
# UNESCO

# Land Subsidence International Initiative

# ANNUAL REPORT 2024

December, 9th 2024

## 1. Members

The UNESCO LaSII is chaired by Pietro Teatini (member, Italy) and vice-chaired by Shujun Ye (member, PR China). The technical secretary is Claudia Zoccarato (affiliate, Italy).

The members of the group are the following (including new members admitted in 2024 during the annual meeting):

1. Henri Andreas (Indonesia)
2. Enrique Cabral-Cano (Mexico)
3. Dora Carreon-Freyre (Mexico)
4. Loupasakis Constantinos (Greece)
5. Gilles Erkens (The Netherlands)
6. Peter Fokker (The Netherlands)
7. Gerardo Herrera García (Spain)
8. Abidin Hasanuddin (Indonesia)
9. Kelvin Hung (Taiwan)
10. Kenji Daito (Japan)
11. Agnieszka Malinowska (Poland)
12. Mahdi Motagh (Germany)
13. Roberto Tomas Jover (Spain)
14. Manoochehr Shirzaei (US)
15. Michelle Sneed (US)
16. Chuen-Fa Ni (Taiwan)
17. Luigi Tosi (Italy)
18. Hanmei Wang (PR China)

## 2. Observers

The observers of the group are the following (including new observers admitted in 2024 during the annual meeting):

1. Appeaning Addo K. (Ghana)
2. Luke Bateson (UK)
3. Kakar Najeebullah (Pakistan)
4. Hamed Niroumand (Iran)
5. Tomochika Tokunaga (Japan)

## 3. Affiliates

The affiliates of the group are the following (including new affiliates admitted in 2024 during the annual meeting):

1. Mahmoud Bakr (Egypt)
2. Roberta Bonì (Italy)
3. Pablo Ezquerro (Spain)
4. Ashley Greuter (US)
5. Kai Gu (PR China)
6. Martin Hernandez (Mexico)
7. Kay Koster (The Netherlands)
8. John Lambert (The Netherlands)
9. Qingshan Ma (PR China)
10. Philip Minderhoud (The Netherlands)
11. Gil Ochoa González (Mexico)
12. Shih-Jung Wang (Taiwan)
13. Ta-Kang Yeh (Taiwan)
14. Lin Zhu (PR China)

**Group Activities**

1. **Annual Meeting:** The annual meeting of the UNESCO LaSII group was held on July 23 2024 at the Grand Mercure Hotel Kemayoran Central Jakarta in Jakarta and remotely.

**Conference contributions/Presentations related to the topic of land subsidence**

1. **A. Malinowska**. Report on IV Commission Activities of International Society for Mine Surveying (ISM). "*Land Subsidence management - subsidence damages estimation*"; Report on preparation of 52nd ISM Presidium Meeting in Poland 2025, during the 51st ISM Presidium Meeting , Paarl, Western Cape, South Africa 6 - 9 October 2024
2. A**. Malinowska** . "*Land subsidence associated to mining in Poland"* at the Scientific Meeting Insight Best Practice of Management against Land Subsidence Disaster, Jakarta, Indonesia, July 24, 2024.
3. A. Malinowska. "Kinematics of displacements and delaminations of the roof in the salt rock mass based on the example of KS 'Wieliczka' S.A." Mine Surveying Conference. Jawor, Poland, 11th Oct.- 13th Oct. 2023
4. **A. Malinowska**. "*Preserving outstanding value of historical mining sites by providing reliable and complex observation– case of Wieliczka Salt Mine a UNESCO Word Heritage Site* " XVIII International ISM Congress; Smart Surveying and Mapping & Green Mine; Beijing · Xuzhou · Shanghai, China 26th Oct.- 29th Oct 2023
5. **Motagh, M.**, Haghshenas Haghighi, M., Piter, A., and Vassileva, M. (2024). Mining-induced subsidence and fault reactivation due to open pit lignite mining in the Hambach region, North Rhine-Westphalia, Germany: Insights from Sentinel-1 based European Ground Motion Service (EGMS) and field surveys, EGU 2024, https://meetingorganizer.copernicus.org/EGU24/EGU24-11866.html
6. Haghshenas Haghighi, M., and **Motagh, M.** (2024)**.** The growing groundwater crisis in Iran and its impact on land subsidence: A nationwide survey using satellite InSAR, EGU 2024, https://meetingorganizer.copernicus.org/EGU24/EGU24-15656.html
7. Navarro-Hernández, M., Pozo, S., Valdes-Abellan, J., **Tomás, R.** (2024). Automated analysis of strain-stress curves for aquifer system characterization , EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-4174, 2024.
8. Navarro-Hernández, M.I., Valdes-Abellan, J., **Tomás, R.**, Tessitore, S., **Ezquerro, P.**, **Herrera, G.**, (2024). Integrating InSAR and 2D hydraulic models to analyse Land Subsidence Impact on Flood Risk. 2024 Dragon Symposium, Lisbon, 24-28 June 2024.
9. **Tomás, R.**, Zeng, Q., Lopez-Sanchez, J.M, Li, Z., Zhao, C., Liu, X., Navarro-Hernández, M.I., Hu, L., Luo, J., Chen, H., Reyes-Carmona, C., Du, J., Pastor, J.L., Zhuo, G., Riquelme, A., Dai, K., Cano, M. (2024). Spaceborne SAR Interferometry (InSAR) Monitoring of Land Subsidence and Landslides Geohazards. 2024 Dragon Symposium, Lisbon, 24-28 June 2024.
10. Hu, L., **Tomás, R.**, Tang, X., Li, T., Zhang, X., López-Vinielles, J., **Herrera, G**. (2024). Identification and monitoring of landslides in the mining areas of La Unión (Spain) integrating InSAR and LiDAR datasets. In: Tomás, R., Cano, M., Riquelme, A., Pastor, J.L., Benavente, D., Ordóñez, S. (eds.) New Challenges in Rock Mechanics and Rock Engineering. CRC Press, London, 327-332.
11. **K. Daito**. "Groundwater use at disaster without causing subsidence" at the Japan Society of Engineering Geology, Chubu Branch, Technological exchange association and Lecture meeting, July 5, 2023. (in Japanese)
12. **K. Daito**. "Land Subsidence Prevention in Japan" at the Scientific Meeting Insight Best Practice of Management against Land Subsidence Disaster, Jakarta, Indonesia, July 24, 2024.
13. **M. Sneed**. "Water Availability and Land Subsidence: San Joaquin Valley, California, USA" at the Scientific Meeting Insight Best Practice of Management against Land Subsidence Disaster, Jakarta, Indonesia, July 24, 2024.
14. **M. Sneed**. "Novel Extensometry Techniques Quantify Depth-Specific Aquifer-System Compaction: Implications for Management of Groundwater and Land Subsidence" at the American Geophysical Union Annual Meeting, San Francisco, California, December 13, 2023.
15. **M. Sneed**. "Impact of Land Subsidence on Home Sales Value: Evidence from California" at the Agricultural and Applied Economics Association meeting, New Orleans, Louisiana, July 28-30, 2024.
16. **Hung, W. C.,** Invited Speaker: "Time to think more effectively about monitoring land subsidence." Insight Best Practice of Management against Land Subsidence Disaster. Jakarta, Indonesia. July 24, 2024.

17. **Hung, W. C.,** Invited Speaker: "Research and development of multi-sensor observation technology applications." Taiwan International Water Week. Taipei, Taiwan. September 10-11, 2024.
18. **Hung, W. C.,** "IoT and big data technology applied to land subsidence monitoring in central Taiwan". Macau, The 10th Cross-Strait Surveying and Mapping Development Seminar with Hong Kong and Macao, September 25-27, 2024.
19. **L. Tosi**. Land subsidence in Italian coastland: past and recent perspective. Scientific Meeting "Insight Best Practice of Management against Land Subsidence Disaster", Jakarta, Indonesia, July 24, 2024.
20. **CF. Ni**. Workshop lecture: "Groundwater resources, protection, and sustainable use." 2024 Advanced Institute –Environment Exposure and Health Impacts in South-East Asia. Thi Nguyen, Vietnam. March 25-27, 2024.
21. **C.F. Ni**. Invited talk: "Groundwater resources and recent advances in land subsidence monitoring and modeling in Taiwan." Northern Division for Water Resources Planning and Investigation, Hanoi, Vietnam. March 28-29, 2024.
22. **C.F. Ni.** "Experimental and Numerical Assessment of Fresh Water and Seawater Interactions in the Coastal Aquifer of the Taoyuan Tableland, Taiwan." 21st Annual Meeting of the Asia Oceania Geosciences Society (AOGS2024). Pyeongchang, Gangwon-do, Korea. June 23 – 28, 2024.
23. **C.F. Ni.** "Data-driven Investigations Into Land Subsidence Evolution and Its Impacts on Infrastructures in Choushui River Fluvial Plain." 21st Annual Meeting of the Asia Oceania Geosciences Society (AOGS2024). Pyeongchang, Gangwon-do, Korea. June 23 – 28, 2024.
24. **C.F. Ni**. Invited Speaker: "Groundwater recharge under a changing environment in Taiwan." Taiwan International Water Week. Taipei, Taiwan. September 10-11, 2024.
25. **H. Niroumand**. Invited keynote speaker at the Ministry of Cultural Heritage, Tourism, and Handicrafts in Iran to discuss land subsidence and its impact on heritage and historical buildings. May 2024
26. Cigna F., **Bonì R.**, **Teatini P.**, Paranunzio R., **Zoccarato C.** 2024. Present-day and future urban subsidence risk in Italy based on multi-scale satellite InSAR workflows and advanced modelling. URBIS24 – URBan Insights from Space, 16-18 September 2024, ESA-ESRIN, Frascati (RM), Italy.
27. **Bonì R.,** Taramelli A., Cigna F., **Teatini P.**, Paranunzio R., **Zoccarato C.**, Marcaccio M., Mazzei M., Severi P. 2024. Assessment of the potential of InSAR time series to support sustainable groundwater management in the Emilia-Romagna region. In: Candigliota E. & Immordino F. (eds), 14° Workshop Tematico AIT-ENEA, Telerilevamento applicato alla gestione delle risorse idriche, 6-7 June 2024, Bologna, Italy, ISBN: 978-88-8286-471-2, pp. 43-45
28. Cigna F., **Bonì R., Teatini P.**, Paranunzio R., **Zoccarato C.** 2024. Land subsidence induced by groundwater exploitation: using satellite InSAR to estimate current and future risk for urban landscapes in Italy. In: Candigliota E. & Immordino F. (eds), 14° Workshop Tematico AIT-ENEA, Telerilevamento applicato alla gestione delle risorse idriche, 6-7 June 2024, Bologna, Italy, ISBN: 978-88-8286-471-2, pp. 47-49
29. **Bonì R.,** Cigna F., **Teatini P.**, Paranunzio R., **Zoccarato C.** 2024. Assessing and mapping of land subsidence risk at different scales in major urban areas in Italy. EGU General Assembly 2024, 14-19 April 2024, Vienna, Austria & online, abstract id. EGU24-10558, doi:10.5194/egusphere-egu24-10558
30. Barra, A., Cuevas-González, M., Navarro, J., Béjar-Pizarro, M., **Ezquerro, P.**, Bianchini, S., Zezere, J. L., Medici, C., Del Soldato, M., Palamà, R., Shahbazi, S., Mateos, R. M., Poyiadji, E., Alfonso Jorde, D., Crosetto, M., and Monserrat, O.: ADATools: free and user-friendly tools to semiautomatically extract and analyse wide PSI displacement maps. Applications to the European Ground Motion Service (EGMS). EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-20708, https://doi.org/10.5194/egusphere-egu24-20708, 2024.
31. Bru, G., **Ezquerro, P.**, Azañón, J. M., Mateos, R. M., Tsige, M., Béjar-Pizarro, M., and Guardiola-Albert, C.: Assessing the Impact of Stabilization Measures on a Slow-Moving Landslide in Arcos de La Frontera town (SW Spain) using InSAR, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-15817, https://doi.org/10.5194/egusphere-egu24-15817, 2024.
32. Rivera Rivera, J. S., Béjar Pizarro, M., Aguilera Alonso, H., **Ezquerro, P.**, Guardiola-Albert, C., and Monserrat, O.: Automated classification of ground deformation processes in Spain: a machine learning approach using a novel national InSAR-based database, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-8369, https://doi.org/10.5194/egusphere-egu24-8369, 2024.
33. Rivera Rivera, J. S., Béjar Pizarro, M., Aguilera Alonso, H., **Ezquerro, P.**, Guardiola-Albert, C., and Monserrat, O.: Automated classification of ground deformation processes in Spain: a machine learning

approach using a novel national InSAR-based database, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-8369, https://doi.org/10.5194/egusphere-egu24-8369, 2024.

34. M. Bejar-Pizarro, J. Rivera-Rivera, **P. Ezquerro**, G. Bru, D. Alfonso, J. Lopez-Vinielles, C. Guardiola-Albert, H. Aguilera, R.M. Mateos, J.C. Garcia-Davalillo, R. Sarro, M. Martinez-Corbella, O. Monserrat, A. Barra, M. Cuevas-Gonzalez, J. Portela, A. Staller. Caracterización de procesos geológicos activos mediante datos InSAR, utilidad del servicio EGMS de Copernicus. XI Congreso Geológico de España. Avila, 2-6 de Julio de 2024
35. J. Rivera-Rivera, M. Bejar-Pizarro, R.M. Mateos, **P. Ezquerro**, R. Sarro, M. Martinez-Corbella, H. Aguilera, C. Guardiola-Albert. Mapa Simplificado de Litologías Orientado a Procesos Geológicos de España. Escala 1:50.000. XI Congreso Geológico de España. Avila, 2-6 de Julio de 2024
36. **K. Gu**. "In-situ seepage measurement using actively heated fiber optics based thermal response test" at the 7th National Conference on Geotechnical Engineering of Islands and Reefs, Zhuhai, China, May 10-12, 2024
37. **K. Gu**. "Refined testing technology of soil thermal properties and its application in land subsidence regions" at the 9th Youth Geoscience Forum, Xiamen, China, May 17-20, 2024.
38. **K. Gu**. "Detecting ground thermal conductivity via a novel thermal response test in land subsidence regions" at the International Symposium on Innovations in Geotechnical Engineering towards Sustainability, Hong Kong, China, November 30-December 4, 2023.
39. Maoret, V., Candela, T., van Dinther, Y., **Koster, K.**, **Teatini, P.**, van Wees, J.-D., and **Zoccarato, C**. (2024). Land subsidence induced by urbanization: towards building damage predictions. EGU24
40. Verberne, M., **Koster, K.**, de Bresser, H., and, **Fokker P.** (2024). Unveiling the hidden depths: insights in intermediate depth compaction from 50 years of extensometer data in the Netherlands. EGU24
41. Zhai, G., Candela, T., and **Koster, K.** (2024). InSAR space geodesy for land subsidence. NCG24
42. Van der Meulen, M., Koster, K., Candela, T., and Geurts, C. (2024). Subsidence in the Dutch lowlands. AEG24
43. Ozer, E., Melo, J., Dilo, A., **Koster, K.**, and Zouros, I. (2024). SAFE: advancing life cycle management of subsiding hydraulic structures through satellite technology and artificial intelligence. LCM24
44. Zhai, G., Candela, T., **Koster, K.**, Esteves Martins, J., Abdul Fattah, R., van Wees, J.-D., and Hasselman, J. (2024). Efficient ground motion monitoring using advanced PSDS methods: merging DS and PS in the framework of SBAS. AGU24
45. Verberne, M., **Teatini, P.**, **Koster, K.**, **Fokker, P.**, and **Zoccarato, C.** (2024). An integral approach to disentangle and quantify subsidence causes in the Ravenna region, northern Italy. AGU24
46. Maoret, V., Candela, T., van Dinther, Y., **Koster, K.**, **Teatini, P.**, van Wees, J.-D., and **Zoccarato, C**. (2024). Sinking cities: towards prediction of subsidence-induced building damage. AGU24
47. **Minderhoud, PSJ**; et al.; *Science-Informed Management of Groundwater Exploitation to Mitigate Land Subsidence and Relative Sea-Level Rise in Coastal Areas.* AGU Fall Meeting Abstracts 2023 NS32A-02
48. Seeger, Katharina; **Shirzaei, M.**; **Minderhoud, PSJ** et al., ; *How much is the ayeyarwady delta (Myanmar) affected by land subsidence? Insights into vertical land motion based on a multitemporal DInSAR algorithm* AGU Fall Meeting Abstracts 2023 EP23E-1985
49. **Minderhoud, PSJ**; et al.; *Insights in land subsidence and relative sea-level rise along West Africa's Gulf of Guinea coast*. AGU Fall Meeting Abstracts 2023 EP23E-1986
50. Miao Ye, **L. Zhu**, **P. Teatini**, Andrea Franceschini, Jie Yu. Peridynamics modelling of earth fissures associated to aquifer exploitation and pre-existing normal faults with applications to Beijing, China. EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024.
51. Shuai Li, **L. Zhu**, Huili Gong, Li Xiaojuan, Binghua Li. Simulation of groundwater level response to precipitation and groundwater extraction based on multi-head self-attention mechanism and deep learning model. International Groundwater Conference 2024, Changchun, China, 9-11 Aug 2024.
52. Chenzhihao Qian, **L. Zhu**, Huili Gong, Shuai Li, Miaomiao Han. Groundwater level simulation based on the coupling of numerical model and machine learning model. International Groundwater Conference 2024, Changchun, China, 9-11 Aug 2024.
53. **S. Ye**. Presentation entitled "Practice of Management against Land Subsidence In Shanghai, China" at the Scientific Meeting Insight Best Practice of Management against Land Subsidence Disaster, Jakarta, Indonesia, July 24, 2024.

54. **S. Ye**. International Symposium of Urban Geology in Shanghai, China, July 27, 2024. Round table forum with the theme of "Challenges and Responses - International Symposium on Land Subsidence in Shanghai" which finally released"Shanghai Initiative for the Prevention and Control of Land Subsidence"
55. **S. Ye**. Annual meeting of scientific committee of National Field Scientific Observation and Research Station for Groundwater and Land Subsidence in the Plain Area in Cangzhou, Hebei Province, April 18-19, 2024. As a member of scientific committee, I suggested that the national station needs its own website, posts data open to the world, and encouraged international collaboration projects.
56. **S. Ye**. Presentation entitled "Sensitivity Analysis of Controlling Factors for Earth Fissures in Aquifer Systems with Abrupt Thickness Changes" at the First National Congress of Groundwater Resources and Eco-Environment, Wuhan, China, April, 13, 2024.
57. **Niroumand, H.** (2024), Innovative Approaches to Soil Improvement: Separating Macro, Micro, Nano, and Pico Additives for the Future of Physical Modelling in Geotechnical Engineering, 4TH ASIA-PACIFIC CONFERENCE ON PHYSICAL MODELLING IN GEOTECHNICS (ACPMG 2024), New York University in Abu Dhabi (NYUAD), Dubai, UAE (the importance of ground improvement in land subsidence and sinkholes)
58. **Niroumand, H.** (2024), exploring the Impact of Physical Modelling on Land Subsidence in Geotechnical Engineering, 4TH ASIA-PACIFIC CONFERENCE ON PHYSICAL MODELLING IN GEOTECHNICS (ACPMG 2024), New York University in Abu Dhabi (NYUAD), Dubai, UAE
59. **Niroumand, H.** (2024), Consequences of land subsidence in Iran, at the Scientific Meeting Insight Best Practice of Management against Land Subsidence Disaster, Jakarta, Indonesia
60. **Luigi Tosi**, Marta Cosma, Cristina Da Lio, Sandra Donnici, Massimiliano Ferronato, Annamaria Mazzia, **Pietro Teatini**, **Claudia Zoccarato**. Revisiting The Impact of Relative Sea-Level Rise on The Venice Lagoon (Italy). First West African International Workshop on Coastal Land Subsidence, Theme: Coastal Land Subsidence in Africa: The Emerging Trends, 4-8 November 2024, Accra, Ghana.
61. **Dora Celia Carreón Freyre**. The UNESCO Land Subsidence International Initiative (LaSII). Keynote Speaker. Topic T31. Geohazards. Session 2: Outreach tools as a way to increase preparedness for geological hazards. 37th International Geological Congress 2024. 28 August 2024. Busan Corea.
62. **Dora Celia Carreón Freyre**. Geological risk assessment in Mexico City: The Interactive Observatory of Land Subsidence and Fracturing, OIHFRA. Keynote Speaker. Topic T31. Geohazards. Session 2: Outreach tools as a way to increase preparedness for geological hazards. 37th International Geological Congress 2024. 28 August 2024. Busan Corea.

**Publications in international journals**

1. Tang, W., Gong, Z., Sun, X., Liu, Y., **Motagh, M.**, Li, Z., Li, J., **Malinowska, A.**, Jiang, J., Wei, L., Zhang, X., Wei, X., Li, H., & Geng, X. (2024). Three-dimensional surface deformation from multi-track InSAR and oil reservoir characterization: A case study in the Liaohe Oilfield, northeast China. *International Journal of Rock Mechanics & Mining Sciences*, *174*, Article 105637.
2. Bockstiegel, M., Richard-Cerda, J. C., Muñoz-Vega, E., Haghighi, M. H., **Motagh, M.**, Lalehzari, R., Schulz, S. (2024): Simulation of present and future land subsidence in the Rafsanjan plain, Iran, due to groundwater overexploitation using numerical modeling and InSAR data analysis. - *Hydrogeology Journal*, 32,289-305. https://doi.org/10.1007/s10040-023-02657-y
3. Haghshenas Haghighi, M., **Motagh, M.** (2024): Uncovering the impacts of depleting aquifers: A remote sensing analysis of land subsidence in Iran. - *Science Advances*, 10, 19.https://doi.org/10.1126/sciadv.adk3039
4. Tang, W., Zhao, X., Wang, J., **Motagh, M.**, Xu, H., Ru, Z. and Wang, Y., 2024. Land surface response to groundwater drawdown and recovery in Taiyuan city, Northern China, analyzed with a long-term elevation change measurements from leveling and multi-sensor InSAR. *Journal of Hydrology*, 641, p.131781. https://doi.org/10.1016/j.jhydrol.2024.131781
5. Esteban, E., Dinar, A., Calvo, E., Albiac, J., Calatrava, J., **Herrera, G.**, **Teatini, P.**, **Tomás, R.**, **Ezquerro, P.** and Li, Y. (2024). Modeling the optimal management of land subsidence due to aquifers overexploitation. Journal of Environmental Management, 349: 119333. DOI: https://doi.org/10.1016/j.jenvman.2023.119333

6. Hu, L., Tang, X., **Tomás, R.**, Li, T., Zhang, X., Li, Z., Yao, J., Lu, J. (2024). Monitoring surface deformation dynamics in the mining subsidence area using LT-1 InSAR interferometry: A case study of Datong, China. International Journal of Applied Earth Observation and Geoinformation, 131: 103936. DOI: https://doi.org/10.1016/j.jag.2024.103936
7. Tung, S., Kaven, O., **Shirzaei, M.**, Masterlark, T., Wang, H.F., Huang, W.C. and Feigl, K.L., 2024. Seismicity zoning at Coso geothermal field and stress changes from fluid production and migration. *Earth and Planetary Science Letters*, *646*, p.119000.
8. Carlson, G., Werth, S. and **Shirzaei**, M., 2024. A novel hybrid GNSS, GRACE, and InSAR joint inversion approach to constrain water loss during a record-setting drought in California. *Remote Sensing of Environment*, *311*, p.114303.
9. Nicholls, R.J. and **Shirzaei**, M., 2024. Earth's sinking surface. *Science*, *384*(6693), pp.268-269.
10. Ohenhen, L.O., **Shirzaei**, M., Ojha, C., Sherpa, S.F. and Nicholls, R.J., 2024. Disappearing cities on US coasts. *Nature*, *627*(8002), pp.108-115.
11. Ohenhen, L.O., **Shirzaei**, M. and Barnard, P.L., 2024. Slowly but surely: Exposure of communities and infrastructure to subsidence on the US east coast. *PNAS nexus*, *3*(1), p.pgad426.
12. Fernández-Torres* E.A., **E, Cabral-Cano,** D. Solano-Rojas, L. Salazar-Tlaczani, J. García-Venegas, B. Marquez-Azúa, S. Graham, K. M. Villarnobo-González, 2024. Country-scale assessment of urban areas, population, and households exposed to land subsidence using Sentinel-1 InSAR, and GPS time series. Natural Hazards (ISSN 0921-030X, EISSN 1573-0840). v. 120, p. 1577-1601. DOI: https://doi.org/10.1007/s11069-023-06259-5
13. D. Solano-Rojas, S. Wdowinski, **E. Cabral-Cano,** B. Osmanoğlu, 2024. Geohazard assessment of Mexico City's Metro System derived from SAR interferometry observations. Scientific Reports (ISSN 2045-2322). DOI: https://doi.org/10.1038/s41598-024-53525-y
14. Fernández-Torres E.A., **E. Cabral-Cano**, L. Salazar-Tlaczani, D. Solano-Rojas, 2024. Economic risk to differential subsidence in Mexico City (2014-2022). Natural Hazards. DOI: https://doi.org/10.1007/s11069-024-06891-9
15. Faunt, Claudia C., Jonathan A. Traum, Scott E. Boyce, Whitney A. Seymour, Elizabeth R. Jachens, Justin T. Brandt, **Michelle Sneed**, Sandra Bond, and Marina F. Marcelli, 2024, Groundwater Sustainability and Land Subsidence in California's Central Valley, *Water* 16, no. 8: 1189. https://doi.org/10.3390/w16081189.
16. **Hung, W. C.,** Hwang, C., Lin, S. H., Wang, C. S., Chen, Y. A., Tsai, P. C., & Lin, K. C. (2024). Exploring groundwater depletion and land subsidence dynamics in Taiwan's Choushui river alluvial fan: insights from integrated GNSS and hydrogeological data analysis. Frontiers in Earth Science, 12, 1370626. https://doi.org/10.3389/feart.2024.1370626
17. **Tosi, L.,** Da Lio, C., Cosma, M., & Donnici, S. (2024). Vulnerability of tidal morphologies to relative sea-level rise in the Venice Lagoon. Science of the Total Environment, 931, 173006. DOI: https://10.1016/j.scitotenv.2024.173006
18. Chang, C.M., **Ni, C.F.**, Lin, C.P., Lee, I.H., 2024. Stochastic analysis of the interaction between excess fluid flow and soil deformation in heterogeneous deformable porous media. Physics of Fluids, Accepted.
19. Ouédraogo, A.R., Hsu, S.H.M, Chen, Y.W., **Ni, C.F.**, 2024. Data-driven Gray Box Modeling for Predicting Basin-scale Groundwater Variations in Central Taiwan. Journal of Hydrologic Engineering, Accepted.
20. **Ni, C.F.**, Chang, C.M., Lin, C.P., Lee, I.H., 2024. Stochastic quantification of spatial variability of flow fields in heterogeneous, non-uniform, confined aquifers. Transport in Porous Media 151, 1475–1492. https://doi.org/10.1007/s11242-024-02084-x.
21. Chang, C.M., **Ni, C.F.**, Lin, C.P., Lee, I.H., 2024. Variability in the displacement of solute particles in heterogeneous confined aquifers. Advances in Water Resources, 186, 104660. https://doi.org/10.1016/j.advwatres.2024.104660.
22. Nainggolan, L., **Ni, C.F.**, Darmawan, Y., Lo, W.C., Lee, I.H., Lin, C.P., Hiep, N.H., 2024. Cost-effective Groundwater Potential Mapping by Integrating Multiple Remote Sensing Data and the Index-overlay Method. Remote Sensing, 16(3), 502. https://doi.org/10.3390/rs16030502
23. Huang, C.W., Yau, S.Y., Kuo, C.L., Kuan, T.Y., Lin, S.Y., Tsou, C.S., **Ni, C.F.**, Lin, Y.C., Chang, L.C., 2024. Identifying private pumping wells in a land subsidence area in Taiwan using deep learning technology and

street view images. Journal of Hydrology: Regional Studies, 51, 101636. https://doi.org/10.1016/j.ejrh.2023.101636.

24. Tzampoglou Pl., **Loupasakis C.**, (2023) Hydrogeological Hazards in Open Pit Coal Mines–Investigating Triggering Mechanisms by Validating the European Ground Motion Service Product with Ground Truth Data. Water 2023, 15, 1474. https://doi.org/10.3390/w15081474
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37. Carpentier, S., Meekes, S., Frumau, A., Verberne, M., Candela, T., and **Koster K.** (2024). A novel geophysical method to monitor ultra-shallow reservoirs: mapping of soil moisture content in subsiding peatlands to forecast drought effects and CO2 emissions. First Break 42, 85-91
38. Pedretti Laura , Giarola Alessia , Korff Mandy , **Lambert John** , Meisina Claudia. Comprehensive database of land subsidence in 143 major coastal cities around the world: overview of issues, causes, and future challenges. Frontiers in Earth Science, 12, 2024. https://doi.org/10.3389/feart.2024.1351581
39. **PSJ Minderhoud**, **M Shirzaei**, **P Teatini**. *Combatting Relative Sea-Level Rise at a Global Scale: Presenting the International Panel on Land Subsidence (IPLS).* Qeios. https://doi.org/10.32388/R5JEG2
40. Avornyo, Selasi Yao; **Minderhoud, Philip SJ**; **Teatini, Pietro**; et al., *The contribution of coastal land subsidence to potential sea-level rise impact in data-sparse settings: The case of Ghana's Volta delta*. Quaternary Science Advances 14 100175 2024 Elsevier

41. **Lin Zhu**, Jiangtao Li, Huili Gong, Miao Ye, Zhenxue Dai, Xiaojuan Li, **Pietro Teatini**. Simulating earth deformation evolution caused by groundwater pumping through ordinary state-based Peridynamics method[J]. Journal of Hydrology, 2024, 634: 131133. DOI: https://doi.org/10.1016/j.jhydrol.2024.131133
42. Z. Hosseini, E. Raeisi, I. Abdollahifard and **P. Teatini**, Comprehensive hydrogeological study of the Nubian aquifer System, Northeast Africa, *Journal of Hydrology*, 636, 131237, doi:10.1016/j.jhydrol.2024.131237, 2024.
43. E. Zancanaro, F. Morari, I. Piccoli, A. Carrera, **C. Zoccarato** and **P. Teatini**, A novel technique to mitigate saltwater intrusion: Freshwater recharge via drainpipe in permeable paleochannel, *Hydrological Processes*, 38, e15299, doi:10.1002/hyp.15299, 2024.
44. López-Vinielles, J., **Ezquerro, P.,** Béjar-Pizarro, M., Sarro, R., Cuevas-González, M., Barra, A., Mateos, R.M. Potential socio-economic impacts of ground movements in the coastal municipalities of Spain: Insights from the supra-regional implementation of the European Ground Motion Service. (2024) Ocean & Coastal Management, Volume 259, 2024, https://doi.org/10.1016/j.ocecoaman.2024.107452.

**Organization of scientific conferences/Session convening at scientific meetings**

1. Hung, W. C., Conference Organizer and Chair International Forum: 2024 Promotion of Geoid Model Applications and Surface Deformation Monitoring Techniques at The 42$^{ND}$ Conference on Surveying and Geomatics. Aug. 28-30, 2024. (~400 attendance)
2. Session Chair: Sustainability Research & Innovation Congress (SRI) (Session: Empowering Resilient Communities: Interactive Strategies for Asia and Arctic Futures), Helsinki, Finland. June 10-15, 2024.
3. Chuen-Fa Ni. Co-Char: 2024 Taiwan Groundwater Resource and Water Quality Protection Conference. Sep. 2-3, 2024. (~200 attendance)
4. Chuen-Fa Ni. Workshop Organizer: “Introduction to geochemical and reactive transport modeling in groundwater” Sep. 3, 2024. (~60 attendances)
5. Chuen-Fa Ni. Technical Forum Organizer: “Technologies and Management Strategies for Mitigation of Land Subsidence in Western Central Taiwan.” November 5, 2024. (plan)(~100 attendances)
6. “Land Subsidence: Quantifications, Projections, Impacts, and Mitigation in Natural and Urbanized Coastal Environments”. EGU 2024. Vienna, Austria. Convener: Claudia Zoccarato | Co-conveners: Roberta Bonì, Makan Karegar, Manoochehr Shirzaei, Esther Stouthamer
7. R. Bonì, P. Teatini, PSJ Minderhpud. Member of the scientific committee for the organization of a 1-week international workshop on coastal land subsidence and relating SLR in West Africa in the framework of the ENGULF Research Programme. Accra, 4-8 November, 2024. Programme includes a training day for local students on land subsidence. https://www.afd.fr/en/actualites/agenda/international-workshop-engulf-research-programme
8. AGU General Assembly: *Coastal Land Subsidence: Quantifications, Projections, Impacts, and Countermeasures in Natural and Urbanized Coastal Environments*. PSJ Minderhoud, M Shirzaei, P Teatini, S Ye - AGU23, 2023 – San Francisco, USA
9. S. Ye. Co-organizing the session of comprehensive treatment of groundwater overexploitation and artificial recharge, and presenting “Study on the schemes of pumping and artificial recharge to control land subsidence in Shanghai” at the National Forum on Groundwater, Changchun, China, August 10, 2024.
10. AGU General Assembly. Land Subsidence and Relative Sea Level Rise: Assessments, Projections, and Mitigation in Natural and Urban Environments. AUG2024, 2024, Washington DC, US. Convener: A. Guzy. Co-conveners: C. Zoccarato, P. Minderhoud, M. Shirzaei.
11. Tomás, R. Conference organizer: ISRM European Rock Mechanics Symposium. July 15-19, 2024, Alicante, Spain. New challenges in rock mechanics and rock engineering. The conference had an specific session on Hazards and risks with contributions related to mining subsidence.
12. Tomás, R. Chair of the session "Solid Earth & Disaster Reduction" of the 2024 Dragon 5 Final Results and Dragon 6 kick-off Symposium. ESA-MOST Dragon Cooperation. Lisbon, 24-28 June 2024
13. Dora Celia Carreón Freyre. Chair of the Organizing Committee. “Primer Coloquio Queretano de Estudios Interdisciplinarios del Suelo”. 9-10 December, 2024. Instituto de Geociencias. Campus UNAM Juriquilla. Commemoration of ONU’s Soil International Day.

**Conference and proceedings publications**

1. Ellis, John, Knight, Jacob, White, Jeremy, **Sneed, Michelle**, Ramage, Jason, and Hughes, Joseph, 2024, The GULF 2023 Model and Ensemble: Land Subsidence Results for the Gulf Coast Aquifer System [abs]: proceedings from MODFLOW and More 2024, June 2-5, 2024, Princeton University.
2. Da Lio, C., Cosma, M., Donnici, S., Ferronato, M., Mazzia, A., **Teatini, P., Tosi, L.,** and **Zoccarato, C.** (2004): Rethinking the resilience of salt marshes to land subsidence and sea-level rise: The RESTORE project approach, EGU 2024, Vienna, Austria, EGU24-15985, https://doi.org/10.5194/egusphere-egu24-15985
3. **Hung, W. C.,** Lin, S. H., Chen, Y. A., & Lin, G. Z. (2024). Multi-sensor System for Detecting Land Subsidence in Central Taiwan (No. EGU24-10022). Copernicus Meetings.
4. Lin, S. H., **Hung, W. C.,** & Hu, J. C. (2024). InSAR Decomposition Reveals Varied Deformation Patterns in Coastal Subsidence Regions (No. EGU24-15224). Copernicus Meetings.
5. **Loupasakis** C., Tzampoglou Pl. (2023) Contradictive Mining Geohazards at the Perimeter of Open Pit Coal Mines. The Case of the Amyntaio Coal Mine, Greece. XIV IAEG Congress 2023 Abstracts. Chengdu, China, pp 21-22.
6. Antoniadis N., Alatza St., **Loupasakis** C., Kontoes Ch. (2023) Coastal Cities under the Threat of Land Subsidence and Flooding. The Cases of Messolonghi & Aitolikon, Greece, XIV IAEG Congress 2023 Abstracts. Chengdu, China, pp 400-401.
7. **Loupasakis** C., Tzampoglou Pl. (2023) Landslides Vs Land Subsidence at the Perimeter of Open Pit Coal Mines. The Case of The Anyntaio Coal Mine, Greece. 6th World Landslide Forum Abstracts, pp 502.
8. **Niroumand, H.**, Balachowski, L. (2024), The role of nano-materials and nanotechnology as a high-tech technology in geotechnical engineering, XVIII European Conference on Soil Mechanics and Geotechnical Engineering, 26th-30th August 2024, Lisbon, Portugal (the importance of ground improvement in land subsidence and sinkholes)
9. Tsai, C. S., Liu, J., **Tokunaga**, T., and Ito, Y., 2023, Investigation of shallow groundwater salinization by upstream migration of seawater along a tidal river, the coastal subsided region of Chiba Prefecture, Japan. EP23EE-1990
10. Cigna F., **Bonì R.**, **Teatini P.**, Paranunzio R., **Zoccarato C.** 2024. Multi-scale assessment of land subsidence risk in major urban areas of Italy using satellite InSAR, hydrogeological and climate data. Proc. 2024 IEEE International Geoscience and Remote Sensing Symposium (IGARSS), pp. 5394-5397, doi:10.1109/IGARSS53475.2024.10641505
11. Cigna F., **Bonì R.**, **Teatini P.**, Paranunzio R., **Zoccarato C.** 2024. Assessing current and future land subsidence risk induced by groundwater exploitation in Italy using Earth observation. Proc. 2024 IEEE Mediterranean and Middle-East Geoscience and Remote Sensing Symposium (M2GARSS), pp. 406-409, doi:10.1109/M2GARSS57310.2024.10537240
12. Bru, G., **Ezquerro, P.**, Béjar-Pizarro, M., Guardiola-Albert, C., Fernández-Merodo, J.A., Hornero, J.E., Herrera, G. (2024). "InSAR-Based Assessment of Land Subsidence Related to Aquifer Overexploitation in Spain: A Comprehensive Review," 2024 IEEE Mediterranean and Middle-East Geoscience and Remote Sensing Symposium (M2GARSS), Oran, Algeria, 2024, pp. 386-390, doi: 10.1109/M2GARSS57310.2024.10537561.
13. Cerca M., **Carreón Freyre, D.**, Ortega-Cervantes, C., 2024. Estimating static elastic properties of the volcanic sequence in the Valley of Queretaro and implications to land subsidence-related ruptures. ISRM European Rock Mechanics Symposium. New Challenges in Rock Mechanics and Rock Engineering. Alicante, Spain. https://eurock2024.com/. 6 p.

**Publications in international/national books:**

1. **Teatini, P.,** Da Lio, C., **Zoccarato, C.** & **Tosi, L.** (2024). Natural Compaction of Sediments. In: Chaussard, E., Jones, C., Chen, J.A., Donnellan, A. (eds) Remote Sensing for Characterization of Geohazards and Natural Resources. Springer Remote Sensing/Photogrammetry. Springer, Cham. https://doi.org/10.1007/978-3-031-59306-2_19
2. Mateos, R.M., Béjar-Pizarro, M., Bru, G., **Ezquerro, P.**, López-Vinielles, Guardiola-Albert, C., Herrera, G. (2024) La Vigilancia de los Peligros Geológicos desde el Espacio. Instituto Geológico y Minero de España: 175 años. Editorial Consejo Superior de Investigaciones Científicas. 404 pp. ISBN: 978-84-00-11309-4 (Written in Spanish)

3. G. Bru, **P. Ezquerro**, J. López-Vinielles, C. Reyes-Carmona, C. Guardiola-Albert, M. Béjar-Pizarro. (2024) Manual básico sobre el uso de datos InSAR para medir desplazamientos de la superficie del terreno. ISBN: 978-84-09-62312-9. https://digital.csic.es/handle/10261/360969
4. Ha, Quang Khai; Phung, Thanh Huy; Phan, Nam Long; **Minderhoud, Philip SJ**; Le Vo, Phu; Essink, Gualbert Oude; *Groundwater resource challenges and abstraction-induced land subsidence in the Vietnamese Mekong Delta*. Book chapter in *The Mekong River Basin* 421-451, 2024 Elsevier.

**Publication in national journals**

1. **Kenji Daito**. Management of Groundwater in the Nobi Plain that Modeled Groundwater Use for Earthquake Disasters and Improvement of Aquatic Environment, Proc. the 2nd Conf. on Construction Resources for Environmentally Sustainable Technologies, Fukuoka, Japan (2023), pp.45-48, 2023.
2. **Kenji Daito**. Volume VII Groundwater and Disaster, Chapter 4 Subsidence and Groundwater, pp.456-464, Volume VIII Construction Work and Groundwater, Chapter 1 Outline of Groundwater Problem in Construction Work and Measures, pp.467-471, Cyclopedia of Groundwater, Japanese Association of Groundwater Hydrology, Asakura Publishing Co., Ltd , 2024. (in Japanese)
3. Kwinta, A., **Malinowska, A.**, & Hejmanowski, R. (2024). Modelling and visualization of deformations caused by underground mining. *Bulletin of the Polish Cartographic Society*, (30), 44. https://kartografia.pwr.edu.pl/wp-content/uploads/2024/05/Biuletyn_SKP_nr30.pdf
4. Huijbregts, R., Geurts, C., **Koster, K.**, and Willems, M. (2024). Gebouwschade door bodemdaling voorspellen en voorkomen. Binnenlands bestuur
5. **Lin Zhu**, Huili Gong, Xiaojuan Li, Chaofan Zhou, Miao Ye, Haigang Wang, Ke Zhang, Miao Miao Han. Research progress and prospect of land subsidence[J]. Hydrogeology & Engineering Geology, 2024, 51(4): 167-177. DOI: 10.16030/j.cnki.issn.1000-3665.202212043 (In Chinese)
6. Huolian Zhang, Shenlin He, Yongwei Zhang, Dejie Yu, Xulong Gong, **Shujun Ye**. Sensitivity Analysis of Controlling Factors for Earth Fissures in Aquifer Systems with Abrupt Thickness Changes, Geological Journal of China Universities, 2024, 30 (4): 442-450. (in Chinese)

**News and media**

- Cracks and sinkholes appear across Iran amid groundwater crisis, *The Guardian*, https://www.theguardian.com/science/2024/sep/25/terrawatch-sinkholes-iran-groundwater-depletion-crisis
- Crisis under the earth, *Iran Newspaper* (The official daily newspaper for the government of Iran), https://irannewspaper.ir/8460/15/91227
- Subsidence affecting the whole Iran, *Payamema* ( A newspaper focused on topics related to sustainable development in Iran), https://payamema.ir/payam/116122
- *El Diario*: La sobrexplotación de los acuíferos para el regadío hunde el suelo y agrava el riesgo en la España inundable. https://www.eldiario.es/sociedad/sobrexplotacion-acuiferos-regadio-hunde-suelo-agrava-riesgo-espana-inundable_1_10988617.html
- *National Geographic España*: Ciudades que se hunden: la lucha de Yakarta contra las aguas. https://www.nationalgeographic.com.es/medio-ambiente/ciudades-que-se-hunden-lucha-yakarta-contra-aguas_23066
- This year, the work of M. Shirzaei's team on land subsidence has been featured in over 450 national and international outlets, reaching 43.3 million people, per Virginia Tech's PR, including *USA Today, New York Post, Newsweek, Wired, and the front page of New York Times*.
- El Heraldo de México Comarca Lagunera. Se hunde el suelo en La Laguna: académicos de la UNAM advierten sobre la explotación del acuífero. Published on August 1, 2024. https://heraldodemexico.com.mx/nacional/2024/8/1/se-hunde-el-suelo-en-la-laguna-la-unam-advierte-sobre-la-explotacion-del-acuifero-626021.html
- *Le Scienze*: La diversità geologica della laguna veneziana minacciata dall'innalzamento del mare https://www.lescienze.it/news/2024/05/21/news/la_diversita_geologica_della_laguna_veneziana_minacciata_dallinnalzamento_del_mare-15937448/

- *Ansa*. Nella laguna di Venezia l'80% delle coste a rischio A causa dell'innalzamento del mare e l'abbassamento del suolo https://www.ansa.it/canale_scienza/notizie/terra_poli/2024/05/24/nella-laguna-di-venezia-l80-delle-coste-a-rischio_1f9673f0-9be5-4b9e-a4b2-3a64fc9f7c2d.html
- *Corriere del Veneto*. Venezia, innalzamento dei mari e Mose: nel 2050 le barene della Laguna saranno sommerse https://corrieredelveneto.corriere.it/notizie/venezia-mestre/cronaca/24_maggio_22/venezia-innalzamento-dei-mari-e-mose-nel-2050-le-barene-della-laguna-saranno-sommerse-b5186f7b-33c1-4b79-9329-ee3c74b96xlk.shtml;
  https://www.ilgazzettino.it/nordest/venezia/laguna_innalzamento_mari_rischio_scomparsa_2050-8131880.html
- *Linkiesta*. La subsidenza è la variabile più sottovalutata delle alluvioni in Italia https://www.linkiesta.it/2024/05/alluvioni-emilia-romagna-milano-subsidenza-abbassamento-suolo-pioggia/
- *Greenplanner*. Venezia sprofonda e la sua subsidenza mette a rischio anche la sua geodiversità https://www.greenplanner.it/2024/05/24/venezia-sprofonda-rischio-geodiversita/
- *Il Gazzettino*. Ingegneria geologica per salvare Venezia https://www.ilgazzettino.it/tecnologia/moltofuturo/ingegneria_geologica_per_salvare_venezia-8246517.html
- Hamed Niroumand developed two social media channels and pages on Instagram (*subsidence.sinkhole*) and Telegram (*subsidence.sinkhole*) dedicated to land subsidence and sinkholes. Since 2014, these platforms have helped increase awareness about the 'national crisis of land subsidence in Iran' among the general public and relevant managers.
- Hamed Niroumand has been frequently invited as an expert on Iranian TV channels such as TV 3 and TV 4, as well as radio programs like Radio Tehran and Radio Salamat, to discuss various aspects of land subsidence and sinkholes in Iran. These discussions have covered reasons, monitoring systems, management techniques, the role of universities, effects on historical buildings and infrastructure, and necessary requirements. Over the past decade, H. Niroumand has been recognized for his suggestion on this issue, which has been labeled as a "National Crisis in Iran".
- Diario.es. La sobrexplotación de los acuíferos para el regadío hunde el suelo y agrava el riesgo en la España inundable. 16 de marzo de 2024. https://www.eldiario.es/sociedad/sobrexplotacion-acuiferos-regadio-hunde-suelo-agrava-riesgo-espana-inundable_1_10988617.html
- Radio: Onda Regional Murcia. Programa Reacción en Cadena, 2024. Subsidencia del terreno en el Valle del Guadalentín. https://vertice.cpd.ua.es/291798
- Dora Celia Carreón Freyre. Dissemination talk. “El paradigma de la gestión de agua subterránea en México: subsidencia y crecimiento de zonas urbanas”. Seminario por invitación en el Instituto de Investigaciones en Ecosistemas y Sustentabilidad (IIES). Campus Morelia, UNAM. Presencial. 18 de junio de 2024. Estudios de fracturamiento en la Alcaldía de Iztapalapa. Colaboración UNAM-AI 2007-2024. Primer Foro “Planeación y Desarrollo. Iztapalapa, Capital de la Metropoli” Hundimientos Diferenciales y Fracturamiento del Subsuelo en Iztapalapa. Congreso de la Unión, CDMX. Conferencia invitada. Presencial. 28 de febrero de 2024.

**Land Subsidence Collaboration, Management and Dissemination**

- Malinowska, A. organized the Invited lectures for Visiting prof. Pietro Teatini 2024 AGH University of Krakow, Poland
- Malinowska, A. was land subsidence advisory board member for:
    - Preparation of the program for land subsidence management above salt energy storage in salt Cavern Kosakowo Poland
    - Verification of Land Subsidence monitoring system for post mining areas above salt cavern in Wieliczka Salt Mine
    - Safety establishment and land subsidence simulation for Żelazny Most Tailings, Poland
- Motagh, M. starts a collaboration with the University of Padova in Italy (Prof. Pietro Teatini) in the framework of a national project funded by the Federal Ministry of Economic Affairs and Climate Action (BMWK) in Germany related to land subsidence due to open-pit mining in Germany
- R. Tomás have been nominated as: Miembro del Subgrupo de Trabajo de Inestabilidad del terreno del Grupo de Trabajo formalizado por el Ministerio de Transportes, Movilidad y Agenda Urbana (Orden TMA

de 8 de febrero de 2023) para la preparación del Plan Nacional de Vigilancia Sísmica, Volcanológica y de otros Fenómenos Geofísicos, encargado por el Gobierno a dicho ministerio (Real Decreto-ley 2/2022, de 22 de febrero).

- Enrique Cabral-Cano has been nominated as member of the Comité Científico Asesor del Sistema Nacional de Protección Civil (SINAPROC) sobre Fenómenos Geológicos.
- Kenji Daito has been nominated as chairman of Analytical Department Committee, Tokai Three Prefecture Land Subsidence Investigate Committee, Japan.
- Kenji Daito is chairman of Geo-Environmental Society, Aichi Prefecture, Japan.
- Michelle Sneed helped develop 'Land Subsidence Best Management Practices' documents for the California Department of Water Resources in support of the Sustainable Groundwater Management law.
- Michelle Sneed helped modernize a subsidence mitigation strategies brochure for the Federal Emergency Management Agency (FEMA)
- Michelle Sneed. Email alias administrator for U.S. Geological Survey and National non- U.S. Geological Survey Subsidence Interest Group
- Michelle Sneed is land subsidence subject matter expert for
    - extensometer construction projects in Virginia, Texas, and California
    - quality assurance of aquifer-system compaction and land subsidence data and for processing and storage of those data (projects throughout the United States)
    - numerical modeling of aquifer-system compaction and land subsidence for projects in California and Texas.
    - U.S. Geological Survey (USGS) Geospatial Data and Vertical Datum Focus Group
    - technical requirements of National Aeronautics and Space Administration (NASA)'s InSAR-capable NiSAR satellite for land deformation caused by fluid withdrawal
    - update to the book 'Land Subsidence from Groundwater Use in CA'
    - economists working on the economic impacts of land subsidence (paper is in preparation)
    - students working on land subsidence projects (interviewed on several occasions)
- Kai Gu was involved in the following activities:
    - Preparation of the Codes of Practice of Ministry of Natural Resources 'Land subsidence and ground fissures monitoring using distributed optical fiber sensing', which now is under formal implementation.
    - Held three seminars on distributed optical fiber monitoring technology for land subsidence in the fields of geological survey, water conservancy and transportation.
    - Helped modernize subsidence mitigation strategies for Nantong, Zhenjiang and Suzhou in Jiangsu Province, China.
- J. Lambert. Generation and distribution of a monthly overview of new literature and other announcements regarding to land subsidence for UNESCO LaSII and other interested.
- Initiating activities for the new International Panel on Land Subsidence (IPLS) initiative (www.IPLSubsidence.org)
- PSJ Minderhoud leads the ENGULF project 'SubsidENce along the GULF of Guinea, West Africa'. Project aims to build a 'Community of Interest' and capacity building among local researchers.
- Lin Zhu have fostered the following international academic collaborations:
    - The 2022-2027 memorandum of understanding (MoU) between Capital Normal University and University of Padova, liaisons: Lin Zhu and Pietro Teatini.
    - Jointly establish International research center on land subsidence, liaisons: Lin Zhu and Pietro Teatini.
    - *The Innovative Talent International Cooperation Training Program* under the China Scholarship Council (CSC). Partner universities include Capital Normal University (liaison: Lin Zhu), University of Padova (liaison: Pietro Teatini), and the University of Alicante (liaison: Roberto Tomás Jover), Ca'Foscari University of Venice, Eötvös Loránd University and Flinders University. Through this program, two PhD students (Miao Ye, Huilin Yu) have been funded for joint training at the University of Padova, while two faculty members (Lin Zhu, Lin Guo) have been funded to conduct research collaboration at the University of Padova, and one faculty member (Mi Chen) has been funded to the University of Alicante.
- Lin Zhu have promoted the awareness of land subsidence:

    - As Deputy Secretary-General of Beijing Geographical Society, I organized a special session on water cycle and land subsidence at the annual geographical academic conference.
    - As a member of Capital's Employee Education and Training program, I give lessons on land subsidence to practitioners working in institutes related to geology and hydrology .
- K. Koster on request by the Dutch Ministry of Economic Affairs and Climate Change disseminated subsidence to citizens at the following events:
    - Townhall meeting on subsidence in urban areas surrounding the oil field of Schoonebeek
    - Special interest group meetings on surface motion processes in urban areas surrounding the underground gas storage of Norg
    - Special interest group meetings on surface motion processes in urban areas surrounding the underground gas storage of Grijpskerk
- K. Koster have been involved as expert in land subsidence to provide input regarding peatland subsidence for art displayed at the townhall of the municipality of Amsterdam.
- K. Koster have been involved as expert in land subsidence to provide knowledge and data input for an architectural exposition focused on subsiding coastal lands at the International Architecture Biennale Rotterdam
- S. Ye reviewed the draft Specification for risk assessment of land subsidence written by China Geological Survey, which will be issued by Ministry of Natural Resources of the People's Republic of China
- S. Ye reviewed the draft Specification for land subsidence monitoring and control written by Shanghai Institute of Geological Survey, which will be issued by Ministry of Natural Resources of the People's Republic of China
- Since January 2022, Hamed Niroumand has been selected to participate in various meetings on land subsidence, including those held by the Ministry of Road and Urban Development in Iran, among others.
- Roberto Tomás manages the Spanish Group on Land Subsidence, its webpage and submit the annual report of the group every year to the IHP Spanish representative.

**Awards and recognition**

- K. Najeebullah has been recognized with the *Shaanxi Provincial Innovation Achievement Award* in China. This prestigious award was granted based on the innovative methodology and contributions to subsidence research demonstrated in his recent publication.
- Capital Normal University nominated Pietro Teatini as a candidate for the Beijing Science and Technology Award-International Cooperation Zhongguancun Award (liaison: Lin Zhu).

**International and National projects:**

1. RS4Taipei:The Groundwater Budget and Subsidence Risk in Taipei Basin, Taiwan, from Remote Sensing and Numerical Modelling, funded by National Science Foundation (DFG) in Germany, and Ministry of Research in Taiwan (2024-2027). PI Motagh, M.
2. Sustainable groundwater RESources managEment by integrating eaRth observation deriVed monitoring and flOw modelling Results (RESERVOIR). PRIMA, European Comission (EU). 2020- 2024. Members/affiliates involved: R. Tomás, P. Teatini, P. Ezquerro, C. Zoccarato
3. ENGULF-Coastal land subsidENce in the GULF of Guinea: Assessing relative sea-level rise and land subsidence of coastal mega-cities and river deltas along the Gulf of Guinea". Funded by the French Development Agency (AFD). 2022-2024. Members/affiliates involved: A. Addo, P. Teatini, P. Minderhoud, M. Shirzaei, R. Bonì.
4. 2020-2024. Study of the surface and subsoil deformation of the territory of the Iztapalapa Municipality, through the "Deformation Measurement System SIMED-AI". (Estudio de la deformación superficial y del subsuelo del territorio de la Alcaldía de Iztapalapa por medio del "Sistema de Medición de Deformación, SIMED-AI)". Responsible Dora Carreón Freyre. Collaboration project with Alcaldía de Iztapalapa, Mexico City. No. CV-COSJ-CGEO-006-X/2020.
5. Submitted Project Collaboration Mexico – Germany. Pumping-induced Land Subsidence and Ground fissures in Central Mexico: Insights fromRemote Sensing, Geospatial Artificial Intelligence, and

Geomechanical Modelling. Submitted in collaboration with Enrique Cabral, UNAM, and Mahdi Motagh, Leibniz University Hannover (LUH).

6. “REconstruct subsurface heterogeneities and quantify Sediment needs TO improve the REsilience of Venice saltmarshes” funded by NextGenerationEU within the -Projects of great national interest (PRIN) - funded by the National Recovery and Resilience Plan (PNRR). PI: L. Tosi
7. “Work Package 1: Land subsidence and mean sea level” within the NMIA - Studies on the physical habitat of North Manila Bay for biodiversity offset. PI: L. Tosi
8. “Evaluation of ground motions induced by gas storage in the Collalto field (North Italy)” PI: L. Tosi
9. COPERNICUS EMS_ES - Copernicus Emergency Management Service (CEMS) Risk and Recovery Mapping (RRM) Tailor-Made Products (FLEX). European Commission, Joint Research Centre (2024-2028). PI: C. Loupasakis
10. Qatar Geological Mapping Project - Phase II (TC-B-84-2459-2022), Ministry of Municipality (MM), State of Qatar (2024-2028). PI: C. Loupasakis
11. AERGEO - Aerial Ground Monitoring and Bathymetry for Geotechnical Hazard Assessment, ``RESTART 2016 – 2020``, Research and Innovation Foundation (RIF) of Cyprus (2024-2027). PI: C. Loupasakis
12. SUBRISK+ Enhancing our understanding of Subsidence RISK induced by groundwater exploitation towards sustainable urban development. Funded in the framework of the Research Projects of Significant National Interest (PRIN) - National Recovery and Resilience Plan (PNRR) call 2022. 2023-2025. https://www.subrisk.eu/ PIs: Roberta Bonì, Pietro Teatini, C. Zoccarato
13. EGMS RASTOOL: European ground motion risk assessment tool (101048474). DG-ECHO, European Comission (EU). 2022-2024. Members/affiliates involved: P. Ezquerro
14. Geological Survey of Europe – mapping and understanding land subsidence along the coastlines of the European Union. Members/affiliates involved: K. Koster
15. The mechanism of land subsidence-ground rupture with the background of rising groundwater field. National Natural Science Foundation of China, No. 42271082, 2023-2026 (principal investigator: Lin Zhu).
16. S. Ye is involved in two projects related to land subsidence. One is numerical modeling of land subsidence caused by geothermal exploitation, and the other is land subsidence in Yellow River Delta.

**Data release**

1. Haghighi and Motagh, 2024. Land Subsidence in Iran Estimated from a Nationwide InSAR Analysis of Sentinel-1 Observations 2014-2020. Zenodo. doi: 10.5281/zenodo.10815578. Interactive map of land subsidence in Iran, developed as a collaboration between Leibniz University Hannover and the GFZ German Research Centre for Geosciences. It provides insights into land subsidence in Iran using InSAR analysis of Sentinel-1 satellite data, highlights regions affected by land subsidence and aids in monitoring and understanding subsidence trends.

**PhD and post-doctoral supervision**

1. María Inés Navarro Hernández. Aplicación de técnicas InSAR para la gestión sostenible de acuìferos detríticos y sus potenciales impactos de subsidencia y riesgo de inundación. Directores: Javier Valdés, Roberto Tomás. Universidad de Alicante. Junio de 2024. Outstanding cum Laude.
2. Leonard Ohenhen (2024) Earth Observation Data-Driven Assessment of Local to Regional, Contemporary, and Emerging Coastal Environmental Security Challenges, Virginia Tech. Supervisor: M. Shirzaei.
3. Enrique Antonio Fernández Torres, 2019-2024. Doctorate at the Posgrado en Ciencias de la Tierra, UNAM. Evaluación del Riesgo Social y Económico por Subsidencia en México Utilizando Series de Tiempo InSAR. Graduated February 9, 2024. Supervisor: Enrique Cabral-Cano
4. Marta Cosma. Post-doctoral projects on “The Holocene Imprint on the future Evolution of Transitional Environments” and “Vulnerability of the Veneto coastland” at CNR-IGG (Italy). Supervisor: L. Tosi
5. Land subsidence, due to natural and anthropogenic causes, in areas of Attica Region, Greece. Assigned to A. Kaitantzian. Supervisor: C. Loupasakis
6. Geocatastrophic phenomena related to groundwater dynamics. The Messara basin, Heraklion, Crete. Assigned to I. Michalakis. Supervisor: C. Loupasakis
7. Impacts of Megaflood Events in Subsidence-Affected Plains Areas. Assigned to N. Antoniadis. Supervisor: C. Loupasakis

8. R. Bonì. PhD supervision in Sustainable Development and Climate Change (PhD SDC) program funded by the Italian Space Agency and entitled “Integration of EO data into subsidence risk assessment to support sustainable groundwater management”.
9. M. Verbene. Data assimilation and human-induced land subsidence at different depths. Supervisor: K. Koster
10. V. Maoret. Land subsidence in urban areas. Supervisor: K. Koster

**Master students supervision**

1. Daniel Hernández Luna, 2022-Present. Master of Science at the Posgrado en Ciencias de la Tierra, UNAM. Caracterización de subsidencia y exposición de la población vulnerable en la zona metropolitana de La Laguna. In progress. Supervisor: Enrique Cabral-Cano
2. Leandra Luna Celín, 2024-Present. Master of Science at the Posgrado en Ciencias de la Tierra, UNAM. Caracterización de subsidencia en ciudades del norte de México. In progress. Supervisor: Enrique Cabral-Cano
3. María Clara Madrigal Madrigal, 2024-Present. Master of Science at the Posgrado en Ciencias de la Tierra, UNAM. Caracterización de subsidencia en municipios metropolitanos del Estado de México. In progress. Supervisor: Enrique Cabral-Cano
4. Miryam Marlene Mancha Moreno. 2024-Present. Master of Science at the Posgrado en Ciencias de la Tierra, UNAM. Caracterización de subsidencia en municipios metropolitanos de Guadalajara. In progress. Supervisor: Enrique Cabral-Cano
5. Mahsa Khoshraftar. Assesment of subsidence risk: in the Alborz province, Supervisor: Hamed Niroumand. Imam Khomieni International University – Buein Zahra Campus. 2024.
6. Hongshan Han. Dynamic response and prediction of groundwater levels in the Beijing Plain under different precipitation and human activity impacts. Director: Lin Zhu. Capital Normal University. Jun 2024.
7. Miaomiao Han. Groundwater level simulation and prediction based on coupling of MODFLOW and LSTM in the upper and middle parts of Chaobai River alluvial fan. Director: Lin Zhu. Capital Normal University. Jun 2024.
8. Yueting Li. Uncertainty Quantification of the Continuous and Discontinuous Geomechanical Response in Over-exploited Aquifers. University of Padova. 2024. Supervisor: P. Teatini. Co-supervisor: C. Zoccarato
9. Subsidencia del terreno en el acuífero detrítico de Caudete-Villena: análisis, causas y consecuencias. Marta Gómez Cebrián. Julio de 2024. Master in Engineering Geology. Supervisor: Roberto Tomás
10. Estudio de la subsidencia del terreno de la Costa del Sol Occidental (Málaga, España). Lisbeth Núñez Haugh. Julio 2024. Master in Engineering Geology. Supervisor: Roberto Tomás

**Editorial activity**

- C. Loupasakis. Guest Editor of the Special Issue "Mapping and Monitoring of Geohazards with Remote Sensing Technologies II", Remote Sensing, MDPI.
- C. Loupasakis. Guest Editor of the Special Issue "New Perspectives for the Monitoring and Early Detection of Geohazards", Remote Sensing, MDPI.
- K. Koster. Guest editor ‘Land Subsidence in the Netherlands’ for the Netherlands Journal of Geosciences
- C. Zoccarato. Editorial Board member of the Communication Earth and Environment Journal.
- R. Tomás. Guest editor of the special issue: Imaging Geodesy and Infrastructure Monitoring II. Remote Sensing. MDPI
- L. Tosi. Associated Editor: Marine and Petroleum Geology
- L. Tosi. Editorial Board: Scientific Reports