# A TROPICAL CYCLONE WIND, WAVE AND STORM TIDE RISK DESIGN AND WARNING TOOLBOX FOR AUSTRALIA

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## INTRODUCTION

The paper will describe the development and operation of a comprehensive tropical cyclone wind, wave and storm tide risk design and warning software toolbox that covers all of tropical-influenced Australia, The toolbox is designed to provide both rapid assessment and detailed design capabilities for coastal, port, offshore and nearshore design, including projected future climate change. It also provides real-time emergency management functionality.

## FOUNDATIONS

The authors have a combined consulting, research and development experience of over 70 years, specializing in tropical cyclone related coastal and ocean hazards. The toolbox has been built from a series of comprehensive government-sponsored coastal and ocean statistical and numerical modelling studies (e.g. Harper (2004) for the east coast of Queensland), plus Torres Strait, Gulf of Carpentaria, Darwin (e.g. Harper 2010) and many other Northern Territory communities. The development has also leveraged globally influential North West Shelf industry-sponsored initiatives (e.g. Harper 2008) and international linkages with the tropical cyclone atmospheric science community (e.g. Velden et al. 2006, Kossin et al 2007, Knaff & Harper 2010, Harper 2013). In addition to numerical modelling components, a pivotal aspect has been the development of a robust verified 50,000-year tropical cyclone track and wind climatology for Australia (Harper & Mason 2016).

## PHILOSOPHY

The toolbox provides a probabilistic design framework that facilitates the essential need for sensitivity analysis of both inputs and outputs without pre-conceived risk thresholds. It provides the essential hazard component in a robust and verified context that can then, depending on the application, enable more focused and efficient deterministic modelling stages using models of choice.

- Fully probabilistic framework
- Verified against available wind, wave, tide data
- Efficient and accurate implicit numerics
- Scale-appropriate and practical

## COMPONENTS

The toolbox comprises (Figure 1) base coastal coverage using 26 spherical 2D barotropic hydrodynamic model domains (MMUSURGE) at 0.025°arc and 3rd Gen spectral wave model (WAMGBR) after Hardy et al. (2001). These include sub-grid parameterisation of the Great Barrier Reef. Ocean scale domains at 0.125° extend beyond and 0.005° nested domains cover major population centres and/or ports. Wind, wave and storm tide climates have been discretely simulated up to 50,000 years. Parametric models are also available that provide rapid real-time early warning (SEAtide) and efficient sensitivity testing of design assumptions (SEAsim). Non-cyclonic storm tide blending (typically dominant to at least 100y ARI) is also available for most major population centres based on residual resampling.
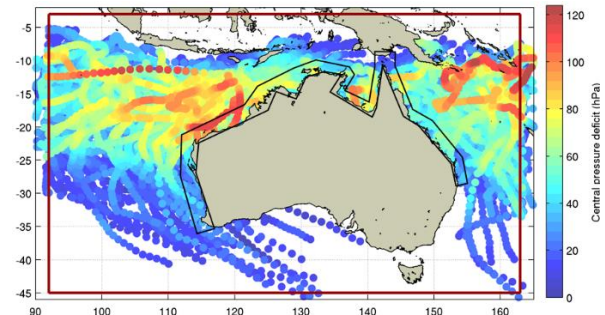


Figure 1 - Sampled 55 years (historical span) from the 50,000-year tropical cyclone climatology and 0.025° model resolution coverage (black).

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