Neural Network for Higher Wind Speed Estimation from Multi-parameter Radar Altimetry Data

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Abstract: The ability of satellite altimeter to estimate wind speed in tropical cyclone condition has been investigated. In calm condition at low variation in time and space, the empirical algorithm from radar backscatter (σ_0) and even including the significant waves height (SWH) have managed to estimate wind speed at high accuracy. However, in the extreme condition with higher spatio-temporal variation such as tropical cyclone, the ocean-atmosphere interaction was very complex that makes the algorithm become an ill-posed solution. In such condition, the single frequency σ_0 and SWH were not enough. Besides, to obtain reliable wind speed at higher speed regime, the solution was also contaminated by rain. Therefore, more parameters derived from different satellite altimeter missions are needed to comprehensively account for this condition and thus improve the accuracy of wind speed retrieval. Beside the altimeter instrument, the microwave radiometer is also onboard. For example, in Jason-2 and Jason-3, the corresponding radiometers record the brightness temperature (T_B) and offered concurrent information about the rain condition in the tropical cyclone. To accommodate multiple related parameters for wind speed derivation, the neural network approach (NN) is proposed. The unique advantage of NN is this technique can make multi-parameters relation without dwelling deeply into physical detail. The error between the network output and targeted value can then back propagated to adjust the weight applied and improved wind speed fitting accuracy from multiple parameters complex relationship. Therefore, this study intended to determine the parametric model for estimating higher wind speed from multi-mission satellite altimeters during the tropical cyclone using NN method. The correlation coefficient and sensitivity analysis are presented. The result is anticipated to identify the significant parameters to be included in estimating tropical cyclone wind speed. This study is also expected to improve the accuracy of estimated wind speed in tropical cyclone condition.

Keywords: Wind Speed, Altimeter, Tropical Cyclone.