51. Emil, M. K., **Sultan, M.**, Al-Akhras, K., Gebremichael, E., Izadi, M., & Karki, S. 2018. Detecting and monitoring ground deformation using InSAR time series in arid environments; Doha City and its surroundings, Qatar. In American Geophysical Union, Fall Meeting. Washington, D.C. USA. 10-14 December
52. Gebremichael, E., **Sultan, M.**, Al-Akhras, K., Saleh, A., Yellich, J. A., Emil, M. K., & Karki, S. 2018. Detecting Sinkhole and Land Deformation Hazards Related to Carbonate Dissolution in Qatar using Geodetic Methods. In American Geophysical Union, Fall Meeting. Washington, D.C. USA. 10-14 December
53. Karki, S., **Sultan, M.**, Elkadiri, R., & Elbayoumi, T. 2018. Forecasting harmful algal blooms over the coastal water, Charlotte County, Florida. In American Geophysical Union, Fall Meeting. Washington, D.C. USA. 10-14 December.
54. Pankratz, H. G., **Sultan, M.**, Sauck, W., Al-Sefry, S. A., Al-Harbi, H., & Abdelmohsen, K. 2018. Delineating Subsurface Salt Diapirs along the Southern Red Sea Coastline, Saudi Arabia using Geophysical and Remote Sensing Techniques. In American Geophysical Union, Fall Meeting. Washington, D.C. 10-14 December
55. Abdelmohsen, K., **Sultan, M.**, & Save, H. 2018. Comparison of GRACE Response (RL06 versus RL05) over Fossil Aquifers in NE Africa. In American Geophysical Union, Fall Meeting. Washington, D.C. 10-14 December 2018
56. Elhebiry, M. S., M. Sultan, A. E. Kehew, I. Abu El-Leil, M. H. Bekiet, and N. M. Soliman. 2018. Ordovician Glaciation in NE Africa: Field and Remote sensing-based evidences from the South Eastern Desert of Egypt. In Geological Society of America, Annual Meeting. Indianapolis, Indiana, USA. 4-7 November
57. Emil, M., **Sultan, M.**, Al-Harbi, Talal., Al-Bassam, A. M., Abuabdullah, M., Al-Sefry, S. 2018. Geochemical evidences from fossil aquifers of central Arabia for cooler environments during aquifer recharge. In Geological Society of America, Annual Meeting. Indianapolis, Indiana, USA. 4-7 November
58. Sahour, H., **Sultan, M.**, Abdelmohsen, K., A., Karki, S., Gebremichael, E., Elbayoumi, T. 2018. Assessment of the spatio-temporal variations in groundwater storage using down-scaled GRACE data. In Geological Society of America, Annual meeting, Indianapolis, Indiana, USA. 4-7 November.
59. Pankratz, H. G., **Sultan, M.**, Alsefry, S., Fathy, K., Al-Harbi, H., Elkadiri, R., Emil, M., Gebremichael, E. 2017. Remote sensing and geophysical constraints on the distribution and deformation associated with salt dome intrusions along the southern Red Sea coastline, Saudi Arabia. In Geological Society of America, Annual Meeting, Seattle, Washington, USA.
60. Karki, S., **Sultan, M.**, Elkadiri, R., & Chouinard, K. 2017. Developing Predictive Models for Algal Bloom Occurrence and Identifying Factors Controlling their Occurrence in the Charlotte County and Surroundings. In American Geophysical Union, Fall Meeting, New Orleans, Louisiana, USA. 11-15 December
61. Sataer, G., **Sultan, M.**, Yellich, J. A., Becker, R., Emil, M. K., & Palaseanu, M. 2017. Shoreline Erosion and Slope Failure Detection over Southwest Lakeshore Michigan using Temporal

- Radar and Digital Elevation Model. In American Geophysical Union, Fall Meeting, New Orleans, Louisiana, USA. 11-15 December
62. Gebremichael, E., **Sultan, M.**, & Becker, R. 2017. Holocene Flexural Deformation over the Nile Delta: Evidence from Radar Interferometry. In American Geophysical Union, Fall Meeting, New Orleans, Louisiana, USA. 11-15 December
 63. Othman, A., **Sultan, M.**, Becker, R., Sefry, S., Alharbi, T., Alharbi, H., & Gebremichael, E. 2017. Groundwater-related Land Deformation over the Mega Aquifer System in Saudi Arabia: Inferences from InSAR, GRACE, Earthquake records, Field, and Spatial Data Analysis. In American Geophysical Union, Fall Meeting, New Orleans, Louisiana, USA. 11-15 December
 64. Emil, M. K., **Sultan, M.**, Abdellatif, B., Fathy, K., Sahour, H., Sataer, G., Karki, S., El Bastawesy, M., Metwaly, M. R. 2017. Temporal Analysis of Multi-sensor Data to Identify and Monitor Natural Groundwater Discharge in Arid Environments. In American Geophysical Union, Fall Meeting, New Orleans, Louisiana, USA. 11-15 December
 65. Fathy, K., **Sultan, M.**, Ahmed, M., Save, H., Emil, M. K., & Elkaliouby, B. 2017. Structural Control and Groundwater Flow in the Nubian Aquifer. In American Geophysical Union, Fall Meeting, New Orleans, Louisiana, USA. 11-15 December
 66. Sahour, H., **Sultan, M.**, Fathy, K., Yellich, J. A., Karki, S., & Wireman, M. 2017. Assessment of the Spatial and Temporal Variations in TWS and GWS in Michigan's Lower Peninsula and Identification of the Controlling Factors. In American Geophysical Union, Fall Meeting, New Orleans, Louisiana, USA. 11-15 December
 67. Abotalib, A.Z., **Sultan, M.**, Krishnamurthy, R.V., and Elkadiri, R., 2016, A reassessment of the Quaternary Paleoclimatic data from the Sahara, AGU, San Francisco, California, December, 2016.
 68. Ahmed, M., **Sultan, M.**, and El Bayoumi, T.M., 2016, Projecting Grace-derived terrestrial water storage (TWS) over the African watersheds, GSA, Denver CO, 2016.
 69. Ahmed, M., **Sultan, M.**, and Save, H., 2016, Developing sustainable management scenarios for Saharan and Arabian aquifer systems using GRACE data, AGU, San Francisco, California, December, 2016.
 70. Emil, M.K., **Sultan, M.**, Alharbi, T., Albassam, A.M., Chouinard, K., Abuabdullah, M.M., 2016, Nature, timing, and origin of wet climatic periods in Arabia from geochemical (stable isotopes, noble gas thermometry, geochronology) an geomorphological data, AGU, San Francisco, California, December, 2016.
 71. Fathy, K., **Sultan, M.**, Bettadpur, S.V., Save, H., Ahmed, M., Zahran, K.H., Emil, M.K., Helaly, A., Abotalib, A.Z., Isnail, A., 2016, Integration of satellite gravity data with ground-based geophysical data for a better understanding of the structural control of groundwater flow in the Nubian Sandstone Aquifer System, AGU, San Francisco, California, December, 2016.
 72. Gebremichael, E., **Sultan, M.**, Becker, R., El Bastawesy, M., Cherif, O., Emil, M., Ahmed, M., Fathy, K., Karki, S., 2016, Investigating the Origin of Natural and Anthropogenic Deformation across the Nile Delta Using Radar Interferometry, GRACE, Modeling, and Field data, AGU, San Francisco, California, December, 2016.
 73. Gebremichael, E., **Sultan, M.**, Becker, R., El Bastawesy, M., Cherif, O., Emil, M., 2016, Assessment of rates and factors causing subsidence across the Nile Delta from radar interferometric techniques, GSA Denver CO, 2016.
 74. Karki, S., **Sultan, M.**, Emil, M.K., Harbi, H., Sefry, S., Abuifadhael, E., Elkadiri, R., Chouinard, K., 2016, Development of Early Warning System using Temporal Radar Images for Debris Flows in Jazan Province, Saudi Arabia, AGU, San Francisco, California, December, 2016.
 75. Othman, A, **Sultan, M.**, Gebremichael, E., Sefry, S., Yanar, R., Alharbi, H., Albalawi, S., Emil, M.K., and Pankratz, H.G., Spatial and Temporal Characteristics of Land Deformation in Northern Saudi Arabia: Inferences from Radar Interferometric Applications, AGU, San Francisco, California, December, 2016.
 76. Pankratz, H.G., **Sultan, M.**, Fathy, K., Almogren, S.M., Harbi, H., Sefry, S., Emil, M., Elkadiri, R., Ahmed, M., Othman, A., Chouinard, K., 2016, Assessment of the extent of land deformation associated with salt domes within the Jazan City and surroundings, Saudi Arabia, AGU, San Francisco, California, December, 2016.
 77. **Sultan, M.**, Sturchio, N.C., Ahmed, M., Sefry, S., Mohamed, A., Abuabdullah, M.M., Emil, M.K., Bettadpur, S.V., Save, H., Fathy, K., and Chouinard, K., 2016, Assessment of the hydrologic

- setting and mass transport within Saharan and Arabian Aquifers using GRACE, geochemical, geophysical and subsurface data, AGU, San Francisco, California, December, 2016.
78. **Sultan, M.**, Ahmed, M., Sturchio, N., Al Sefry, S., Emil, M., Abuabdullah, M., and Othman, A.G., 2016, A geochemical, geophysical, and remote sensing-based approach for the assessment of the age, origin, and sustainable utilization of fossil aquifers in Saharan Africa and Arabia, GSA, Denver, CO, 2016.
 79. **Sultan, M.**, Becker, R., Gebremichael, E., Emil, M., Ahmed, M., Elkadiri, R., Pankratz, H., Chouinard, K., 2015, Applications of Radar Interferometric Techniques to Assess Natural Hazards and their Controlling Factors. AGU, San Francisco, California, December, 2015.
 80. Othman, A., **Sultan, M.**, Ahmed, M., Alharbi, T., Gebremichael, E., Emil, M., 2015, An Integrated Approach for the Assessment of the Natural and Anthropogenic Controls on Land Subsidence in the Kingdom of Saudi Arabia. AGU, San Francisco, California, December, 2015.
 81. Mohamed, L., **Sultan, M.**, Ahmed, M., Abotalib, A.Z., 2015, Fault zone hydrogeology of crystalline and sedimentary aquifers in arid regions: The case Sinai Peninsula, Egypt. AGU, San Francisco, California, December, 2015.
 82. Elkadiri, R., **Sultan, M.**, Elbayoumi, T., Chouinard, K., 2015, Forecasting Precipitation over the MENA Region: A Data Mining and Remote Sensing Based Approach. AGU, San Francisco, California, December, 2015.
 83. Pankratz, H., **Sultan, M.**, Elkadiri, R., Almogren, S., Gebremichael, E., Ahmed, M., Emil, M., 2015, Integrated Approach for the Assessment of Land Deformation in the Jazan City and Surroundings, Saudi Arabia. AGU, San Francisco, California, December, 2015.
 84. Ahmed, M., **Sultan, M.**, 2015. Monitoring temporal variations in water resources across the Arabian Peninsula and identification of their controlling factors. AGU, San Francisco, California, December, 2015.
 85. Abotalib, A.Z., **Sultan, M.**, Forman, S., Krishnamurthy, R.V. 2015, Origin, age, and paleoclimatic setting of the Late Quaternary deposits in Wadi Feiran, Sinai Peninsula: Geomorphologic, geochronologic, and isotopic constraints. AGU, San Francisco, California, December, 2015.
 86. Emil, M., **Sultan, M.**, Abotalib, A.Z. Abouelmagd, A., Ahmed, M., 2015, Timing and Nature of Wet Climatic Periods in North Africa and in the Arabian Peninsula: Inferences from Isotopic, Chronologic, and Remote sensing data. AGU, San Francisco, California, December, 2015.
 87. Mohamed, A., **Sultan, M.**, Yan, E., Ahmed, E., Sturchio, N., 2015, Towards a better understanding of the hydrologic setting of the nubian sandstone aquifer system: inferences from groundwater flow models, cl-36 ages, and grace data. AGU, San Francisco, California, December, 2015.
 88. Gebremichael, E., **Sultan, M.**, Becker, R., Emil, M., Ahmed, M., Chouinard, K., 2015, Use of Persistent Scatterer Interferometry to Assess Land Deformation in the Nile Delta and its Controlling Factors. AGU, San Francisco, California, December, 2015.
 89. **Sultan, M.**, Emil, M., Abotalib, Z.A., Abouelmagd, A., AlZahrani, A., Refai, A., AlQathamy, K., Alaamry, M., Bahamil, A., 2015. Nature and timing of the quaternary wet climatic periods in north africa and arabia: isotopic, chronologic, and remote sensing constraints. GSA, Baltimore, MY, 2015.
 90. Abotalib, Z.A., **Sultan, M.**, Elkadiri, R., Heggy, E., Saad, A., 2015, Origin of theater-headed valleys in the sahara: implication for outflow channels on Mars. GSA, Baltimore, MY, 2015.
 91. **Sultan, M.**, 2015, Egypt's Water Resources, Present and Future, 2015, 8th International Conference on the Geology of the Middle East, Ain Shams University, Cairo Egypt, March 29-30 2015.
 92. **Sultan, M.**, 2005, Use of GRACE data to monitor Saharan and Sub-Saharan hydrologic systems, 2015, Groundwater Regional Workshop, Tunis City Center, Tunisia, April 6-8, 2015.
 93. **Sultan, M.**, 2015, Integration of RS with traditional data sources and modelling to assess groundwater potential in arid terrains: Case studies from Egypt, 2015, Groundwater Regional Workshop, Tunis City Center, Tunisia, April 6-8, 2015.
 94. **Sultan, M.**, Ahmed, M., 2015, Use of GRACE and Land Surface Models to Monitor Water Availability in Central Asia and Surroundings, 2014, 4th International Seminar on Human Being and Ecological Environment of Central Asia, 2-6th February 2015, Xinjiang University, China.

95. Mohamed, A., **Sultan, M.**, Ahmed, M., Yan, E., 2014. Quantifying modern recharge to the Nubian Sandstone Aquifer System: inferences from GRACE and Land Surface Models. AGU, San Francisco, California, December, 2014.
96. Othman, A. **Sultan, M.**, Alharbi, H., Youssif, A., Ahmed, M., Emil, M., Zabramwi, Y., Alzahrani, S., Bahmil, A., Chouinard, K., 2014. Assessment of the nature, distribution and causes of land subsidence in Central and Northern Saudi Arabia. AGU, San Francisco, California, December, 2014.
97. Abouelmagd, A., McCabe, M., Castro, C., **Sultan, M.**, Jana, R., Al-Mashharawi, S., 2014, Recharge regimes of the Saq aquifer system, Saudi Arabia: Inferences from geochemical and isotopic compositions, AGU, San Francisco, California, December, 2014.
98. **Sultan, M.**, Ahmed, M., Yan, E., Milewski, A., Mohamed, L., Farag, A., 2014. Management of Egypt's Surface and Groundwater Resources: Present and Future. AGU, San Francisco, CA, December, 2014.
99. Emil, M., **Sultan, M.**, Ahmed, M., Chouinard, K., 2014. Understanding the paleohydrological setting of the Arabian Peninsula: An integrated approach. AGU, San Francisco, California, December, 2014.
100. Manche, C., **Sultan, M.**, El Kadiri, R., Uddin, S., Al-Dousari, A., Chouinard, K., 2014. Controls on Algal Bloom Propagation in the Kuwait Bay Utilizing: An Integrated Remote Sensing and Statistical Approach. AGU, San Francisco, California. Fall Meeting, December, 2014.
101. Alharbi, T., **Sultan, M.**, Ahmed, M., Chouinard, K., 2014. Assessment of climate vulnerabilities of the Arabian Peninsula. AGU, San Francisco, California, December, 2014.
102. Ahmed, M., **Sultan, M.**, Wahr, J., Yan, E., 2014. Monitoring natural and anthropogenic induced variations in water availability across Africa. AGU, San Francisco, California, December, 2014.
103. Abotalib, Z., **Sultan, M.**, El Kadiri, R., Abdelhalim, A., 2014. Did Groundwater Processes Shape the Saharan Landscape during the Previous Wet Periods? A Remote Sensing and Geostatistical Approach. AGU, San Francisco, California, December, 2014.
104. Mohamed, L., **Sultan, M.**, Abotalib, Z., 2014. Structural Control of Groundwater flow in The Sinai Peninsula: Integrated Studies. AGU, San Francisco, California, December, 2014.
105. Mohamed, A., **Sultan, M.**, Bakheit, A., Ezzat, A., Ahmed, M., Farag, a., 2014. Geophysical (global gravity field model) and field (well data) Constraints on Groundwater Flow in the Nubian Sandstone Aquifer in Egypt, Sudan, Libya, and Chad. GSA, Vancouver, BC, October 2014.
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Book Reviews

- Sultan, M.**, 1987, Review of *Remote Sensing Digital Image Analysis: An Introduction*: J.A., Richards, (1986), Springer Verlag: *Geology*, v. 15, pp. 985-986.
- Sultan, M.**, 1991, *The Geology of Egypt*. R. Said, (1991), A.A. Balkema, Rotterdam, *Episodes*, v. 14, no. 2, pp. 163-164.

Invited Talks (1998-present)

- EGU General Assembly 2023, Recharge from Reservoirs, Groundwater Flow, and Response to Climate Variability in Arid Basins: Revelations from GRACE Observations, Session: Hydrology, hydrometeorology and climate in drylands, April 23-28 2023, Vienna, Austria (**Keynote Speaker**).
- COP27, Sharm El Sheikh, Egypt, Response of Engineered and Non-Engineered Basins in Arid Settings to Climate Change, November 6-18, 2022
- COP27, Sharm El Sheikh, Egypt, Remote Sensing Solutions for Protecting Egypt's Coastal Areas and Heritage sites in the 21st Century, November 6-18, 2022
- Ain Shams College of Science Fifth Annual Scientific Conference, Remote Sensing Solutions for Protecting Egypt's Coastal Areas and Heritage sites in the 21st Century, November 15-18th 2022, Hurghada, Egypt (**Keynote Speaker**)
- Ain Shams University 10th Scientific Conference, Egypt's Water Resources: Challenges and Solutions, March 29-31, 2021, Ain Shams University, Cairo, Egypt (**Keynote Speaker**).
- Ain Shams College of Science Fourth Annual Scientific Conference, Monitoring Hydrologic Systems from Space: Case Studies from Africa and Arabia, November 16, 2021, Hurghada Egypt (**Keynote Speaker**)
- California State University, Fullerton, Integrated Remote Sensing Applications in Hydrology, October 2021
- 7th Arab Conference on Astronomy and Geophysics, Remote Sensing Investigations of the Hydrologic Systems of Africa and Arabia, October 11-14, 2021 (**Keynote Speaker**)
- 7th Arab Conference on Astronomy and Geophysics, Satellite-based investigations of the Artificial Reservoirs in the Nile Basin, October 11-14, 2021
- Ain Shams University, Dept. Geology, An Integrated Study of the Depletion, Replenishment, Response, and Optimum Utilization of the Nubian Aquifer System, March 2017
- National Authority for Remote Sensing and Space Sciences (NARSS), Egypt's Present and Future Water Resources: Inferences from Remote Sensing and Traditional Water Resources, March 2017
- Assessment of the hydrologic setting, longevity, and mass transport within Saharan and Arabian Aquifers using GRACE, geochemical, geophysical, and subsurface data, March 2017
- Geological Society America Annual Meeting, Remote Sensing Applications in Hydrology and Geology, Seattle, Washington, October 22-25, 2017
- Geological Society America Annual Meeting, Remote Sensing applications in hydrology and geology session, Seattle, Washington, Denver, VO, September 25-28, 2016.
- American Geophysical Union, 2016, session: Mass Transport and mass distribution in the Earth System;
- The University of Delaware, Department of Geological Sciences, (Departmental seminar) December 2015;
- Groundwater Regional Workshop, Tunis City Center, Tunisia, April 6th – 8th, 2015;
- 8th International Conference on the Geology of the Middle East, (**Keynote Speaker**), Ain Shams University, Cairo, Egypt, March 29th – 30th, 2015;
- Geological Society America Annual Meeting, Satellite Remote Sensing Applications in Hydrology and Geology session, Vancouver, Canada, October 19th -22nd, 2014;
- 4th International Seminar on Human Being and Ecological Environment of Central Asia, Xinjiang University, China, 2nd – 6th February 2015;
- King Abdullah University for Science and Technology (KAUST), Saudi Arabia, (Divisional seminar) January 2014;
- Workshop on the Red Sea, its origin, structure, and environment, Jeddah, Saudi Arabia, Saudi Geological Survey, Saudi Geological Survey, Jeddah, Kingdom Saudi Arabia, February 2nd – 5th, 2013;
- Tulane University Dept. of Earth and Environmental Sciences, (Departmental seminar), March 2013;

- The University of Huston, Dept. of Earth and Atmospheric Sciences (Departmental seminar), April 2013;
- Third Arab Conference in Astronomy and Geophysics, National Research Institute of Astronomy and Geophysics (NRIAG), Helwan Egypt, October 8th – 11th, 2012 (**Keynote Speaker**);
- Seventh International Symposium on Geophysics (ISG-7), Tanta, Egypt, April, 23rd – 24th, 2012 (**Keynote speaker**);
- International Conference for Water Resources & Environment (ICWRE), Marakech, Morocco, Nov 20th – 24th, 2011;
- Saudi Geological Survey, Jeddah, Kingdom of Saudi Arabia, (Divisional seminar), December 2011;
- St Louis University, Dept. of Earth and Atmospheric Sciences (Departmental seminar), April 2010;
- University Illinois, Chicago Dept. of Earth and Environmental Sciences (Departmental Seminar), March 2009;
- Northern Illinois University Dept. of Geography (Departmental seminar), March 2009;
- Workshop on Supercomputing Applications in Climate Sciences and Remote Sensing, Cairo, Egypt, May 14th. 2008;
- University Texas Dallas, Programs in Geosciences (departmental seminar), March 2008;
- University of Toledo, Dept. of Environmental Sciences (Departmental seminar), January 2008;
- GSA Annual Meeting, Denver, Colorado, October 2007;
- Saudi Geological Survey, Jeddah, Kingdom of Saudi Arabia, lecture series on the applications of geochemical and isotopic techniques in groundwater exploration (Divisional seminars), July 2007;
- Al Farabi University Dept. of Chemistry, Kazakhstan, lecture series on remote sensing solutions for environmental problems, (Departmental seminar), June 2007;
- Kuwait Institute for Scientific Research, Kuwait City, Kuwait, (Divisional seminar), 2006;
- US-Egypt Workshop: Water Resources and Environment Issues in Egypt, and Research Needs, Cairo, Egypt, December 2003;
- Buffalo Association of Professional Geologists, October 2003; University at Buffalo Departments of Geology, Geography, and Civil, Structure and Environmental Engineering, 2002 & 2003;
- Kuwait Institute for Scientific Research, Kuwait City, Kuwait, (Divisional seminar), March 2002;
- IGCP 430 2nd workshop, "Mantle responses to Tethyan closure," Halong Bay City, Vietnam, April 1st – 11th, 2002;
- Western Michigan University, Department of Geosciences, Kalamazoo, MI, (Departmental seminar) October 2001;
- University of Illinois at Chicago Department of Earth and Environmental Sciences (Departmental Seminar), February 2001;
- Miami University, Department of Geology and Environmental Earth Science, Ohio, (Departmental seminar), January 2000;
- IGCP 430 workshop "Mantle dynamics responses to the Africa-Eurasia collision," June 2000, Romania;
- Desert Research Institute, Divisional Seminar, May 2000;
- Idaho State University, Department of Geosciences, (Departmental seminar), March 2000; Third International Conference and Trade Fair on Environmental Management and Technologies, Cairo, Egypt, Nov 24th – 26th, 1999;
- Northern Illinois University, Department of Geography, (Departmental seminar) 1999;
- Fourth Conference on the Geology of the Arab World, Cairo University, Egypt, 1998; U.S. Egypt Workshop on Priorities of Desert Studies, Cairo, Egypt, February 1998.

Statement about Research (Research Interests)

The use of holistic and interdisciplinary approaches to characterizing and interpreting the Earth system and its component parts represents one of the most significant advances in Earth and Environmental Science in the past several decades. My research group applies an interdisciplinary research approach that takes advantage of the best available tools to address a wide range of timely and complex geologic and environmental problems. I believe that the adoption of interdisciplinary research approaches leads most directly to the resolution of complex geologic and environmental problems. This approach often

requires acquisition of considerable expertise in disciplines other than the area of one's own primary training, coupled with close interaction with specialists in other fields. I believe that an interdisciplinary researcher should spend his or her efforts to acquire adequate expertise in the various fields and disciplines that are appropriate for addressing the problem under investigation. This acquired multidisciplinary expertise advances collaborations on interdisciplinary projects in many ways. It provides the researcher with a comprehensive understanding of the capabilities and limitations of the various methodologies that are being applied by his co-workers, and it provides a common platform for interactions between researchers coming from different backgrounds. My publication and funding record covers a wide range of disciplines (remote sensing, GIS, hydrology, surface runoff and groundwater flow modeling, geophysics, geochemistry, geochronology and isotope geochemistry, tectonics, Precambrian geology, and Quaternary geology) and attests to the fact that I pursued an interdisciplinary research approach early in my career.

Locations of geographic interest include arid and semi-arid areas worldwide where demand for freshwater supplies is on the rise because of increasing populations and limited water supplies. The increasing demand on conventional freshwater supplies in Middle Eastern, Saharan, and the Arabian Peninsula countries could contribute to political instabilities and extreme stresses on the freshwater. Several of my ongoing and recently completed projects address the potential influences of natural processes, global change, and regional human activities on hydrologic systems and landforms. Under NSF funding, my collaborators and I developed and applied an integrated system approach to assess, monitor, and model the recent and future impacts of changes in the landscape and land cover associated with the major agricultural development projects in the Tigris-Euphrates watershed. Using NSF funding, we applied an interdisciplinary (geochemistry, hydrologic modeling) approach to examine the hydrologic and geomorphologic impacts of the Aswan High Dam. In the upstream, we are applying radar interferometric techniques to investigate the impacts of reduced river sediment load, now impounded behind the dam, on land subsidence in the Nile Delta. In the downstream, we constructed a calibrated hydrologic model that showed that increasing sediment thickness at the bottom of Lake Nasser reduces recharge to the underlying aquifer and promotes encroachment of rising Lake Nasser water onto surrounding lands. Using UNDP funding, we developed integrated cost-effective methodologies for the assessment and sustainable management of groundwater resources in arid lands using the Eastern Desert of Egypt as a test site. The success of our applications in the Eastern Desert of Egypt led to three new projects, a NATO-funded project in the Sinai Peninsula, a USAID-funded project in the Quetta region in Pakistan, and a Mojave water agency-funded project in the Lucerne Valley, in southwest USA, where the developed methodologies are being applied. For the latter project we are using hydrologic models, remote sensing, and geophysical methods to evaluate the role of the transcurrent fault systems in channeling groundwater from the mountains to the surrounding lowlands. In the Arabian Peninsula, we demonstrated (using isotopic, geochemical, remote sensing, and GIS) that the Empty Quarter aquifers were largely recharged by precipitation during previous wet climatic periods over the Red Sea Hills, yet are still receiving modern precipitation in the prevailing dry climatic periods such as those being witnessed nowadays.

One of the most exciting research areas that we are currently involved in is the applications of the Gravity Recovery and Climate Experiment (GRACE) temporal gravity data for the assessment of water storage variability in the Saharan and African aquifers and watersheds. Dr Sultan is a member of NASA's GRACE Science Team. Our research team has been funded over the past twelve years by NASA to pursue this research topic and our findings were published in *Geology*, *Earth Science Reviews*, *GSA Bulletin*, *Surveys in Geophysics*, and *Remote Sensing*. Results show that temporal and spatially smoothed (250 km; Gaussian) mass variations are largely controlled by elements of the hydrologic cycle such as runoff, infiltration, and groundwater flow, and that these mass variations are probably modulated, but not obscured by noise as previously thought. We used GRACE data to assess the nature and magnitude of recharge from the artificial lakes, namely Lake Nasser, on the recharge of the Nubian Sandstone fossil aquifer. We demonstrated that infiltration and groundwater flow is rapid along a network of karst and faults. We also showed that highly engineered watersheds such as the

Tigris Euphrates are best prepared to deal with climatic variabilities associated with global warming in the 21st century.

Another area of research that we acquired extensive expertise in is the application of radar interferometric techniques in monitoring land deformation caused by natural and anthropogenic factors. We applied those technologies over various settings including: (1) the Nile Delta and predicted subsiding areas that are susceptible to sea encroachment in the 21st Century, (2) uplift associated with the rise of a salt diapir in the Jazan city, Saudi Arabia, and (3) subsidence in central and northern Arabia related to groundwater extraction. The most significant application in this field is the development of a fully automated system for monitoring land deformation over the entire country of Qatar (<https://www.esrs.wmich.edu/webmap/qatar/>).

A comprehensive understanding of Earth systems sciences requires substantial integration among scientific disciplines in terms of concepts, understanding, skills, and problem-solving techniques. The scale of existing global geologic data sets, their extremely uneven documentation, and the relative scarcity of user-friendly access tools are major obstacles to interdisciplinary research. New approaches entail the application of GIS technologies on a global scale, to spatial-temporal integration, visualization, and analysis of geochemical, geophysical, remote sensing, and geodetic data sets. Applications of information technology in geosciences are not restricted to the compilation, visualization, and distribution of geologic data sets, but also in the use of these data sets to apply online dynamic models and simulations for various geologic processes. The application of web-based GIS technologies is especially advantageous in developing countries, where obtaining basic data sets that are relevant to geologic applications, such as digital topography, aerial photography, satellite data, and geologic maps, is often cost prohibitive. We expanded our expertise in the general area of geoinformatics and we are applying the acquired experience to address environmental and tectonic problems of interest. Using the Google Earth Interface, we have now developed a comprehensive web-based GIS (<http://www.esrs.wmich.edu/webmap/>) that encompasses all the databases we generated and the custom tools that we constructed throughout the years for the distribution, analysis, visualization, and modeling of accumulated data sets. Examples of these databases are the Egyptian database, Saudi database, African GRACE database, and the Mojave database.

We developed our research capabilities and expertise in the area of aquatic remote sensing, specifically in limnologic (inland or fresh water) and coastal remote sensing. To expand our research activities in this area, we established a direct downlink and processing system for remote sensing data. This system acquires and examines real-time data over the Great Lakes, where there is great interest, expertise, and ongoing research at UB. The system has been acquired, installed, and is currently fully operational. We have real-time access to the Advanced Very High Resolution Radiometer (AVHRR) L-band sensor data transmitted by National Oceanic and Atmospheric Administration (NOAA) satellites, as well as the Orbview-2 satellite that carries the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) instrument (<http://isis.geology.buffalo.edu/UB-receiving-Station-Lakes.htm>). Together with scientists from SUNY - College of Environmental Science and Forestry, SUNY - Univ. at Buffalo, SUNY Brockport, Univ. of Vermont, and Univ. of Tennessee we explored the utility of chlorophyll extraction techniques to map the spatial and temporal variations in algal blooms in Lake Erie and Lake Ontario with predictions from a hydrodynamic and particle tracking model to determine transport pathways. Using funding from the Kuwait Institute for Scientific Research (KISR), we developed statistical models to identify the factors that contribute the most to the propagation of algal blooms in the Kuwait Bay and surroundings. These include multivariate regression, hybrid multivariate regression, artificial neural network (ANN), and hybrid artificial neural network model. The ANN performance was found to be considerably better than all other techniques. Recently, we developed and applied a fully automated systems for harmful algal bloom prediction in South Florida.

All of the projects that are described above have one thing in common: they impact large sectors of the population in many ways. One research area that I would like to venture into is to complement our existing efforts by bringing on board expertise in the general area of Social Sciences. I can think of many ways in which such expertise can advance our ongoing research activities. One way would be to examine, assess, and model the impacts of our findings on impacted populations. For example, we could assess population migration patterns that are related to development of the major engineering projects in the Tigris Euphrates watershed. Social scientists could also provide guidelines as to how our methodologies and approaches can be optimized to factor in the social aspects that will eventually dictate whether our developed methodologies will be practical enough or appealing enough to be adopted/implemented. Breaching the gap between physical and social sciences is becoming more and more a necessity for the success of many of the applied projects today and many of the funding agencies are realizing the importance of such approach. Physical scientists from various disciplines have done quite well working together to address complex environmental problems. Such integrated research will benefit from expanding existing models to encompass social disciplines as well.