AI-ML-assisted Analysis, Generative Evolutionary Bio-Inspired Coding, and Food-Energy-Water Master Planning Scenarios for Coastal Cities, 2018-2100

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Abstract

This international research project is focused on Artificial Intelligence assisted design scenarios for the bio-inspired and evolutionary algorithm-driven Water-Energy-Food Nexus masterplans for future carbon-positive infrastructure, landscape, and buildings in Greater Miami Islands. The scenarios align with the Paris Agreement of the 21st International Conference of Parties (COP 21), and the UN framework convention on Climate Change (UNFCCC) supports professional, municipal, architectural and urban design practices that reduce greenhouse gasses by operating cities with zero carbon emissions. In addition, Miami benefits from several large-scale grants focused on strategic solutions for adapting to global warming, sea-level rise, flooding, hurricane impacts, heat waves, and saltwater intrusion. This research paper presents the critical results of a research effort through a transdisciplinary, four-year research project funded by European Union Horizon 2020, EU Belmont agencies and the U.S.-National Science Foundation (NSF), working in collaboration with numerous partners globally. It critically compares transdisciplinary methods, AI-ML-driven experiments, and coding for bio-inspired scenarios for infrastructure, architectural, and city scales from 2018 to 2100 and beyond. All iterative methods include the Parametric Open Data integration workflow and bio-scripting synthetic biology growth computational approaches. These methods quantified social and economic impacts from SLR and storm surges for designing adaptive, blue-green infrastructure and buildings from 2018 through 2100. The paper's critical comparison of the results of several methods and open-access synthesis is the development and comparison of several combined scenarios of different sizes for different units and locations in the low-lying areas of Miami.

Keywords: Artificial Intelligence (AI),Bio-inspiration, Carbon-Positive,Evolutionary Algorithm (EA), Food-Energy-Water Nexus (FEW)