Geophysical Research Abstracts
Vol. 20, EGU2018-10421, 2018
EGU General Assembly 2018

Water-Energy-Food-Carbon Nexus: An Optimization Approach

Zeinab Chamas (1), Majdi Abou Najm (1), Mahmoud Al Hindi (2), Ali Yassine (3), and Farook Hamzeh (1)

(1) American University of Beirut, Civil & Environmental Engineering, Beirut, Lebanon (majdian@aub.edu.lb), (2) American University of Beirut, Chemical and Petroleum Engineering, Beirut, Lebanon, (3) American University of Beirut, Industrial Engineering & Management, Beirut, Lebanon

Pressures from rapidly growing populations and increased urbanization intensified the demands for water, energy and food. This increase in demands has caused overwhelming stress on natural resources; threatening global water, energy and food securities which are intrinsically intertwined. As growing demand and shrinking supplies have reached a critical point, the nexus concept between water, energy and food (WEF) evolved to assess the intertwining between those sectors in an effort to boost efficiencies of all nexus pillars. While the literature is rich with multiple frameworks and modelling schemes evaluating one or two of the WEF sectors, it lacks models that attempt to incorporate the three sectors simultaneously. As such, there is a need to develop a comprehensive mathematical model to optimize the full nexus. We address this challenge through the development of an optimization model that incorporates energy to an existing water-food optimization model (Mortada et al., 2018) by utilizing the resource footprint concept. This incorporation recognized the wide range of energy sources and the significant differences in their carbon footprint, leading to its incorporation as a significant component in the nexus. The model is distinguished from other tools in that it is based on the footprint concept, which assigns water, energy and carbon footprints for each optimum unit of resource produced or naturally generated. The model serves as an effective decision-making tool that enables policy makers to assess multiple WEF sources and recommend the optimum resource allocation under various policy, technology, and resource constraints. Serving as a comprehensive nexus tool, the model also allows to test different frameworks, targets and concepts such as the planetary boundary concept which constrains anthropogenic carbon generation to a recommended limits. Finally, the model was successfully validated using a generic case study.