

Geo-EnvironMeet 2025

GSP 360

Climate Change, Sustainability, and Resilience

Selected Papers from Geo-EnvironMeet 2025
Louisville, Kentucky • March 2–5, 2025

EDITED BY

Arvin Farid, Ph.D., P.E.
Milind V. Khire, Ph.D., P.E., D.GE
Idil Deniz Akin, Ph.D.

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of the American Society of Civil Engineers

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Preface

The Geotechnical Special Publication (GSP) presented here compiles papers from GeoenvironMeet 2025, the ASCE Geo-Institute's Geoenvironmental Engineering conference, held from March 2–5, 2025. This event marks nearly four decades since the inaugural geoenvironmental specialty conference. Held every six to eight years, it serves as a vital platform for addressing current issues in our field. The theme of the 2025 conference, "Sustainability and Resilience of the Geoenvironment in Facing a Changing Climate," underscores our commitment to tackling pressing challenges. GeoenvironMeet 2025 drew a diverse audience of geoenvironmental professionals, fostering invaluable exchanges amidst the backdrop of unprecedented industry challenges. While the conference featured numerous discussions and networking opportunities, this publication offers a focused selection of papers centered on Climate Change, Sustainability, and Resilience. These topics were chosen for their shared technical subdisciplines and relevance to the conference theme, reflecting ongoing and emerging developments in the field. The rigorous review process adhered to ASCE GSP standards, with each of the submitted manuscripts evaluated by two or more independent peer reviewers. Publication required consensus from at least two peer reviewers. We extend our heartfelt gratitude to the session chairs and reviewers whose dedication ensured the success of both the conference and these proceedings. It is our hope that this compilation serves as a valuable resource for the geoenvironmental engineering community in the years ahead.

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Contents

Climate Change and the Geoenvironment

Effectiveness of Compost at Stimulating Soil Carbon Sequestration and Storage.....1
Jerome Wright and Bret N. Lingwall

Effect of Storm Surge-Induced Scour on the Bearing Capacity of Shallow Foundations for Coastal Residential Buildings 10
Hiramani Raj Chimauriya, Nripojyoti Biswas, Anand J. Puppala, and Amit Gajurel

Laboratory Studies on Enzyme and Microbially Induced Carbonate Precipitation for Mitigation of Fugitive Dust from Saline Soil.....20
Farideh Ehsasi, Edward Kavazanjian Jr., Leon van Paassen, and Angel Gutierrez

Unravelling the Dynamics of Debris Flow in Uttarakhand, India 29
Renu Priyanka Kosana and Pala Gireesh Kumar

Land Subsidence—A Geo-Hydro-Enviro-Problem.....39
Chin Man W. Mok, Pin-Ching Li, Barbara A. Carrera, Hiroko M. Hort, and Meng-Chia Li

Laboratory Investigations into the Effects of Heating on Clay's Mechanical and Hydraulic Changes Using Geophysical Methods.....47
Elizabeth Nunez, Wing Shun Kwan, and Cesar Leal

Surficial and Chemical Characterization of Ash after the 2022 Bolt Creek Fire in the Western US 57
Mustafa Demir, Alishan Ahmed, Peter R. Robichaud, and Idil Deniz Akin

Comprehensive Hydraulic Characterization of Partially Saturated Soil for Enhanced Earthen Dam Stability Assessment under Extreme Weather Conditions 67
Puneet Bhaskar, Aditya Deshmukh, and Anand J. Puppala

Numerical Performance Evaluation of a Lime-Stabilized Coal Ash Slope Subjected to Rainfall 78
C. S. S. U. Srikanth, B. J. Ramaiah, and A. M. Krishna

Hydrophobicity Inducement on Laboratory Soil Specimens to Study Wildfire Impacts on Infiltration, Revegetation, and Erosion.....88
Max Veneris and Arvin Farid

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Temperature Sensitivity of Three Conductivity Sensors for Measuring the Electrical Conductivity of Soil Pore Fluid 98
William J. Baker III, Siamak Yoosefi, Mohammadreza Jebeli, and Christopher L. Meehan

Experimental Study on the Effect of Salinity Variations on the Water Retention of a Marine Lean Clay and Kaolinite 108
Mohammadreza Jebeli, Siamak Yoosefi, William J. Baker III, and Christopher L. Meehan

Optimization of Carbonate Precipitation of EICP Technique Using Three-Level Full Factorial Design Analysis 118
Kaniz Roksana, Shaini Aluthgun Hewage, and Cheng Zhu

Peridynamic Modeling of Impact Loading in Frozen Soils for In Situ Resource Utilization in the Arctic 128
Cocou D. R. Aza-Gnandji and Tugce Baser

Climate Adaptive Contaminated Site Remediation: Review of Case Studies 139
Jyoti K. Chetri, Sylvia Pimentel, Valeria Kandou, Jimmy D'Angelo, and Krishna R. Reddy

Effects of Wet–Dry Cycling on Tensile Strength of Lightly Cemented Dune Sand from a Kangaroo Rat Habitat 147
Sera Tirkes, Duygu Aydin, Haluk Beyenal, and Idil Deniz Akin

Modeling of Soil Freezing Water Characteristic Curve Considering Phase Change 156
Ali Behdad, Jongwan Eun, and Incheol Kim

Microbially Induced Calcium Carbonate Precipitation as a Carbon Sequestration Technique for Mining Waste 165
S. M. Wilcox, C. N. Mulligan, and C. M. Neculita

Study of Existing Soil Characteristics, Flood Protection Methods, and Community Involvement for Proposing Zone-Wise Flood Management Strategy in Bangladesh 178
Minhaz Mohammad Shahriar, Berjees Anisa Ikra, Syed Washiqun Nabi, and Jeba Mubashira

Landslide Prediction Using Deep-Learning Frameworks and Wireless Sensor Networks 188
Syed Mujtaba Hussaine, Syed Abu Sayeed Mohammed, Arif Ali Baig Moghal, and Bhaskar Chittoori

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Sustainability and Resilience

Improvement of Mechanical Behavior of Soils Extracted from Disaster Debris by Short Fibers for Further Use as Geomaterial Fillers 198
Jakhongirbek Ganiev, Takayuki Sakai, Masaki Nakano, and Yoshikazu Otsuka

Use of Sawmill Residuals as a Geotechnical Amendment for Reclamation and Site Restoration 207
Calvin Tohm and Bret N. Lingwall

Validation of an Empirical Model for Underwater Noise due to Pile Driving Based upon High Attenuation at Lower Frequencies in Shallow Water 216
Raphael Crowley, Mariam Makoleo, Consolatha Mushi, Amanda Schaaf, Emily Sapp, Jim Gelsleichter, and Ryan Shamet

Accelerated Carbonation of Mine Tailings for Acid Mine Drainage Treatment and Carbon Dioxide Sequestration 226
Hamidreza Vashaghian and Lianyang Zhang

Global Review of Carbon Capture and Sequestration with Case Studies in Asphalt Binder Producing Oil Refining Industry 233
Sushmit Sharma Bhattarai, Jihyeon Yun, Il-Ho Na, Hyemin Park, and Hyunhwan Kim

Evaluating the Role of pH on Bio-Catalyzed CO_2 Trapping 248
Mert Kavala and Alexandra Clarà Saracho

Development of Low-Carbon Building Products Using CO_2 Sequestered into Chemically Stabilized Soils 259
Ashish Bastola, Atolo Tuinukuafe, Pavan Akula, and Jessica Rimsza

Deformation Response of Tire-Derived Aggregate during Foundation Loading 269
John S. McCartney and Axel Yarahuaman

Carbon Capture, Sequestration, and Utilization by Mine Tailings through Alkali Activation 277
Shayan S. Narani and Sumi Siddiqua

Enhancing Soil Subgrade Strength Using Waste Plastic Water Bottles as a Reinforcement 283
Alka Shah and Tejaskumar Thaker

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Short-Term Effect of External Sulfate Contamination on Physico-Chemical and Index Properties of Carbide Lime Stabilized Expansive Soil.....291
N. Narmada and T. Thyagaraj

Simulation of Combined Impacts of Earthquakes and Floods on Failure Probability of Earthen Levees.....305
Mohammad Reza Mahdavizadeh, Mohsen Ajdari, and Farshid Vahedifard

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Effectiveness of Compost at Stimulating Soil Carbon Sequestration and Storage

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ABSTRACT

Soils have remarkable capacity to store and sequester atmospheric carbon and participate actively in the global carbon cycle. When considering the vast amounts of soil and soil surface areas across the planet, it is well known that one of the most effective principle means of carbon sequestration is in the soil. However, contrary to most people's view, soil carbon is stored foremostly in the exudates of plants and microbiota rather than in macro-carbon. In this study, four sites in South Dakota were studied for 4–15 years with compost as a geo-environmental soil amendment used to kick-start carbon sequestration while simultaneously reducing erosion and increasing crop yields. These four sites include an active farm, a non-grazed hay field, a residential kitchen garden, and a slope located in a long-term geotechnical erosion study site. Compost was added to the soil at each site, and soil carbon was measured over long-time periods. Baseline measurements from adjacent non-intervention sites were also collected to account for more global atmospheric and other conditions include landscape management. Data from the four sites show that compost can be used to stimulate the storage of carbon through plant exudates in soil if the landscape is managed in regenerative frameworks and oxidation of organic matter is not allowed to occur and negate the effects of the compost amendments.

INTRODUCTION

Carbon capture, storage and sequestration are key considerations in the fight against atmospheric carbon induced climate change. Surficial soils (the arena of expertise and practice for geo-environmental engineers) have significant potential for being powerful tools to be leveraged to capture, store, and sequester atmospheric carbon. Here we note carbon storage in soil is primarily through increases in soil organic carbon content (part of the organic matter in the soil). We note that carbon sequestration is primarily though increases in soil inorganic carbon content (notably through calcite precipitation). However, how can soils be activated to their role in carbon management solutions for society? The experiments in this study show that by utilizing compost soil amendments, soil carbon storage and sequestration can be initiated at meaningful scales.

Compost is developed using the natural decomposition process of organic matter, by managing and applying appropriate amounts of moisture, air, and feedstock (Aggelides and Londra 2001). Compost is stable and provides humus to the soil (Kibblewhite et al. 2008). The composting process produces a soil amendment with an acceptable carbon nitrogen ratio, safe levels of pathogens, a relatively balanced pH, and stable in its respiratory rate (Adunga 2016). The purpose of composting is to change organic waste material into a stable and usable product. Soil amended with compost will improve soil aggregation and the root zone environment (Hurisso et al. 2013). Soil organic matter is important determinant of available water content

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