DEVELOPING BETTER PREDICTIONS AND FORECASTS FOR EXTREME WATER LEVELS AROUND AUSTRALIA

C.B. Pattiaratchi[1,2], Y. Hetzel[1,2], I. Janeković[1,2] , E.M.S. Wijeratne[1,2], I.D. Haigh[3], M. Eliot[1,4] [1] School of Civil, Environmental, and Mining Engineering, The University of Western Australia [2] The UWA Oceans Institute [3] The University of Southhampton, UK [4] Damara WA

THE OCCURRENCE OF EXTREME WATER LEVELS CAN LEAD TO LOSS OF LIFE AND DAMAGE TO COASTAL INFRASTRUCTURE. TO BETTER PREPARE, COASTAL ENGINEERS, EMERGENCY MANAGERS AND PLANNERS REQUIRE ACCURATE ESTIMATES OF EXTREME WATER LEVELS

BACKGROUND

- Extreme water levels result from the **combination** of different physical processes including **tides, storm surges, tsunamis, seasonal and inter-annual mean sea level variations**.
- These signals may be forced by both local and remote forcing, with processes active over a temporal range from **hours to decades**.
- This work will **improve the accuracy** of predictions of extreme water levels by investigating the effects of several key processes that are often ignored.

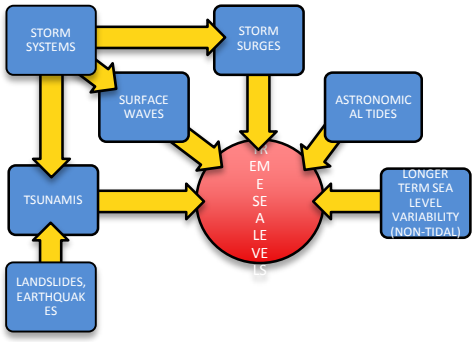


Figure 1. Illustration of the various physical processes that contribute to create extreme water levels.

OBJECTIVES

Develop better predictions and forecasts for extreme water levels arising from:

- Tides.
- Storm surges
- Surface gravity waves
- Continental shelf waves
- Tsunamis (meteorological)

RESEARCH UPDATE

Including waves in storm surge models

Wave setup is the increase in mean water level due to waves at the coast and is one of the many effects waves can have on simulated water levels (Fig 2.).

A coupled wave-surge model indicated that including wave effects increased simulated storm surges by 10-48%.

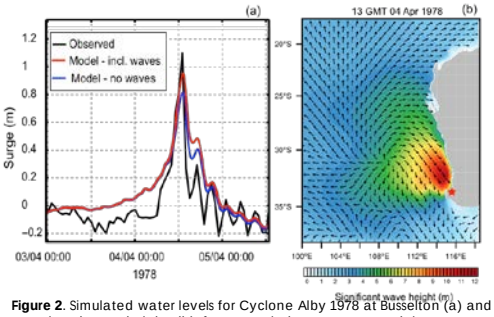
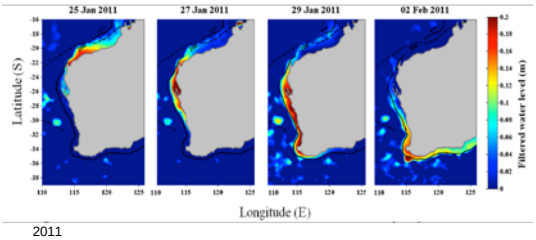


Figure 2. Simulated water levels for Cyclone Alby 1978 at Busselton (a) and associated wave heights (b) from coupled wave-surge model.

Continental Shelf Waves

Weather systems crossing the coast can release a mass of water that travels anti-clockwise around Australia as a continental shelf wave.

Continental shelf waves due to Cyclone Bianca came within hours of coinciding with the land fall of the storm and high tide at Perth– a near miss that would have flooded the underground rail system (Fig 3).



2011

Meteorological Tsunamis

Using 5 years of data from 13 tidal stations around Australia we have identified 214 events that satisfy the criteria for meteorologically induced tsunamis with most occurring in the southern regions: Western Australia, Victoria and Tasmania.

Figure 4. Numbers of meteo-tsunami events identified in tide gauge data around Australia between of 2009 and 2014.

Transition from tropical to extratropical cyclones

Parametric cyclone wind models fail to reproduce the wind fields when tropical cyclones interact with midlatitude weather systems, whilst new reanalysis models do capture some of the structural changes that can induce extreme sea levels.

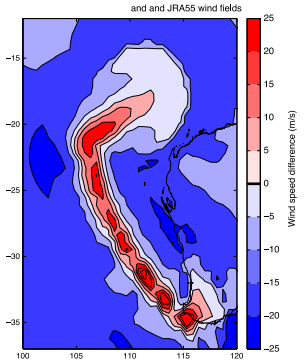


Figure 4. Difference between Holland 2010 and JRA55 wind models for Cyclone Alby 1978. Blue/red indicates weaker/stronger winds in the Holland 2010 parametric model compared to JRA55 reanalysis.

'This project provides a comprehensive benchmark that will underpin the ability to manage the impacts of extreme water levels on coastal regions at local, regional and national scales.' Martine Woolf, lead end-user from Geoscience Australia