

United Nations Educational, Scientific and Cultural Organization



Intergovernmental

Hydrological

Programme

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UNESCO Land Subsidence International Initiative

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New Literature

Dead Sea

Vey, S., Al-Halbouni, et al., Delayed subsidence of the Dead Sea shore due to hydro-meteorological changes. Sci Rep 11, 13518 (2021). <u>https://doi.org/10.1038/s41598-021-91949-y</u>

With Pietro as one of the co-authors.

Global analysis



https://presentations.copernicus.org/EGU21/EGU21-14985_presentation.pdf

Monitoring

Hooijer, A., Vernimmen, R. Global LiDAR land elevation data reveal greatest sea-level rise vulnerability in the tropics. Nat Commun 12, 3592 (2021). <u>https://doi.org/10.1038/s41467-021-23810-9</u>

Jakarta, Manilla, Singapore

Rapti Siriwardane-de Zoysa et al.,

The 'wickedness' of governing land subsidence: Policy perspectives from urban Southeast Asia.

Indonesia, Semarang

Muchi Juma Ameir et al., Cultural Capital of a community to adapt in prone areas with floods, land subsidence and its Architectural representation. Case Study in Bandarharjo Semarang

https://jurnal.unmer.ac.id/index.php/lw/article/view/3704/pdf

Iran, General

Roohollah Noori et al.,

Anthropogenic depletion of Iran's aquifers.

PNAS June 22, 2021 118 (25) e2024221118; https://doi.org/10.1073/pnas.2024221118

Iran, Ahvaz Subway

Lotfeali Ayeneh et al., Evaluation of geological hazard of the subway (case study: Ahvaz subway, southwest of Iran). Int. J. Environ. Sci. Technol. (2021). <u>https://doi.org/10.1007/s13762-021-03427-7</u>

Iran, Rafsanjan Plain

Elham Rafiei Sardooi et al., (2021) Comparison of statistical and machine learning approaches in land subsidence modelling, Geocarto International,

https://doi.org/10.1080/10106049.2021.1933211

Iran, Tabriz

Bakhtiar Feizizadeh, Davoud Omarzadeh, Zahra Ronagh, Ayyoob Sharifi, Thomas Blaschke, Tobia Lakes,

A scenario-based approach for urban water management in the context of the COVID-19 pandemic and a case study for the Tabriz metropolitan area, Iran,

Science of The Total Environment, Volume 790, 2021, 148272, ISSN 0048-9697,

https://doi.org/10.1016/j.scitotenv.2021.148272.

(https://www.sciencedirect.com/science/article/pii/S004896972103343X)

Abstract: The world's poorest countries were hit hardest by COVID-19 due to their limited capacities to combat the pandemic. The urban water supply and water consumption are affected by the pandemic because it intensified the existing deficits in the urban water supply and sanitation services. In this study, we develop an integrated spatial analysis approach to investigate the impacts of COVID-19 on multi-dimensional Urban Water Consumption Patterns (UWCPs) with the aim of

forecasting the water demand. We selected the Tabriz metropolitan area as a case study area and applied an integrated approach of GIS spatial analysis and regression-based autocorrelation assessment to develop the UWCPs for 2018, 2019 and 2020. We then employed GIS-based multicriteria decision analysis and a CA-Markov model to analyze the water demand under the impacts of COVID-19 and to forecast the UWCPs for 2021, 2022 and 2023. In addition, we tested the spatial uncertainty of the prediction maps using the Dempster Shafer Theory. The results show that the domestic water consumption increased by 17.57% during the year 2020 as a result of the COVID-19 pandemic. The maximum increase in water consumption was observed in spring 2020 (April–June) when strict guarantine regulations were in place. Based on our results, the annual water deficit in Tabriz has increased from ~18% to about 30% in 2020. In addition, our projections show that this may further increase to about 40–45% in 2021. Relevant stakeholders can use the findings to develop evidence-informed strategies for sustainable water resource management in the post-COVID era. This research also makes other significant contributions. From the environmental perspective, since COVID-19 has affected resource management in many parts of the world, the proposed method can be applied to similar contexts to mitigate the adverse impacts and developed better informed recovery plans.

Iran, Tehran

Yousefi, R., Talebbeydokhti, N. Subsidence monitoring by integration of time series analysis from different SAR images and impact assessment of stress and aquitard thickness on subsidence in Tehran, Iran. Environ Earth Sci 80, 418 (2021). <u>https://doi.org/10.1007/s12665-021-09714-3</u>

Mexico, Mexico City



https://presentations.copernicus.org/EGU21/EGU21-15723_presentation.pdf

Although a little bit late (this article was already published in 2020, but escaped from my attention) Agnieszka and others published:

Malinowska, A.A.; et al., Satellite-Based Monitoring and Modeling of Ground Movements Caused by Water Rebound. Remote Sens. 2020, 12, 1786. <u>https://doi.org/10.3390/rs12111786</u>

PR China, Shaanxi Province

Chen, J.; Zhou, Y.; Chen, G.; Hao, M. Decades of Ground Deformation in the Weihe Graben, Shaanxi Province, China, in Response to Various Land Processes, Observed by Radar Interferometry and Levelling. Remote Sens. 2021, 13, 2374. <u>https://doi.org/10.3390/rs13122374</u>

PR China, Shanghai

Yu, Q. et al., A Spatial-Scale Evaluation of Soil Consolidation Concerning Land Subsidence and Integrated Mechanism Analysis at Macro-, and Micro-Scale: A Case Study in Chongming East Shoal Reclamation Area, Shanghai, China. Remote Sens. 2021, 13, 2418. https://doi.org/10.3390/rs13122418

PR China, Shenzen

He, Y.; Xu, G.; Kaufmann, H.; Wang, J.; Ma, H.; Liu, T. Integration of InSAR and LiDAR Technologies for a Detailed Urban Subsidence and Hazard Assessment in Shenzhen, China. Remote Sens. 2021, 13, 2366. <u>https://doi.org/10.3390/rs13122366</u>

Taiwan, Choshui River alluvial fan

Hone-Jay Chu et al., (with Thomas Burbey as co-author)

Development of spatially varying groundwater-drawdown functions for land subsidence estimation,

Journal of Hydrology: Regional Studies, Volume 35, 2021, 100808, ISSN 2214-5818, https://doi.org/10.1016/j.ejrh.2021.100808.

(https://www.sciencedirect.com/science/article/pii/S2214581821000379)

Study region

Choshui River alluvial fan, Taiwan.

Study focus

Land subsidence caused by groundwater overexploitation is a critical global problem. The spatial distribution of land subsidence is crucial for effective environmental management and land planning in subsidence prone areas. Because of the nonlinear relationship between subsidence and drawdown due to groundwater exploitation in heterogeneous aquifers, a spatial regression (SR) model is developed to effectively estimate nonlinear and spatially varying land subsidence. Considering various data inputs in the Choshui River alluvial fan, the SR model offers a robust method for accurately estimating the spatial patterns of subsidence using only drawdown as input data.

New hydrological insights for the region

Without requiring extensive calibration or an elaborate numerical groundwater flow and subsidence model, the model provides annual subsidence patterns using a spatially varying relationship between drawdown and resulting land subsidence. Results show that the largest water-level cone of depression occurs in the distal fan area. Nonetheless, the calculated subsidence bowl closely

approximates the observed one located much farther inland. The root-mean-square-errors (RMSEs) of annual subsidence is less or equal to 0.76 cm for the SR. Results indicate that the SR model reasonably estimates the spatial distribution of the skeletal storage coefficient in the aquifer system. The large coefficient that represents high potential of inelastic compaction occurs in the southern inland area, whereas the small coefficient that represents elastic compaction occurs in the northern area and proximal fan. Furthermore, this method can be used efficiently for subsidence management/ regulation and might be widely used for subsidence estimation solely based on drawdown.

Thailand, Bangkok

This study is about the influence of increasing groundwater levels on the bearing capacity of pile foundations:

Phoban, H. et al., Numerical Modeling of Single Pile Behaviors Due to Groundwater Level Rising.

Appl. Sci. 2021, 11, 5782. https://doi.org/10.3390/app11135782

USA, California

Quinn, N.W.T.; Oster, J.D. Innovations in Sustainable Groundwater and Salinity Management in California's San Joaquin Valley. Sustainability 2021, 13, 6658. <u>https://doi.org/10.3390/su13126658</u>

USA, Louisiana

Olson, K. and Suski, C. (2021) Mississippi River Delta: Land Subsidence and Coastal Erosion. Open Journal of Soil Science, 11, 139-163. doi: 10.4236/ojss.2021.113008.

https://www.scirp.org/journal/paperinformation.aspx?paperid=107757

Maps

New maps of foundation risk at neighbourhood level in the Climate Impact Atlas <u>https://www.preventionweb.net/news/view/78698</u>



An example of a foundation risk map in the Climate Impact Atlas. The maps are intended primarily to help municipal authorities to conduct climate stress tests

From the Press

Peatlands and climate change: from threat to cure

https://www.innovationnewsnetwork.com/peatlands-and-climate-change-from-threat-tocure/12156/



Fig 2: Global distribution of peatlands (Creator: Levi Westerveld, 2017; https://www.grida.no/)

Asia

Asian, tropical coastlines most vulnerable to rising seas - study

https://www.reuters.com/article/global-climate-coastlines-idAFL3N2OB2OS

Indonesia

Oil Palm Expansion in Indonesia Risks Peatlands and Livelihoods

https://www.hrw.org/report/2021/06/03/why-our-land/oil-palm-expansion-indonesia-risks-peatlands-and-livelihoods

Indonesia, Jakarta

Hiroshi Takagi et al.,

People's perception of land subsidence, floods, and their connection: A note based on recent surveys in a sinking coastal community in Jakarta,

Ocean & Coastal Management, Volume 211, 2021, 105753, ISSN 0964-5691,

https://doi.org/10.1016/j.ocecoaman.2021.105753.

(https://www.sciencedirect.com/science/article/pii/S0964569121002362)

Abstract: Land subsidence has triggered severe coastal floods in Jakarta, whose mechanism has been extensively investigated by researchers and engineers. The government has also recognized this fact, which has partially contributed to the recent announcement that the capital will be relocated to East Kalimantan. However, it is not clear whether ordinary people perceive the progress of land subsidence as their own issue. To ascertain this, a field survey was conducted after a major coastal flood that took place in December 2017, which revealed that nearly half of the people living in a rapidly sinking coastal community were not aware of the ongoing land subsidence under their own houses. Severe flood and land subsidence were not strongly recognized as interlinked problems by local citizens. Rain-induced flooding is common in the community, and this may explain why a quarter of respondents did not fear the 2017 coastal flood, despite their houses being flooded, in some cases to a depth above their heads. Land subsidence has an adverse effect on flooding. Awareness building programs for normal citizens should be promoted, in order to articulate the significance of stopping groundwater extraction for mitigating land subsidence and the flooding it induces.

Indonesia, Semarang

Indonesians pay high price to shield homes from rising sea levels



Bamboo sticks and nets are used as barriers at Tambakrejo village, which is affected by rising sea 1/2 level and land subsidence, in Semarang, central Java in Indonesia. (Reuters)

https://www.arabnews.com/node/1592231/world

Malaysia, Penang

Groundwater extraction unsuitable for Penang: PBAPP

Island's small landmass, residential density make it impractical, says Penang Water Supply Corporation

https://www.thevibes.com/articles/news/31049/groundwater-extraction-unsuitable-for-penangpbapp

Poland, North-Central Poland

H. Rajaoalison and D. Knez

Current trends in land subsidence of the North-Central part of Poland using DInSAR technique

https://doi.org/10.1051/e3sconf/202126603006

PR China, Hongkong

Land subsidence occurs at Kai Tak Cruise Terminal.

https://www.dimsumdaily.hk/land-subsidence-occurs-at-kai-tak-cruise-terminal/

Southeast Asia,

The 'wickedness' of governing land subsidence: Policy perspectives from urban Southeast Asia

Rapti Siriwardane-de Zoysa et al.,

https://doi.org/10.1371/journal.pone.0250208

Taiwan, Choushui Alluvial Fan

Kelvin collaborated in following:

Yi-An Chen et al.,

Space-Time Evolutions of Land Subsidence in the Choushui River Alluvial Fan (Taiwan) from Multiple-Sensor Observations

Remote Sens. 2021, 13(12), 2281; https://doi.org/10.3390/rs13122281

https://www.mdpi.com/2072-4292/13/12/2281

USA, Florida

FIU experts available to discuss Surfside building collapse.

https://news.fiu.edu/2021/fiu-engineering-professor-available-to-discuss-surfside-buildingcollapse?utm_source=main&utm_medium=feed&utm_campaign=newsroomreferrals&utm_term=homepage

FIU professor: Collapsed Surfside building showed signs of subsidence in '90s

https://news.fiu.edu/2021/fiu-professor-collapsed-surfside-building-showed-signs-of-subsidence-in-90s-era-space-radar-data

USA, Texas

Phase 2 of subsidence study in Montgomery County underway

https://communityimpact.com/houston/conroe-montgomery/environment/2021/06/15/phase-2-of-subsidence-study-in-montgomery-county-underway/

USA, Virginia

Help Shape Priorities for Virginia Beach Flood Protection Program

Complete the PublicInput.com survey by June 27.

Virginia Beach is a low-lying community (no more than a dozen feet above sea level at our "highest" points) surrounded by water — the Lynnhaven River, the North Landing River, the Chesapeake Bay, Back Bay, countless lakes, canals and streams and, of course, the Atlantic Ocean. Scientists are predicting more intense storms more often and this, combined with sea level rise and land subsidence (the gradual sinking of an area of land), creates the potential for increasing threats to coastal cities like Virginia Beach.

Virginia Beach's Stormwater Engineering Center has been working on a variety of ways to mitigate this problem, and the City Council is considering putting a bond referendum on the fall ballot to help fund a broader strategy with more aggressive timelines for implementing projects than what the current stormwater fees can support. To help guide how the City should move forward and determine the best mix of funding and projects, the City is asking residents to complete a survey at <u>publicinput.com/FloodProtection</u>. Residents are encouraged to provide their thoughts about a



range of topics, from existing and proposed flood protection initiatives and funding options to general knowledge questions. Incorporating citizen feedback into the planning is key for staff who are developing the overall plan.

The survey will be open for responses through Sunday, June 27.

https://www.vbgov.com/government/departments/communications-office/citypage/Pages/Flood-Survey.aspx

Vietnam, Ho Chi Minh City

HCM City restricts use of groundwater, provides more clean water for residents

https://vietnamnews.vn/society/972330/hcm-city-restricts-use-of-groundwater-provides-moreclean-water-for-residents.html

Mining

Jiaqi Jin, Chicheng Yan, Yixuan Tang, Yilong Yin, "Mine Geological Environment Monitoring and Risk Assessment in Arid and Semiarid Areas", Complexity, vol. 2021, Article ID 3896130, 10 pages, 2021. https://doi.org/10.1155/2021/3896130

Brazil

Mahdi Motagh reported following:

Below is a short report that was just appeared in Guardian regarding our latest publication for subsidence analysis in Brazil

https://www.theguardian.com/science/2021/jun/02/terrawatch-a-saltmine-and-a-sinking-city-inbrazil

Germany

Mahdi also collected a few reports regarding another work that was recently published for mininginduced subsidence in Germany; most of the them are in German; We were happy that the story went to Frankfurter Allgemeine, which is widely read in Germany. He was reached even by local people who invited him to the site to show how their properties were affected by subsidence.

- 1. "Wenn der Boden unter den Füßen absackt", Frankfurter Allgemeine, <u>https://www.faz.net/aktuell/wissen/erde-klima/instabiler-tagbau-wenn-der-boden-im-</u> <u>rheinischen-braunkohlerevier-absackt-17056029.html</u>
- 2. "Risiken sind besser einzuschätzen", Kölner Stadt-Anzeiger, <u>https://www.ksta.de/html/dumont-</u> <u>consent/index.html?param=eyJyZWRpcmVjdFVybCl6li9yZWdpb24vcmhlaW4tZXJmdC9pbnRl</u> <u>cnZpZXctenVtLXRhZ2ViYXUtLWR1cmNoLWRpZS1zYXRlbGxpdGVuZGF0ZW4ta29lbm5lbi11bm</u> dsdWVja2UtdmVybWllZGVuLXdlcmRlbi0tMzc2Mjl4MTA/Y2I9MTYxNTc0ODQ3MD
- 3. "Tagebau Hambach Forscher machen beunruhigende Entdeckung auf Satellitenfotos", EXPRESS, <u>https://www.express.de/nrw/tagebau-hambach-forscher-machen-beunruhigende-entdeckung-auf-satellitenfotos-37584246?cb=1615748697083</u>
- 4. "Durch die Satellitendaten können Unglücke vermieden werden", Kölnische Rundschau

a. <u>https://www.rundschau-online.de/region/rhein-erft/interview-zum-tagebau--durch-die-</u> satellitendaten-koennen-ungluecke-vermieden-werden--37622810?cb=1615838490405

5. "Better monitoring for open-cast mines", PHYSORG, <u>https://phys.org/news/2020-11-open-cast.html</u>

6. A New Method to Monitor Soil Stability at Open-cast Mines From Space, Aggregates and Mining Today,

https://cc.bingj.com/cache.aspx?q=hambach+subsidence+motagh&d=4563394342490798&mkt= de-DE&setlang=en-US&w=oY_f2MICMuEbMToIkrJ08YHunvD6NB-U

Poland, Legnica

Tracking Deformation Processes at the Legnica Glogow Copper District (Poland) by Satellite InSAR—II: Żelazny Most Tailings Dam

by Paolo Mazzanti, Paolo Benedetta Antonielli, Alessandra Sciortino, Stefano Scancella and Francesca Bozzano Land 2021, 10(6), 654; https://doi.org/10.3390/land10060654 - 18 Jun 2021

Abstract The failures of tailings dams have a major negative impact on the economy, surrounding properties, and people's lives, and therefore the monitoring of these facilities is crucial to mitigate the risk of failure, but this can be challenging due to their size and [...] Read more. (This article belongs to the Special Issue Geomatics for Resource Monitoring and Management)

https://www.mdpi.com/journal/land

Presentations

Denmark

A twelve minutes during presentation: Impacts of land subsidence and subsurface properties on water management

https://www.youtube.com/watch?v=gogAs5xt2pY&ab_channel=GeopartnerLandinspekt%C3%B8rer

Vietnam, Ho Chi Minh City

HCM City restricts use of groundwater, provides more clean water for residents

https://vietnamnews.vn/society/972330/hcm-city-restricts-use-of-groundwater-provides-moreclean-water-for-residents.html