# UNCERTAINTY ANALYSIS OF ENVIRONMENTAL LOADS RESPONSE FOR FIXED OFFSHORE PLATFORM IN CLIMATE CHANGE CONDITION

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*Abstract – Face to the increasing tendency of extreme sea hazards' intensity and disasters' losses, this paper proposes an uncertainty analysis method for fixed offshore platform response. The multivariate compound extreme value distribution model and uncertainty analysis are used to predict the extreme sea state and deck elevation. Compared with API and DNV recommended practice, the prediction sufficiently demonstrates the new method's rationality and security.*

*Keywords –Climate Change; Global Uncertainty Analysis; Multivariate Compound Extreme Value Distribution*

In 2005, Hurricane Katrina and Rita triggered disastrous damage to New Orleans, and resulted in hundreds of destroyed and damaged platforms. Face to the increasing tendency of extreme sea hazards' intensity and disasters' losses, the lesson from 2005 disasters showed that some ambiguous definitions recommended by API and DNV must be taken into account.

In this paper, the combined effect of climate change induced extreme sea hazards and global uncertainty analysis of environments in offshore platform design are studied and some design code calibration are made as follows.

1.Typhoon/hurricane induced sea hazards such as wave, wind, surge, current combined design loads are the most important factors for platform stability, reliability and deck elevation. Due to the complexity and randomness of sea hazards, the data series have to involved the different kinds of uncertainties: method-model uncertainty; data sampling uncertainty; statistical uncertainty[1]. The different coefficient variation of uncertainties COV and confidence intervals can be obtained of statistical analysis.

2. The Global Uncertainty Analysis (GUA), Global Sensitivity Analysis (GSA)[2] as main tools can be used for input sea environments with uncertainties and corresponding sensitivity of structure responses. Through the forward-feedback process for input-output with uncertainty- sensitivity analysis, the more reasonable responses can be obtained. (See Fig.1)

3.Multivariate Compound Extreme Value Distribution (MCEVD) was firstly published in US ASCE journal as Compound Extreme Value Distribution (CEVD)[3] and 1982 used for long term prediction of hurricane characteristics along Gulf of Mexico and Atlantic coasts[4]. Since 2005 hurricane Katrina and Rita disasters proved accuracy of 1982 predicted hurricane characteristics and after disaster calculated results by MCEVD[5,6,7], it stands to reason that MCEVD is a practicable model for prediction of typhoon/hurricane/ tropical cyclone induced extreme events. In this paper the MCEVD with GUA, GSA and the effects of global climate change (sea level rise and typhoon/hurricane increasing tendency)[8,9] is used to calculate the extreme sea environments responses and deck elevation of jack-up platform in South China sea .

4. Comparing different design loads standards, this paper gives four definitions about the design extreme loads (See below), takes a Jacket platform with 30m design depth of water as example, and analyzes the maximum structural stress and deformation with different design standards.

(1) Traditional Design Method: 100-yr. return period wave height combined with associated wind and current.

(2) Single Factor Method: 100-yr. return period wave height combined with 100-yr. return period wind speed and 100-yr. return period current speed

(3) MCEVD design method: MCEVD considers the correlation among the factors and takes the simultaneous wave, wind and current as design criteria, so it can give the real "100-year" sea state.

(4) GUA design method: Based on MCEVD: 100-year sea state is defined by taking account of the influence of climate change and other uncertainty factors.

5. Comparison between our proposed method and API, DNV and china design code recommended method[10,11] shows: The result by our method is more reasonable(See Table 1,2) and it also can be proved by 2005 Gulf of Mexico some damaged platforms [12].

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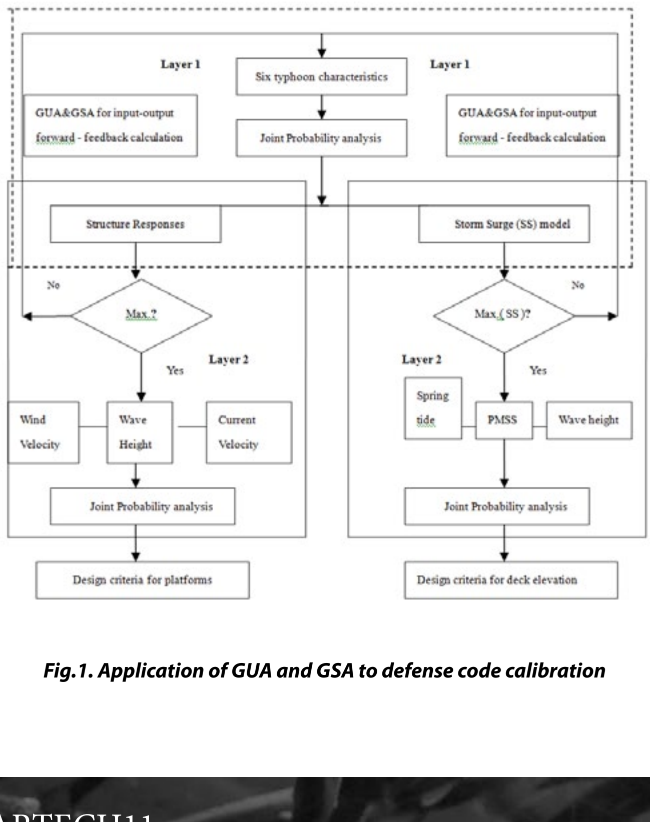


***Fig.1. Application of GUA and GSA to defense code calibration***