Parametric presentation of asymmetric Tropical Cyclones

Mohammad Olfateh and David P. Callaghan

School of Civil engineering, The University of Queensland, Brisbane, Australia email: <u>m.olfateh@uq.edu.au</u>

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Sparse meteorological data availability makes the parametric representation of pressure and wind field of Tropical Cyclones inevitable. Asymmetry in TC's pressure and wind field is a natural feature that can be induced by the Beta effect, landfall of TC and more significantly by the effect of a high pressure system adjacent to the TC. These meteorological events are known as cut-off lows in east Australia. Despite the frequent observations of Asymmetric TCs and their well-known dynamics, there is no proper asymmetric parametric model developed yet.

In this paper, new directional functions are developed to be used with any existing axisymmetric parametric pressure model. This gives the models the capability to construct the asymmetry of TCs. In addition, the parameters of the new models give a criterion for evaluation of the TC's level of asymmetry. The gradient wind field of the TC is derived from the parametric pressure field analytically and numerically using the gradient wind equilibrium. The models are evaluated using all recorded TCs in the east coast of Australia from 1956 (c.a. 120 TCs). In addition to capturing the asymmetry of TCs qualitatively, the quantitative goodness of fit criteria such as RMSE improve significantly for the new model compared to existing axisymmetric models. This large scale evaluation also gives the statistical distribution of the parameters for the new and also conventional models for east coast TCs. The derived distributions can be applied to construct more realistic TC pressure and wind fields in areas such as storm surge modeling, synthetic generation of TCs for coastal hazard analyses and other relevant areas.