United Nations Educational, Scientific and Cultural Organization

Intergovernmental Hydrological Programme

UNESCO Land Subsidence International Initiative

Newsletter of the Unesco Land Subsidence International Initiative

Vol.9 December 2020

First of all: a Happy New Year to Everyone, we hope and wish that we can meet another this year and wish all Happiness and Good Health.

Publication in Science

We are happy to announce a publication in Science that was realized by the Spanish group under the lead of *Gerardo Herrera,* member of UNESCO LaSII. A large group, mainly members and observers of LaSII have contributed to this publication and the world map. This is a real a great achievement. Congratulations.

The link to the publication is not yet available in good order but we have already access to the world map that shows vulnerability to land subsidence on a real small scale.

The publication was also positively received by the press: herewith a number of links. (Some of them were send to us by Michelle)

https://science.sciencemag.org/content/371/6524/34?rss=1

Gives access to a summary of the publication.

The Hindu Business Line: https://www.thehindubusinessline.com/economy/land-subsidence-may-impact-19-of-global-population-by-2040-study/article33471558.ece

Mail Online (UK, Daily Mail): https://www.dailymail.co.uk/sciencetech/article-9102853/Subsidence-FIFTH-worlds-population-affected-sinking-land-2040.html

The Guardian: https://www.theguardian.com/world/2020/dec/31/land-subsidence-will-affect-almost-fifth-of-global-population

The Tribune (India): https://www.tribuneindia.com/news/science%20technology/sinking-land-will-affect-635-million-people-globally-report-192314

Pehal News (India): https://www.pehalnews.in/land-subsidence-will-affect-almost-fifth-of-global-population/409704/

International Business Times: https://www.ibtimes.co.in/environmentalists-seek-attention-sinking-earths-surface-new-year-begins-831694

Course

Online Course on Remote-Sensing Applications in Groundwater Extraction Measurements by NIT Srinagar [Jan 11-16]: Register by Jan 8

https://www.noticebard.com/course-remote-sensing-applications-groundwater-extraction-measurements/

Measuring, Modelling and Projecting

Philip Minderhoud was so kind to attend send me the following paper, which was published in Nature Reviews Earth & Environment

Manoochehr Shirzaei et al.,

Measuring, modelling and projecting coastal land subsidence

Both Philip and Devin Galloway, our former chair were co-authors.

The following link gives access to the full text:

rdcu.be/cbYRl

Monitoring

From Shujun we received following interesting short report, written by Dr. Kai Gu of the Nanjing University:

Multifield monitoring using fiber optics in vertical boreholes

Kai Gu

School of Earth Sciences and Engineering, Nanjing University

Vertical boreholes are very common in geology survey. While most of boreholes are abandoned after short services, the application of fiber optic sensing technology revitalize the utilization of boreholes.

Shallow geothermal energy---- Accurate estimation of thermal ground properties plays a key role in the fields of shallow geothermal energy, geological disaster prevention, geological engineering, geotechnical engineering, hydraulic engineering, hydrology, and water resources management. A special challenge is posed by the often significant heterogeneity and variability of the geological

media at a site. An innovative investigation method so-called actively heated fiber optics based thermal response test (ATRT) has been developed for the in-situ thermal conductivity coefficient evaluation by Dr. Kai Gu and his group in Nanjing University, China. In vertical boreholes, a type of copper mesh heated optical cable (CMHC), which both serves as a heating source and a temperature sensing cable, was applied (Figure 1). By inducing the electric current to the cable at a relatively low power of 26 W/m, the in-situ heating process was recorded at high depth resolution. This information serves to infer the thermal conductivity distribution along the borehole. Field application has indicated that this novel method can provide a reliable thermal conductivity distribution along the borehole but with lower energy cost and a shorter test time than reported for related field methods. This offers a more efficient thermal property evaluation in the field, both technically and economically. The article about this research has been published in ***Renewable and Sustainable Energy Reviews*** (https://doi.org/10.1016/j.rser.2020.110336).

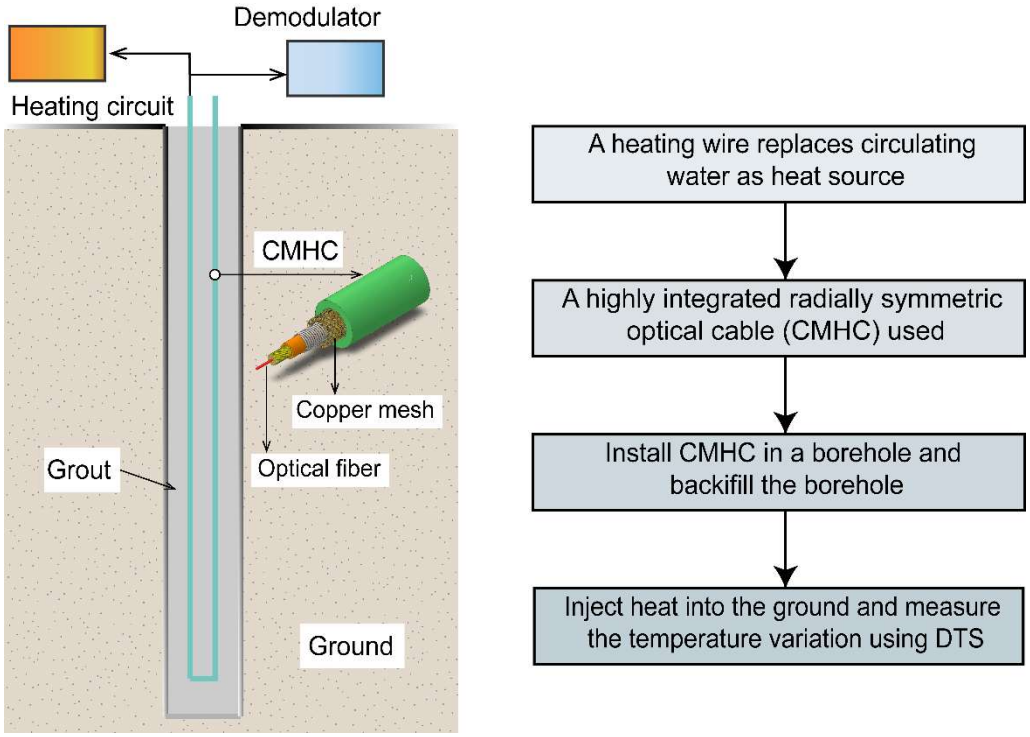


Figure 1 The setup of actively heated fiber optics based thermal response test.

Land subsidence----It is notable that vertical boreholes installed with fiber optics have also been used to obtained the subsurface deformation. Dr. Gu and his group developed a novel and promising method for land subsidence monitoring using distributed fiber optic sensing techniques, so called *Borehole Full Section Monitoring Method using DFOS* (Figure 2). DFOS techniques offer continuous monitoring of subsurface deformation both in space and time and therefore provide rich details on the subsidence process, meaning that the deformation distribution along the entire borehole can be obtained. This provides a very useful tool for the land subsidence monitoring and is of great significance for the mitigation and control of land subsidence, the policy making and eventually the sustainable development of cities that suffering subsidence. (https://doi.org/10.5194/piahs-382-95-2020)

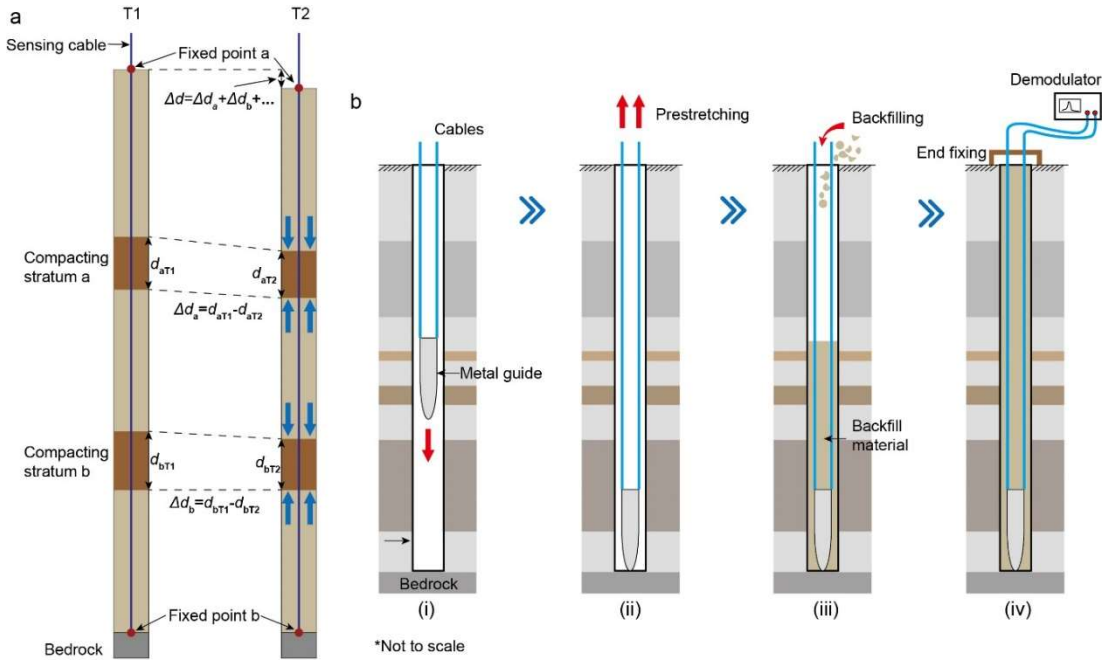


Figure 2. (a) The idea of land subsidence monitoring using DFOS, d: thickness of a stratum; T1&T2: time of data acquisition. (b) The procedure of the cable installation (cable insert➞cable prestretching ➞backfilling with standard materials➞end fixing)

Special Issue

Monitoring Land Subsidence Using Remote Sensing

edited by Massimo Fabris,
Nicola Cenni andSimone Fiaschi
submission deadline **31 Dec 2020** | 7 articles
Keywords: **Land subsidence**; **Anthropogenic and natural components**; **Climate change impact**; **Time series analysis**; **Remote sensing monitoring techniques**; **InSAR**; **Integrated monitoring approaches**
(This special issues belongs to the Section **Environmental Remote Sensing**)

https://www.mdpi.com/journal/remotesensing/special_issues

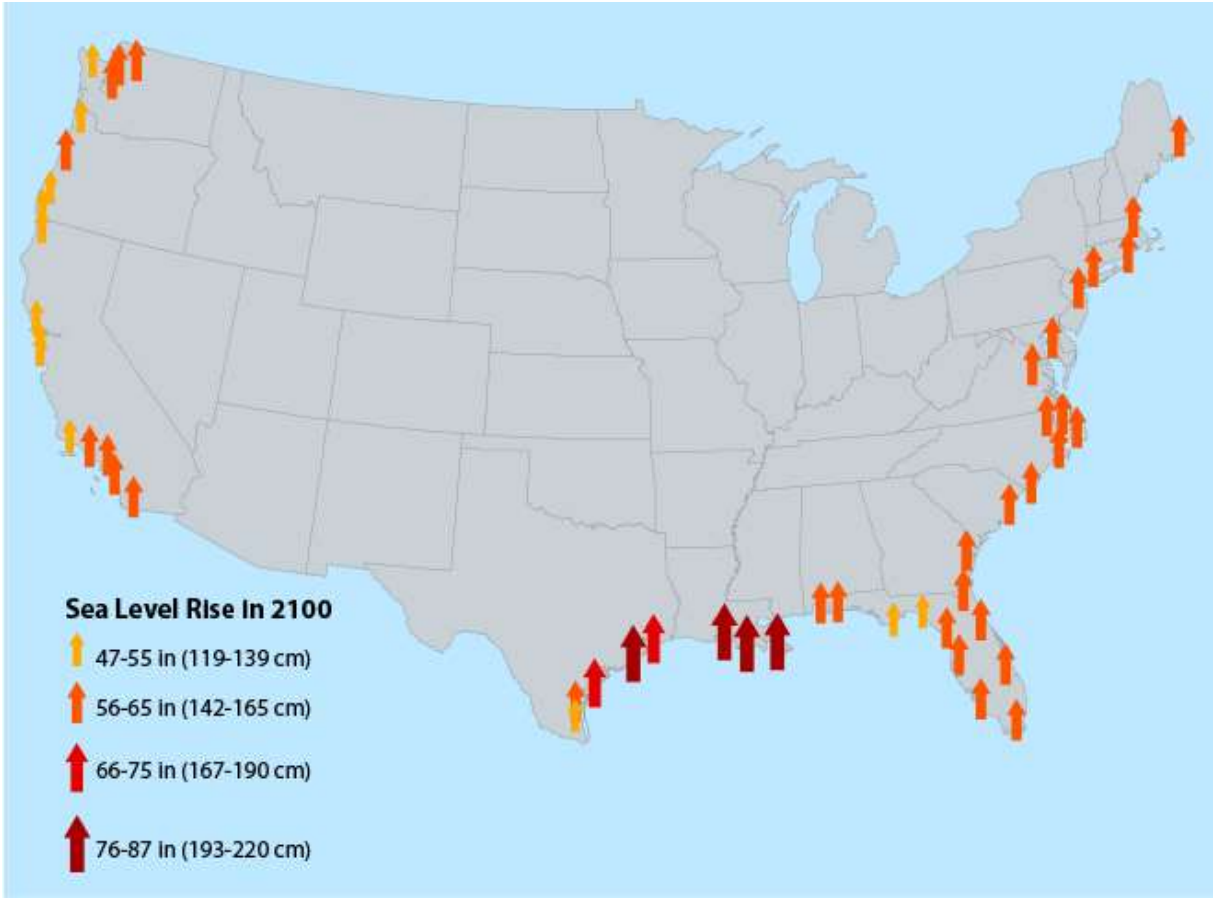
MAPS

Sri Lanka, Matale

A hazard zonation Map of Matale:

https://www.nbro.gov.lk/index.php?option=com_content&view=article&id=25&Itemid=179&lang=en#matale-subsidence

USA



Map shows projected relative (to land) sea level rise under the Reference scenario for select coastal counties in the contiguous U.S. Projections are based on global mean sea level rise in 2100 (56 inches), adjusted for local subsidence and uplift.30

https://www.epa.gov/cira/methods-analysis-sea-level-rise-projections

Report

United States, Arizona, El Mirage

Report on City Planning, containing interesting chapters about Land Subsidence and Fissuring in the state and the City.

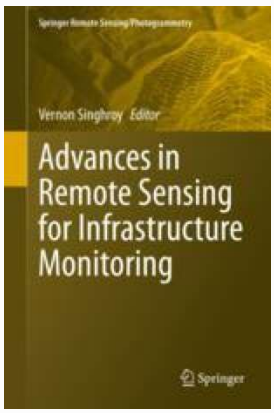
http://www.elmirageaz.gov/DocumentCenter/View/1157/Background-and-Current-Conditions-Volume-12-28-20

New Literature

Monitoring

Nicola Casagli et al.,

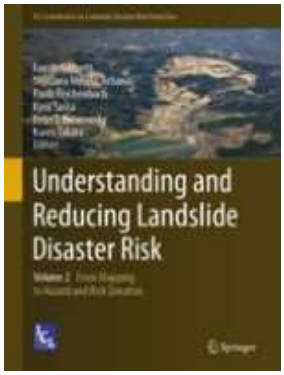
Sentinel-1 InSAR Data for the Continuous Monitoring of Ground Deformation and Infrastructures at Regional Scale



https://link.springer.com/chapter/10.1007/978-3-030-59109-0_3

Del Soldato Matteo et al.,

From Satellite Images to Field Survey: A Complete Scheme of Landslide InSAR Monitoring



https://www.springerprofessional.de/en/from-satellite-images-to-field-survey-a-complete-scheme-of-lands/18706990

Colombia, Bogota

Mora–Páez, H., Díaz–Mila, F. & Cardona, L. 2020. Mapping land subsidence in Bogotá, Colombia, using the interferometric synthetic aperture radar (InSAR) technique with TerraSAR–X images. In: Gómez, J. & Pinilla–Pachon, A.O. (editors), The Geology of Colombia, Volume 4 Quaternary. Servicio Geológico Colombiano, Publicaciones Geológicas Especiales 38, p. 515–548.
Bogotá. https://doi.org/10.32685/pub.esp.38.2019.16

Indonesia, Jakarta

Karlina Triana et al., Sea Level Rise in Indonesia: The Drivers and the Combined Impacts from Land Subsidence in: Asean Journal on Science and Technology for Development, vol. 37, no.3 (2020).

http://ajstd.org/index.php/ajstd/article/view/627

Indonesia, Sumatra

Ward, C., Stringer, L.C., Warren-Thomas, E. *et al.* Smallholder perceptions of land restoration activities: rewetting tropical peatland oil palm areas in Sumatra, Indonesia. *Reg Environ Change* **21,** 1 (2021). https://doi.org/10.1007/s10113-020-01737-z

https://link.springer.com/article/10.1007/s10113-020-01737-z#citeas

Japan,

Ajit Joshi et al., Poroelastic Modeling of a Heterogeneous Geologic Medium: A Case Study from Kanto Basin in Japan

https://doi.org/10.1111/gwat.13070

Mexico, Mexico City

Francesca Cigna et al., Present-day land subsidence rates, surface faulting hazard and risk in Mexico City with 2014–2020 Sentinel-1 IW InSAR

https://www.sciencedirect.com/science/article/abs/pii/S0034425720305344#!

PR China, Heze

Our member Mahdi Motagh is one of the co-authors of:

Chuanguang Zhu et al., Assessments of land subsidence along the Rizhao–Lankao high-speed railway at Heze, China, between 2015 and 2019 with Sentinel-1 data

https://nhess.copernicus.org/articles/20/3399/2020/nhess-20-3399-2020.pdf

Romania, Bucharest

Alina Radutu et al., Sentinel-1 Data for Underground Processes Recognition in Bucharest City, Romania

file:///C:/Users/Gebruiker/Downloads/remotesensing-12-04054%20(1).pdf

Saudi Arabia, Dammam

Kamal Abdelrahman et al.,

Assessment of land subsidence as an environmental threat facing Dammam city, eastern Saudi Arabia based on soil geotechnical parameters using downhole seismic approach,

Journal of King Saud University - Science,

Volume 33, Issue 1,

2021,

101233,

ISSN 1018-3647,

https://doi.org/10.1016/j.jksus.2020.101233.

(http://www.sciencedirect.com/science/article/pii/S1018364720303451)

Abstract: To meet the increasing in population, urbanization and public transportation needs of Dammam big city a new transportation infrastructure network is planned and being developed. In the same time, environmental threats of land subsidence on network has been raised and needs to be addressed. Site characterization for designing this transportation lines is crucial to ensure reliable and economic substructure design, because weak site soil conditions may cause land subsidence problems. Downhole seismic (DS) testing is commonly used to determine compression wave (P) and shear wave (S) velocity profiles in geotechnical engineering, which are required in evaluating responses to shaking of geotechnical sites and structures. A DS survey was conducted through boreholes at the center of the Dammam metropolitan city, Saudi Arabia. A sledgehammer horizontally striking a wooden plate generated shear (S) waves polarized in the crossline and inline directions, whereas a vertical hammer hitting a metal plate generated the P wave. Data were obtained using Freedom Data PC, a downhole tool with a triaxle geophone package, and a seismograph. In the downhole technique, the geophones were equestrian on an internal rotating block, and a built-in fluxgate compass as well as servo motor system maintained the orientation of the geophones inside the borehole. The instrumentation and processes complied with the standard test methods for downhole seismic testing (Standard and D7400-08, 2008). This represents, a versatile platform for evaluating structures/infrastructures and geophysical seismic engineering surveys. The estimated seismic velocities were used in estimating the various elastic moduli and density variations within the mapped boreholes. The integrated approach of proper geotechnical characterization and 1D velocity profile proved to be a helpful tool for assessment of subsidence of Dammam city in the future which, in turn, will reduce the environmental threats facing the city.

USA, California

Donald W. Vasco et al., Using geodetic data in geothermal area:

https://library.seg.org/doi/epub/10.1190/tle39120883.1

USA, Louisiana

R. Eugene Turner et al., Salt Marsh Elevation Limit Determined after Subsidence from Hydrologic Change and Hydrocarbon Extraction

https://www.mdpi.com/2072-4292/13/1/49/pdf

Vietnam, Ho Chi Minh City

C. Elizabeth Duffy et al., Surface Subsidence in Urbanized Coastal Areas: PSI Methods Based on Sentinel-1 for Ho Chi Minh City

https://www.google.com/search?q=land+subsidence&rlz=1C1GCEA_enNL857NL857&source=lnt&tbs=qdr:d&sa=X&ved=2ahUKEwiukKPPuNXtAhWgwAIHHaTKBBIQpwV6BAgFECU&biw=1680&bih=882

Master Thesis

Netherlands

A master thesis from the Technical University Delft about subsidence modelling

Sofie ten Bosch

Modelling subsidence in the Dutch Holocene coastal-plain: Investigating subsidence components and their relevance for different situations

https://repository.tudelft.nl/islandora/object/uuid%3A2c308062-e0fa-4704-9b10-c745505a8cdd

Thailand, Bangkok

Another nice study was made by a student architecture in Thailand:

ING-FAH LAOHACHANAKOOR

king mongkut's university of technology thonbury

She made a presentation of 2 possible situations for Bangkok in 2050: Dystopia and Utopia:

https://soad.kmutt.ac.th/work/dystopia-utopia-2/

Online Conference

IWRA 2020

A poster of: Lili YU & Fengyue SUN
Dual Control Management of Groundwater Table and Groundwater Exploitation in China

https://www.iwra.org/member/congress/resource/IWRA2020_OnlineConf_Theme4_Poster_LiliYU_FengyueSUN.pdf

From the Press

India, Andra Pradesh

Opposition against oil exploration in Andra Pradesh, because of subsidence

https://www.thehindu.com/news/national/andhra-pradesh/opposition-to-oil-exploration-plan-in-ap/article33310214.ece

the Netherlands, Groningen Gas field

Drill core from sandstone gas reservoir yields clues to mechanisms controlling induced subsidence and seismicity

https://www.uu.nl/en/news/drill-core-from-sandstone-gas-reservoir-yields-clues-to-mechanisms-controlling-induced-subsidence

PR China

As seas go up, land goes down. About 32 Chinese coastal cities face land subsidence, with Tianjin and Shanghai, as well as Panjin in the northeastern Liaoning province, facing an accumulated land subsidence of more than 2 meters, mainly due to groundwater exploitation and high-rise construction. In some coastal areas, subsidence is so serious, protective levees are shrinking by up to 20 centimeters each year. As a result, the relative sea-level rise is even higher.

Central Shanghai had sunk by up to 3 meters in the 19th century, making the city center noticeably concave with an altitude of only 2 meters, says Wen Jiahong, head of the disaster risk assessment center at Shanghai Normal University.

During a 1997 storm surge, a Shanghai hydrological station saw a record-breaking, 5.72-meter-high storm tide. Taking into account the subsidence that has since occurred, such a tidal level would put waters at nearly 3 meters above Shanghai's city center, says Wen. "It looks like a ship, and the surrounding water is higher than the bottom of the ship," he says. "This will give huge pressure to flood control and drainage."

To control land subsidence, the city government carried out measures such as groundwater recharge. The land subsidence rate slowed down, though it did not stop. In 2018, Tianjin subsided 17 millimeters on average, while Shanghai subsided 5.1 millimeters on average.

http://www.sixthtone.com/news/1006652/rising-seas-threaten-chinas-long%2C-low%2C-and-crowded-coast

USA, California

Money to fix sinking canal approved in federal budget. Will California pay for the rest?

https://www.fresnobee.com/fresnoland/article248031210.html

USA, Texas

The Fort Bend Subsidence District was created by the Texas Legislature in 1989 as a conservation and reclamation district (Act of May 26, 1989, 71st Leg., R.S., ch. 1045, 1989 Tex. Gen. Laws 4251). The District's purpose is to regulate the withdrawal of groundwater within the District to prevent subsidence that contributes to flooding and infrastructure damages. The District's boundary is defined as all the territory within Fort Bend county.

https://fbsubsidence.org/

Vietnam, Ho Chi Minh City

HCMC trying its best to cope with ground subsidence

https://sggpnews.org.vn/hochiminhcity/hcmc-trying-its-best-to-cope-with-ground-subsidence-89865.html