6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 – 15 June 2018, Glasgow, UK

EFFECT OF UNCERTAIN INITIAL CONDITIONS AND RANDOM FORCING ON THE EVOLUTION OF HURRICANE EARL

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Key Words: *coupled ocean-atmosphere-wave model, uncertainty, stochastic forcing.*

A computational study is performed of the effect of uncertain initial conditions and random perturbations on the stochastic evolution of Hurricane Earl (2010). Simulations are performed using the Unified Wave INterface - Coupled Model (UWIN-CM), a fully-coupled atmosphere-wave-ocean (AWO) system. The simulations are used to generate a storm realization ensemble, considering perturbations of the initial winds. Polynomial chaos (PC) expansions are used to build surrogate models for the evolution of both maximum wind speed and minimum sea level pressure (SLP). The resulting PC surrogate models provide statistical insights on probability distributions of model responses throughout the simulation time span.

Statistical analysis of rapid intensification (RI) process suggests that storms with initially intensified and counter-clockwise rotated winds are more likely to undergo a RI process. In addition, the RI process seems mostly sensitive to mean wind strength and rotational stretch, rather than storm size and asymmetric wind amplitude perturbations. This is consistent with global sensitivity analysis of PC surrogate models. Finally, we combine parametric storm perturbations with global stochastic kinetic energy backscatter (SKEBS) forcing in the UWIN-CM simulations and conclude that whereas the storm track is substantially influenced by global SKEBS forcing perturbations, it is weakly affected by the properties of the intial storm.