IMBeR West Pacific Symposium 2021

Session 6: Marine Extreme Events: Impacts, Forecasting, and Risk Management

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Marine extremes including heatwaves, deoxygenation events, upwelling, and flood plumes – are becoming more common in many regions of the world. These extremes are often exacerbated by climate change, such that impacts on marine resource users and coastal communities is greater than in the past. Even earthquakes have led to coastal ecosystem impacts and fishery closures, as occurred after the 2016 Kaikōura event in New Zealand. Managers closed the local pāua (abalone) fishery for 6 years (Dec 2021) to protect the surviving animals and associated habitat, as well as other shellfish and seaweed resources along the earthquake-affected coastline.

This conference session was headlined by a keynote address from Prof. Neil Holbrook, a founding member of the International Marine Heatwaves working group. Prof Holbrook described the impacts of marine heatwaves (MHW) on three tropical western and central Pacific Island nations and their communities – Palau, Fiji and Samoa. These regions are among the most vulnerable to climate change and extreme events, with observed changes to coral reef and seagrass habitats and livelihoods. The link between climate drivers, such as ENSO, and MHWs is not straight forward, however, projections are clear – more MHWs are expected in this region over the next 20 years regardless of the emission scenario, but after 2040 the likely frequency depends on choices that society makes about emission reduction.

The first two of eight invited papers covered impacts of a tropical cyclone in Indonesia (Riza Setiawan) which led to an injection of nutrients to the euphotic zone and enhanced primary production, and a 2016 flood plume event in the East China Sea which injected sediments and changed water turbidity (Jianzhong Ge). A multi-component numerical model used to examine the effects of this flood plume and provided a realistic simulation to examine a range of nutrient responses.

The drivers of extreme events were covered in the next two presentations, both with a focus on MHWs, while a third explored the ocean-atmosphere coupling as part of a 2017 El Nino. Maxime Marine developed a heat budget analysis of extreme upper ocean MHWs in a global ocean circulation model (10 km, 1982-2014, OFAM3), and characterised the heat contribution from the atmosphere (heat flux) and the ocean

(advection) to determine the driving mechanisms of MHWs. Ying Zhang explored the formation of long-lasting MHWs in the tropical Indian Ocean, an understudied region, and identified the important role of subsurface warming induced by downwelling oceanic waves. Qihua Peng described how extreme sea level anomalies along the coast were associated with the 2017 extreme “coastal” El Nino and developed an understanding that suggest prediction was possible 1 month in advance.

The next two presentations covered prediction of MHW events using a dynamical model in the Pacific (Grant Smith), and a statistical model in Australia (Fabio Boschetti) and show that warning for the probability of these extreme events several months into the future is now possible. These prototype forecasts are providing early warning for coral reef systems, and ocean areas around Australia. The final invited presentation (Simon Nicol) considered the management responses that could be implemented in response to climate change. These same themes – impacts, drivers, prediction, and management were covered in a series of short talks, which added richness and more examples to the Session.

Clearly, an understanding of impacts, forecasting, and risk management for extreme events is critical in the West Pacific, where many coastal communities rely on the ocean for food, transport, and livelihoods. The research community must work together with West Pacific nations to speed progress from extreme event process understanding to developing response options in this region.