EGU21-5826, updated on 24 Oct 2021
https://doi.org/10.5194/egusphere-egu21-5826
EGU General Assembly 2021

Use of Machine Learning algorithms in evaluating the WRF model parameter sensitivity for the simulation of tropical cyclones

Baki Harish, Sandeep Chinta, Chakravarthy Balaji, and Balaji Srinivasan
Indian Institute of Technology Madras, Mechanical Engineering, Chennai, India (me16d412@smail.iitm.ac.in)

The Indian subcontinent is prone to tropical cyclones that originate in the Indian Ocean and cause widespread destruction to life and property. Accurate prediction of cyclone track, landfall, wind, and precipitation are critical in minimizing damage. The Weather Research and Forecast (WRF) model is widely used to predict tropical cyclones. The accuracy of the model prediction depends on initial conditions, physics schemes, and model parameters. The parameter values are selected empirically by scheme developers using the trial and error method, implying that the parameter values are sensitive to climatological conditions and regions. The number of tunable parameters in the WRF model is about several hundred, and calibrating all of them is highly impossible since it requires thousands of simulations. Therefore, sensitivity analysis is critical to screen out the parameters that significantly impact the meteorological variables. The Sobol' sensitivity analysis method is used to identify the sensitive WRF model parameters. As this method requires a considerable amount of samples to evaluate the sensitivity adequately, machine learning algorithms are used to construct surrogate models trained using a limited number of samples. They could help generate a vast number of required pseudo-samples. Five machine learning algorithms, namely, Gaussian Process Regression (GPR), Support Vector Machine, Regression Tree, Random Forest, and K-Nearest Neighbor, are considered in this study. Ten-fold cross-validation is used to evaluate the surrogate models constructed using the five algorithms and identify the robust surrogate model among them. The samples generated from this surrogate model are then used by the Sobol' method to evaluate the WRF model parameter sensitivity.