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## The Role of Communication and Public Education in Tsunami Early Warnings and Responses in New Zealand

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Individuals and communities are known to respond in different ways to official tsunami warnings and natural tsunami warning signs. This interdisciplinary research seeks to understand how official warnings are decided upon and communicated, and the ways in which warnings can be tailored through educational measures to improve tsunami awareness and preparedness. By improving the understanding of tsunami responses to official warnings and natural warning signs through examining the interactions between different emergency agencies, the mitigation methods for various tsunami hazards, and the numerous approaches to public warning communication, it is proposed that more tsunami resilient communities can be developed in New Zealand.

Online social research methods were used to investigate tsunami early warnings and responses in New Zealand. 106 documents and archives were collected to examine the nature and content of official tsunami information and the methods currently used to communicate these warnings, including director's guidelines, memorandums of understanding, standard operating procedures, ministerial reviews, and technical standards. 57 semi-structured interviews were conducted with tsunami researchers, warning specialists, and emergency managers to gain an understanding of the opinions held on the effectiveness of official warnings and public education. The participants were recruited from research institutes, national agencies, regional groups, and local councils in New Zealand, Australia, the Pacific Islands, the UK, and the USA.

Three key findings have been established. First, the division of responsibilities between the various research institutes, national agencies, regional groups, and local councils involved in monitoring, disseminating, and responding to official tsunami warnings leads to the potential for error and delay in issuing official warnings, highlighting the need for consistent messages and coordinated responses. Second, whilst New Zealand has the capability to communicate official warnings for distal events, the country relies on educating the public to observe natural warning signs for local events, with emergency drills as well as awareness and preparedness campaigns in place to promote self-evacuation. Third, whilst sirens can be useful for issuing official tsunami warnings in

rural or isolated communities, they can create confusion if the tone is misunderstood, whilst Emergency Mobile Alerts (EMAs) can only be used in areas with good reception but provide more information on the approaching hazard.

Further public education around the warning communications issued by national, regional, and local agencies, as well as New Zealand's vulnerability to distally, regionally, and locally generated tsunamis, would contribute to more effective tsunami responses. The advantages and disadvantages of sirens and EMAs emphasise the value of these two methods of tsunami warning being used holistically, in a multi-channel approach, to provide more thorough warning communication. This research concludes that improvements must be made to emergency agency interaction, tsunami mitigation methods, and warning communication approaches in order to develop tsunami resilience in New Zealand.