

CURRICULUM VITAE

Ni-Bin Chang

FNAI, FAAAS, FASCE, FIEEE, FSPIE, FRSC, FEURASC, LEED

Professor, Department of Civil, Environmental and Construction Engineering
Director, Stormwater Management Academy
University of Central Florida
Orlando, Florida, 32816, USA
Telephone: (407) 823-1375
Email: nchang@ucf.edu
Homepage: <http://www.cece.ucf.edu/chang/>
Stormwater Management Academy: <http://www.stormwater.ucf.edu/>

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SUMMARY OF TEACHING/RESEARCH INTERESTS AND ACHIEVEMENTS

Dr. Ni-Bin Chang is Professor of Environmental Systems Engineering having held this post in the US since 2002. He is a Professional Engineer in the United States with over 20 more years' experience in research, teaching, and outreach/community services. Chang's research lies at the intersection of sustainability science/engineering and industrial ecology with highly interdisciplinary nature. In the past 20 more years, the focus of his teaching covers the latest forefront in the nexus of "Environmental Sustainability, Industrial Ecology, Green Engineering, and Systems Analysis" with an emphasis on evolving green infrastructure systems and green production under the impact of global changes. He also conducted highly interdisciplinary research to discover new knowledge of industrial ecology, green chemistry, remote sensing, and machine learning to explore urban metabolisms, urban ecology, and earth system processes coupling the built environment and natural system. With the aid of systems engineering approaches, he strived to tackle cross-linked issues in water availability and quality, air quality, waste flows, urban growth, and urban food-energy-water nexus with varying scale. His inventions with different green sorption media for nutrient removal from stormwater and wastewater led to 9 patented technologies in the nexus of food-energy-water-waste nexus and he had licensed to industry after acquiring \$20 million industrial investment and affected some government regulations. His research efforts not only help the minimization of operational disruption of infrastructure systems due to human activities and natural disasters, but also promote sustainable infrastructure management, green production, and community resilience. All the multi-faceted efforts led to provide risk-informed, forward-looking, cost-effective, and environmental benign solutions for sustainable development at varying scales. Chang has been invited for presentations worldwide, published over 260 peer review journal articles, delivered many books/book chapters, and provided journal leaderships of Editor-in-Chief, Associate Editors, and Board Members affiliated with over 20 journals relevant to sustainable development. His academic leadership as a program director in the Hydrologic Sciences Program and the Cyber-Innovation Sustainability Science and Engineering Program at the National Science Foundation from 2012 to 2014 had produced national impact on academic community. These activities have a significant influence on research policy, promote technology advancement, and shape the direction for a broad spectrum of the environmental science and resources management toward environmental sustainability. He has received 38 honor/awards since 1987, including the Outstanding Achievement Award from the American Society of Civil Engineers in 2010, the Fulbright Scholar Award from the Department of State and German-American Fulbright Council in 2012, the Bridging the Gaps Award from the Engineering and Physical Sciences Research Council in the United Kingdom in 2012, the Distinguished Visiting Fellowship from the Royal Academy of Engineering in the United Kingdom in 2014, and the Blaise Pascal Medal from the European Academy of Sciences in 2016. He has managed almost \$13 million worth of research contracts. These investigations have provided the contributions for a large and diverse scientific community. According to Google Scholar, as of Aug. 2019, his research publications have been cited over 10,800 times in which his h-index is 53 and i10-index is 201. At UCF, he has been directing the Stormwater Management Academy (<http://stormwater.ucf.edu/>) since 2011. He was inducted Fellow of the National Academy of Inventors (FNAI), the American Society of Civil Engineers (FASCE), the Institute of Electrical and Electronics Engineers (FIEEE), the International Society of Optics and Photonics (FSPIE), the American Association for the Advancement of Science (FAAAS), the Royal Society of Chemistry (FRSC) in the United Kingdom, and the European Academy of Sciences (FEURASC).

HONOR AND AWARDS

National Awards

1. Fellow, the National Academy of Inventors (NAI), Dec. 2018 (Citation: Dr. Chang was elevated to Fellow of NAI for his contributions to the field of nutrient monitoring, removal, and possible recovery in aquatic environment.)
2. Fulbright Scholar Award, Department of State in the United States and the German-American Fulbright Commission, July, 2012, hosted by the Institute of Bio and Geoscience (IBG) of the Forschungszentrum Jülich, Germany, Jülich, Germany.
3. Intergovernmental Personnel Award, National Science Foundation, USA, Aug., 2012 – Aug. 2014. (Dr. Chang was appointed as the program director in the Hydrologic Sciences Program and the Cyber-Innovation Sustainability Science and Engineering Program at the National Science Foundation from Aug. 2012 to Aug. 2014.)
4. Fellow, American Association for the Advancement of Science (AAAS), USA, Feb., 2012. (ID: 40295539) (Citation: Dr. Chang was elevated to Fellow of AAAS in 2011 “for contributions to the Integrated Sensing, Monitoring and Modeling for Decision Making”.)
5. Outstanding Achievement Award, Environmental and Water Resources Institute (EWRI), ASCE, USA, May, 2010.
6. Fellow, the American Society of Civil Engineers (ASCE), USA, Feb., 2009 (ID: 285056).

Best Paper Awards

7. Best Paper Award in the 6th International Conference on Environmental Informatics, Bangkok, Thailand, Nov. 21-23, 2007.
8. Best Paper Award, Chinese Institute of Environmental Engineering, Taiwan, April, 1997.

International Awards

9. IEEE Distinguished Lecturer, the IEEE Systems Council, May, 2018.
10. Fellow, the Institute of Electrical and Electronics Engineers (IEEE), Nov., 2017. (ID: 90573668) (Citation: Dr. Chang was elevated to Fellow of IEEE in 2017 “for contributions to computational techniques for the analysis of environmental sustainability”.)
11. Fellow, the International Association of Grey System and Uncertainty Analysis (IAGSUA), Nov. 2016.
12. The Blaise Pascal Medal in Earth and Environmental Sciences, the European Academy of Sciences, Nov., 2016. (Citation: “for his contributions to the environmental sustainability, green engineering, and systems analysis”).
13. Fellow, the Royal Society of Chemistry (RSC), the United Kingdom, June, 2015 (ID: 571142).
14. IEEE 2014 Meritorious Services Award, IEEE Systems, Man, and Cybernetics Society, Oct., 2014.
15. Fellow, the International Society of Optics and Photonics (SPIE) (Formerly Society of Photographical Instrumentation Engineers), Dec., 2014. (ID: 882117) (Citation: Dr. Chang was elevated to Fellow of SPIE in 2014 “for contributions to the integrated sensing, monitoring and modeling for environmental decision analysis”).
16. Board Member, Earth Science and Environmental Science Division, the European Academy of Sciences, 2010-2016.
17. Distinguished Visiting Fellowship, Royal Academy of Engineering (RAE), United Kingdom, Feb., 2014.
18. Honorary Distinguished Chair Professor, Tunghai University, Taiwan, June, 2012.
19. Bridging the Gaps Award, Engineering and Physical Sciences Research Council (EPSRC), Exeter, United Kingdom, May, 2012.
20. Distinguished Chair Professorship, National Science Council, Taiwan, June, 2010.
21. Honorary Visiting Professor, Chaoyang University of Technology, Taiwan, May, 2010.

22. Fellow, European Academy of Sciences (<http://www.eurasc.org>), European Union, Oct., 2008.
23. International Fellowship Award for Visiting Europe, National Science Council, Taiwan, 2001.
24. International Fellowship Award for Visiting Europe, National Science Council, Taiwan, 2000.
25. Young Engineer Award, Chinese Institute of Engineers, Taiwan, 1999.
26. Research Excellence Award, National Science Council, Taiwan, 1999-2001.
27. Research Excellence Award, National Science Council, Taiwan, 1997-1999.
28. Russell Ackoff Award, 1994, International Conference of Solid Waste Technology and Management, Univ. of Penn., USA, Oct., 1994.
29. Annual Research Award, National Science Council, Taiwan, Feb., 1996.
30. Annual Research Award, National Science Council, Taiwan, Feb., 1995.
31. Annual Research Award, National Science Council, Taiwan, Feb., 1994.
32. National Scholarship Award for Overseas Graduate Study, Ministry of Education, Taiwan, Aug., 1987-July 1990.

University of Central Florida Awards and Honor

33. UCF Innovator Award, USA, Aug. 2012.
34. UCF Research Incentive Award, USA, March, 2013.
35. UCF Chapter Member, the National Academy of Inventors (NAI), USA, Nov. 2017. (in recognition of his advanced technology development and innovation issued by the United States Patent and Trademarks Office.)
36. UCF Research Incentive Award, USA, March, 2018.
37. Excellence in Research Award, College of Engineering and Computer Science, UCF, Jan. 2019.
38. University Excellence in Research Award, UCF, Feb. 2019. (in recognition of his outstanding contributions in research and commitment to excellence in scholarly and creative activities)

DEGREES

- Ph.D. Major in Environmental Systems Engineering, Cornell University, USA, Aug. 1991.
 Minors: Operation Research and Environmental Economics
- M.S. Environmental Systems Engineering, Cornell University, USA, Aug. 1989.
- B.S. Civil Engineering, National Chiao-Tung University, Taiwan, June 1983.

JOURNAL EDITORSHIP

1. Advances in Water Resources (editorial board member) (current)
2. SPIE Official Journal of Applied Remote Sensing (guest editor, associate editor) (editor-in-chief, current)
3. Ecological Informatics (guest editor, editorial board member) (current)
4. Journal of Civil Engineering and Environmental Systems (guest editor, editorial board member) (current)
5. ISEIS Official Journal of Environmental Informatics (founding editor-in-chief, guest editor) (associate editor) (current)
6. IEEE Systems Journal (guest editor, associate editor) (current)
7. International Journal of Environment and Climate Change (past editor-in-chief)
8. Journal of Environmental Management (editorial board member) (current)
9. Stochastic Environmental Research & Risk Assessment (guest editor, editorial board member) (current)
10. Journal of Environmental Modeling & Assessment (guest editor, editorial board member) (current)

11. Frontiers of Earth Sciences (associate editor-in-chief) (current)
12. Grey Systems: Theory and Application (editorial board member) (current)
13. Journal of Exposure and Health (scientific advisory board member) (current)
14. International Journal of Environmental Science and Technology (associate editor) (current)
15. Journal of Hydroinformatics (editorial board member) (current)
16. Earth Science Informatics (editorial board member) (current)
17. Journal of Cleaner Production (editorial board member) (retired)
18. Journal of Bioprocessing & Biotechniques (editorial board member) (current)
19. Advances and Applications in Bioinformatics and Chemistry (editorial board member) (retired)
20. AGU Official Journal of Water Resources Research (associate editor) (retired)
21. ASCE Official Journal of Hazardous, Toxic, and Radioactive Waste Management, ASCE (guest editor, editorial board member) (retired)
22. ASCE Official Journal of Hydrological Engineering (guest editor, associate editor) (retired)
23. Journal of Recent Patents on Chemical Engineering (editorial board member) (retired)
24. Environnemental Management (editorial board member) (retired)
25. Environmental Impact Assessment Review (editorial board member) (retired)

PROFESSIONAL AFFILIATIONS

1. International Association of Grey System and Uncertainty Analysis (IAGSUA) (Founder and Fellow)
2. American Society of Civil Engineers (ASCE) (Fellow)
3. Royal Society of Chemistry (RSC), the United Kingdom (Fellow)
4. American Association for the Advancement of Science (AAAS) (Fellow)
5. International Society of Optics and Photonics (SPIE) (Fellow)
6. Institute of Electronics and Electrical Engineers (IEEE) (Fellow)
7. European Academy of Sciences, European Union (Fellow)
8. CUAHSI (Consortium of Universities for the Advancement of Hydrologic Science, Inc.) – Representative of University of Central Florida (Member)
9. International Water Association (IWA) (Member)
11. American Society of Mechanical Engineers (ASME) (Member)
12. Florida Climate Institute (FCI) (Board Member)
13. American Geophysical Union (AGU) (Lifetime Member)
15. Association of Environmental Engineering and Science Professors (AEESP) (Member)
16. Professional Engineer (PE) and Member of the Professional Engineers of Texas
17. ISO14001 Environmental Management System Leader Auditor (Certificate)
18. Leadership in Energy and Environmental Design (LEED), U.S. Green Building Council (Certificate)
20. Diplomat of Water Resources Engineering (DWRE), ASCE (Certificate)

ACADEMIC APPOINTMENTS

<u>Date</u>	<u>Position</u>
1. Oct. 2011~the present	Director, UCF Stormwater Management Academy http://www.stormwater.ucf.edu/ University of Central Florida Orlando, FL, 32816, USA
2. Aug. 2012~ Aug. 2014	Program Director, Hydrological Sciences Program

- Program Director, Cyber-enabled Sustainability Science and Engineering (CyberSEES) Program
National Science Foundation
Arlington, VA, USA
3. Jan. 2009~May 2009
Visiting Scientist
Center of Remote Sensing and Modeling for Agricultural Sustainability, USDA, Fort Collins, CO, USA
4. Sept. 2008~Jan. 2009
Visiting Scientist
National Risk Management Research Laboratory, USEPA
Cincinnati, Ohio, USA
5. Aug. 2005~the present
Professor
Department of Civil and Environmental Engineering (primary appointment from 2005 to the present)
Department of Industrial Engineering and Management System (secondary joint appointment from Aug. 2009 to Aug. 2014)
University of Central Florida
Orlando, FL, 32816, USA
6. Jan. 2002~ Aug. 2005
Professor
Department of Environmental Engineering
Texas A&M University-Kingsville
Kingsville, Texas, 78363, USA
Graduate Coordinator
Associate Director, NSF Center for Research Excellence in Science & Technology (CREST)
7. Aug. 1997 ~ Jan. 2002
Professor
Dept. of Environmental Engineering
National Cheng-Kung University
Tainan, Taiwan
8. June 1999 ~ Aug., 2000
Associate Director
Research Institute of Resources Recycling and Management
National Cheng-Kung University
Tainan, Taiwan
9. June, 1999 ~ Sep., 1999
Visiting Professor
Department of Systems Engineering
University of Pennsylvania
Philadelphia, USA
10. Jan. 2000 ~ June, 2000
Adjunct Professor
Graduate Institute of Environmental Science
Tunghai University
Taichun, Taiwan
11. June, 1998 ~ Aug., 1998
Visiting Professor
Institute of Engineering Thermophysics
Chinese Academy of Science
Beijing, China
12. Jan. 1998 ~ June, 1998
Adjunct Associate Professor
Graduate Institute of Environmental Engineering
National Taiwan University
Taipei, Taiwan
13. Aug. 1992 ~ Aug. 1997
Associate Professor
Dept. of Environmental Engineering

National Cheng-Kung University
Tainan, Taiwan

INDUSTRIAL AND NON-ACADEMIC APPOINTMENTS

<u>Date</u>	<u>Position</u>
1. Feb. 1992 ~ July 1992	Deputy Manager Division of Environmental Engineering Fichtner Pacific Engineers, Inc. (German-based Consulting Firm) Taipei, Taiwan
2. Aug. 1991 ~ Feb. 1992	Deputy Manager Ecology & Environment, Inc. Taiwan Branch Office (US-based Consulting Firm) Taipei, Taiwan
3. Jan. 1986 ~ Aug. 1987	Environmental Engineer Dept. of Environmental Engineering Housing and Urban Development Bureau Taiwan Provincial Government Taipei, Taiwan
4. Aug. 1985 ~ Jan. 1986	Environmental Engineer Bureau of Environmental Protection Kaohsiung City Government Kaohsiung, Taiwan
5. Oct. 1983 ~ Aug. 1985	Junior Lieutenant, the Navy of Taiwan

RESEARCH PUBLICATION SUMMARY

1. **Refereed English Books:** 3
2. **Edited English Books/Proceedings:** 6
3. **Refereed Journal Papers:** 260
4. **Invited Book Chapters, Encyclopedia, and Newsletters:** 24
6. **Conference Papers/Invited Presentations:** 300
7. **Technical Reports:** 80
8. **US Patents:** 9 (approved)

Research publications under categories from 1 to 8 mentioned above are not all-inclusively listed in this document. Instead, representative publications are classified according to research topics.

RESEARCH TOPICS

In this section, relevant refereed journal papers, encyclopedia articles, book chapters and books are categorized according to research topics.

**Sustainable Systems Analysis,
Sustainability Sciences, and Global Changes**

Book

1. Chang, N. B. (2010): *Systems Analysis for Sustainable Engineering*. Published by McGraw Hill, New York, USA, 688 pp. ISBN-13: 978-0071630054

Book Chapters

1. Fang X., Chang, N. B., Lee M. K. and Wolf, L. W. (2010): Chapter 3 Environmental Assessment of Using Stone Quarries as Part of an Integrative Water Supply System in Fast Growing Urban Regions. In: *The Effects of Urbanization on Groundwater: An Engineering Case-based Approach for Sustainable Development*, Ed. Chang, N. B. (ASCE), 26-50.
2. Chang, N. B. (2010): Chapter 1 The Frontiers of Sustainable Development in Urban Regions. In: *The Effects of Urbanization on Groundwater: An Engineering Case-based Approach for Sustainable Development*, Ed. Chang, N. B. (ASCE), 1-5.

Journal Papers: Coupled Natural System and the Built Environment

• Theory and Concepts

1. Chang, N. B., Wen, C. G. and Wu, S. L. (1995): Optimal management of environmental and land resources in a reservoir watershed by multi-objective programming. *Journal of Environmental Management*, **44(2)**, 145-161.
2. Chang, N. B. and Wang, S. F. (1995): Optimal planning for the coastal wastewater treatment and disposal system. *Coastal Management*, **23**, 153-166.
3. Chang, N. B. (2005): Sustainable water resources management under uncertainty. *Stochastic Environmental Research and Risk Assessment*, **19(2)**, 1-2.
4. Chang, N. B. (2010): Hydrological connections between low impact development, watershed best management practices and sustainable development. *Journal of Hydrologic Engineering, ASCE*, **15(5)**, 1-2.
5. Ning, S. K., Chang, N. B., Yang, L., Chen, H. W., and Hsu, H. Y. (2001): Assessing pollution prevention program by QUAL2E simulation analysis for water quality management in the Kao-Ping river basin, Taiwan. *Journal of Environmental Management*, **61(1)**, 61-76.
6. Ning, S. K. and Chang, N. B. (2007): Watershed-based point sources permitting strategy and dynamic permit trading analysis. *Journal of Environmental Management*, **84(4)**, 427-446.
7. Ernest, A., Bokhim, B., Chang, N. B. and Huang, I. J. (2007): Fluvial geomorphologic and hydrodynamic assessment in the tidal portion of the Lower Rio Grande River, US-Mexico Borderland. *Journal of Environmental Informatics*, **10(1)**, 10-21.
8. Ji, J. H. and Chang, N. B. (2005): Risk assessment for optimal freshwater inflow in response to sustainability indicators in a semi-arid coastal bay. *Stochastic Environmental Research and Risk Assessment*, **19(2)**, 111-124.
9. Chang, N. B., Parvathinathan, G. and Dyson, B. (2006): Multi-objective risk assessment of freshwater inflow on ecosystem in San Antonio Bay, Texas. *Water International*, **31(2)**, 169-182.
10. Chang, N. B., Chen, H. W., Ning, S. K., Shao, K. T. and Hung, T. C. (2010): Sizing an off-stream reservoir with respect to water availability, water quality, and biological integrity. *Environmental Modeling and Assessment*, **15(5)**, 329-344.
11. Sun, Z., Lotz, T., and Chang, N. B. (2017): Assessing the long-term effects of land use changes on runoff patterns and food production in a large lake watershed with policy implications. *Journal of Environmental Management*, **204(1)**, 92-101.

• Systems Analysis with Uncertainty

1. Chang, N. B. and Wang, S. F. (1995): A grey nonlinear programming approach for planning coastal wastewater treatment and ocean disposal system. *Water Science and Technology*, **32(2)**, 19-29.
2. Chang, N. B., Wen, C. G., Chen, Y. L. and Yong, Y. C. (1996): Optimal planning of the reservoir watershed by grey fuzzy multi-objective programming (I): theory. *Water Research*, **30(10)**, 2329-2334.
3. Chang, N. B., Wen, C. G., Chen, Y. L. and Yong, Y. C. (1996): Optimal planning of the reservoir watershed by grey fuzzy multi-objective programming (II): application. *Water Research*, **30(10)**, 2335-2340.
4. Chang, N. B., Wen, C. G. and Chen, Y. L. (1997): A fuzzy multi-objective programming approach for optimal management of the reservoir watershed. *European Journal of Operational Research*, **99(2)**, 304-323.
5. Chang, N. B. and Chen, H. W. (1997): Water pollution control in a river basin by interactive fuzzy interval multi-objective programming. *Journal of Environmental Engineering, ASCE*, **123(12)**, 1208-1216.
6. Chen, H. W. and Chang, N. B. (1998): Water pollution control in a river basin by genetic algorithm-based fuzzy multi-objective programming. *Water Science and Technology*, **37(8)**, 55-63.
7. Chang, N. B., Yeh, S. C. and Wu, G. C. (1999): Stability analysis of grey compromise programming and its applications. *International Journal of Systems Science*, **30(6)**, 571-589.
8. Chen, H. W. and Chang, N. B. (2006): Decision support for allocation of watershed pollution load using grey fuzzy multiobjective programming. *Journal of American Water Resources Association*, **42(3)**, 725-745.
9. Chen, H. W. and Chang, N. B. (2010): Using fuzzy operators to address the complexity in decision making of water resources redistribution in two neighboring river basins. *Advances in Water Resources*, **33**, 652-666.

Journal Papers: Information Technologies

1. Chang, N. B. Chen, H. W., Ning, S. K. and Cheng, K. Y. (2001): Prediction analysis of non-point pollutant loadings for the reservoir watershed via the use of GIS/GPS/RS information technology. *Water International*, **26(2)**, 239-252.
2. Ning, S. K., Cheng, K. Y. and Chang, N. B. (2002): Evaluation of non-point sources pollution impacts by integrated 3S information technologies and GWLF model in the Kao-ping river basin, Taiwan. *Water Science and Technology*, **46(6)**, 217-224.
3. Chang, Y. C. and Chang, N. B. (2002): The design of a web-based decision support system for the sustainable management of an urban river system. *Water Science and Technology*, **46(6)**, 131-139.
4. Chen, J. C., Chang, N. B., Chang, Y. C. and Lee, M. T. (2003): Mitigating the impacts of combined sewer overflow in an urban river system via web-based share-vision modeling analysis. *Journal of Civil Engineering and Environmental Systems*, **20(4)**, 213-230.

Journal Papers: Water Sustainability, Climate, and Ecosystem Services Assessment

• Ecosystem Valuation and Environmental Economics

1. Chen, H. W., Chang, N. B. and Shaw, D. G. (2005): Valuation of in-stream water quality improvement via fuzzy contingent valuation method. *Stochastic Environmental Research and Risk*

Assessment, **19(2)**, 158-171.

• Urban Sewer Systems and Sustainable Development

1. Chen, J. C., Chang, N. B., Fen, C. S. and Chen, C. Y. (2004): Assessing the stormwater impact to an urban river ecological system using an estuarine water quality simulation model. *Journal of Civil Engineering and Environmental Systems*, **21(1)**, 33-50.
2. Chen, J. C., Chang, N. B. and Chen, C. Y. (2004): Minimizing the ecological risk of combined-sewer overflow in an urban river system by a system-based approach. *Journal of Environmental Engineering, ASCE*, **130(10)**, 1-16.
3. Chang, N. B. and Hernandez, E. A. (2008): Optimal expansion strategies for a sanitary sewer system under uncertainty. *Environmental Modeling and Assessment*, **13(1)**, 93-113.
4. Yeh, S. C., Chang, N. B., Wei, H. P., Chang, C. H., Chai, H. B. and Huang, J. W. (2011): Optimal expansion of coastal wastewater treatment and disposal system under uncertainty (I): simulation analysis. *Civil Engineering and Environmental Systems*, **28(1)**, 19-38.
5. Chang, N. B., Yeh, S. C. and Chang, C. H. (2011): Optimal expansion of coastal wastewater treatment and disposal system under uncertainty (II): optimization analysis. *Civil Engineering and Environmental Systems*, **28(1)**, 39 -59.

• Water Quality Classification

1. Chang, N. B., Chen, H. W. and Ning, S. K. (2001): Identification of river water quality using the fuzzy synthetic evaluation approach. *Journal of Environmental Management*, **63(3)**, 293-305.

Journal Papers: Global Change, Urban Growth, Precipitation, Stream Flows, and Drainage Infrastructures

1. Makkeasorn, A., Chang, N. B. and Zhou, X. (2008): Short-term stream flow forecasting with global climate change implications – A comparative study between genetic programming and neural network models. *Journal of Hydrology*, **352**, 336-354.
2. Wang, C., Chang, N. B. and Yeh, G. (2009): Copula-based Flood Frequency (COFF) analysis at the confluences of river systems. *Hydrological Processes*, **23**, 1471-1486.
3. Kao, S. C. and Chang, N. B. (2012): Copula-based flood frequency analysis at ungauged basin confluences: a case study for Nashville, TN. *Journal of Hydrologic Engineering, ASCE*, **17(7)**, 790-800.
4. Sun, Z., Chang, N. B., Huang, Q. and Opp, C. (2012): Precipitation patterns and associated summer extreme flow analyses in the Yangtze River, China using TRMM/PR data. *Hydrologic Sciences Journal*, **57(7)**, 1-10.
5. Mullon, L., Chang, N. B., Yang, J. and Weiss, J. (2013): Integrated remote sensing and wavelet analyses for short-term teleconnection pattern identification between sea surface temperature and greenness in northeast America. *Journal of Hydrology*, **499**, 247-264.
6. Chang, N. B., Valdez, M., Chen, C. F., Imen, S., and Mullon, L. (2015): Global nonlinear and nonstationary climate change effects on regional precipitation and forest phenology in Panama, Central America. *Hydrological Processes*, **29(3)**, 339-355.
7. Bai, K., Chang, N. B., and Gao, W. (2016): Quantification of relative contribution of Antarctic ozone depletion to increased austral extratropical precipitation during 1979-2013 period. *Journal of Geophysical Research - Atmospheres*, **121(4)**, 1459–1474.

8. Bai, K., Chang, N. B., Shi, R., Yu, H., and Gao, W. (2017): An inter-comparison of multi-decadal observational and reanalysis data sets for global total ozone trends and variability analysis. *Journal of Geophysical Research - Atmospheres*, **122**, 7119–7139.
8. Joyce, J., Chang, N. B., Harji, R., Ruppert, T., and Imen, S., (2017): Developing a multi-scale modeling system for resilience assessment of green-grey drainage infrastructures under climate change and sea level rise impact. *Environmental Modelling and Software*, **90**, 1-26.
9. Chang, N. B., Yang, J., Imen, S., and Mullon, L. (2017): Multi-scale quantitative precipitation forecasting using nonlinear and nonstationary teleconnection signals and artificial neural network models. *Journal of Hydrology*, **548**, 305-321.
10. Chang, N. B., Imen, S., Bai, K., and J. Yang (2017): The impact of global unknown teleconnection patterns on terrestrial precipitation across North and Central America. *Journal of Atmospheric Research*, **193**, 107–124.
11. Lu, Q., Joyce, J., Imen, S., Chang, N. B. (2017): Linking socioeconomic development, sea level rise, and climate change impacts on urban growth in New York City with a fuzzy cellular automata-based Markov chain model. *Environment and Planning B: Urban Analytics and City Science*, DOI: 10.1177/2399808317720797.
12. Joyce, J., Chang, N. B., Harji, R., Ruppert, T., and Singhofen, P. (2017): Cascade impact of hurricane movement, storm tidal surge, sea level rise, and precipitation variability on flood assessment in a coastal watershed. *Climate Dynamics*, **51(1)**, 383-409.
13. Joyce, J., Chang, N. B., Harji, R., and Ruppert, T. (2018): Coupling infrastructure resilience and flood risk assessment via copulas analyses for a coastal green-grey-blue drainage system under extreme weather events. *Environmental Modelling and Software*, **100**, 82-103.
14. Lu, Q., Chang, N. B., and Joyce, J (2018): Predicting long-term urban growth in Beijing (China) with new factors and constraints of environmental change under integrated stochastic and fuzzy uncertainties. *Stochastic Environmental Research and Risk Assessment*, **32(7)**, 2025-2044.
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Summary of major achievements in environmental and water resources systems analysis

Major Accomplishments: Basin-scale water quality simulation analysis based on multitemporal land-use and land-cover changes characterized by using multispectral satellite remote sensing images, such as SPOT and LANDSAT images was conducted for supporting optimization analysis and generating spatially-varied permit trading ratios with seasonal transaction prices among different polluters. Besides, global Sea Surface Temperature (SST) anomalies have a demonstrable climate change effect on spatial and temporal precipitation patterns in the terrestrial system via ocean-atmosphere interactions. Dr. Chang was the first scientist who analyzed a series of short-term (10-year), and long-

term (30 years) nonstationary and nonlinear teleconnection signals of SST anomalies at the Atlantic and Pacific Oceans and identified some non-leading/unknown teleconnection patterns. These non-leading teleconnection patterns combined with existing leading teleconnection patterns, such as the El Nino Southern Oscillation (ENSO) and North Atlantic Oscillation (NAO), were integrated to account for the associated variations of forest phenology and precipitation changes with remote-sensing-based wavelet analysis. On the other hand, quantification of relative contribution of Antarctic ozone depletion to increased austral extratropical precipitation during 1979-2013 period was conducted by his research team, which represents a big discovery in earth systems science. Besides, a series of studies for the urban growth in megacities under the impact climate change were conducted by Dr. Chang and his students. Dr. Chang and his students developed the fuzzy synthetic evaluation approach to address such uncertainty in decision making for water quality classification and diagnosis. This series of work pioneered some scientific frontiers in sustainable development.

Role: In this subject area, Dr. Chang is the team leader in a few multi-year extensive research projects that were funded by NSF, USEPA, British Council, and other agencies collaborative with visiting scientists and foreign partners from several countries. Dr. Chang led this series of research and conceived, developed, and/or tested several different types of systems analysis models and environmental sustainability technologies. He mentored students to conduct the integrated sensing, monitoring, and modeling analysis toward sustainable decision analysis in cooperation with partners worldwide.

Impact: The ability to quantitatively evaluate the pollution load allocation and relocation based on permit trading ratios across differing pollution units is a milestone achievement in remote sensing-based watershed management. With such advancements, the publication of “Watershed-based point sources permitting strategy and dynamic permit trading analysis,” published by *Journal of Environmental Management* above has been incorporated in the European Commission’s environmental news service for policy makers, distributed to over 6,000 subscribers – Science for Environment Policy News Alert (Feb. 10, 2008). It has been greatly impacted the policy making for water resources management in different part of the world. Besides, the paper titled identification of river water quality using the fuzzy synthetic evaluation approach published by the *Journal of Environmental Management* has been cited by 320 times as of June, 2018, due to the novelty in dealing with the uncertainty embedded in water quality classification in river systems. The body of work of teleconnection signal propagation studies with pattern recognition via wavelet analysis has contributed greatly to the foundations of climate informatics in relation to terrestrial precipitation, streamflow, and vegetation greenness in North and Central America. In addition to sea surface temperature anomalies, relative contribution of Antarctic ozone depletion to increased austral extratropical precipitation in terrestrial systems in Australia has been completed. Such advancements deepened the understanding of these climate factors through a suite of big data analytics techniques and have resulted in new geophysical knowledge under climate change. Besides, the use of the remote sensing-based genetic programming model for streamflow forecasting, water quality monitoring, and wavelet-based empirical orthogonal function for precipitation forecasting under climate change have also had seminal contribution on water resources management under climate change. Dr. Chang’s basic and applied research has significantly impacted the urban water infrastructure assessment quantitatively and qualitatively, which is deemed the world’s premier urban water management studies under climate change impact. Dr. Chang was elevated to Fellow of IEEE in 2017 “for contributions to computational techniques for the analysis of environmental sustainability”. He was selected as the IEEE Distinguished Lecturer by the IEEE Systems Council in 2018.

Hydrological and Environmental Remote Sensing and Monitoring Networks

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Summary of major achievements in environmental and hydrological remote sensing

Major Accomplishment: Delineating accurate distributions of the quality and quantity of water, air pollutants and greenhouse gases in the atmospheric environment, ecosystem state in natural systems, as well as land use and land cover changes requires the integration of various remote sensing technologies. For example, nutrient fluxes in surface and groundwater systems may be driven by atmospheric deposition, agricultural runoff, and urbanization effect such that space-borne, air-borne and *in situ* sensors are all needed for monitoring the fate and transport of them. With a thorough coverage of over 50 satellite remote sensing sensors based on a 40-year literature review, conducted by Dr. Chang's research team, he developed a suite of water quality monitoring research efforts for a broader range of environmental assessment, ecosystem restoration, and agricultural applications. Dr. Chang was the first scientist who developed a series of new algorithms with different platforms and sensors for monitoring eutrophication in lakes, coastal bays, and reservoirs. They include integrated data fusion and mining (IDFM) algorithm for improving spatial and temporal resolution of images, the Spectral Information Adaptation and Synthesis Scheme (SIASS) algorithm for coupling several satellites to work together synchronously for cloudy pixel recovery, and the SMart Information Reconstruction (SMIR) method to complement the SIASS for final cloudy pixel reconstruction from the time-space-spectrum continuum with the aid of a machine learning tool. These efforts through developing the IDFM, SMIR and SIASS algorithms have culminated into his most recent invention of the cross-mission data merging with image reconstruction and mining (CDMIM) which is deemed as the first decision support system of its kind in the world providing monitoring capacity in a timely manner over extensive area with accuracy. he has developed a plethora of remote sensing technologies that were demonstrated in terms of monitoring turbidity and Chlorophyll-a concentrations in Lake Okeechobee, nutrient concentrations in Tampa Bay, Total Organic Carbon (TOC) in Lake Harsha, water transparency in Lake Valencia, nutrients in Lake Nicaragua, microcystin in Lake Erie and Total Suspended Solid (TSS) and TOC in Lake Mead. Such a myriad of novel advancements/publications appears to be a break-through in remote sensing science for environmental protection. Dr. Chang was also the first scientist to apply the partial lanczos extreme learning machine (PL-ELM) for processing SPOT images and the neural-fuzzy inference approach for processing Formosat-2 data for analyzing two types of urban systems. This series of work was extended to examine urban heat island effect associated with local hydroclimatic conditions using MODIS satellite data and dynamic linkages between evapotranspiration and land use/land cover changes with Landsat TM and ETM+ data, both of which demonstrate pioneered investigation of urban sustainability issues. To account for climate change impact on water resources management, Dr. Chang and his collaborators also explored a unique hydrometeorological process of precipitation patterns and associated summer extreme flow using TRMM/PR data. This body of research pioneered some scientific frontiers in hydroinformatics regime with the aid of a suite of Earth observing systems. More recently, the paper titled "Multi-Decadal Mangrove Forest Change Detection and Prediction in Honduras, Central America, with Landsat Imagery and a Markov Chain Model" demonstrated the first effort to forecast the possible mangrove forest changes for the future using remote sensing technologies. Finally, in response to the needs for long-term water quality monitoring in drinking water distribution systems, one of the most significant challenges currently facing the water industry is to investigate the physical, chemical, and biological sensor placement strategies with modern concepts of and approaches to risk management. Most of the previous research mainly focuses on using optimization models to deal with small-scale

drinking water networks. Yet the challenge of computational burden when handling large-scale networks can hardly be overcome. Dr. Chang and his students conducted the pioneering work of using graph theory-based optimal sensor deployment strategies in a Rule-based Expert System (RBES) to reduce computational burden as we oftentimes encountered in various types of large-scale optimization analyses. Besides, both Automatic Pulse Tracer Velocimeter (APTV) and Groundwater Variability Probe (GVP) were developed by his team to measure the low flow regime in heterogeneous aquatic environments. This series of modeling efforts using graph theory and expert system to aid in sensor network deployment in drinking water networks have created a new direction in this field.

Role: Dr. Chang conceived the research niches and led these research activities to conduct some of the retrospective and perspective analyses. He initiated this series of remote sensing research, developed the hypotheses, led the development of the methodology and framework, cooperatively designed field experiments and field campaigns with the support of NASA and USEPA staff, conducted the ground-truth data collection in some projects, and performed part of the data analysis. The scope of the research programs expanded significantly over time and involved a large team across several countries that was coordinated and managed by Dr. Chang for several extended studies.

Impact: Dr. Chang had successfully demonstrated the ability to map and monitor large-scale soil moisture variations in a big watershed using RADARSAT-1 L-band imageries with genetic programming model leading to support the ecosystem health assessment in riparian zones and stream flow forecasting under climate change in South Texas. These results elevated the importance of soil moisture measurements within NASA's Earth Observation Program. These studies were critical to the applications of soil moisture products to support drought monitoring and water availability monitoring, in various urban regions. With a series of breakthroughs in remote sensing science, graduate students from University of Valencia in Spain, East China Normal University in China, and National Central University in Taiwan came over to UCF for their dissertation work. These projects had been highly successful at addressing a broad range of the optimal sensor integration strategies at different scales and had been the basis for numerous advanced applications in students' thesis research. The data had been used in Lake Nicaragua studies that went well beyond the initial research concept. Dr. Chang was the first scientist who has been impacting remote sensing research with a wealth of evolutionary computing as well as fast and deep learning techniques to enhance the feature extraction power. As a result of this series of research, new discoveries and insights involving the complex multi-sensor and multi-temporal change detection were made possible. Results from this body of research for land use changes have been recognized as highly innovative and significant by a SPIE highlighted online news reported his achievement of using SPOT-5 high resolution satellite images. This online article is titled "Satellite-based Multi-temporal Change Detection in Fast Growing Urban Environments" in the SPIE Newsroom published on 21 January 2011. Besides, the paper titled "Multi-Decadal Mangrove Forest Change Detection and Prediction in Honduras, Central America, with Landsat Imagery and a Markov Chain Model" has been included in a synthesis report introducing the global status and ecosystem services provided by mangrove forests, compiled by the World Conservation Monitoring Centre (WCMC), the United Nations Environment Program (UNEP). Dr. Chang was elevated to Fellow of AAAS in 2011 and SPIE in 2014 "for contributions to the Integrated Sensing, Monitoring and Modeling for Decision Analysis".

Stormwater and Wastewater Treatment Process Optimization

Books

1. Chang, N. B. (Ed) (2010): The Effects of Urbanization on Groundwater: An Engineering Case-based Approach for Sustainable Development. Publisher: American Society of Civil Engineers (ASCE), Reston VA, USA, 400 pp. ISBN: 978-0-7844-1078-3

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1. Chang, N. B., Wanielista, M., Moberg, M. and Hossain, F. (2010): Chapter 8 Use of Functionalized Filter Media for Nutrient Removal in Stormwater Ponds. In: *The Effects of Urbanization on Groundwater: An Engineering Case-based Approach for Sustainable Development*, Ed. Chang, N. B. (ASCE), 199-223.
2. Chang, N. B., Wanielista, M., Daranpob, A., Hossain, F., and Xuan, Z. (2010): Chapter 9 Comparative Assessment of Two Standard Septic Tank Drain Fields Using Different Sand with Recirculation for Nutrient Removal. In: *The Effects of Urbanization on Groundwater: An Engineering Case-based Approach for Sustainable Development*, Ed. Chang, N. B. (ASCE), 224-250.

Patents

1. Passive Nutrient Removal Material Mixes. (DIV A) US Patent 7824551 issued on Nov. 2, 2010.
2. Retention/Detention Pond and Green Roof Passive Nutrient Removal Material Mixes (Green Roof). US Patent 7897047 issued on March 1, 2011.
3. Passive Underground Drainfield for Septic Tank Nutrient Removal Using Special Functionalized Green Filtration Media. US Patent 7927484 issued on April 19, 2011.
4. Functionalized Green Filtration for Passive Underground Drainfield for Septic Tank Nutrient Removal. US Patent 7955507 issued on June 7, 2011.
5. Passive Nutrient Removal Material Mixes. (DIV) US Patent 8002985 issued on August 23, 2011.
6. Retention/Detention Pond Stormwater Treatment System. US Patent 8153005 issued on April 10, 2012.
7. On Site Wastewater Treatment Using a Functionalized Green Filtration Media Sorption Field. US Patent 8101079 issued on Jan. 24, 2012
8. Green Sorption Media for Water Treatment. US Patent 8002984 issued on August 23, 2012.
9. Subsurface Upflow Wetland System for Nutrient and Pathogen Removal in Wastewater Treatment Systems. US Patent 8252182, issued on August 28, 2012.
10. Automatic Pulse Tracer Velocimeter (APTV), UCF0047682-A1, filed Nov. 18, 2017 pending for final approval.
11. Iron and Clay-based Media for Water Treatment, UCF-33809, filed on Jan. 18, 2018, initially approved by June 16, 2018, pending for final approval.

Journal Papers: Green Sorption Media for Wastewater and Stormwater Treatment

• Overviews

1. Chang, N. B., Hossain, F. and Wanielista, M. (2010): Use of filter media for nutrient removal in natural systems and built environments (I): previous trends and perspectives. *Environmental Engineering Science*, **27(9)**, 689-706.
2. Chang, N. B., Wanielista, M. and Makkeasorn, A. (2010): Use of filter media for nutrient removal in natural systems and built environments (II): design challenges and application potentials. *Environmental Engineering Science*, **27(9)**, 707-720.
3. Chang, N. B. (2011): Making a progress to speed up the nitrification and denitrification processes in novel biosorption activated media: can Archaea be in concert with Anammox? *Journal of Bioprocessing and Biotechniques*, **1(2)**, 1-5.

• Technology Development – Wastewater Treatment for Nutrient Management

1. Xuan, Z., Chang, N. B., Wanielista, M. and Hossain, F. (2010): Laboratory-scale characterization of the green sorption medium for wastewater treatment to improve nutrient removal. *Environmental Engineering Science*, **27(4)**, 301-312.
2. Hossain, F., Chang, N. B., Wanielista, M., Xuan, Z. M. and Makkeasorn, A. (2009): Nitrification and denitrification effect in a passive on-site wastewater treatment system with a recirculation filtration tank. *Journal of Exposure and Health*, **1(3-4)**, 31-46.
3. Xuan, Z. M., Chang, N. B., Makkeasorn, A. and Wanielista, M. (2009): Initial test of a subsurface constructed wetland with green sorption media for nutrient removal in on-site wastewater treatment systems. *Journal of Exposure and Health*, **1(3)**, 159–169.
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3. O'Reilly, A., Wanielista, M., Chang, N. B., Xuan, Z. and Harris, W. G. (2012): Nutrient removal using biosorption activated media: Preliminary biogeochemical assessment of an innovative stormwater infiltration basin. *Science of the Total Environment*, **432**, 227-242.
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12. Lin, K. S., Chang, N. B., Hartshorn, N., Wanielista, M., and Chiang, C. L. (2016): An innovative solar energy-powered floating media bed reactor for nutrient removal (II): material characterization. *Journal of Cleaner Production*, **133**, 1128–1135.
13. Chang, N. B., Wen, D., McKenna, A., and Wanielista, M. (2018): The impact of carbon source as electron donor on composition and concentration of dissolved organic nitrogen in biosorption-activated media for stormwater and groundwater co-treatment. *Environmental Science and Technology*, 52 (16), 9380–9390.
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• Controller Design

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3. Chen, W. C., Chang, N. B. and Chen, J. C. (2003): Rough set-based fuzzy neural controller design for industrial wastewater treatment. *Water Research*, **37(1)**, 78-90.
4. Chen, J. C. and Chang, N. B. (2007): Mining the fuzzy control rules of aeration in submerged biofilm wastewater treatment process. *Engineering Applications of Artificial Intelligence*, **20**, 959-969.
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Journal Papers: Cost Benefit Analysis

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Summary of major achievements in stormwater management and wastewater treatment

Major Accomplishment:

Rapid urbanization and climate variability triggered more extreme precipitation and drought events, challenging stormwater management in terms of both flood control and water quality management in both urban and rural areas. Understanding nitrogen cycle in natural systems and the built environment has been deemed one of the fourteen grand challenges by the National Academy of Engineering. With a suite of laboratory tests and field campaigns, Dr. Chang and his team members reviewed a broader range of field conditions for a series of green sorption media including the Biosorption Activated Media (BAM) and the Iron-filings-based Green Environmental media (IFGEM) for stormwater, groundwater and wastewater treatment toward nutrients, heavy metals, and pathogens removal. Modeling these unique stormwater and wastewater treatment processes for planning, design and operation was conducted by using system dynamic modeling approach. Conducted by Dr. Chang and his colleagues/students, results from extended investigations include optimal control studies, tracer studies, kinetics studies with temperature variations, and possible combination with some nanomaterials. Dr. Chang was the first scientist who conducted this series of research building a myriad of system analysis models, tools, methods, and platforms with confirmed performance through calibration and validation thereby opening a new path to widespread applications for the Best Management Practices. Overall, this body of work demonstrated pioneered investigation in regard to water sustainability issues in urban regions.

Role: Dr. Chang conceived the research niches, select research topics, and led these research activities by conducting part of the literature review and modeling analysis. Development of the BAM and IFGEM were confirmed with efforts after culminating a series of laboratory and field studies. With the long-term funding support, Dr. Chang identified the study objectives, initiated a series of science questions, developed the hypotheses, and led the development of the experimental design and modeling analysis framework, cooperatively planned/designed the stormwater and wastewater test beds on/off campus, and performed part of the data analysis. The scope of the research program expanded significantly over time and involves a series of comparisons of results across several countries (i.e., Singapore, Hong Kong, China, and New Zealand) that was coordinated and communicated by Dr. Chang within a series of extended outreach endeavor.

Impact: Dr. Chang had successfully demonstrated the ability to remove nutrients, heavy metals, and pathogens with BAM and IFGEM, and conducted the possible sensitivity analysis with system dynamic modeling. This was the first effort of its kind to bring together a diverse body of sorption media into an operational level. These projects had also been highly successful at addressing a broad range of application potential. BAM- or IFGEM-oriented Low Impact Development (LID) technologies have been licensed to industry, including Suntree Technologies Inc. (<http://www.suntreetech.com/>) and Environmental Conservation Solutions (<https://ecs-water.com/stormwater-management/>) in Florida after attracting \$20 million industrial investment. These LID technologies have been applied to over 70 locations in Florida and elsewhere, such as Alligator Creek for creek restoration, Ruskin, Zolfra Spring, and Palatka for restoration of stormwater wet ponds, and cities of Kissimmee and Dunnellon for retrofitting storm sewer to reduce waste loads. These studies were critical to the possible extended applications of spring field conservation and conjunctive treatment of stormwater, wastewater, and groundwater in the United States. These discoveries and insights triggered a brand-new spectrum of urban sustainability research with a great commercialization potential. The data have been used in various studies over different countries that went well beyond the initial research concept by impacting scientific research in flood treatment via stormwater infiltration ponds, canal treatment with pipe reactor and stormwater treatment with exfiltration and upflow media bed reactor. Dr. Chang was the first scientist who invented the BAM and IFGEM with his colleague Dr. Martin P. Wanielista having 9 relevant US patents approved for nutrient

removal in dealing with nutrient-laden stormwater runoff, agricultural discharge, and wastewater effluent, which have all been licensed to industry.

Industrial Ecology, Green Engineering, Ecosystem Science, and Ecological Engineering

Book

1. Jorgensen, S. E., Chang, N. B., and Xu, F. L. (Eds) (2014): Ecological Modelling and Engineering of Lakes and Wetlands. Published by Elsevier in the book series of Developments of Environmental Modelling, Amsterdam, Netherland, 730 pp, ISBN: 978-0-444-63249-4

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1. Megic, B. and Chang, N. B. (2010): Chapter 11 Use of a Wetland System for Groundwater Recharge in an Urban Wastewater Treatment Plan in Orlando, Florida. In: The Effects of Urbanization on Groundwater: An Engineering Case-based Approach for Sustainable Development, Ed. Chang, N. B. (ASCE), 277-307.
2. Chang, N. B. and Xuan. Z. M., (2014): Chapter 1 Introduction, by Jorgensen, S. E. Change, N. B., and Xu, F. L. (Eds) (Elsevier). In Ecological Modelling and Engineering – Lakes and Wetlands, by Jorgensen, S. E. Change, N. B., and Xu, F. L. (Eds) (Elsevier).
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4. Weng, Y. C., Chang, N. B. and Lee, T. Y. (2008): Nonlinear time series analysis of ground-level ozone dynamics in Southern Taiwan. *Journal of Environmental Management*, **87(3)**, 405-414.
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Journal Papers: Life Cycle Assessment

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3. Xuan, Z. M., Chang, N. B., Wanielista, M., and E. S. Williams (2013): System dynamics modeling of nitrogen removal in a stormwater infiltration basin with biosorption activated media. *Journal of Environmental Quality*, **42**, 1086-1099.

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5. Marimon, Z. A., Xuan, Z., and Chang, N. B. (2013): System dynamics modeling with sensitivity analysis for floating treatment wetlands in a stormwater wet pond. *Ecological Modelling*, **267**, 66–79.
6. Chang, N. B., Mohiuddin, G., Crawford, A. J., Bai, K., and Jin, K. R. (2015): Diagnosis of the AI-based predictions of flow regimes in a constructed wetland for stormwater pollution control. *Ecological Informatics*, **28**, 42-60.
7. Hartshorn, N., Marimon, Z., Xuan, Z., Cormier, J., Chang, N. B., and Wanielista, M. (2016): Complex interactions among nutrients, chlorophyll-a, and microcystins in three stormwater wet detention ponds with floating treatment wetlands. *Chemosphere*, **144**, 408-419.
8. Hartshorn, N., Merimon, Z., Xuan, Z. M., Chang, N. B., and Wanielista, M. (2016): Effect of floating treatment wetlands on the control of nutrients in three stormwater wet detention ponds. *Journal of Hydrologic Engineering, ASCE*, **21(8)**, 04016025.

Summary of major achievements in industrial ecology and ecological engineering

Major Accomplishment: This body of work explored short-term emergency response planning and risk assessment via an integrated multi-scale modeling system for chemical and energy industries in liquid, gas, and solid forms. To confirm the sustainability of various alternatives of industrial products waste incineration, and drinking water production, streamlined life cycle assessment were also assessed with scales given the carbon-regulated management framework. To improve the essence of industrial ecology in the nexus of green and smart cities, Dr. Chang and his students performed a unique green optimal production planning for a textile dyeing industry under uncertainty. Dr. Chang was the first scientist who developed a series of spatial decision support systems with information and communication technologies for emergency response planning and green production planning for a textile industry of its kind with scales for eco-industrial parks. Later, he extended the work to a green building design leading to optimally balance the energy and water consumption under uncertainty and eco-hydraulics study in a constructed wetland area – the Stormwater Treatment Area in the Everglades, Florida – creating a diagnosis of the artificial intelligence-based predictions of flow regimes in regard to the flow patterns and the hydraulic retention time for phosphorus uptake. Dr. Change was the first scientist exploring such type of system design issues under uncertainty in a green building and green infrastructure. Besides, several new ecological engineering technologies have been developed and applied to deal with nutrient removal in stormwater runoff, wastewater effluent and agricultural discharge. These advancements include two types of floating treatment wetland technology for nutrient removal in different stormwater wet ponds were tested for the enhancement of stormwater management. Besides, carbon-regulated flux analyses for water supply and lake ecosystem health assessment under climate change and human impact to improve the sustainability of drinking water infrastructure management and expansion. Dr. Change was also the first scientist for the initiation of a series of sustainability science assessment and field experiments in diverse types of pond structures and environments that address critical issues of implementing floating treatment wetland technology including the effectiveness of nutrient removal in different conditions, the chemical and biological signatures of nutrient removal, the cold weather impact, the need for replacement of plant species, the complex interactions among nutrients, chlorophyll-a and microcystins, as well as the comparisons between storm vs. non-storm events.

Role: Dr. Chang conceived those research niches and led this series of research projects, developed science questions and hypotheses with the aid of some local utility engineers, and performed part of the data analysis.

Impact: Environmental exposure and risk assessment developed for emergency response planning deepened the understanding via the use multi-media chemical fate and transport modeling, remote sensing, and geographical information systems to aid in decision making. These emergency response planning for nuclear energy and chemical industries were critical to the validation of integrated sensing, monitoring, modeling for decision making. The approach to parameterization of emergency response plan, lake ecosystem assessment under climate change and human impact, and modeling the green production planning strategies for decision analysis has been adopted throughout the relevant industries and government agencies. His work presented a key step for advancing the green engineering approach used in the future in relevant industrial sectors. Dr. Chang received the Blaise Pascal Medal from the European Academy of Sciences in 2016 “for his contributions in environmental sustainability, green engineering, and systems analysis”.

Waste Management and Resources Recycling Strategies and Technologies for Municipal and Industrial Streams

Book

- b. Chang, N. B. and Pires, A. (2015): Sustainable Solid Waste Management: A Systems Engineering Approach. In IEEE Book Series on Systems Science and Engineering, Published by Wiley/IEEE, New York, USA, 920 pp, ISBN: 978-1-118-45691-0

Book Chapters

1. Chang, N. B., Pires, A., and Martinho, G. (2013): Chapter 17: Impacts of Life Cycle Assessment on Solid Waste Management. In Encyclopedia of Environmental Management, Ed, Jorgensen, S. E. (Taylor & Frances Group) Volume IV – page 2399 – 2414.
2. Chang, N. B., Pires, A., and Martinho, G. (2013): Chapter 29: Environmental Legislation for Solid Waste Management in EU Countries via the Use of Economic and Policy Instruments. In Encyclopedia of Environmental Management, Ed, Jorgensen, S. E. (Taylor & Frances Group) Volume II – page 892 – 913.

Journal Papers: Integrated Solid Waste Management Strategies

• Overviews

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2. Chang, N. B., Pires, A. and Martinho, G. (2011): Empowering systems analysis for solid waste management: challenges, trends and perspectives. *Critical Reviews in Environmental Science and Technology*, **41(16)**, 1449-1530.

• System of Systems Engineering and Integrated Waste Management Strategies

1. Chang, N. B., Schuler, R. E., and Shoemaker, C. A. (1993): Environmental and economic optimization of an integrated solid waste management system. *Journal of Resource Management and Technology*, **21(2)**, 87-98.

2. Chang, N. B. and Lin, Y. T. (1997): Optimal siting of transfer station locations in a metropolitan solid waste management system. *Journal of Environmental Science and Health*, **A32**, (8), 2379-2401.
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• **Multicriteria Decision Analysis**

1. Chang, N. B. and Wang, S. F. (1996): Solid waste management system analysis by multi-objective mixed integer programming model. *Journal of Environmental Management*, **48**, 17-43.
2. Chang, N. B. and Chang, Y. H. (2001): Optimal shipping strategy of solid waste streams with respect to throughput and energy recovery goals of incineration facilities. *Civil Engineering and Environmental Systems*, **18**, 193-214.

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2. Chang, N. B., Yong, Y. C., and Wang, S. F. (1996): Solid waste management system analysis with noise control and traffic congestion limitations. *Journal of Environmental Engineering, ASCE*, **122**(2), 122-131.
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• **Sustainability Analysis between Recycling and Incineration**

1. Chang, N. B. and Wang, S. F. (1997): Integrated analysis of recycling and incineration programs by goal programming techniques. *Waste Management & Research*, **15**(2), 121-136.
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2. Chang, N. B. and Wang, S. F. (1997): A fuzzy goal programming approach for the optimal planning of solid waste management systems. *European Journal of Operational Research*, **99(2)**, 287-303.
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• Uncertainty Analysis – Minimax Regret

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2. Davila, E., Chang, N. B. and Diwakaluni, S. (2005): Dynamic landfill space consumption assessment in the Lower Rio Grande Valley, South Texas by GIP-based game theory. *Journal of Environmental Management*, **75(4)**, 353-366.
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2. Chang, N. B., Chang, Y. H. and Chen, Y. L. (1997): Cost-effective and workload balancing operation in solid waste management systems. *Journal of Environmental Engineering, ASCE*, **123(2)**, 178-190.
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Journal Papers: Information Technologies

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Journal Papers: Waste Treatment, Recycling and Reuse Technologies

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1. Chang, N. B., Chang, Y. H. and Chen, W. C. (1997): Evaluation of heat values and its prediction for refuse-derived fuel. *Science of the Total Environment*, **197**, 139-148.
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1. Chang, N. B., Wang, H. P., Huang, W. L. and Lin, K. S. (1999): The assessment of reuse potential for MSW and RDF incineration ashes. *Resources, Conservation, & Recycling*, **25(3-4)**, 255-270.
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1. Chang, N. B., Lin, K. S., Sun, Y. P. and Wang, H. P. (2001): Oxidation kinetics of combustible construction and demolition waste. *Journal of Environmental Quality*, **30**, 1392-1401.
2. Chang, N. B., Lin, K. S., Sun, Y. P. and Wang, H. P. (2001): An engineering assessment of the burning of the combustible fraction of construction and demolition waste in a redundant brick kiln. *Environmental Technology*, **22**, 1405-1418.
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• Controller Design to Promote Waste Heat Recovery

1. Chang, N. B. and Chen, W. C. (2000): Fuzzy controller design for municipal incinerators with the aid of genetic algorithms and genetic programming Techniques. *Waste Management & Research*, **18(5)**, 429-443.

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3. Chen, J. C., Chen, W. H. and Chang, N. B. (2008): Diagnosis analysis of a small-scale incinerator by neural networks model. *Civil Engineering and Environmental Systems*, **25(3)**, 201-213.

• **Petrochemical Waste Treatment**

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• **Soil and Groundwater Remediation**

1. Yen, H. K., Chang, N. B. and Lin, T. F. (2003): Bioslurping model to assess the light hydrocarbon recovery in a contaminated unconfined aquifer (I): simulation analysis. *Journal of Hazardous, Toxic, and Radioactive Waste Management, ASCE*, **7(2)**, 114-130.
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Journal Papers: Policy Analysis

2. Chang, N. B. (2008): Economic and policy instrument analyses in support of the scrap tires recycling program in Taiwan. *Journal of Environmental Management*, **86**, 435-450.
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Summary of major achievements in waste management research with respect to resources conservation and recovery

This body of research relates urban waste management to transportation systems analysis, recycling impact with respect to household recycling programs and/or centralized material recovery facilities, financial factors in decision making, and environmental constraints via a myriad of forecasting, simulation, optimization, and control analysis. Emphasis has been placed on the linkages of models of engineered waste management systems to smart and green urban waste collection scheme, to significant policy and economic/econometric analyses under uncertainty and risk. The spectrum of the investigations covers all stages of waste management from planning, to design, to operation and to final disposal with rich social contexts. This series of work addresses environmental, economic, management, and sustainability challenges posed by a series of transitions under global change impacts seeking to generate alternatives from various decentralized versus centralized systems frameworks in the United States and elsewhere. Issues and concerns may include but are not limited to the integrated waste management options in relation to various sizes and types of intermediate waste management

infrastructures and shipping patterns in the networks to reduce reliance on landfill space for final disposal. Extended research areas include mitigation of environmental effects of waste management, optimal distribution of raw waste streams, environmental and social impacts, energy recovery through incineration, material recycling, life cycle impact, carbon regulated shipping patterns, and reuse of recycled materials with system thinking. The sustainability metrics includes the wide range anticipated social, economic, environmental, and health impacts across multiple regions in various geographic contexts. Dr. Chang was the first scientist who systematically explored almost all aspects of waste management alternatives from the systems perspective and generated a variety of managerial strategies to promote urban sustainability with the aid of integrated sensing, monitoring, and modeling technologies in the nexus of smart city, green engineering, and environmental sustainability.

Role: Dr. Chang conducted this series of research, developed science questions and hypotheses, led the development of the modeling analysis, cooperatively designed and carried out part of the policy analysis with foreign scholars, and performed the big data analysis.

Impact: This body of work has contributed greatly to the foundations of urban waste management systems, leading to deepen the fundamental understanding of the complexity of centralized versus decentralized management alternatives. It has resulted in new knowledge from the systems analysis in waste management and urban sustainability. The breadth and depth of Dr. Chang’s waste management studies in relation to social, economic, environmental, and health impacts demonstrated the niches of using system engineering approach. Further, as a result of this advancement, new discoveries and insights involving the use of “System of Systems Engineering” approach and smart/green city imitative had generated some profound impact on the development and expanded applications in relevant fields. The culmination of this body of work led to the generation of a book with over 900 pages titled “Sustainable Solid Waste Management: A Systems Engineering Approach” published by IEEE Book Series on Systems Science and Engineering, through John Wiley/IEEE in 2015. This was the first book of its kind in the world to thoroughly explore the waste management issues with strong urban sustainability implications. The paper titled “Combining GIS with fuzzy multiple attribute decision making for landfill siting in a fast-growing urban region” has been cited for over 470 times as of June 2018 according to Google Scholar. Graduate students working with many universities around the world, such as Huazhong University of Science & Technology in China, National Central University, Taiwan, University of Regina, Canada, and Universidade Nova de Lisboa, Portugal, had adopted many waste management methods developed by Dr. Chang.

RESEARCH SUPERVISION

To date, Dr. Chang has supervised or co-supervised 17 Ph.D. and 44 master’s students (as summarized in the following tables) who have successfully completed their graduate degrees and now hold meaningful employment in industry, academia and government. He has also mentored 5 Post-Doctoral and 6 Visiting Scholars. Additionally, he has been mentoring several mid-career research scientists overseas promoting collaborative research among Germany, the United Kingdom, China, Taiwan, Hong Kong, Japan, Spain, Denmark, and the US. He has been mentoring many undergraduate students as well. Under his supervision, one of undergraduate honor students (Mr. Brent Wimberly) received the UCF Founder’s Day Award due to thesis’s originality and depth, level of research, and amount of social impact, in Feb. 2013.

b. M.S. Thesis Students (name and year granted or anticipated)

Wang, San-Fei, 1995	Chang, Yin-Hsin, 2002	Benjamin W. Vannah, 2013
Yang, Zhen-Hsin, 1995	Cheng, Kai-Yu, 2002	Islam, Kamrul, 2014
Wang, M., 1995	Chang, Der-Quay, 2002	Houmann, Cameron, 2014
Wu, Si-Long, 1995	Syamala, Diwakaruni, 2004	Marimon, Zachary, 2014

Lu, Hon-Yi, 1996	Ko, Andi, 2005	Mohiuddin, Golam, 2015
Chen, Yu-Liang, 1996	Davila, Eric, 2005	Crawford, James, 2015
Lin, Yu Ting., 1996	Hossain, Fasim Nipun, 2008	Hartshorn, Nickolas, 2016
Wei, Yu-Lin., 1997	Handerson, Devan, 2008	Lu, Qi, 2017
Tseng, Chen-Chien, 1997	Moberg, Mikhal, 2008	Joyce, Justin, 2017
Wu, Chia-Chin, 1998	Ryan, Patrick, 2008	Mostafiz, Chandan, 2018
Chen, Wei Chen., 1998	Xuan, Zhemin, 2009	Alqassar, Abdullah, 2019
Xu, Hsin-Yi, 2000	Rivera, Brian, 2009	Valencia, Andrea, 2019
Chen, Zen-Thian, 2001	Liu, Sha, 2010	Ordonez, Diana, 2019
Weng, Yu-Chi, 2001	Prapinppongsanone, Natthaphon, 2011	Alves Jr., Eranildo, 2019
Wu, Ming Chan., 2001	Mullon, Lee 2012	Hanan Elhakiem, 2019
Dug, C. H., 2001	Jones, Jamie, 2013	

b. Ph.D. Dissertation Students (name and year granted or anticipated)

Chang, Yin-Hsin, 1998	Lu, Jia-Wei, 2011	Khin, Lau Va, 2019
Chen, Ho-Wen, 1999	O'Reilly, Andrew, 2012	Al-Quradaghi, Shimaa, 2020
Ning, Shu-Kuang, 2001	Valdez, Miguel Conrado, 2013	Andrew Valencia, 2020
Chen, Jeng-Chung, 2002	Bai, Kaixu, 2014	Craig Jariz, 2021
Makkeasorn, Ammarin, 2007	Imen, Sanaz 2015	
Ana Lourenco Pires, 2009	Doña Monzo, Carolina, 2017	
Hossain, Fasim Nipun, 2010	Wen, Dan, 2018	
Qi, Cheng, 2011	Wei, Xiaoli, 2019	

RESEARCH FUNDING

Since 1992, Dr. Chang has continuously held many grants from International, Federal, State, and Local government agencies. He was the Principal Investigator in a suite of NASA and EPA projects for environmental remote sensing research, Project Leader in the Stormwater Management Academy in Florida, associate director of the Centre for Excellence of Science and Technology (NSF funded CREST Center) in Texas, and PI/CoPI of a series of research grants of nutrient management through innovative stormwater and wastewater treatment in Florida, PI/Co-PI of many research grants funded by the NSF, NOAA/Florida Sea Grant, USACE, Florida Department of Environmental Protection, Florida Department of Transportation, Florida Fish and Wildlife Commission, South Florida Water Management District, Southwest Florida Water Management District, and Texas Higher Education Board for various types of research in relation to environmental sustainability.

Funded Research Grants and Contracts: From 1993 to 2019, Dr. Chang has involved highly interdisciplinary research with total budget up to 13 million USD of funding support as PI/Co-PI/Senior Personnel that is listed below.

- “(ENLARGE) Enabling large-scale adaptive integration of technology hubs to enhance community resilience through decentralized urban food-water-energy nexus decision support,” National Science Foundation Award ID: ICER 1830036 (PI: Ni-Bin Chang, Co-PIs: Qipeng Zheng, Naim Kapucu, Lixing Gu, Philip Fairey) (\$750,000) (60% effort) in partnership with the University of Florida and Florida Solar Energy Center in the United States, the Delft University of Technology in the Netherlands, and the Ecofilae/IRSTEA/ECOSEC in France; total consortium budget is 1.5 million Euro dollars equivalent to 2 million USD including UCF total budget: \$868,584 in which \$750,000 is from NSF), July 15, 2018-July 14, 2021.

- “Innovative and Integrative Best Management Practices (BMPs) for Surface and Groundwater Protection,” funded by Florida Department of Transportation, PI (Kelly Kibler), Co-PI: Ni-Bin Chang, Dingbao Wang) (total budget: \$792,160) (28% effort), June, 2017-Sept. 2019.
- “Developing Software Platform of Cross-mission Data Merging with Image Reconstruction and Mining (CDMIM) in support of Water Quality Monitoring in Lake Nicaragua,” funded by National Central University, Taiwan, (PI) (\$28,933) (100% effort), funded, Aug., 2016.
- “Empowering Satellite Remote Sensing with Integrated Inverse Modeling Techniques for Feature Extraction of Water Quality Constituents in Lake Managua,” funded by National Central University, Taiwan, (PI) (\$28,787) (100% effort), funded, June, 2016.
- “Bio-sorption Activated Media for Nitrogen Control in a Rapid Infiltration Basin,” funded by Florida Department of Environmental Protection, (PI: Ni-Bin Chang and Co-Pis: Steve Duranceau, Dingbao Wang, Arvind Singh) (\$119,305 with match \$100,000 from City of DeLand, \$200,000 from SJRWMD, and \$100,000 from FDEP providing for construction) (30% effort), funded, July, 2016.
- “Optimal Design of Stormwater Basins with Bio-Sorption Activated Media (BAM) in Karst Environments – Phase II: Field Testing of BMPs – Construction,” funded by Florida Department of Transportation (PI: Kelly Kibler, Co-Pis: Co-PI Ni-Bin Chang) (\$151,946) (40% effort), July, 2016-Dec. 2017.
- “Optimal Design of Stormwater Basins with Bio-Sorption Activated Media (BAM) in Karst Environments – Phase II: Field Testing of BMPs – Monitoring,” funded by Florida Department of Transportation (PI: Kelly Kibler, Co-Pis: Co-PI Ni-Bin Chang) (\$230,634) (40% effort), Oct, 2016-Dec. 2019 (expanded budget of \$172,873 in 2018 for one-year extension till Dec. 2019).
- “Demonstration of a Passive On-site Sewage Treatment Drain Field for Nitrogen Removal at Wekiva State Park,” funded by Florida Department of Environmental Protection, (PI) (\$34,911) (50% effort), Dec., 2015.
- “Removal Effectiveness of Co-mingling Off-site Flows with FDOT Right-of-way Stormwater,” funded by Florida Department of Transportation, (PI) (\$149,991) (50% effort), Dec., 2015.
- “Comparative Nitrogen and Pesticide Removal with Sorption Media in Linear Ditch for Groundwater and Stormwater Treatment,” funded by June, 2015, Florida Department of Transportation in partnership with the AECOM consulting company with match \$200,000 from Swannee River Water Management District. (PI) (\$208,600) (60% effort), Nov., 2015.
- “Water Availability and Water Quality Forecasting Tool with Environmental Change Reconstruction (Phase II),” funded by the NRMRL, US Environmental Protection Agency (US EPA) (PI) (\$68,280), (100% effort), Dec., 2015.
- “Multi-temporal Change Detection of the Water Quality in Lake Nicaragua and Lake Managua with Remote Sensing Technologies,” funded by National Central University in partnership with the National Autonomous University of Nicaragua with cost share \$80,000, (PI) (\$29,560) (100% effort) Feb., 2015.
- “Multi-Sensor Fusion of Satellite Remote Sensing Images for Water Leaving Reflectance Data Fusion under Cloudy Conditions,” funded by National Central University in partnership with the National Autonomous University of Nicaragua with cost share \$80,000, (PI) (\$29,556) (100% effort) Feb., 2015.
- “Optimal Design of Stormwater Basins with Bio-sorption Activated Media (BAM) in Karst Environments – Phase I: Site Screening and Selection,” funded by the Florida Department of Transportation, (PI) (\$39,673) (60% effort), Feb., 2015.
- “Flood Impact Assessment in Mega Cities under Urban Sprawl and Climate Change,” in partnership with University of Exeter in the UK and Tsinghua University in China, funded by British Council Global Innovation Initiative, (Co-PI) (\$230,000) (30% effort) April, 2015.

- “Coupling Risk and Resilience Assessment for Networked Sustainable Drainage Systems in a Coastal City under Climate Change Impact,” (total: \$306,000) funded, NOAA Florida Sea Grant, (PI) in partnership with Pinellas County Government and Florida Sea Grant College program (NOAA’s National Sea Grant College Program) (\$199,000 with match \$107,000) (100% effort), Dec., 2014.
- “Monitoring the Water Quality of Lake Nicaragua and Lake Managua with Remote Sensing Technologies in Wet Seasons,” funded by National Central University, Taiwan, (PI) (\$39,500) (100% effort) Feb., 2014.
- “Water Availability and Water Quality Forecasting Tool with Environmental Change Reconstruction (Phase I),” funded by the NRMRL, US Environmental Protection Agency (US EPA) (PI) (\$76,000) (100% effort), Dec., 2013.
- “Developing a Sustainable Hong Kong through Low Impact Development: from Science to Innovation Policy (Co-PI) (HK\$455,975), funded by the Hong Kong Research Council, (5% effort), July, 2013.
- “Assignment of the Program Director of the Hydrological Science Program,” (PI) funded by National Science Foundation (\$217,066), NSF IPA grant, (100% effort), Aug. 2013.
- “Stormwater Management Area (STA) Hydrodynamic Study,” funded by the South Florida Water Management District (PI) (\$59,000) (100% effort), May, 2013.
- “Developing the Next Generation Remote Sensing Algorithms and Platforms for Lake Water Quality Monitoring (PI) (\$25,000) funded by National Central University, (100% effort), May, 2013.
- “Improvement of Water Availability Index Forecasting Tool with Environmental Change Reconstruction,” funded by the NRMRL, US Environmental Protection Agency (US EPA) (PI) (\$70,000) (100% effort), Dec., 2012.
- “Demonstration Project for Bio-sorption Activated Media for Ultra-urban Stormwater Treatment,” funded by the Florida Department of Transportation (FDOT) (Co-PI) (\$277,999) (25% effort), Sept., 2012.
- “Assignment of the Program Director of the Hydrological Science Program,” (PI) National Science Foundation (\$208,175), funded by the National Science Foundation, NSF IPA grant, (100% effort), Aug. 2012.
- “Best Management Practices for Aquatic Restoration in Lakes, Streams, and Wetlands,” (PI) funded by the Florida Fish and Wildlife Conservation Commission (FFWCC) (\$80,000) (50% effort), Oct., 2011.
- “Maintenance Practices of Stormwater Runoffs,” funded by Florida Department of Transportation (FDOT) (PI) (\$285,000) (50% effort), Nov., 2011.
- “Multi-scale Water Infrastructure Characterization Study Using Remote Sensing (Phase III): Improvement of Water Availability Index Forecasting Tool with Environmental Change Reconstruction,” funded by the NRMRL and NHEERL, US Environmental Protection Agency (US EPA), (PI) (\$80,000) (100% effort), Aug., 2011.
- “A Mesocosm Study of Biohaven Floating Islands for Nutrient Removal in Stormwater Ponds,” (PI), (\$25,000), funded by Floating Islands Environmental Solutions, Inc., (100% effort), March, 2011.
- “Floating Wetland Systems for Nutrient Removal in Stormwater Ponds” funded by the Florida Department of Transportation (FDOT), (Co-PI) (\$200,706) (50% effort), Feb., 2010.
- Multi-scale Water Infrastructure Characterization Study Using Remote Sensing (Phase II),” funded by the NRMRL and NHEERL, US Environmental Protection Agency (US EPA), (PI) (\$89,000 (100% effort), Jan., 2009.
- “Analysis of Predrainage Lake Okeechobee and Upper Everglades Modeling,” funded by the South Florida Water Management District, Florida, (PI) (\$20,000) (100% effort), Sept., 2009.

- “CERP (Comprehensive Everglades Restoration Program) ASR Alkalinity, Metal, and Mineral Impacts on Phosphorus Fate and Transport in Lake Okeechobee,” funded by the South Florida Water Management District and US Army Corps of Engineers (USACE), Florida, (PI) (\$25,000) (100% effort), Feb., 2009.
- “Denitrification Study beneath Stormwater Infiltration Ponds for Promoting Stormwater Reuse and Drinking Water Quality,” funded by the UCF Boardman Foundation, (PI) (\$5,000) (100% effort), Jan, 2009.
- “Sediment Characterization in Lake Okeechobee,” funded by the South Florida Water Management District, Florida, (PI) (\$90,000), (100% effort), March, 2008.
- “Multiscale Water Infrastructure Characterization Study Using Remote Sensing (Phase I),” funded by the NRMRL and NHEERL, US Environmental Protection Agency (US EPA), (PI) (\$138,000), (100% effort), Sept., 2008.
- “Improving Local Water Supply in Rural Communities via a Sensor Network with the Aid of a Rule-based Expert System in a GIS Platform,” funded by the Kentucky Science & Engineering Foundation, (Co-PI) (\$150,000), (33% effort), April, 2007.
- “Performance-based and Passive On-site Wastewater Treatment Systems Evaluation for Nutrients Removal,” funded by the Florida Department of Environmental Protection, (PI) (\$1,050,558), (67% effort), March, 2007.
- “Alternative Stormwater Sorption Media for Control of Nutrients,” funded by the Southwest Florida Water Management District, Florida, (Co-PI) (\$100,000), (50% effort), Nov., 2006.
- “Assessment of Nonpoint Source Pollution in the Arroyo Colorado River Basin due to Intensive Agricultural Practices in the Coastal Watershed,” funded by the Texas Soil and Water Conservation Board (TSSWCB) and US Environmental Protection Agency (EPA 319 grant), (PI) (\$223,000), (100% effort, career move before start date), July, 2005.
- “Enhancing Instrumentation Capabilities at TAMUK to Perform Advanced Environmental Analysis,” funded by the Department of Defense (DOD), (Senior Personnel) (\$399,897), Jan. 2005.
- “Composting Feasibility Study and Regionalization Assessment for the City of Harlingen,” funded by City of Harlingen, Texas (PI) (\$30,000), (100% effort), Oct., 2004.
- “Composting Feasibility Study and Regionalization Assessment for the City of Mission,” funded by City of Mission, Texas (PI) (\$30,000), (100% effort), Oct., 2004.
- “Biosolid Treatability Study and Pilot Plant Planning” funded by City of Edinburg, Texas (PI) (\$10,000), (100% effort), Oct., 2004.
- “Municipal Solid Waste Landfill Site Selection Analysis” funded by City of Harlingen (PI) (\$25,000), (100% effort), May, 2004.
- “The Planning and Design of Decentralized Wastewater Treatment System in Suburban Colonias, Lower Rio Grande Region, Texas,” funded by the Rensselaerville Institute, (PI) (\$ 45,000), (100% effort), May, 2004.
- “Remote Sensing and Variable Rate Technology for Citrus Pest Management and Impact on Water Quality,” funded by the Advanced Technology Program (ATP) in Texas Higher Education Coordination Board, (PI) (\$100,000), (Project Number: 003639-0019-2003), (50% effort), Nov., 2003.
- “Feasibility Study of the Potential for Re-routing Domestic Wastewater Streams,” funded by City of Pharr, Texas, USA. (PI) (\$2,900), (100% effort), Nov., 2003.
- “Storm Water Management Plans for Various Municipalities in the Lower Rio Grande Valley,” funded by the Regional Task Force of Storm Water Management, Texas, USA. (PI) (\$60,000), (100% effort), July, 2003.
- “Lower Rio Grande Valley Texas Pollutant Discharge Elimination System (TPDES): Task Force Project” funded by the Storm Water Management Task Force in Lower Rio Grande Valley, Texas,

USA. (PI) (\$55,000), (100% effort), Oct., 2003.

- “Stream Flow Prediction by Remote Sensing and Genetic Programming Technologies,” funded by National Aeronautics and Space Administration (NASA), USA. (PI) (\$300,000), (NAG13-03008), (100% effort), Oct., 2002.
- “Research on Environmental Sustainability of Semi-Arid Coastal Areas (RESSACA)” Center for Research Excellence in Science & Technology (CREST) at Texas A&M University-Kingsville, funded by National Science Foundation, USA. (award ID: 0206259) (Senior Personnel/Associate Director) (\$5,000,000), (5% effort), Sept., 2002.
- “Acquisition of a GC/MS for the Study of Hydrocarbons in the South Texas Region,” funded by National Science Foundation, USA. (Co-PI) (\$180,000) (25% effort), Aug., 2002.
- “Feasibility Study of Reusing the Scrap Solvent as Auxiliary Fuel in the Cement Kiln” funded by the Cleanaway International Corporation, Taiwan Branch Office, (PI) (\$13,000) (100% effort), April, 2001.
- “Feasibility Study of Using Plasma Arc Process for Handling Oily Sludge” funded by the Kaohsiung Harbor Management Bureau, Kaohsiung, Taiwan, (PI) (\$80,000) (100% effort), April, 2001.
- “Nonpoint Sources Pollution Modeling and Application” funded by National Science Council, Taiwan, NSC 90-2211-E-006-044, (PI) (\$33,000) (100% effort), May, 2001.
- “Combined Research and Curriculum Development: Environmental Informatics and Systems Analysis” funded by National Science Council, Taiwan, NSC 90-2511-S-006-044, (PI) (\$170,000) (100% effort), June, 2001.
- “National Cost-Benefit Database for Environmental Pollution Control: Master Plan (II)” funded by the National Science Council, Taiwan, NSC89-2211-E-006-006, (PI) (\$13,000) (100% effort), June, 2000.
- “National Cost-Benefit Database Construction for Solid Waste Management (II)” funded by the National Science Council, Taiwan, NSC89-2211-E-006-005, (PI) (\$9,500) (100% effort), June, 1999.
- “Environmental Restoration of Zen-Ai River in Kaohsiung – Master Plan” funded by the National Science Council, Taiwan, NSC89-2621-Z-006-002, (PI) (\$19,000) (100% effort), June, 2000.
- “Environmental Restoration of Zen-Ai River in Kaohsiung – Optimization Analysis for Sewage Treatment and Ocean Outfall System” funded by the National Science Council, Taiwan, NSC89-2621-Z-006-002, (PI) (\$15,000) (100% effort), May, 2000.
- “Sustainable Management and System Planning in the Tseng-Wen River Basin” funded by the National Science Council, Taiwan, NSC88-2211-E-006-050, (PI) (\$7,000) (100% effort), June, 1999.
- “National Cost-Benefit Database Construction for Environmental Pollution Control – Master Plan (I)” funded by the National Science Council, Taiwan, NSC88-2211-E-006-074, (PI) (\$14,000) (100% effort), June, 1999.
- “National Cost-Benefit Database Construction for Solid Waste Management (I)” funded by the National Science Council, Taiwan, NSC88-2211-E-006-073, (PI) (\$10,000) (100% effort), June, 1999.
- “Use of Economic Instrument and Systems Analysis for Water Pollution Control in the Kao-Ping River Basin” funded by the Environmental Protection Administration, Taiwan, EPA-88-U1G1-03-001, (PI) (\$114,000) (100% effort), May, 1999.
- “Community-based Allocation of Compensation Fund in the Proximity of Waste Incineration Facility via AHP-based Decision-Making” funded by the Taipei County Government, Taiwan, (PI) (\$40,000) (100% effort), May, 1999.
- “Cost-benefit Analysis for Food Waste Recycling” funded by the Tainan County Government,

Taiwan, (Co-PI) (\$40,000) (50% effort), May, 1999.

- “Emergency Preparedness and Response Planning for Three Nuclear Power Plants via 3D Spatial Decision Support System” funded by the Taiwan Power Company, Taiwan, (PI) (\$250,000), May, 1999.
- “Spatial Decision Support System for Scrap Automobile Management” funded by the 3R Foundation, Taiwan, 3RF-88-A-003-01, (PI) (\$50,000) (100% effort), June, 1999.
- “Environmental Tax/Charge Assessment for Scrap Tire Management” funded by the Environmental Protection Administration, Taiwan, EPA-88-HA21-03-419, (PI) (\$160,000), (100% effort), June 1999.
- “Resources and Energy Recovery for Combustible Demolition Waste Using a Redundant Brick Tunnel” funded by Brick Tunnel Association, Taichung, Taiwan, (PI) (\$38,000) (100% effort), ay, 1999.
- “Environmental and Ecological Investigation of the Hou-lung River Basin in Central Taiwan” funded by the Ministry of Economics, Taiwan, (Co-PI) (\$100,000) with the Academia Sinica research team (10% effort), June 1999.
- “Stabilization of Incineration Ash Using Phosphorous Compounds” funded by the Waste Management, Inc., Taiwan Branch Office, (PI) (\$7,000) (100% effort), June, 1999.
- “Environmental Impact Assessment for a Regional Mall in Kaoshiung City” funded by Fichtner Pacific Engineer, Inc., Taiwan, (PI) (\$50,000) (100% effort), June, 1998.
- “Strategic Planning of Recycling in a Fast-growing Urban Region” funded by the National Science Council, Taiwan, NSC87-2211-E-006-011, (PI) (\$6,000) (100% effort), June, 1998.
- “Resources Recovery from Incineration Process (III)” funded by National Science Council, Taiwan, NSC87-2621-P-006-004, (PI) (\$14,000) (100% effort), Dec., 1998.
- “Use of Artificial Intelligence for Water Pollution Control in the River Basin” funded by the National Science Council, Taiwan, NSC87-2211-E-006-012, (PI) (\$10,000) (100% effort), June, 1998.
- “Water Resources Systems Analysis and GIS Application for the Tseng-Wen River Basin” funded by the Ministry of Economics, Taiwan, (PI) (\$62,000) (100% effort), May, 1998.
- “Optimal Planning of Presorting Process prior to Shu-Lin Municipal Incinerator in Taipei County” funded by the Taipei County Government, Taiwan, (\$85,000) (100% effort), Dec. 1998.
- “Strategic Planning for ISO14001 Accreditation in the Textile Dying Industry” funded by the Environmental Protection Administration, Taiwan, EPA-86-G03-09-11, (PI) (\$31,000) (100% effort), Oct. 1997.
- “Computer Aided Engineering Design of Large-scale Municipal Incinerators” funded by the China Ship Manufacturing Inc., Taiwan, (PI) (\$42,000) (100% effort), May, 1997.
- “Management Information System and Network Communication Planning for Solid Waste Management in Taiwan” funded by the Department of Environmental Protection, Taiwan Provincial Government, Taiwan, (CO-PI) (\$33,000) (100% effort), June, 1997.
- “Resources Recovery from Incineration Process (II)” funded by the National Science Council, Taiwan, NSC86-2621-P-006-004, (PI) (\$13,000) (100% effort), June, 1997.
- “Genetic Algorithm-based Optimization Analysis for Regional Solid Waste Management Planning” funded by the National Science Council, Taiwan, NSC86-2211-E-006-017, (PI) (\$8,000) (100% effort), June 1997.
- “Chemical Emergency Preparedness and Response Planning Program” funded by the funded by Environmental Protection Administration, Taiwan, EPA-85-E3J1-09-06, (PI) (\$80,000) (100% effort), June, 1996.
- “Chemometric Analysis for the prediction of Dioxins/Furans Emissions from Large-scale Municipal Incinerators” funded by the Environmental Protection Administration, Taiwan, EPA-85-13S4-09-07, (PI) (\$16,000) (100% effort), June, 1996.

- “Environmental Informatics for Metropolitan Solid Waste Management” funded by the Environmental Protection Administration, Taiwan, EPA-85-L105-03-20, (PI) (\$35,000) (100% effort), June, 1996.
- “Resources Recovery from Incineration Process (I)” funded by the National Science Council, Taiwan, NSC85-2621-P-006-033, (PI) (\$14,000) (100% effort), Jan. 1996.
- “Strategic Planning and Regionalization Assessment of Solid Waste Management in Taipei Metropolitan Region” funded by the Environmental Protection Administration, Taiwan, EPA-044-840-040, (PI) (\$80,000) (100% effort), May, 1995.
- “Optimization Analysis for Solid Waste Collection, Recycling, Treatment and Disposal System” funded by the National Science Council, Taiwan, NSC87-2211-E-006-011, (PI) (\$10,000) (100% effort), June, 1995.
- “Compatible Analysis between Recycling and Energy Recovery in Tainan City” funded by the Tainan City Government, Taiwan, (PI) (\$15,000) (100% effort), Dec. 1993.
- “Recovery and Reuse of RFCC Scrap Catalyst for Removing VOCs in the Petrochemical Industry” funded by the National Science Council, Taiwan, NSC83-0421-P006-001Z, (PI) (\$21,000) (50% effort), Jan., 1994.

KEYNOTE ADDRESSES

Since 1992, Dr. Chang has presented several keynote addresses at national and international conferences held in the United Kingdom, United States, Germany, Taiwan, Singapore, Hong Kong, China, Japan, Portugal, The Netherlands, and Nicaragua. In addition, Dr. Chang was invited guest speaker over fifty universities, national laboratories, and governmental agencies nationally and internationally, including the Graduate Institute of Environmental Engineering, National Chiao-Tung University, Taiwan (1997), National Taiwan University, Taiwan (1998), Chinese Academy of Sciences, China (1998, 2002), Eastern China University of Science and Technology, China (2002), University of Louisiana – Lafayette (2004), Arizona State University, USA (April, 2005), University of Louisville, USA (May, 2005), Louisiana State University, USA (March, 2006), University of Texas – San Antonio, USA (Oct., 2007), Georgia Institute of Technology, USA (Nov., 2007), Natural Resource Ecology Lab. In Colorado State University, USA (Dec. 2008), Center of Remote Sensing and Modeling for Agricultural Sustainability, USDA, USA (April, 2009), Research Center of Environmental Changes, Academia Sinica, Taiwan (June, 2009), Chung-Hua Institution for Economic Research, Taiwan (June, 2009), National University of Kaohsiung, Taiwan (June, 2009), George Mason University, USA (Oct. 2009), University of Cincinnati, USA (April, 2010), Dalian University of Technology, China (June, 2010), Chaoyang University of Technology, Taiwan (June 2010), National University of Kaohsiung, Taiwan (June, 2010), Eastern China Normal University, China (June, 2010), University of Tokyo, Japan (June, 2010), University Nova de Lisboa, Lisbon, Portugal (Jan., 2011), Huazhong University of Science and Technology, China (May, 2011), Nanyang Technological University, Singapore (June, 2011), National University of Singapore, Singapore (June, 2011), National Central University, Taiwan (June, 2011, June, 2012), Tunghai University, Taiwan (June, 2011, June 2012; Dec. 2014), University of Exeter, United Kingdom (Sept., 2011, May 2012), Wessex Institute of Technology, United Kingdom (Sept., 2011), The Instituto Nicaragüense de Estudios Territoriales (Nicaraguan Geosciences Institute, INETER), Nicaragua (May 2012), The Institute of Bio and Geoscience (IBG) of the Forschungszentrum Jülich, Germany (July, 2012), University of Waterloo, Canada (Sept. 2012), University of Oklahoma, USA (Sept. 2013), University of Hong Kong, China (Dec., 2013), University of Bristol, United Kingdom (Feb., 2014), Heriot-Watt University, United Kingdom (Feb., 2014), EPSRC in United Kingdom (Feb., 2014), NERC in United Kingdom (Feb., 2014), Northeastern University, USA (Feb., 2014), Colorado School of Mines, USA (March, 2014), University of California-Irvine, USA (May, 2014), Disaster Prevention and Water

Environment Research Center, National Chiao-Tung University, Taiwan (July, 2014), Institute of Water and Environment at Technische Universität München, Germany (Sept., 2014), Florida Atlantic University, USA (Nov., 2014), the King Abdullah University of Science and Technology (KAUST) (May 2015), University of Oxford (June, 2015), University of Exeter in UK (July, 2015), De Montford University in UK (Aug., 2015), University of Hong Kong (Oct., 2015), City University of Hong Kong (Oct., 2015), National Central University (Oct., 2015), Academic Sinica (Oct. 2015), Institute of Geographical Science and Natural Resources, Chinese Academy of Science, China (April, 2016), Department of Hydraulic Engineering, Tsinghua University, China (April 2016), Departamento de Computación, CINVESTAV-IPN, Mexico (May, 2016). Technical University of Delft (Nov., 2016), European Academy of Science (Nov., 2016), National Space Organization Center, Taiwan (Dec., 2016), East China Normal University (Jan., 2017), Academia Sinica (Jan., 2017), Fudan University (Jan., 2017), Swiss Federal Institute of Technology in Zurich (May, 2017), China Meteorological Administration (CMA) in China (Nov. 2017), Chinese Academy of Meteorological Sciences in China (Nov. 2017), University of Hong Kong in China (May, 2018), Sun-Yet-Sen University (May, 2018), National Taipei University of Technology in Taiwan (June, 2018), Xi'an University of Science and Technology in China (June, 2018), University of Florida (Aug., 2018), University of California – Long Beach (Oct., 2018), and Yuan Ze University in Taiwan (Nov., 2018).

EXTERNAL EXAMINERS

External examiner for Ph.D. and Master's theses for universities in China, Portugal, Spain, Taiwan, India, Singapore, United Kingdom, and Canada.

TEACHING

Environmental system modeling (graduate), advanced hydrology (graduate), fluid mechanics (undergraduate), hydraulics (undergraduate), groundwater hydrology (graduate), groundwater modeling (graduate), environmental informatics and remote sensing (graduate), environmental & water resources systems analysis (graduate and undergraduate), environmental policy and regulation (graduate), industrial ecology (graduate), introduction to environmental engineering (undergraduate), engineering process optimization (graduate), ecological engineering (graduate), environmental economics (undergraduate), environmental systems analysis (undergraduate), solid and hazardous waste management (undergraduate), and workshop courses at the graduate and undergraduate levels. Courses were well received and consistently were given high ratings by the students. Courses offered in the US is listed below:

Fall 2002	EVEN6342	Environmental Systems Engineering (Graduate)
Spring 2003	EVEN6318	Environmental Systems Modeling (Graduate)
Fall 2003	EVEN6342	Environmental Systems Engineering (Graduate)
Spring 2004	EVEN6340	Decision Analysis for Environmental Systems (Graduate)
Fall 2004	EVEN 6354	Environmental Regulation and Policy (Graduate)

Spring 2005	EVEN6342	Engineering Optimization for Environmental Systems (Graduate)
Fall 2005	ENV3001	Introduction to Environmental Engineering (Undergraduate)
Fall 2005	CWR4203	Hydraulics (Undergraduate)
Spring 2006	ENV3001	Introduction to Environmental Engineering (Undergraduate)
Spring 2006	CWR4203	Hydraulics (Undergraduate)
Fall 2006	CWR 3201	Fluid Mechanics (Undergraduate)
Fall 2006	CWR4203	Hydraulics (Undergraduate)
Spring 2007	CWR 6102	Advanced Hydrology (Graduate)
Spring 2007	ENV3001	Introduction to Environmental Engineering (Undergraduate)
Fall 2007	EES 5318	Industrial Ecology (Graduate)
Fall 2007	ENV 5636	Environmental and Water Resources Systems Analysis (Graduate)
Spring 2008	CWR 6102	Advanced Hydrology (Graduate)
Fall 2008	Sabbatical	
Spring 2009	Sabbatical	
Fall 2009	ENV 5636	Water Resources and Environmental Systems Analysis (Graduate)
Spring, 2010	EES 5318	Industrial Ecology (Graduate)
Fall, 2010	CWR 5125	Groundwater Hydrology (Graduate)
Fall, 2010	CWR 3201	Fluid Mechanics (Undergraduate)
Spring, 2011	CWR 3201	Fluid Mechanics (Undergraduate)
Fall, 2011	ENV 5636	Environmental and Water Resources Systems Analysis (Graduate)
Fall, 2011	ENV 6047	Environmental Informatics and Remote Sensing (Graduate)
Spring, 2012	EES5318	Industrial Ecology (Graduate)
Spring, 2012	CWR 6126	Groundwater Modeling (Graduate)
Fall 2012	Working with National Science Foundation	
Spring 2013	Working with National Science Foundation	
Fall 2013	Working with National Science Foundation	
Spring 2014	Working with National Science Foundation	
Fall, 2014	ENV 5636	Environmental and Water Resources Systems Analysis (Graduate)
Spring, 2015	EES 5318	Industrial Ecology (Graduate)
Fall, 2015	ENV 6617	Ecological Engineering: Receiving Water Impact (Graduate)

Spring, 2016	ENV 6047	Environmental Informatics and Remote Sensing (Graduate)
Fall, 2016	On Sabbatical	
Spring, 2017	On Sabbatical	
Fall 2017	ENV4341	Sustainable Resources Management (Undergraduate)
Fall 2017	ENV 5636	Environmental and Water Resources Systems Analysis (Graduate)
Spring 2018	EES 5318	Industrial Ecology (Graduate)
Fall 2018	ENV4341 and ENV6616	Sustainable Resources Management (Undergraduate) Ecological Engineering: Receiving Water Impact (Graduate)
Spring, 2019	EES5318 and ENV3001	Industrial Ecology (Graduate) Introduction to Environmental Engineering (Undergraduate)
Fall, 2019	ENV 5636	Environmental and Water Resources Systems Analysis (Graduate)

EXTERNAL PROPOSAL REVIEWERS

Carried out proposal review as a panelist for National Science Council, Taiwan 1998-2001. NSF Office of Cyberinfrastructure (OCI) “Cyberinfrastructure Training, Education, Advancement, and Mentoring for Our 21st Century Workforce (CI-TEAM) program”, 2007, Science Foundation Ireland (SFI) of 2008 Research Frontiers Programme (Dublin, Ireland), NSF Environmental Engineering Program - Water Quality/Pollution Control, 2008, the “Complex Exploratory Research Projects” in “Ideas” research program, the National Council for Scientific Research, Romania, 2012, and the U.S. Environmental Protection Agency STAR Graduate Fellowship Program, 2013. Additionally, he has been an ad hoc proposal reviewer for NOAA Center for Sponsored Coastal Ocean Research (CSCOR) – MERHAB Program, DOD Environmental Remediation Technology Program, DOE Recovery Act: Energy Efficiency and Conservation Block Grant (DOE Environmental Management Consolidated Business Center (EMCBC)), USGS National Initiative of Water Resources (NIWR) program, Oak Ridge Associated Universities (ORAU), Water Environment Federation, National Science Council (NSC) in Taiwan, NSF Hydrological Sciences Program and International Research Fellowship Program, U.S. - Israel Binational Science Foundation, Research Grant Council in Hong Kong, China, National Science and Engineering Research Council of Canada (NSERC) in Canada, Joint German-Israeli Research Program in Germany and Israel, National Research Foundation in Singapore, the Portuguese Foundation for Science and Technology (FCT), The State University of New York (SUNY) 4E Network of Excellence Collaboration Grants, the NASA Postdoctoral Program, the Netherlands Organisation for Scientific Research, KU Leuven Impulse Fund Program (University of Leuven, Belgium), and The China (CAS, CASS, MoE, MOST)-Netherlands (OCW, KNAW, NWO) Joint Scientific Thematic Research Programme (JSTP), the Israel Science Foundation (ISF), the National Centre of Science and Technology Evaluation, Republic of Kazakhstan, and The New Zealand Ministry of Business, Innovation & Employment (MBIE) 2015 Science Investment Round.

EUROPEAN ACADEMY OF SCIENCES

Since being elected foreign member of the European Academy of Sciences (EAS) in 2008, Chang has been involving in the EAS activities. He served as one of the board members in Earth Sciences and Environmental Sciences Division. Chang organized and chaired with Dr. Sven Jorgensen (Chair of the Board) a two-day Workshop on the topics “Ecological Modeling for Stormwater Management”, which took place in the Stormwater Management Academy at University of Central Florida on Thursday and Friday, Sept. 27 and 28, 2012. Since 2008, Chang has nominated and voted for several new fellow candidates of the EAS at activities of the board. He co-edited with Dr. Sven Jorgensen a book entitled "Advances in Ecological Modelling and Ecological Engineering - Lakes and Wetlands" published by Elsevier in June, 2014. With the same partnership, he is a member of the organizing committee of the "Encyclopedia for Environmental Management" published by the Taylor and Francis Group in Jan. 2013. Chang was invited as a key note speaker in the EAS annual meeting at Toulouse, France, in Nov., 2013. After 2013, he has been working with the new head of the EURASC Earth and Environmental Sciences Division, Prof. Dr. Antonio Camacho, to promote the divisional activities.

PROFESSIONAL SOCIETY ACITVTITIES

Dr. Chang has been highly active in many professional societies such as American Society of Civil Engineers (ASCE), American Geophysical Union (AGU), International Water Association (IWA), American Association for the Advancement of Science (AAAS), International Society for Optics and Photonics (SPIE) and Institute of Electronics and Electrical Engineers (IEEE). Dr. Chang is one of the founding members and a current board member of the International Society of Environmental Information Management (ISEIS) and International Society of Grey Systems and Uncertainty Analysis (ISGSUA). Dr. Chang has been the chair of the task committee of “Urbanization Effect on Groundwater” in ESRI/ASCE for many years. He has been with Groundwater Management Committee, International Council, Watershed Management Systems Analysis Task Committee, Green Roofs Task Committee, Environmental and Water Resources System Committee in EWRI/ASCE. He is a Member of Watershed and River Basin Management Specialty Group in IWA and a Member, the Leadership Team (LT) of the Joint IAHR-IWA Hydroinformatics Committee. He has been Session Chair, Co-Chair, and Chair of "Remote Sensing and Modeling of Ecosystems for Sustainability, SPIE Remote Sensing Conference, held in San Diego, CA, USA, since 2007 annually. Chang is the Chair of the Committee of Urbanization Effect on Groundwater in EWRI/ASCE. Besides, with the partnership from University of Alberta (Dr. Sushanta K. Mitra and Thomas Thundat), he Co-Chair of session "Water Purification and Monitoring under Minimal Resource Setting" in 2013 AAAS Annual Meeting, Boston, held on 14-18 February, 2013. Chang has been an activist of the IEEE with affiliations in Systems, Man and Cybernetics (SMC) Society through activities such as being a co-chair of the Technical Committee for "Environmental Sensing, Networking and Decision-Making", "Intelligent Transportation System", and "Grey System Technical Committee". He is also affiliated with Technical Committee on "Conflict Resolution" in IEEE SMC, "Earth Science Informatics" Technical Committee in IEEE Geosciences and Remote Sensing Society and IEEE Intelligence System Applications Technical Committee in IEEE Computational Intelligence Society. He is the chair of the Best Paper Award Committee and a member of the International Organizing Committee of the IEEE International Conference on Networking, Sensing and Control (ICNSC), IEEE Systems, Man, and Cybernetics Society held at Paris-Evry, France on April 10 – 12, 2013. He is the chair of the IEEE International Conference on Networking, Sensing and Control (ICNSC) held at Miami, FL, USA on April 7 – 10, 2014. Chang is also an active member of IEEE Geosciences and Remote Sensing Society and IEEE Computational Intelligence Society. He is also the general Co-chair of the SPIE Remote Sensing and Modeling for Ecosystem of Sustainability in San Diego, CA since 2014. He is one of the founding

members of The International Society of Grey Systems and Uncertainty Analysis in Dec., 2015. He is now a guest editor of a special issue of IEEE Systems Journal titled “Cyber-innovated Environmental Sensing, Monitoring and Modeling for Sustainability” and a special issue of SPIE Journal of Applied Remote Sensing titled “Remote Sensing and Sensor Networks for Investigating the Coupled Biogeophysical and Biogeochemical Process of Harmful Algal Blooms”.

INTERNATIONAL NETWORKING AND ACADEMIC COLLABORATION

Dr. Chang has been extremely active in organizing and participating numerous international activities. Dr. Chang fostered over thirty strategic alliances worldwide for research collaboration between the Stormwater Management Academy (SMA) and other institutions. He organized and edited 10 special issues of journals on a range of different topics for Journal of Applied Remote Sensing, Journal of Environmental Modeling & Assessment, Journal of Hazardous, Toxic, and Radioactive Waste Management (ASCE), Stochastic Environmental Research & Risk Assessment, Journal of Environmental Management, Journal of Environmental Informatics, Journal of Civil Engineering and Environmental Systems, Journal of Hydrological Engineering (ASCE), and Ecological Informatics. He was a member of the Graduate Program Assessment Committee of Graduate Institute of Environmental Engineering, National Taiwan University, Taiwan, in May, 2010. He has been an Editor, Associate Editor and Editorial Board member with over 30+ journals at present across the globe and been ad hoc reviewers of 80+ relevant journals. He has been highly active in many professional organizations such as the ASCE, AAAS, IAHR, IWA, SPIE and IEEE from which he built on an international collaborative network. Over the last 10 years, Chang participated in the various international collaborative channels via the co-supervision of overseas Ph.D. students in China, United Kingdom, Spain, Portugal, Singapore, and Taiwan. Throughout his career, Dr. Chang has regularly presented leading-edge research accomplishments over 50 institutes and universities around the globe with a current focus on the partnership with United Kingdom (University of Exeter and University of Bristol), Canada (University of Waterloo), Taiwan (National Central University and Tunghai University), Japan (Tokyo University), Portugal (Universidade Nova de Lisboa), Spain (University of Valencia) and Germany (the Institute of Bio and Geoscience (IBG) of the Forschungszentrum Jülich, the Helmholtz Association of German Research Centre). He was one of the founders of International Society of Environmental Information Management and a board member at present. He was the founding editor-in-chief of the *Journal of Environmental Informatics* and the *British Journal of Environment and Climate Change*. He is the editor-in-chief of SPIE official *Journal of Applied Remote Sensing* as well as an editorial board member of 30+ international journals by which he made a strong networking with international scholars worldwide. Chang is active in international research collaboration and has been working on common research projects across the globe in 2007-the present as briefly described below:

- Universitat de València (Spain) and University of Central Florida (USA): Working on lake eutrophication issue and water resources management
- Eastern China Normal University (China) and University of Central Florida (USA): Working on global climate change issue, lake eutrophication issue, and air quality assessment and management
- University of Exeter (the United Kingdom), Tsinghua University (China) and University of Central Florida (USA): Working on urban flood impact assessment, and mega-city management
- National Autonomous University of Nicaragua (Nicaragua) and University of Central Florida (USA): Working on lake eutrophication and paleolimnology issues.

- National Central University (Taiwan) and University of Central Florida (USA): Working on lake eutrophication, climate change, ecosystem conservation, and mangrove forest assessment issues.
- University of Hong Kong (China) and University of Central Florida (USA): Working on stormwater management, low impact development, and hydrological modeling issues.
- Huazhong University of Science and Technology (China) and University of Central Florida (USA): Working on urban waste management, sustainable development, and sensor network issues.
- Dalian University of Technology (China), National Central University (Taiwan) and University of Central Florida (USA): Working on coastal land use management, sustainable development, and urban growth issues.
- Tonghai University (Taiwan) and University of Central Florida (USA): Working on waste management, sustainable development, and urbanization issues.
- Yuan Ze University (Taiwan) and University of Central Florida (USA): Working on green material and nanomaterial development for pollutant removal and material response characterization issues.
- Universidade Nova de Lisboa (Portugal) and University of Central Florida (USA): Working on waste management, sustainable development, and environmental management issues.
- National University of Kaohsiung (Taiwan) and University of Central Florida (USA): Working on industrial ecology and water management issues.
- Chinese Academy of Science (China) and University of Central Florida (USA): Working on river and lake management, sustainable development, and ecosystem restoration issues.
- The Institute of Bio and Geoscience (IBG) of the Forschungszentrum Jülich (Germany) and University of Central Florida (USA): Working on global climate change and environmental fluid mechanics issues.

CONFERENCE ORGANIZATION

Chang has been the Chair or Co-Chair and main organizer of many international conferences and been an active member of the scientific planning committee of more than 50 other conferences, many of which involved the planning and chairing of special tracks of sessions. Since 2008, Chang has helped to organize and chair special tracks of sessions on “Urbanization Effect on Groundwater” at the annual conferences of the ASCE/EWRI. He is a member of International Advisory Board of the 7th ASCE International Engineering and Construction Conference on “Green Infrastructure System” held on February 13-15, 2012 at Brisbane, Australia. He is a member of International Program Committee in 2011 and 2012 IEEE International Conference on Grey Systems and Intelligent Services. In 2010, he chaired the Workshop of Green Engineering and Industrial Ecology, held in the University of Kaohsiung, on June 3 – June 14, Kaohsiung, Taiwan, 2010 after he chaired the session in Hydrological and Environmental Remote Sensing for Global Changes, 2010, the Western Pacific Geophysical Meeting (WPGM), held on May 22-25, Taipei, Taiwan. In 2013, he organized a session in the international conference on "Stochastic and Statistical Methods in Hydrology and Environmental Engineering to be held in Koblenz, Germany. These ongoing conferences are now called the International Conferences on Water and Environment Research (ICWRER), for which Chang is a member of the ICWRER Steering Committee. He is also the general chair of 2014 IEEE Conference for Sensing, Networking, and Control held in Miami, Florida and has been the chair of SPIE-wide Conference of Remote Sensing and Modeling of Ecosystem for Sustainability held periodically in San Diego, California since 2014.

PROGRAMMATIC LEADERSHIP IN THE NATIONAL SCIENCE FOUNDATION

During the tenure with the National Science Foundation from Aug. 2012 to Aug. 2014, Chang was the program director of the Hydrologic Sciences Program under the Earth Science Division of the Directorate of Geosciences and the Cyber-enabled Sustainability Science and Engineering (CyberSEES) program. Chang has helped to manage the panel meeting twice in a year for the Hydrologic Sciences Program and once in a year of the CyberSEES program handling a broad ranges of research topics relation to geophysics, geochemistry, and engineering topics. Each program has about 12 million\$ annual budget. While serving as the cognizant program director, he was also designated as a member of the Statistical Committee under the Directorate of Geosciences. As a cognizant program director, the main efforts include: 1) Program Planning and Management - Program directors play a central role in managing this merit review process for all proposals with integrity. In addition, they are called upon to anticipate future trends to ensure that the science, engineering, and education activities supported by the Foundation will transform the frontiers of knowledge, technology, and educational practice; 2) Coordination and Liaison - NSF places a high value on interdisciplinary activities and their management. Supporting such activities often requires working across divisional and directorate lines and with interagency partners; 3) Communication and Outreach - A strong relationship with the research and education community is a traditional and important strength of NSF. Through this relationship, NSF is alerted to new areas of investigation, new technologies, and new members of the science and engineering community; and 4) Execution of Independent Research/Development – NSF encourages program directors to sustain his or her own knowledge base at the forefront of the core science areas and at the cutting edges of the interdisciplinary and emerging areas of concerns.

ADMINISTRATIVE DUTIES IN THE UNIVERSITY OF CENTRAL FLORIDA

Chang has served his colleagues in numerous capacities at the departmental faculty and university levels. For instance, At UCF, he has been a Member of numerous committees such as the Promotion and Tenure Committees, Chair Search Committee, ABET Review Committee at the Departmental level, the Sabbatical Committee at the College level, and the Environmental Management Council at the University level. However, he has been serving as director of the Stormwater Management Academy (SMA), from which he is responsible for fostering the growth of a high impact stormwater resources engineering program from both quantitative and qualitative perspectives, and managing the research, educational internship, and industrial outreach components. Responsibilities include promotion of the research funding level from state and federal agencies, industry, and private foundations; fiscal management; operational and strategic planning; establishment, implementation, and measurement of goals and objectives; implementation of policy and procedures; performance evaluation, and partnership strengthening and communication. During his tenure of this director position from Oct. 2011 to the present, he has done the following major contributions:

- The creation of three laboratories including 1) Water Treatment and Sustainability Research Laboratory for treatability study (column study and pilot study), upflow reactor, ecotoxicity testing, stormwater harvesting and reuse (exfiltration trench, pipe reactor, road side harvesting), baffle box with nutrient removal, and treatment train testing; 2) Bioenvironmental Systems Research for Laboratory: green roof, biosorption activated media (BAM), subsurface upflow wetland system for wastewater and stormwater treatment, bioretention swale, floating wetland technologies, stormwater infiltration basin with BAM for stormwater treatment – biogeochemical cycle study, microbial ecology study – real-time polymerase chain reaction (PCR) for underground drainfield with BAM for wastewater treatment, lake, streams, and wetland restoration Best Management Practices (BMPs), green chemistry and advanced materials, and ecological engineering and receiving water impact assessment and BMP

development; and 3) Hydroenvironmental and Ecological Monitoring and Modeling Laboratory for treatment train design software, watershed modeling and wassetload reduction planning, environmental and water resources systems analysis, Geographical Information System (GIS) and spatial analysis, environmental cyberinfrastructure and sensor networks, and environmental, hydrological, and ecological remote sensing and informatics.

- Chang and his colleagues developed a suite of low impact development technologies for wastewater and stormwater treatment having received 9 US Patents that have been licensed to industry for various applications.
- Chang has created a strategic alliance in which over 40 academic institutions worldwide had signed the Memorandum of Understanding (MOU) to promote national and international collaboration.
- Chang has helped to migrate and modify a new web site for the academy.
- Chang has drastically promoted the outreach activities with ASCE, IEEE, SPIE, etc. at different locations and topical areas.
- Up to the year 2018, the academy has received over 20 million dollars of research funding and over 100 graduate and undergraduate students have joined the academy's research projects.
- Chang has hosted a few international interns from European and South America countries in the last few years providing educational service.

INVITED PRESENTATIONS WORLDWIDE FROM 2012 TO 2018

- P1. Chang, N. B. and Vannah, B. (2012): Monitoring Changing Environment and Ecosystems with an Integrated Data Fusion and Mining (IDFM) Technique, The Instituto Nicaragüense de Estudios Territoriales (Nicaraguan Geosciences Institute, INETER), Nigaragua, May 5, 2012. (Local)
- P2. Chang, N. B., Jones, J., Islam, K, and Xuan, Z. (2012): Assessment of Ecosystem Restoration in Lake Istoppoga, Florida. The 23rd Annual Florida Lake Management Society Conference at Gainesville, Florida, USA, June 18-22, 2012. (Regional, Local)
- P3. Jones, J., Islam, K, Chang, N. B., and Lumbert, L. (2012): Assessment of Best Management Practices of Sediment Dredging in Lake Apopka-Beauclair System, Florida. The 23rd Annual Florida Lake Management Society Conference at Gainesville, Florida, USA, June 18-22, 2012, (Regional, Local)
- P4. Chang N. B. (2012): The Challenges of Design for Water-Energy-Environment-Infrastructure Systems under Climate Change Impacts toward Urban Sustainability, Tunghai University, Taiwan, June 25, 2012. (International)
- P5. Chang N. B. (2012): The Assessment of Climate Change Impact on Regional Precipitation via Various Teleconnection Signal Propagation Patterns, The Center for Space and Remote Sensing Research, National Central University, Zhungli, Taiwan, July 11, 2012. (Local)
- P6. Chang N. B. (2012): The Use of Biosorption Activated Media for Nutrient Removal, The Institute of Bio and Geoscience (IBG) of the Forschungszentrum Jülich, Germany, Invited by the Fulbright Scholar program, Jülich, Germany, July 19, 2012. (Local)
- P7. Wanielista, M. P., Chang, N. B., and Islam, K. (2012): Floating Wetland Field Assessment of Nutrient Removal in a Stormwater Wet Pond, The National Hydraulics and Hydrology Engineering Conference (NHEC), Nashville, Tennessee, USA, Aug. 20-27, 2012. (National)
- P8. Chang N. B., Vannah, B., and Xuan, Z. (2012): Monitoring the Total Organic Carbon Concentrations in a Lake with the Integrated Data Fusion and Mining Technique, SPIE OP403:

Remote Sensing and Modeling of Ecosystems for Sustainability VII Symposium at San Diego, California, USA, August 12-16, 2012. (International)

- P9. Chang N. B., L. Mullen, and J. Weiss (2012): Cross Wavelet Analysis for Retrieving Climate Teleconnection Signals between Sea Surface Temperature and Forest Greenness, SPIE OP403: Remote Sensing and Modeling of Ecosystems for Sustainability VII Symposium at San Diego, California, USA, August 12-16, 2012. (International)
- P10. Chang N. B. and Xuan, Z. (2013): Monitoring Nutrient Concentrations in Tampa Bay under Hurricane Impact with MODIS Images and Machine Learning Models, The IEEE International Conference on Networking, Sensing and Control (IEEE Systems, Man, and Cybernetics Society), Paris, France, April 10-12, 2013. (International)
- P11. Marimon, Z., Xuan, Z. M., and Chang, N. B. (2013): Modeling the Treatment Efficiency of a Stormwater Wet Detention Pond with Floating Treatment Wetlands, The 29th Annual Water Resources Seminar, Environmental Water Resources Institute, ASCE, Orlando, FL, April 19, 2013. (Regional, Local).
- P12. Yang, Y., Chang, N. B., Li, Z., Buchberger, S. G., Tong, S., Wang, X., Levine, A., Hinchman, A., Fang, M., Swertfeger, J., and Goodrich, J. A. (2013): A Systems Approach to Manage Drinking Water Quality through Integrated Model Projections, Adaptive Monitoring and Process Optimization. ASCE/EWRI World Environmental and Water Resources Congress at Cincinnati, Ohio, USA, May 20-22, 2013. (International, National, Regional)
- P13. Yang, Y., Chang, N. B., Neal, J., Wei, H., Liang, S., and Keener, T. C. (2013): Water and Carbon Footprints for Sustainability Analysis of Urban Infrastructure, ASCE/EWRI World Environmental and Water Resources Congress at Cincinnati, Ohio, USA, May 20-22, 2013. (International, National, Regional)
- P14. Vannah, B., Chang, N. B., and Yang J. (2013): Integrated Data Fusion and Machine-learning (IDFM) for Monitoring Spatiotemporal Microcystin Distributions in Lake Erie, International Conferences on Water and Environment Research (ICWRER), Koblenz, Germany, June 3rd to 7th, 2013. (International)
- P15. Mullen, L., Chang, N. B., and Yang J. (2013): Prediction of Precipitation Based on Long-term Teleconnection Signal with Remote Sensing-based Wavelet Analysis," International Conferences on Water and Environment Research (ICWRER), Koblenz, Germany, June 3rd to 7th, 2013. (International)
- P16. Imen, S., Chang, N. B., and Yang J. (2013): Exploring the Effect of Teleconnection Signal Propagation on Terrestrial Precipitation in North America, International Conferences on Water and Environment Research (ICWRER), Koblenz, Germany, June 3rd to 7th, 2013. (International)
- P17. Mullen, L., Chang, N. B., and Yang J. (2013): Short- term Interactions between Sea Surface Temperature and Precipitation Patterns in Northeast America," International Conferences on Water and Environment Research (ICWRER), Koblenz, Germany, June 3rd to 7th, 2013. (International)
- P18. Chang, N. B. and Vannah, B. (2013): Integrated Data Fusion and Bio-optical Models for Monitoring Microcystin Concentrations in Lake Erie, Proceedings of SPIE Vol. 8869: Remote Sensing and Modeling of Ecosystems for Sustainability VII Symposium at San Diego, California, USA, August 26-28, 2013. (International, National)
- P19. Chang, N. B. (2013): Remote Sensing and Sensor Networks in Support of Environmental Monitoring for Agricultural Sustainability. The 2nd International Conference on Agro-geoinformatics Fairfax, US, Aug. 12, 2013. (International)

- P20. Chang, N. B. and Vannah, B. (2013): Fusion of Hyperspectral and Multispectral Remote Sensing Data for Near Real-time Monitoring of Microcystin Distributions in Lake Erie, Proceedings of SPIE Vol. 8871 Satellite Data Compression, Communications, and Processing VII Symposium at San Diego, California, USA, August 26-28, 2013. (International, National)
- P21. Chang, N. B. and Imen, S. (2013): Periodicity Analysis for Teleconnection Signal Propagation between Sea Surface Temperature and Forest Greenness across North America, Proceedings of SPIE Vol. 8869: Remote Sensing and Modeling of Ecosystems for Sustainability VII Symposium at San Diego, California, USA, August 26-28, 2013. (International, National)
- P22. Chang, N. B. (2013): Prediction of Precipitation Based on Long-term Teleconnection Signals via Wavelet-driven Artificial Neural Network Models, University of Oklahoma, Norman, Sept. 8, 2013. (Regional, Local)
- P23. Chang, N. B. and Vannah, B. (2013): Comparative Data Fusion between Genetic Programming and Neural Network Models for Remote Sensing Images of Water Quality Monitoring, 2013 IEEE International Conference on Systems, Man, and Cybernetics (SMC), Manchester, UK, October 13th to 16th, 2013. (International)
- P24. Chang, N. B. (2013): Monitoring Water Quality from Space: A New Frontier on Satellite Sensor Fusion, 2013 Annual Meeting of European Academy of Science, Nov. 5, 2013. (International)
- P25. Chang, N. B. (2013): Monitoring Water Quality for Coupled Urban Water Infrastructure and Natural Systems with Remote Sensing and Sensor Networks, University of Hong Kong, Hong Kong, China, Dec. 24, 2013. (International)
- P26. Chang, N. B. (2014): Integrated Data Fusion and Mining (IDFM) for Monitoring Water Quality in Lake Erie, University of Bristol, Bristol, United Kingdom, Feb. 22, 2014. (Receiving the Distinguished Visiting Fellowship Award, Royal Academy of Engineering, United Kingdom) (International)
- P27. Chang, N. B. (2014): Multiscale Monitoring of Coastal City Development and Environmental Impact with Satellite Remote Sensing, Heriot Watt University, Edinburgh, United Kingdom, Feb. 26, 2014. (Receiving the Distinguished Visiting Fellowship Award, Royal Academy of Engineering, United Kingdom) (International)
- P28. Chang, N. B. (2014): Integrated Sensor Fusion and Data Mining for Monitoring Water Quality and Ecosystem in Coastal Cities, Northeastern University, Boston, March 2, 2014. (Regional, Local)
- P29. Chang, N. B. (2014): Integrated Data Fusion and Mining (IDFM) for Monitoring Water Quality in Lake Erie, Colorado School of Mines, Golden, CO, March 20, 2014. (Regional, Local)
- P30. Chang, N. B. (2014): Sustainability Science and Engineering: A New Paradigm under the Global Change Impact, The Center for Hydrometeorology & Remote Sensing (CHRS), University of California-Irvine, May, 10, 2014. (Regional, Local)
- P31. Chang, N. B. (2014): Remote Sensing for Improving Pumping Strategies in Reservoirs and Lakes for Water Treatment, 2014 Sustainable Water Management and Green Technology Workshop, Disaster Prevention and Water Environment Research Center, National Chiao-Tung University, Hsinchu, Taiwan, June 30-July 1 2014. (International)
- P32. Chang, N. B. (2014): Tackling the Challenges of Water Resources Management from Space: A Long-term Perspective on Satellite Sensor Networks and Data Fusion, Symposium of Photonic Innovations and Solutions for Complex Environments and Systems (PISCES), San Diego, California, USA, August 17-21, 2014. (International, National)

- P33. Chang, N. B. and Vannah, B. (2014): Satellite Data Fusion and Information Retrieval with Ground-based Sensor Networks for Monitoring Ecosystem Evolution,” Remote Sensing System Engineering Symposium at San Diego, California, USA, August 17-21, 2014. (International, National)
- P34. Chang, N. B., Imen, S., and Yang, J. (2014): Linkages between Turbidity Levels in Lake Mead and Associated Forest Fire Events in the Lower Virgin Watershed, SPIE: Remote Sensing and Modeling of Ecosystems for Sustainability VII Symposium, San Diego, California, USA, August 17-21, 2014. (International, National)
- P35. Chang, N. B. and Imen, S. (2014): Impact of Teleconnection Phenomena and Local Environmental Factors on Forest Greenness in North and Central America, SPIE Symposium of Remote Sensing and Modeling of Ecosystems for Sustainability, San Diego, California, USA, August 17-21, 2014. (International, National)
- P36. Chang, N. B. (2014): The Development of Urban Water Systems Engineering in Florida under Rapid Global Change Impact, The Institute of Water and Environment, Technische Universität München, Germany Sept. 27, 2014. (International)
- P37. Imen, S., Chang, N. B., and Yang, J. (2014): Spatiotemporal Monitoring of TOC Concentrations in Lake Mead with a Near Real-Time Multi-sensor Network,” 2014 IEEE International Conference on Systems, Man, and Cybernetics (SMC), San Diego, CA, USA, October 6-9, 2014. (International, National, Regional)
- P38. Chang, N. B. (2014): Multi-scale Modeling for Developing Smart Stormwater Management Grids: An Integrated Modeling, Informatics and Cybernetics Approach,” Stormwater Modeling Workshop in City of Fort Lauderdale, Fort Lauderdale, Florida, Oct. 29, 2014. (Regional, Local)
- P39. Chang, N. B. (2014): Satellite Sensor Fusion and Data Mining for Monitoring Water Quality Status in Aquatic Environments, Florida Atlantic University, Boca Raton, FL, Nov. 19, 2014. (Regional, Local)
- P40. Chang, N. B. (2014): Integrative Approaches towards a Sustainable Environment and Society: Principles and Practices with Collaborative Networking, Tunghai Univeristy, Taiwan, Dec. 14, 2014. (International)
- P41. Chang, N. B., Houmann, C., Crawford, A. J., and Wanielista, M. (2015): Field-Scale Evaluation of Floating Treatment Wetlands for Nutrient Removal and Algal Toxin Control in Wet Detention Ponds across Florida,” ASCE LID Conference, Houston, TX, Jan. 17-21, 2015. (National, Regional)
- P42. Crawford, A. J., Houmann, C., Chang, N. B., and Wanielista, M. (2015): Attaining Additional Nutrient Removal in Eutrophic Stormwater Wet Detention Pond Using a Floating Media Bed Reactor," ASCE LID Conference, Houston, TX, Jan. 17-21, 2015. (National, Regional)
- P43. Doña, C., Chang, N. B., Caselles, V., Sánchez, J. M., and Camacho, A. (2015): Investigating the Hydrological Signature of Seasonal Lagoons in La Mancha Húmeda Biosphere Reserve, Spain with Remote Sensing Technologies, Conference on Mapping Water Bodies from Space, The European Space Agency, Rome, Italy, March 18-19, 2015. (International)
- P44. Chang, N. B. and Imen, S. (2015): Improving the Control of Water Treatment Plant with Remote Sensing-based Water Quality Forecasting Model, he 12th IEEE International Conference of Netowrking, Sensing, and Control (ICNSC), Taipei, Taiwan, April 9-12, 2015. (International)
- P45. Di, Y., Ding, W., Small, D. L., Islam, S., and Chang, N. B. (2015): Applying Machine Learning for the Long-Lead Heavy Precipitation Predication, The 12th IEEE International Conference of Netowrking, Sensing, and Control (ICNSC), Taipei, Taiwan, April 9-12, 2015.

- P46. Chang, N. B. (2015): Multi-sensor Fusion and Data Mining for Sustainable Urban Water Infrastructure Systems Analysis, The 12th IEEE Conference of Networking, Sensing, and Control (ICNSC), Taipei, Taiwan, April 9-12, 2015. (International)
- P47. Doña, C., Niclòs, R., Chang, N. B., Caselles, V., Sánchez, J. M., and Camacho, A., (2015): Water Area Variations in Seasonal Lagoons with Remote Sensing Classification Methods and Data Mining Techniques in La Mancha Húmeda, European Geophysical Union, Venna, Austria, April 12-17, 2015. (International)
- P48. Doña, C., Caselles, V., Chang, N. B., Sánchez, J. M., and Camacho, A. (2015): Developing Integrated Remote Sensing Data Fusion and Mining Techniques for Environmental Monitoring of the Water Quality in Spanish Reservoirs, International Conference of Remote Sensing of Environment, presented in Berlin, Germany, May 10-12, 2015. (International)
- P49. Chang, N. B. (2015): Multi-sensor Image Fusion and Data Mining for Environmental Sensing, Networking and Decision-Making, The Sensor Innovation Colloquium, the King Abdullah University of Science and Technology (KAUST), Saudi Arabia, May 23-25, 2015. (International)
- P50. Chang, N. B. (2015): The Growth of Sugar Cane and Bagasse Energy Recovery with Nutrient-laden Stormwater Treatment Area in South Florida, the Water-Energy-Food Nexus Workshop at the University of Oxford, UK, June 28rd to 30th, 2015. (International)
- P51. Chang, N. B. (2015): A New Dimension in Industrial Ecology: Coupling the Resilience and Risk Assessment of Municipal Utility Parks, the Chemical Engineering Seminar Series at the University of Oxford, UK, July 3, 2015. (Local)
- P52. Chang, N. B. (2015): Urban Growth Modeling Analysis and Flood Impact Assessment in Mega Cities, The Center for Water Systems at the University of Exeter, UK, July 6, 2015. (Local).
- P53. Chang, N. B. (2015): Flood Impact Assessment under Urban Sprawl and Climate Change in Three Mega Cities, The Center for Water Systems at the University of Exeter, UK, July 6, 2015. (Local)
- P54. Chang, N. B., Imen, S. and Bai, K. (2015): Long-Term Precipitation Forecasting Based on Teleconnection Signal Propagation across North America, Remote Sensing and Modeling of Ecosystems for Sustainability VII Symposium at San Diego, California, USA, August 8-11, 2015. (International)
- P55. Chang, N. B. (2015): Grey Mathematical Programming for Industrial Decision Making: Challenges and Perspectives, The 5th IEEE Grey System and Intelligent Service, De Montfort University, Leicester, U.K., Aug. 18-20, 2015. (International)
- P56. Di, Y., Ding, W., Imen, S., and Chang, N. B. (2015): Teleconnection Signals Effect on Terrestrial Precipitation: Big Data Analytics vs. Wavelet Analysis, The 5th International Workshop on Climate Informatics, Boulder, Colorado, NCAR Mesa lab., Sept. 24-25, 2015. (International, National)
- P57. O'Reilly, A. M., Chang, N. B., and Wanielista, M. P. (2015): An Innovative Stormwater Infiltration Basin: Integrating Green Infrastructure with the Urban Critical Zone, 42nd IAH (The International Association of Hydrogeologists) Congress, Rome, Italy, Sept. 13-18, 2015. (International)
- P58. Chang, N. B. (2015): Coupling Multi-scale and Multi-attribute Models to Assess the Risk and Resilience of the Sustainable Urban Drainage System, The University of Hong Kong, Hong Kong, China, Oct. 6, 2015. (Local)

- P59. Chang, N. B. (2015): Promoting Low Impact Development via the Land Development Permitting Procedure and the Water Utility District System,” The Univeristy of Hong Kong, Hong Kong, China, Oct. 6, 2015. (Local)
- P60. Chang, N. B. (2015): Remote Sensing and Sensor Networks in Support of Smart and Green Municipal Water Infastructure Systems, The Center of Chaos and Comlex Networks, City Univeristy of Hong Kong, China, Oct. 8, 2015 (Local).
- P61. Chang, N. B. and Imen, S. (2015): Multi-Sensor Acquisition, Data Fusion, Criteria Mining and Alarm Triggering for Discerete Event Analysis in Urban Water Infastructure Systems. IEEE System, Man, and Cybertics Annual Conference, Hong Kong, China, Oct. 9-12, 2015. (International)
- P62. Chang, N. B. (2015): Quantification of Relative Contribution of Teleconnection Signals to Terrestrial Precipitation Variability in America, Academia Sinica, Taipei, Taiwan, Oct. 12, 2015. (Local)
- P63. Chang, N. B. (2015): Can the Climate Change Assessment Framework Be Reshaped by the Advances of Climate Informatics Technologies? National Taiwan Univeristy, Taipei, Taiwan, Oct. 15, 2015. (Local)
- P64. Chang, N. B. (2015): Advances in Multi-sensor Image Fusion and Data Mining for Environmental Monitoring in All-weather Conditions, The Center for Space and Remote Sensing Research, National Central Univeristy, Chongli, Taiwan, Oct. 14, 2015. (International)
- P65. Doña, C., Caselles, V., Sánchez, J. M., Chang, N. B., and Camacho, A. (2015): Evolución de la cubierta de agua en lagunas temporales mediante técnicas de teledetección. Aplicación a La Mancha Húmeda, Spanish Association of Remote Sensing Conference. The 16th Congress of the Spanish Remote Sensing Association, Seville, Spain, Oct. 21-23, 2015. (International)
- P66. Chang, N. B., (2016): Cyber-Physical Systems for Sustainable Operation of Urban Water Supply System in the Water-stressed Western U.S., Univeristy of Virginia, USA, March 14, 2016. (Local)
- P67. Chang, N. B. (2016): Promoting Sustainable Urban Water Infrastructure Management with Cyber-Physical System Technologies, George Mason Univeristy, USA, March 21, 2016. (Local)
- P68. Joyce, J., Chang, N. B., Harji, R., and Ruppert, T. (2016): Assessing the Drainage Infrastructure in a Coastal Urban Watershed via a Worst-Case Scenario of Storm Surge and Sea-Level Rise Impacts, 2016 Annual FFMA Conference, the World Golf Village Renaissance in St. Augustine, Florida, USA, March 30 - April 01, 2016. (State, Local)
- P69. Hartshorn, N., Crawford, A. J., Chang, N. B., and Wanielista, M. P. (2016): Stormwater Treatment for Nutrient Removal with Solar-Powered Media Bed Reactors, 2016 EWRI (Orlando Chapter) Seminar, Orlando, FL, April 8, 2016. (Regional)
- P70. Chang, N. B., (2016): Cross-mission Sensor Image Fusion with Spatial Reconstruction and Data Mining for Lake Eutrophication Assessment, Institute of Geographical Sciences and Natural Resources, Chinese Academy of Sciences, April 18, 2016. (Lcoal)
- P71. Chang, N. B. (2016): Cross-Mission Satellite Data Merging and Mining for Water Quality Monitoring in All-weather Conditions, Department of Hydraulic Engineering, Tsinhuang Univ., China, April 20, 2016. (Local)
- P72. Imen, S. and Chang, N. B. (2016): Developing a Cyber-Physical System for Smart and Sustainable Drinking Water Infrastructure Management, the 2016 IEEE International Conference of Networking, Sensing, and Control presented in the Special Session: Hybrid Machine Learning

Approach in Support of Big Data Analytics for Smart Environments, Mexico City, Mexico, April 28-30, 2016. (International)

- P73. Chang, N. B. (2016): “Data Mining for Attributional Assessment of Teleconnection Signals in Relation to Terrestrial Precipitation Variability in America, Departamento de Computación, CINVESTAV-IPN, Mexico, April 30, 2016. (Local)
- P74. Hartshorn, N., Wen, D., Chang, N. B., and Wanielista, M. P. (2016): Comparative Nitrogen Removal with Sorption Media in Linear Ditch for Groundwater and Stormwater Treatment, ASCE EWRI Annual Congress, May 22-26, 2016, West Palm Beach, FL, USA. (National)
- P75. Hartshorn, N., Chang, N. B., and Wanielista, M. P. (2016): Inventive Engineering Design for Nutrient Removal at Stormwater Infiltration Basins with Bio-sorption Activated Media in Karst Environments, 2016 ASCE EWRI Annual Congress, May 22-26, 2016, West Palm Beach, FL, USA. (National)
- P76. Joyce, J., Chang, N. B., Harji, R., and Ruppert, T. (2016): Integrated Analysis of Storm Tidal Surge, Sea Level Rise, and Precipitation for Flood Hazard Assessment in a Coastal Urban Watershed, The ASCE EWRI Annual Congress, West Palm Beach, FL, USA, May 22-26, 2016. (National, Regional, State, Local)
- P77. Joyce, J., Imen, S., Chang, N. B., Harji, R., and Ruppert, T. (2016): Analyses for Adaptation of Drainage Infrastructure in a Coastal Urban Watershed from Impacts of Long-term Precipitation Variability and Sea Level Rise, ASCE EWRI Annual Congress, May 22-26, 2016, West Palm Beach, FL, USA. (National, Regional, State, Local)
- P78. Joyce, J., Imen, S., Chang, N. B., Harji, R., and Ruppert, T. (2016): Sustainable Drainage Infrastructure Planning in a Coastal Urban Watershed under Long-term Precipitation Variability and Sea Level Rise, The 7th International Conference on Water Resources and Environment Research (ICWRER2016), Kyoto TERRSA, Kyoto, Japan, June 5-9, 2016. (International)
- P79. Chang, N. B. (2016): Remote Sensing for Water Availability and Quality Management: Contemporary Challenges and Perspectives, The EPA National Risk Management Research Laboratory, Cincinnati, OH, Aug. 24, 2016. (National).
- P80. Chang, N. B., Yang, J., Joice, J., and Mostafiz, C. (2016): Prediction of Sea Surface Salinity Based on Landsat 8 Optical Images and MODIS with a Storm Surge Model during the 1991 Hurricane Bob Event in the Mattapoissett Harbor, The Remote Sensing and Modeling of Ecosystems for Sustainability VII Symposium at San Diego, California, USA, August 28-Sept. 1, 2016. (National, International)
- P81. Chang, N. B., Joyce, J., Mostafiz, C., and Yang, J. (2016): Prediction of Sea Surface Salinity Based on Landsat Optical Images and Storm Surge Model in a Small Coastal Bay, The Remote Sensing and Modeling of Ecosystems for Sustainability VII Symposium at San Diego, California, USA, August 28-Sept. 1, 2016. (National, International)
- P82. Joyce, J., Chang, N. B., Harji, R., Ruppert, T., and Singhofen, P. (2016): Exploring Drainage Infrastructure Resilience with LID Technologies for a Coastal Urban Watershed, National Society of Black Engineers Fall Regional Conference-Region III Location: Sheraton Gateway Atlanta Airport, Atlanta, GA, Nov. 4-5, 2016. (Reginal, Local)
- P83. Chang, N. B. (2016): Multi-signals-based Drought Prediction with Both Known and Unknown Teleconnection Signals in the Upper Colorado River Basin, the International Conference of Mechanisms of Drought - Meteorology, Hydrology and Human Agency, Delft University of Technology, Delft, The Netherlands, Nov. 14-15, 2016. (International)

- P84. Chang, N. B. (2016): How Does Artificial Intelligence Work with Remote Sensing Technologies for Multi-scale Environmental Change Detection? The Annual Meeting of the European Academy of Sciences, Nov. 18, 2016. (Receiving the Balise Pascal Medal from the European Academy of Sciences) (International)
- P85. Chang, N. B. (2016): Intelligent Learning of Environmental Features from Satellite Remote Sensing Images with Cross-Mission Data Merging and Mining, National Aerospace Center, Hsinchu, Taiwan, Dec. 27, 2016. (International)
- P86. Chang, N. B. (2016); Developing Intelligent Multi-sensor Data Merging, Fusion and Feature Extraction for Space-borne Water Quality Monitoring, Research Center for Environmental Changes, Academia Sinica, Taiwan, Dec. 29, 2016. (International)
- P87. Chang, N. B., Developing Floating Media Bed Reactors and Floating Treatment Wetlands for Nutrient Removal in Stormwater Ponds, presented to Department of Environmental Science and Engineering, Fudan University, Shanghai, China, Jan. 9, 2017 (invited speech, international).
- P88. Chang, N. B. (2017): Developing an Intelligent Multi-sensor Decision Support System for Space-borne Earth Observations, East China Normal University, Shanghai, China, Jan. 9, 2017. (Receiving the Zijiang Scholar Award) (International)
- P89. Chang, N. B. (2017): Developing Floating Media Bed Reactors and Floating Treatment Wetlands for Nutrient Removal in Stormwater Ponds, The Department of Environmental Science and Engineering, Fudan University, Shanghai, China, Jan. 9, 2017. (International)
- P90. Joyce, J. and Chang, N. B. (2017): Using ICPR for Resilience Assessment of Green-Grey Drainage Infrastructures under Climate Change and Sea Level Rise Impact, The 2017 EWRI (Orlando Chapter) Water Resources Seminar, Orlando, FL, April 8, 2017 (Regional, State, Local)
- P91. Chang, N. B. (2017): Contemporary Challenges and Solutions in Satellite Remote Sensing for Water Quality Monitoring, presented to Institute of Environmental Engineering (IfU), Earth Observation and Remote Sensing, ETH Zurich (Swiss Federal Institute of Technology in Zurich), Zurich, Switzerland, May 14, 2017. (International)
- P92. Wen, D., Chang, N. B., and Wanielista, M. P. (2017): Comparative Nitrogen Removal study with Innovative BMPs for Groundwater and Stormwater Treatment, NFWFMD, Florida Media Day, Tallahassee FL, Jan. 20, 2017. (State, Local)
- P93. Lu, J. W., Chang, N. B., Zhu, F., Hai, J., and Liao, L. (2018): Smart and Green Urban Solid Waste Collection System for Differentiated Collection with Integrated Sensor Networks. The 15th IEEE International Conference on Networking, Sensing, and Control, Zhuhai, China, March 27-29, 2018. (International)
- P94. Yang, Y. J., Neil, C. W., Chang, N. B., Jun, Y. S., Bierwagen, B. (2018): Multi-scale Systems Analysis for Engineering Optimization in Water Supply Infrastructure Systems. ACS National Meeting & Expo - Nexus of Food, Energy & Water, March 18 - 22, 2018 | New Orleans, LA, USA. (National)
- P95. Valencia, A., Chang, N. B., Wen, D. (2018): The Use of Green Sorption Media for Polishing Nitrogen Removal in Wastewater Effluents via a Rapid Infiltration Basin, presented at 33rd Annual Water Resources Seminar, East Central EWRI Section, ASCE, Double Tree by Hilton at Sea World, Orlando, FL, USA, April 20, 2018. (Regional, Local)
- P96. Wen, D., Chang, N. B., and Wanielista, M. (2018): Green Sorption Media for Nitrogen Removal in a Linear Ditch for Integrated Groundwater and Stormwater Treatment, presented at 33rd Annual Water Resources Seminar, East Central EWRI Section, ASCE, Double Tree by Hilton at Sea World, Orlando, FL, USA, April 20, 2018. (National)

- P97. Chang, N. B., Wanielista, M. P., Wen, D., and Hartshorn, N. (2017): Comparative Nitrogen Removal with Sorption Media in Linear Ditch for Groundwater and Stormwater Treatment, Hilton Orlando Lake Buena Vista, Orlando, Florida, April 28, 2017. (Local)
- P98. Chang, N. B. Sun, Z., Chen, C. F., Mostafiz, C., and Gao, W. (2017): Developing a Prototype Satellite-based Cyber-Physical System for Smart Wastewater Treatment, 2017 IEEE International Conference of Networking, Sensing, and Control, Calabria, Italy, May 16-18, 2017. (International)
- P99. Wanielista, M. P., Chang, N. B., and Rios, A. (2017): Passive On-site Wastewater Treatment for Nutrient Removal, WEFTEC Nutrient Symposium, Fort Lauderdale, Florida., USA, June 12-14, 2017. (National)
- P100. Chang, N. B. (2017): Deep and Fast Learning for Feature Extraction of Merged or Fused Remote Sensing Images to Observe Lake Eutrophication, in the Remote Sensing and Modeling of Ecosystems for Sustainability VII Symposium at San Diego, California, USA, Aug. 8- 10, 2017. (International)
- P101. Chang, N. B. and Ruppert, T. (2017): Coupling Risk and Resilience Assessment for Networked Sustainable Drainage Systems in a Coastal City under Climate Change Impact, Coastal Sustainability Symposium Florida Sea Grant Meeting, Gainesville, FL, USA, Sept. 26, 2017. (Regional)
- P102. Chang, N. B. (2017): Challenges and Perspectives for Urban Stormwater Management: Linking Environmental Engineering and Hydrologic Science with Meteorological Dynamics, China Meteorological Administration (CMA), Beijing, China, Nov. 19, 2017. (International)
- P103. Chang, N. B. (2017): Multi-scale Precipitation Forecasting based on Long-term Teleconnection Signals, Chinese Academy of Meteorological Sciences, Beijing, China, Nov. 20, 2017. (International)
- P104. Chang, N. B. (2017): Periodicity Analysis for Teleconnection Signals Propagation Between Sea Surface Temperature and Forest Greenness across North America, Chinese Academy of Meteorological Sciences, Beijing, China, Nov. 20, 2017. (International)
- P105. Chang, N. B. (2017): How Does Artificial Intelligence Work with Remote Sensing Technologies for Multi-scale Environmental Change Detection? Chinese Academy of Meteorological Sciences, Beijing, China, Nov. 21, 2017. (International)
- P106. Chang, N. B. (2017): Integrating Multisensor Satellite Data for Better Environmental Quality Monitoring, Chinese Academy of Meteorological Sciences, Beijing, China, Nov. 21, 2017. (International)
- P107. Chang, N. B. (2018): Remote Sensing for Water Sustainability and Climate. Department of Civil Engineering, University of Hong Kong, Hong Kong, March 26, 2018. (International)
- P108. Chang, N. B., Wei, X., Bai, K., and Gao, L. (2018): Developing a Cyber-Physical System for Mobility Service in Smart Cities Based on Multi-sensor Satellite High-Resolution PM2.5 Concentration Map. The 15th IEEE International Conference on Networking, Sensing, and Control, Zhuhai, China, March 27-29, 2018. (International)
- P109. Chang, N. B. (2018): Teleconnection signals can aid in long-term precipitation forecasting: The North America Experience. School of Meteorological Science, Sun-Yet-Sen University, Zhuhai, China, March 29, 2018. (International)

- P110. Wanielista, M. P., Chang, N. B., and Duranceau, S. (2018): Integrated Wastewater and Stormwater Management using BAM for Water Quality Control, 2018 APWA Florida Chapter Conference & Exposition Florida Public Works EXPO, April 16-20, 2018. (Regional, Local)
- P111. Chang, N. B. (2018): Intelligent Feature Extraction from the Fused Satellite Images for Environmental Monitoring with Spatial-Spectral Ensemble Learning, National Taipei University of Technology, Taipei, Taiwan, June 11, 2018. (Local)
- P112. Chang, N. B. (2018): Multisensor Fusion between Hyperspectral and Multispectral Remote Sensing Data for Monitoring Microcystin Distribution, Presented to Xi'an University of Science and Technology, Xian, China, June 17, 2018. (Local)
- P113. Chang, N. B. (2018): Recent Progress in Remote Sensing for Environmental Change Detection in Water Cycle. Invited Keynote Speaker, The Fifth International Workshop on Earth Observation and Remote Sensing Applications (EORSA), Xi'an, China, June 18-20, 2018. (International)
- P114. Chang, N. B. (2018): Coupling Coastal Transportation and Drainage Infrastructure under Climate Change Impact for Urban Sustainability. presented to Department of Urban and Regional Planning University of Florida, Gainesville, Florida, Aug. 17, 2018. (Local)
- P115. Chang, N. B. and Sun, Z. (2018): Ensemble Learning of Satellite Remote Sensing Images via Integrating Deep and Fast Learning Algorithms for Water Quality Monitoring," Proceedings of SPIE, Remote Sensing and Modeling of Ecosystems for Sustainability, San Diego, California, USA, August 21-23, 2018, (Invited presentation).
- P116. Wanielista, M. P., Wen, D., Comier, J., and Chang, N. B., and Duranceau, S. (2018): Bio-Sorption Activated Media for Control of Nutrients and Fecal Coliforms, the 13th Annual Regional Stormwater Conference, Hilton Head Marriot, SC, Oct. 3-5, 2018. (Regional)
- P117. Chang, N. B. (2018): Multi-sensor Satellite Image Fusion, Data Merging, and Machine Learning for Monitoring Changing Urban Environment, presented to the IEEE Green Energy and Smart Systems Conference at University of California - Long Beach, Oct. 29, 2018 (IEEE Distinguished Lectures, sponsored by the IEEE Systems Council).
- P118. Chang, N. B. (2018): Food-Energy-Water Nexus Analysis for Urban Sustainability: A System Engineering Approach, Yuan Ze University, Zhongli, Taiwan, Nov. 21, 2018. (Local)
- P119. Chang, N. B. (2018): How Does the Integrated Artificial Intelligence and Big Data Analytics Help Remote Sensing for Environmental Change Detection? Yuan Ze University, Zhongli, Taiwan, Nov. 21, 2018. (Local)