Mohamed I. Sultan

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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 – Depart. Geological and Environmental Sciences, Western Michigan University
2004-July 2020	Professor and Chair – Depart. 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 – Department of 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)
Adjunct Full Professor – Department of Geology, Ain Shams University, Cairo, Egypt (2000-present)
Fellow, McDonnell Center for the Space Sciences, Washington University, St. Louis, MO (1988-1996)

Current Support

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, Continues Monitoring of Land Deformation in Qatar: A Radar Interferometric Approach (Qatar Ministry of Municipality and Environment) (2019-2021)

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) (2019-2022).

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) (2017-2021).

Pending Support

Sultan, M., Principal Investigator, Integrated geophysical approach for sustainable agricultural development in Western Desert, Egypt (Society of Exploration Geophysicists: Geoscientists without borders program) (2021-2023)

Sultan, M., Principal Investigator, Investigating the interplay between tectonic, climatic, and anthropogenic forcings on landscape evolution and natural hazards in arid lands, NASA Earth Surface and Interior, (2022-2025)

Previous Support

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) (2011-2018).

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 – A remote sensing – based early warning system for algal blooms in Kuwait Bay and coastal waters (Kuwait Institute for Scientific Research) (2012-2014)

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; Total: $880,000; UB).

Sultan, M., Principal Investigator: A Web-Based GIS for Egypt's geological datasets (NSF) (2003-2007; Total: $59,736; WMU).

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; Total Budget: $602,058; U.S. allocation).

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)

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 form 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

Karem Abdelmohsen, 2020 (December 2020 – present) 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. 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
2. Elhebiry, M.S., **Sultan, M.,** Kehew, A.E., The Late Ordovician Arabian Ice Stream; Is it the largest? Science Advances (in review)
3. 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
4. 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.

5. Pankratz, H., **Sultan, M.,** Abdelmohsen, K., Sauck, W., Alsefry, S., Alharbi, H., Emil, M.K., Gebremichael, E., Asaeidi, 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
6. 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
7. 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
8. 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
9. 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
10. 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
11. **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
12. Abdelmohsen, K., **Sultan, M**., Ahmed, M., Save, H., Elkaliouby, B., Emil, M., Yan, E., Abotalib, A., Krishnamurthy, R.V., AbdeImalik, 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
13. 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
14. Elhebiry, M.S., **Sultan, M**., Kehew, A.E., Abu El-Leil, I., Bekiet,M.H., Soliman, N.M.A., Abdel Shahid, I., 2019, Ordovician Glaciation in NE Africa: Megalineations (MLs) and Glacial Deposits in the South Eastern Desert of Egypt, International Geology Reviews, 62:9, 1187-1204, DOI: 10.1080/00206814.2019.1636416
15. 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
16. 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
17. 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
18. 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
19. 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

20. 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
21. 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
22. 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
23. 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
24. Abotalib A.Z., Sultan, M., Elkadiria, R., 2016, Groundwater processes in Saharan Africa: Implications for landscape evolution in arid environments, Earth Science Reviews, v. 156, p. 108-136.
25. Ahmed, M., **Sultan, M.**, Yan, E. and Wahr, J., 2016, Assessing and improving Land Surface Models over Africa using GRACE and field data, Surveys in Geophysics, v. 37: p. 529–556, DOI 10.1007/s10712-016-9360-8.
26. Elkadiri, R., Manche, H**., Sultan, M**., Aldousari, A., Uddin, S., and Chouinard, K., 2016, Development of a coupled spatiotemporal algal bloom model for coastal areas: A remote sensing and data mining–based approach, IEEE Journal Selected Topics in Applied Earth Observations and Remote Sensing, DOI: 10.1109/JSTARS.2016.2555898.
27. Mohamed, L., **Sultan, M.,** Ahmed, M., Zaki, A., Sauck, W., Soliman, F., Yan, E., Elkadiri, R., Aboelmagd, A., 2015, Structural controls on groundwater flow in basement terrains: Geophysical, remote sensing, and field investigations in Sinai: Surveys in Geophysics, v. 36 (5), p. 717-742.
28. Ahmed, M., **Sultan, M**., Wahr, J., Yan, 2014, The use of GRACE data to monitor natural and anthropogenic induced variations in water availability across Africa, Earth Science Reviews, v. 136, p. 289-300.
29. Dailey, D., Sauck, W., **Sultan**, **M**., Milewski, A., Ahmed, M., Laton, R., Foster, J., Elkederi, R., Schmidt, C., Alharbi, T., 2014, Geophysical, remote sensing, GIS, and geochemical applications for a better understanding of the structural controls on groundwater flow in the Mojave Desert, California: Journal of Hydrology: Regional Studies, 3, 211-232.
30. Elkadiri, R., **Sultan, M.,** Youssef, A., Elbayoumi, T., Chase, R., Bujlkhi, and A., Bujlkhi, M.M., 2014, A Remote-Sensing-Based Approach for Debris-Flow Susceptibility Assessment Using Artificial Neural Networks and Logistic Regression Modeling, IEEE JSTARS, http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6875897.
31. **Sultan, M.,** Ahmed, M., Wahr, J., Yan, E., Emil, M., 2014, Monitoring Aquifer Depletion from Space: Case Studies from the Saharan and Arabian Aquifers, in Lakshmi, V., (Ed.), Remote Sensing of the Terrestrial Water Cycle, AGU Geophysical Monograph # 206, p. 349-366.
32. **Sultan, M.,** Sefry, S., AbuAbdallah, 2014, Impacts of Climate Change on the Red Sea Region and its Watersheds, Saudi Arabia, IN Rasul, N.M.A, and Stewart, I.C.F. (Eds.), The Red Sea: The Formation, Morphology, Oceanography and Environment of a Young Ocean Basin,), Springer Earth System Sciences, ISBN: 978-3-662-45200-4.
33. Zaki, A., **Sultan, M.,** and Elkadiri, R., 2014, Comment on: Polygonal faults in chalk: Insights from extensive exposures of the Khoman Formation, Western Desert, Egypt, Geology, July 2014, v.42, p. 342.
34. Ahmed, M., Sauck, W., **Sultan, M.,** Yan, E., Soliman, F., Rashed, M., 2013, Geophysical Constraints on the Hydrogeologic and Structural Settings of the Gulf of Suez Rift–Related Basins: Case Study from the El Qaa Plain, Sinai, Egypt: Surveys in Geophysics, v. 35, p. 415–430.

35. Abouelmagd, A., **Sultan, M.,** Sturchio, N., Soliman, F., Rashed, M., Ahmed, M., Kehew, A., Milewski, A., Chouinard, K., 2013. Paleoclimate record in the Nubian Sandstone Aquifer, Sinai Peninsula, Egypt. Quaternary Research, v. 81, p. 158-167.
36. Alharbi, T., **Sultan, M.,** Sefry, S., El Kadiri, R., Ahmed, M., Chase, R., Milewski, A., AbuAbdallah, M., Emil, M., Chounaird, K., 2013, An assessment of landslide distribution in the Fifa area, Saudi Arabia, using remote sensing and GIS techniques: Natural Hazards and Earth System Sciences Discussion, v.1, p. 6685-6717.
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Abstracts for Presentations (talks/posters) at Professional Meetings

1. 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
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3. 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, 2019American Geophysical Union, Fall Meeting, San Francisco, 9-13 December
4. 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
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10. 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
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Invited Talks (1998-present)

- 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;
- 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;
- 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 seies 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 African watersheds. Our research team has been funded over the past six years by NASA to pursue this research topic and our findings were published in Geology and in Earth

Science Reviews. 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. If true, our findings suggest that: (1) it is possible to use GRACE to investigate temporal local responses of a much larger suite of (smaller) hydrologic systems (watersheds, lakes, rivers, marshes, etc.) and domains (e.g., source areas, lowlands) within watersheds and sub-basins world-wide, and (2) GRACE data could potentially be used to calibrate land surface models that are being used to drive climatic models and thus provide confidence in the results (e.g., climatic projections) obtained by such models.

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.

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.

Relevant Teaching Experience at Western Michigan University

GEOS 5210: Remote sensing applications in geological and environmental sciences

Credits: 3 hours

Course Description

The course provides rigorous hands-on-exercises on the applications of remote sensing techniques in geological and in environmental sciences (70% of student effort). The hands-on exercises are primarily based on data from case studies (most of which was published in peer-reviewed articles) and data collected by the students using hand-held VNIR spectro-radiometer. In the process of solving the lab exercise, the students will master image processing techniques (e.g., radiometric and geometric enhancement, image classifications, etc.). The course will cover (30% of student effort) the fundamentals of remote sensing as well, since the students cannot start dealing with applications unless they understand the fundamentals. Examples of these applications include:

Compositional and structural mapping with Landsat thematic mapper data Using field data (e.g., sample location), petrographic data (modal abundances), hand-held spectral data, students will develop methodologies to extract compositional (lithologic) and structural information from Landsat thematic mapper data, and produce a geologic map (composition and structure) for study areas (test site).

Large-scale correlations from space-borne observations Africa (Nubia) and Arabia remained contiguous until about 25 Ma, when the Red Sea started opening and the once contiguous shields (Arabian and Nubian shields) started drifting apart. The students will conduct large-scale correlations of lithologies and structures across the Red Sea using processed satellite images to identify the relative orientation of the Arabian and Nubian Shields prior to Red Sea opening. Students will use their findings to constrain the geologic history of the Shields and the mechanics of the Red Sea rifting.

Monitoring the spatial and temporal distribution of algal blooms in Lake Erie, Lake Ontario and over coastal areas in southwest Florida using real-time remote sensing data (MODIS). The students will develop methods to respond to major coastal resource or public health impacts associated with harmful algae blooms (HABs) and will investigate the driving forces for the propagation of these blooms. The students will be analyzing space-borne remote sensing data to study algal blooms, specifically the visible and near-infrared spectral bands. The identification of algal blooms from space-borne observations by the students will be enabled because of the: (1) distinct spectral signature of the algal bloom compared to that of the surrounding water; and (2) large spectral variations over an area within a short interval arising from the explosion in algal population. With the deployment of MODIS, the students can analyze multiple images over the study area per day and hence have a better chance of seeing the bloom in days of high cloud cover.

Assessment, monitoring, and modeling of changes in land use and land cover and their impacts on the water cycle The students will be developing and applying an integrated systems approach (involving remote sensing, geochemical, and hydrologic modeling) to assess, monitor, and model the recent and future impacts of changes in the landscape and land cover associated with major agricultural development projects (e.g., dams, irrigation canals) that affect the water resources of the underlying groundwater aquifers and the existing fresh water ecosystems.

Assessment of renewable water resources The students conduct comprehensive studies to develop, validate, and demonstrate techniques to evaluate the extent of alternative renewable water resources arising from sporadic precipitation over large watersheds. In this exercise the students extract digital elevation models (DEM) from pairs of ASTER scenes, delineate drainage patterns and watershed boundaries from the DEMs, evaluate precipitation over the delineated watersheds using TRMM data, and conduct surface runoff modeling to compute initial losses, surface runoff, and recharge.

Soil settling in Amherst city NY, using radar interferometry Over the past decade, structural damage due to foundation problems has been reported for approximately 500 buildings in the town of Amherst . It has been suggested that the foundation problems are most likely related to soil settling due to dewatering of clay. The extent of this problem is not yet understood. The students will evaluate the extent of this problem using radar interferometry techniques. They will calculate the interference pattern caused by the difference in phase between two images acquired by the space-borne synthetic aperture radar at two distinct times.

Fundamentals covered in the course include:

History and scope of remote sensing: Concept of remote sensing, geophysical remote sensing, milestones. Electromagnetic radiations: Wave model of electromagnetic energy, matter interaction with atmosphere, matter interaction with terrain, radiance and hemispherical reflectance, absorptance, and transmittance Spectroscopy of rocks and minerals and principles of spectroscopy: Causes of absorption, electronic processes, vibrational processes, spectra of miscellaneous minerals and rocks, scattering processes Multispectral and hyperspectral remote sensing: Landsat System, Spot, ASTER, IKONOS, AVHRR, SeaWifs, MISR, Hyperion Active Microwave and Lidar: Geometry of radar image, wavelength, penetration, polarization, SAR, RADARSAT, radar interferometry, LIDAR sensor system, Canopy penetration Thermal infrared radiation: thermal infrared radiation properties, thermal radiation laws, thermal properties of a terrain.