Wenkai Guan, Yang (Katie) Zhao and Cristinel Ababei, 2024, R-DUCT: Robust Dynamic Unified Carbon Modeling Tool Under Severe Uncertainty, 2024 IEEE 15th International Green and Sustainable Computing Conference (IGSC).

Abstract Quantifying uncertainty in carbon modeling is a growing area of interest, and researchers have already developed uncertainty-aware carbon modeling tools. However, these tools capture uncertainty in operational or embodied carbon emissions separately, quantify uncertainty using pre-assumed probability distribution that may not be available, and focus on the part of the hardware components in datacenters. In this work-in-progress paper, we are developing a comprehensive carbon emissions modeling tool under severe uncertainty, which impacts both embodied and operational carbon emissions in datacenters. The proposed approach's key novelty lies in using the information-gap theory-based non-probabilistic models for uncertainty without needing pre-assumed probability distributions. We are implementing the proposed uncertainty model within a carbon modeling tool that holistically considers computer servers, storage devices, and switches. The information-gap theory-based non-probabilistic uncertainty model can be used to reformulate datacenter scheduling algorithms, revealing a potential direction of reducing carbon emissions under severe uncertainty.

Keywords Environmental sustainability, Carbon emissions, Severe uncertainty, Information gap theory, Datacenter.